IEP Long-term Fish Monitoring Program Element Review

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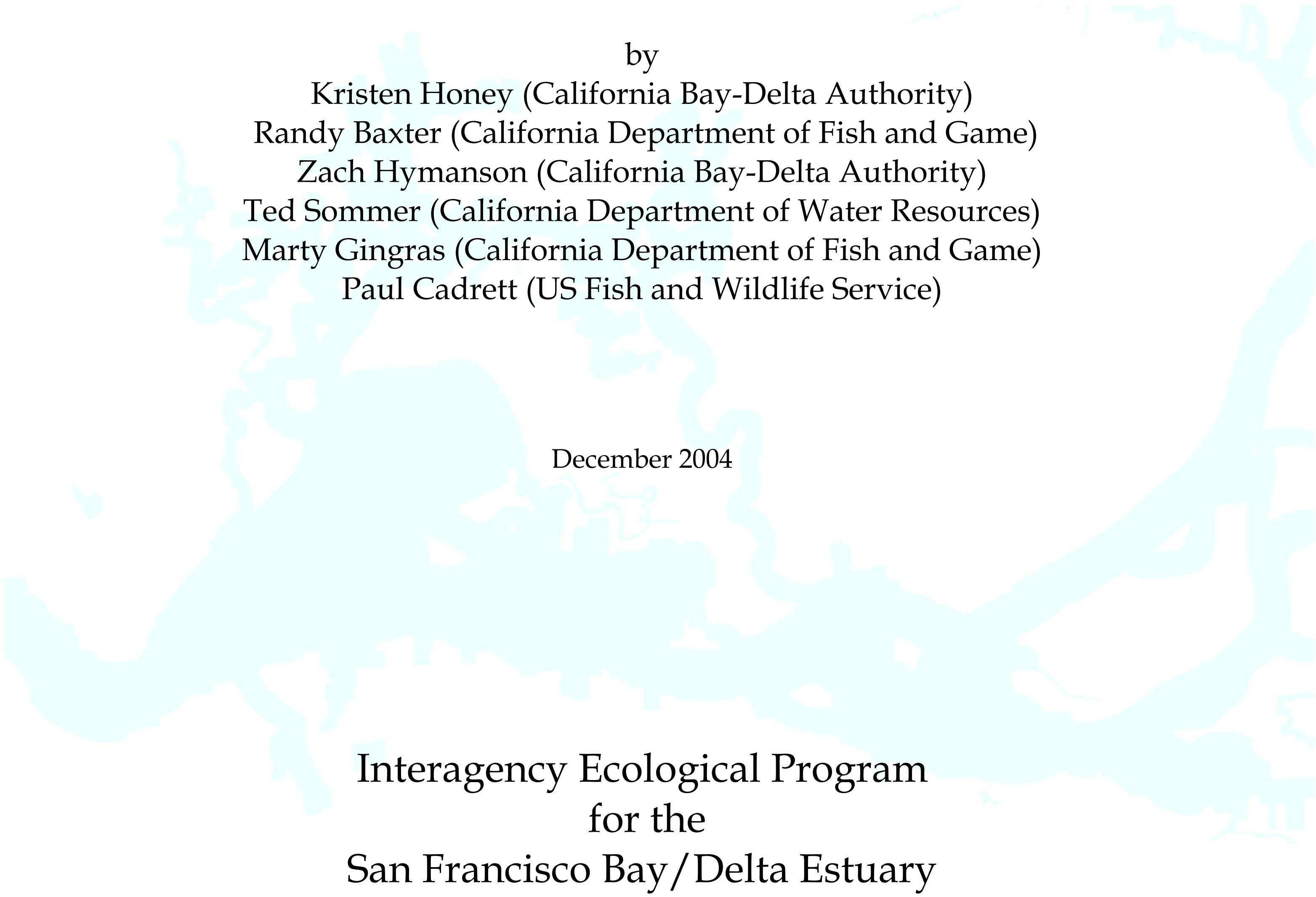

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Interagency Ecological Program
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State of California
The Resources Agency
Department of Water Resources
Interagency Ecological Program

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List of Acronyms

AdBass	Adult Striped Bass Tagging
AdSturg	Adult Sturgeon Tagging
BDAT	Bay-Delta Tributaries Database
BSeine	Delta Juvenile Fishes Monitoring Beach Seine Survey
CALFED	California & Federal Agencies Bay-Delta Program
CBDA	California Bay-Delta Authority
cm	centimeter
CVP	Central Valley Project
DFG	California Department of Fish & Game
DWR	California Department of Water Resources
ESA	Endangered Species Act
EWA	Environmental Water Account
FMWT	Fall Midwater Trawl Survey
IEP	Interagency Ecological Program
JuvSturg	Juvenile Sturgeon Year-class Strength Survey
m	meter
mm	millimeter
MokR	Mokelumne River
MWT	midwater trawl
NBA	North Bay Aqueduct
NMFS	National Marine Fisheries Service
NOAA	National Oceanic & Atmospheric Administration
NGO	nongovernmental organizations
OCAP	Operations Criteria Assessment and Plan
ResFish	Delta Shoreline Resident Fishes Survey
RTM	real-time monitoring
SacT	Sacramento Trawl Survey
SprKod	Spring Kodiak Trawl Survey
SuisM	Suisun Marsh Fish Community Survey
SWRCB	State Water Resources Control Board
SWP	State Water Project
TNS	Summer Townet Survey
UCD	University of California, Davis
USBR	United States Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

1 Introduction

In spring 2004, we initiated a review of the Interagency Ecological Program fish monitoring program elements on behalf of the IEP Management Team. These elements constitute a substantial portion of IEP's overall monitoring efforts. They represent some of IEP's longest standing monitoring elements (also referred to as surveys) collecting data used for decades by scientists and resource managers throughout the San Francisco Estuary.

Given the importance and prominence of these surveys, IEP management[1] requested a programmatic review to assemble relevant information that can help in the ongoing management and implementation of IEP. In addition, IEP management expects to use this information in decisions about performing more in-depth reviews of program elements and in setting overall program priorities and resource commitments. Finally, IEP management is completing a strategic plan, which together with this programmatic review will provide essential information for longer-term program planning, including addressing critical gaps in IEP monitoring efforts. Based on these IEP management needs, the overall goal for this review is:

> *To gather and synthesize project-specific information to educate IEP management about its fish monitoring program elements and how the project products are used, and to help managers in making decisions about longer-term program priorities and resource commitments.*

Unlike recent reviews of program elements, no new technical analyses were completed as part of this review. Instead, this review relies on information obtained from completion of a detailed questionnaire (see Appendices A and B) with the assumption that much of the requested information already exists in a readily available form.

This report serves to help IEP meet future planning and implementation challenges. It is does not identify specific program cuts nor provide technical review of sampling design nor establish program priorities. Information within the questionnaire responses and this summary should help forward such objectives, but additional information is required to fully inform these types of decisions.

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[1] For purposes of this document, IEP management refers to the IEP Management Team, the IEP Coordinators, or both groups.

This review offers the first comprehensive summary of information for all IEP fish-monitoring program elements. The 16 surveys are conducted by 5 organizations: California Department of Fish and Game (DFG), California Department of Water Resources (DWR), University of California Davis (UC Davis), US Bureau of Reclamation (USBR), and US Department of Fish and Wildlife Service (USFWS).

1) Delta Juvenile Fishes Monitoring Beach Seine (Beach Seine Survey) (USFWS)
2) San Francisco Bay Study Survey (Bay Study Survey) (DFG)
3) Fall Midwater Trawl Survey (DFG)
4) Summer Townet Survey (Townet Survey) (DFG)
5) Delta Smelt 20 mm Survey (20 mm Survey) (DFG)
6) Spring Kodiak Trawl Survey (DFG)
7) Juvenile Sturgeon Year-class Strength Survey (Juvenile Sturgeon Survey) (DFG)
8) Suisun Marsh Fish Community Survey (Suisun Marsh Survey) (UC Davis)
9) North Bay Aqueduct Survey (NBA Survey) (DFG)
10) Delta Shoreline Resident Fishes Survey (Resident Fishes Survey) (DFG)
11) State Water Project and Central Valley Project Fish Salvage (DFG with DWR and USBR)
12) Chipps Island Trawl Survey (USFWS)
13) Sacramento River Trawl Survey (USFWS)
14) Mossdale Trawl Survey (USFWS)
15) Adult Sturgeon Tagging Survey (DFG)
16) Adult Striped Bass Tagging Survey (DFG)

This review is based on data gathered in spring 2004 for active IEP fish monitoring program elements. These data reflect the current role and sampling protocol for each IEP fish monitoring program element, as well as products produced between 1994 and 2003. Information on historical activities was not gathered as part of this review, so there is no explicit analysis to determine how the purpose or methods may have changed over time. Historical survey components not currently in use and not reviewed include: (1) Striped Bass Larva Sampling; (2) Bay Study Beach Seine; (3) Bay Study Plankton Sampling; (4) Spring Midwater Trawl Survey (transformed to Spring Kodiak Trawl Survey); and (5) Suisun Marsh Larva Survey. Furthermore, the roles of many surveys have broadened over time; e.g., information gathered on the Fall Midwater Trawl Survey reports a current focus on monitoring the distribution and abundance of delta smelt in addition to the historical focus on monitoring the abundance and distribution of young striped bass. Similar changes have occurred in the State Water Project (SWP) and Central Valley Project (CVP) Fish Salvage programs, which initially focused on estimating the salvage of salmon and striped bass.

Throughout this report we summarized questionnaire responses as received; however, we augmented those responses by drawing on our own understanding of the fish monitoring program elements, best professional judgment, and other sources of information. This supplemental information enabled us to increase consistency in the level of survey detail and information. For example, not all questionnaire respondents reported their budgets and costs in a consistent manner—some excluded boat operators and cost accounting, etc. To adjust for this information gap, we used IEP annual budget information to compare surveys. When outside data supplemented questionnaire responses, we highlighted the need for the supplemental information and its source. Such supplemental information was verified through personal communication with questionnaire respondents or through a general comment period.

This report begins with a summary of basic information and descriptions of the IEP fish monitoring program elements. Next, the report presents a summary of budgetary and resource information. A majority of the report is devoted to a synthesis of information related to how the fish monitoring program elements are meeting overall IEP goals and an examination of program element strengths and weaknesses. To examine program element outputs and use, the report also summarizes information on data products and reporting and customer use. The report concludes with a summary of additional comments received from completed questionnaires.

2 Basic Information and Program Element Description

This section summarizes and synthesizes project-specific information about 16 IEP fish monitoring program elements (i.e., surveys), and describes how their monitoring survey products are used by agency personnel, academic researchers, and other resource management interests.

Appendix A includes the original questionnaire goals, timeline, and IEP mission and goals presented to respondents in spring 2004. Appendix B contains unabridged survey responses for the 19 questionnaires with responses about these 16 surveys. Multiple responses for the Beach Seine Survey and SWP and CVP Salvage are combined for summary and synthesis.

Table 1 summarizes basic information and program element descriptions for the 16 surveys. The surveys, conducted by 5 different organizations, focus on fish monitoring within the San Francisco Estuary, which includes portions of the Delta (Figure 1). The majority of surveys target species of concern and those listed under the federal and State Endangered Species Acts (ESAs), namely, winter-run Chinook salmon, spring-run Chinook salmon, Central Valley steelhead, coastal steelhead, delta smelt, and splittail. Fall-run Chinook, striped bass, and other sport fishes also emerged as significant monitoring targets.

Table 1 Basic information and program element description

Program	Agency	Mandate information	Design	Years surveyed	Months	Survey interval	Gear
Survey Group 1: Multiple, fixed location sampling							
1. Beach Seine Survey	USFWS	Soft mandate in NOAA OCAP as part of Oct-May RTM	Systematic	1976 to present	All	Weekly	Beach seine
2. Bay Study	DFG	Soft mandate in water rights decision D 1641	Systematic	1980 to present	All	Monthly	Otter trawl, midwater trawl
3. Fall Midwater Trawl	DFG	Spring 2004 OCAP for delta smelt	Systematic	1967 to present (no data 1974, 1979)	Sep-Dec	Monthly	Midwater trawl
4. Summer Townet	DFG	Spring 2004 OCAP for delta smelt	Systematic	1959 to present (no data 1966; no striped bass index 1995 or 2002)	Jun-Aug	2 weeks	Townet
5. 20 mm Survey	DFG	Spring 2004 OCAP for delta smelt	Systematic	1995 to present	Mar-Jul	2 weeks	20 mm
6. Spring Kodiak Trawl	DFG	Spring 2004 OCAP for delta smelt	Systematic	2002 to present	Jan-Apr	2 weeks	Kodiak trawl
7. Juvenile Sturgeon	DFG	Not mandated	Systematic	1991 to present (no data 1992, 1993, 1994, or 2003)	Jun-Aug	Monthly	Long-line
8. Suisun Marsh Survey	UCD	Soft mandate in D 1641	Systematic	1980 to present	All	Monthly	Otter trawl, Beach seine
9. NBA Survey	DFG	Pilot study for broad, within-delta larva survey is mandated in spring 2004 OCAP for delta smelt	Systematic	1995 to 2004	Feb-Jul	2-4 days	Plankton net

Program	Agency	Mandate information	Design	Years surveyed	Months	Survey interval	Gear
Table 1 continued from previous page							
Survey Group 2: Fixed regional strata, random location							
10. Resident Fishes	DFG	Not mandated	Stratified	1995, 1997, 1999, 2001-present	All	Monthly	Boat electrofishing
Survey Group 3: Single, fixed location sampling							
11. SWP and CVP Fish Salvage	DFG with DWR, USBR	Spring 2004 OCAP for delta smelt	Temporally systematic	1979 to 1992 involved less comprehensive sampling compared to post-1992 to present	All	Daily from as frequent as hourly counts	Screened louvers and holding tanks
12. Chipps Island Trawl	USFWS	Soft mandate in NOAA OCAP as part of Oct-May RTM	Temporally systematic	1976 to present	All	2-3 days (daily May-Jun)	Midwater trawl
13-14. Sacramento and Mossdale trawls	USFWS	Soft mandate in NOAA OCAP as part of Oct-May RTM	Temporally systematic	1976 to present (no data 1982 to 1987)	All (M)	2-3 days	Midwater trawl, Kodiak trawl
Survey Group 4: Flexible location sampling							
15. Adult Sturgeon Tagging	DFG	Not mandated	Mark recapture	1967,1968, 1974, 1979, 1984, 1985, 1987, 1990, 1997, 1998, 2001, 2002	Sep-Oct	Varies	Trammel net
16. Adult Striped Bass Tagging	DFG	Not mandated	Mark recapture	1969 to present (no data 1995, 1997, 1999, 2001)	Apr-May tagging & some recovery; creel check all	Annual 1969-1994, 2003+;Biennial 1995-2002	Gill net, fyke traps, and creel check

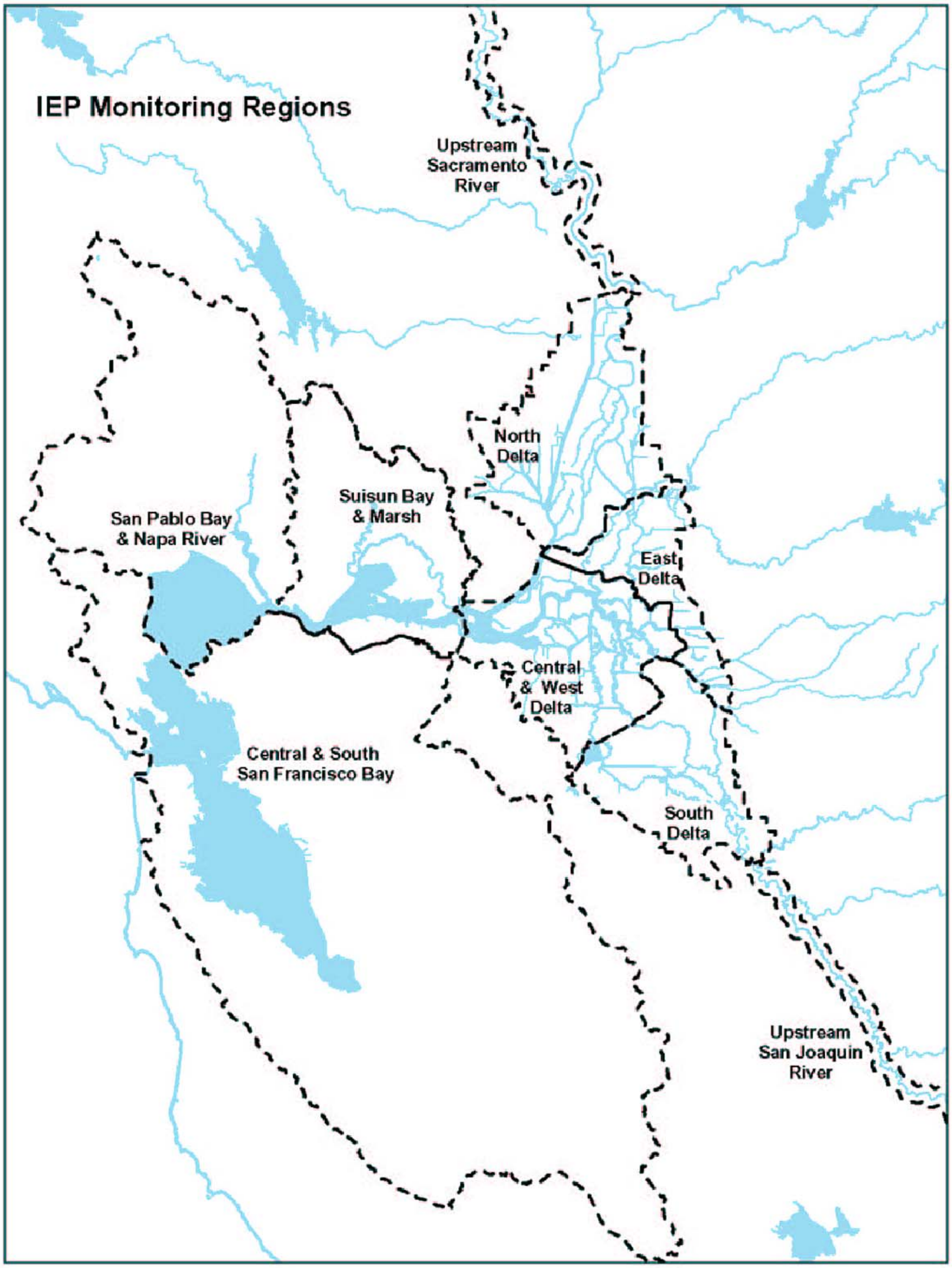

Figure 1 San Francisco Estuary monitoring regions

The regulatory and management value of fish survey information has led to direct and indirect incorporation of some program elements into the terms and conditions for CVP and SWP operations regulatory documents through ESA Consultations or Water Right Decisions. When incorporated into Operations Criteria Assessment Plans (OCAPs) or Water Rights Decisions, a survey becomes mandated monitoring. Here we distinguish 2 types of mandates:

1) A survey is considered "mandated" when listed by name in the terms and conditions of a Biological Opinion or a Water Right Order.

2) A survey is considered to have a "soft mandate" when it strongly or solely contributes to a specific term or condition. For example, real-time monitoring is mandated by the 2004 National Oceanic and Atmospheric Administration (NOAA) OCAP; 4 USFWS surveys and one each from CVP and SWP contribute directly and substantially to Realtime Monitoring.

Eleven of 16 surveys fall into one or both of these categories; the most recent mandates are identified for each survey (see Table 1). The soft mandate category contains program elements broadly construed as responses to a recent OCAP (previous example) or orders within the current Water Right Decision for San Francisco Bay and the Sacramento-San Joaquin Delta Estuary, Decision 1641, such as the following:

> 11 (b) Conduct ongoing and future monitoring surveys as recommended by the DFG, the USFWS or the National Marine Fisheries Service (NMFS), and acceptable to the Executive Director of the SWRCB [State Water Resources Control Board] concerning food chain relationships, fisheries impacts, or impacts to brackish tidal marshes, as they are affected by operations of the SWP or the CVP in the Delta and Suisun Marsh (Decision 1641, pg 149).

Decision 1641 maintains intact several orders from the previous Water Right Decision, 1485, including:

> 10 (c) Participate in research studies to determine:
>
> i) Outflow needs in San Francisco Bay, including ecological benefits of unregulated outflows and salinity gradients established by them.
>
> ii) The need for winter flows for long-term protection of striped bass and other aquatic organisms in the Delta (Decision 1485, pg 30).

Order 10 (c) (i) led directly to the implementation of the Bay Study Survey.

None of the aforementioned mandates preclude necessary changes; however, they do indicate the need for regulatory consultation when large-scale changes are anticipated. Terms of Water Rights Decisions, in particular, leave broad latitude for agency interpretation and implementation.

Generally, the evolution of IEP fish monitoring program elements occurred in stages spanning almost 5 decades (late 1950s through the 1990s). This evolution tracks the shifting concern for select fish species and the programmatic response of IEP. Initially (1950s through 1960s), 2 geographically broad surveys (Summer Townet and Fall Midwater Trawl) were implemented to sample the distribution and abundance of age-0 striped bass and the pelagic fish community in the Delta and upper estuary. Also in 1960s, more narrowly targeted surveys were added to monitor the abundance of select sport fishes, white sturgeon, and striped bass. Analyses of data from existing surveys also began to emphasize results for sport fish. IEP fish monitoring program elements continued to focus on sport fishes in 1970s. Three new surveys (the

USFWS Beach Seine Survey, Sacramento Trawl, and Chipps Island Trawl) were added to track the timing and abundance of emigrating juvenile Chinook salmon. Also beginning in the 1970s, salvage data from the SWP and CVP were regularly used to estimate the salvage of striped bass and salmon resulting from Delta exports. Analyses of data from existing surveys continued to focus heavily on trends in the abundance of sport fishes, particularly striped bass and Chinook salmon. Two new fish community surveys, Bay Study and Suisun Marsh, were initiated in the 1980s to monitor fish communities in under-sampled areas of the estuary. These new surveys also used methods to estimate the abundance of demersal fish species, as well as pelagic fish species in the case of the Bay Study Survey. From the 1960s to early 1990s, striped bass was considered the key indicator fish species for the upper estuary and Delta, and much of the analyses of fish monitoring data focused on this species, but concerns about increased water exports also led to analyses of flow effects on abundance of a suite of sport and native species, concluding in the first X2 publications (X2, or the location of 2 parts per thousand bottom salinity, is used as a species habitat indicator whose position is influenced by outflow).

In the 1990s several native fishes were listed as threatened (delta smelt, splittail, Central Valley and coastal steelhead, and spring-run Chinook salmon) or endangered (winter-run Chinook salmon) under the federal or State ESAs. A few other species were considered candidates for listing (longfin smelt, San Joaquin fall-run Chinook salmon, and green sturgeon). These listings resulted in a shift in analysis and reporting with greater emphasis on listed species in particular and native species in general. In addition, two new surveys were added that targeted delta smelt (20 mm Survey Trawl, NBA Survey). Others expanded—Fall Midwater Trawl geographically and temporally into spring. Surveys for Chinook salmon were expanded temporally—Beach Seine Survey and Chipps Island, Sacramento, and Mossdale trawls. Much of the larval fish sampling was discontinued in the 1990s due to high cost and the underutilization of these data. Finally, a delta shoreline fishes survey—Resident Fishes—was implemented in the mid-1990s based in part because this important Delta community was poorly sampled and understood. Finally in winter and spring 2002, IEP improved sampling for adult delta smelt by changing gear from a midwater trawl to a larger, surface-oriented Kodiak trawl, initiating the Spring Kodiak Trawl Survey.

Despite the shifting emphasis on different target species, the IEP fish monitoring program elements have not changed much in methodology throughout the past 5 decades. This constancy in sampling techniques and locations has created substantial long-term records of tremendous value to agency, consultant, and academic customers. The constancy has not, however, prevented survey expectations, objectives, and goals from changing to reflect evolving priorities. Several surveys have been added and some discontinued as a result of shifting emphasis. Shifts in emphasis of data analysis and reporting also strongly reflect evolving priorities.

Sampling Strategies

To facilitate information synthesis and report analysis, we assigned the 16 long-term monitoring surveys to one of 4 groups based upon survey design (see Table 1). Nine of the surveys are designed to sample fishes somewhat systematically through varying portions of the estuary. Surveys 1 through 9 are in Survey Group 1 (see Table 1). Eight of the 9 surveys tow nets of varied configurations to target fishes during their first year of life; Survey 7, Juvenile Sturgeon, uses baited hooks. Several surveys, such as the Bay Study Survey, Fall Midwater and Spring Kodiak trawls, and Suisun Marsh Survey, are also effective capturing older age groups. Only one survey samples shoreline fishes using a stratified random sampling scheme (Survey 10 in Table 1). This survey captures fishes of multiple ages using boat electrofishing.

Four surveys sample at single locations repeatedly within sampling days year-round (surveys 11 to 14, Table 1). These surveys also capture predominantly age-0 fishes, but all catch some older age groups, particularly Chipps Island Trawl and the SWP and CVP Salvage surveys. Finally, 2 surveys are somewhat flexible in their sampling locations, fishing for about 2 months in survey years and targeting adult white sturgeon or legal-sized (≥ 18 inches) striped bass (surveys 15 to 16, Table 1). These surveys use mark-recapture techniques to estimate absolute abundance of both species and annual mortality rate of white sturgeon.

Each of the 16 surveys can calculate current or projected abundance indices for its target species. The first 10 surveys also provide general information on the distribution of target species.

Sampling Methods and Gear

Delta Juvenile Fishes Monitoring Beach Seine Survey

Photo 1 Beach Seine Survey: Seine is being hauled to shore.

The USFWS Beach Seine Survey uses a 15-meter long by 1.2-m high seine with 1/8-inch delta mesh set from shore to capture fishes from water generally ≤ 1-m deep. Two technicians deploy the seine over a roughly rectangular area and record maximum depth and dimensions of the area swept (Photo 1). Single seine hauls are conducted weekly year-round at each of 57 current sampling locations that range from Central San Francisco Bay upstream into the lower Sacramento and San Joaquin rivers. A complete survey requires 2 technicians, a truck or small boat, and 6 to 7 days. All fishes ≥ 25 mm (with some exceptions) and some shrimp and crabs are identified to species and enumerated; all salmonids and up to 50 of each other fish species are measured to the nearest millimeter fork length or total length. All organisms are returned to the water except fin-clipped salmon. See Appendix B 1 for more details.

San Francisco Bay Study Survey

The Bay Study Survey employs the 42-foot research vessel Longfin to fish a midwater trawl and an otter trawl monthly year-round at each of 52 open-water sampling locations. Sampling locations range from southern South San Francisco Bay through San Pablo and Suisun bays and into the Delta. The survey takes a 4- to 5-person crew 7 days to complete. The midwater trawl has a 3.7-m^2 mouth and meshes that graduate from 20.3 cm at the mouth to 1.3 cm at the cod end. The midwater trawl is towed with the current for 12 minutes and retrieved obliquely, sampling the water column from bottom to surface. The volume filtered is calculated as the product of the mouth area under tension (10.7 m^2) and the distance traveled as measured by a flow meter. The otter trawl has a 4.9-m head rope, a 2.5-cm stretch mesh body, and a 1.3-cm woven mesh cod end. This trawl is towed against the current for 5 minutes on the bottom. Area swept by the trawl is calculated as the product of the door spread under tension (3.4 m) and the distance towed estimated by Loran C or GPS, converted to meters (Photo 2). All fish and Cancer crabs are identified to species and enumerated, and up to 50 fish and 30 crab of each species are measured (crabs are also sexed) before being returned to the water. Jellyfish are counted and returned to the water, and shrimp are preserved and returned to the lab for identification and measurements. See Appendix B 2 for more details.

Photo 2 Bay Study Survey: The last of the otter trawl is pulled onboard Research Vessel Longfin.

Fall Midwater Trawl

The Fall Midwater Trawl Survey can be conducted from one of several research vessels, primarily Scrutiny (32 feet), Munson (25 feet), or New Alosa (42 feet). The survey sets a midwater trawl at 116 locations monthly from September through December and takes a 3-member crew 8 days to complete (Photo 3). Sampling locations range from San Pablo Bay upstream through Suisun Bay and Marsh and into the Delta as well as the lower Sacramento and San Joaquin rivers. The Fall Midwater Trawl uses the same trawl design and 12-minute oblique tow as the Bay Study. Fish, shrimp, and jellyfish are identified to species and enumerated. Up to 50 fish of each species are measured to nearest millimeter fork-length (or total length). Although a flow meter is placed in the water for each tow, and volume filtered can be estimated, fish densities are reported in catch per tow. See Appendix B 3 for more details.

Photo 3 Fall Midwater Trawl: Trawl retrieval is almost complete from back deck of Research Vessel Scrutiny.

Summer Townet Survey

Photo 4 Summer Townet Survey: The townet is being brought back aboard the Research Vessel New Alosa.

The Townet Survey can also be conducted from one of several research vessels, primarily the Munson (25 feet), Scrutiny (31 feet), or New Alosa (42 feet). A 3-person crew can complete the 32-location sampling schedule in 5 days. Sampling locations range from eastern San Pablo Bay upstream through Suisun Bay and Marsh and into the Delta, including the lower Sacramento and San Joaquin rivers. This survey runs every other week from early June through late August and uses a 4.3-m long net attached to a skid mounted frame and possessing a 1.5-m^2 mouth, a 2.1-m body of 20-mm woven mesh and a 2.1-m cod end of 4-mm woven mesh. At each location, up to 3 oblique 10-minute tows are made; only 2 tows are made if no fish are caught (Photo 4). All fish are identified to species and enumerated, and a subset is measured to the nearest millimeter fork-length. This survey runs on alternate weeks to the 20 mm Survey during June and July. See Appendix B 4 for historical differences and more details.

Delta Smelt 20 mm Survey

Photo 5 20 mm Survey. Clockwise from top, Research Vessel Munson tows 20 mm net; ichthyo-samples prior to return to the lab; mouth view of 20 mm net with zooplankton net on top; measuring water temperature and electrical conductivity.

The 20 mm Survey is generally conducted from either the Scrutiny (31 feet) or the Munson (25 feet). It takes a 3-person crew 6 days to sample the 41 survey locations (46 in a wet year). The process is conducted every other week from late March through July. Sampling locations range from eastern San Pablo Bay through Suisun Bay and Marsh and throughout the Delta. Three 10-minute oblique tows are conducted at each location using a 5.1-m long, skid mounted net with a 1.5-m^2 mouth, a 1.6-mm mesh body, and a removable 2.2-L cod-end jar (Photo 5). After each tow, cod-end jar contents are preserved, labeled, and returned to the lab for identification. Volume filtered is determined from readings of a flow meter suspended in the net mouth and mouth area. See Appendix B 5 for more details.

Spring Kodiak Trawl Survey

The Spring Kodiak Trawl Survey requires 2 boats, usually the Scrutiny (31 feet) and a Kvichak (24 feet), a crew of 4, and 4 to 5 days to cover the 39 sampling locations monthly from late January though mid-May (Photo 6). A second sampling scheme, conducted monthly 2 weeks after the first, focuses 1 to 2 days of sampling in regions of high delta smelt density to gather more information on gonad maturity. The 39 primary sampling locations are distributed from Napa River and Carquinez Strait through Suisun Bay and Marsh and throughout the Delta. At each location a single, 10-minute surface tow is made using a 7.6-m wide by 1.8-m high Kodiak trawl, which tapers to 6-mm mesh. The net is retrieved to the larger vessel and brought on board. Both vessels travel to the next location while the fish are identified, enumerated, measured to the nearest millimeter fork-length, and released, except for delta smelt which are preserved and returned to the lab for gonad staging. See Appendix B 6 for more information.

Photo 6 Spring Kodiak Trawl. Kodiak trawl underway looking astern from Research Vessel Scutiny flying bridge; orange floats mark the net end. The second boat is out of view to the left.

Juvenile Sturgeon Year-class Strength Survey

The Juvenile Sturgeon Survey requires only a single vessel from 24 feet to 31 feet and a crew of 3 to sample approximately 21 locations during a 2-week period monthly from June through August. Sampling locations range from eastern San Pablo Bay through Suisun Bay into the western Delta. At each location, baited setlines are fished for approximately 24 hours targeting age 1 to 7 (juvenile) sturgeon using as bait lamprey, threadfin shad, mud shrimp, ghost shrimp, bay shrimp, and pickled squid. Each setline includes a 1,800-foot ground tackle with approximately 100 gangions attached. Each gangion includes a halibut snap, a 3-foot leader, and a single baited hook. Up to 4 lines are fished at a time. See Appendix B 7 for more information.

Suisun Marsh Fish Community Survey

The Suisun Marsh Survey uses a dedicated vessel to sample monthly year-round at 21 slough locations with an otter trawl and at 2 shoreline locations with a beach seine; all sampling locations are in Suisun Marsh. This sampling takes a 2-person crew about 4 days. At each slough location 2 otter trawl tows are made using 5.3-m long by 2.5-m head rope trawl with a 35-mm mesh body and 6-mm mesh cod end towed on the bottom at about 4 km per hour for 5 minutes. Seine hauls are conducted from shore at 2 locations using a 10-m net. Organism abundance is expressed as catch per tow or haul. Fishes from all samples are identified to species, enumerated, and measured to the nearest millimeter standard length before being returned to the water. Macro-invertebrates are identified and enumerated (mysids are given abundance rankings); Chinese mitten crabs are sexed and measured to the nearest millimeter maximum carapace width. See Appendix B 8 for additional information and other parameters measured.

North Bay Aqueduct Survey

The NBA Survey (present schedule terminated in 2004) used primarily the research vessel Beowulf (25 feet) to sample at either 4 (every 2 days) or all 8 (every 4 days) survey locations in the north Delta. A crew of 3 conducted a single oblique ichthyoplankton tow at each location on survey dates beginning February 15 and ending July 15 using a 3.4-m long, skid mounted net composed of 505-micron mesh nylon with a mouth area of 0.37 m^2. This resulted in 15 to 16 field days per month during the survey period. A flow meter mounted in the net mouth and the mouth area allowed calculation of volume filtered. Captured organisms were preserved and returned to the lab for identification. See Appendix B 9 for more information.

Delta Shoreline Resident Fishes Survey

The Resident Fishes Survey uses an 18-foot Smith Root electrofishing boat and a crew of 2 to sample monthly year-round at 20 randomly selected 500-m reaches of shoreline (<4 m deep) spread across 5 regions, all within the Delta. The survey takes about 10 field days a month to complete. Sampling consists of the boat moving systematically down the shoreline, re-orienting perpendicular to shore, then completing the circuit, whereupon fish within the created electrical field are attracted to forward-mounted anode probes (Photo 7). Stunned fish netted by the technician in the bow are transferred to a live well until sampling at the current reach is completed, at which time they are identified, enumerated, and measured to the nearest millimeter fork length, then released Effort is determined by the number of “shocking seconds” expended sampling the reach. In spring approximately 400 largemouth bass are tagged annually to investigate angler harvest rate. See Appendix B 10 for more information.

Photo 7 Resident Fishes Survey. Fish within a created electrical field are attracted to boat's forward-mounted anode probes.

State Water Project and Central Valley Project Fish Salvage

The SWP and the CVP are located in the southern Delta. Each exports water from a single location. Both employ louvered screens across their water intake channels to guide fish out of the export water stream and into a bypass system from which they will be collected and trucked back to the western Delta (Photo 8). The louvers guide fish whenever water is being pumped, and counts are made periodically throughout each day of pumping, which requires on average 3 persons per day (one for each shift) per facility. The number of fish and crabs salvaged by these systems is estimated by periodically counting organisms from a known proportion of the bypassed flow and scaling up. For example, the number of organisms from 20 minutes of sampled flow over a 2-hour interval would be multiplied 6 times to estimate total salvage. Both facilities identify and enumerate all fish collected > 20 mm fork length and measure a subset of each species. See Appendix B 11.a and B 11.b for more information.

Photo 8 SWP and CVP Salvage: Aerial views of fish protective facilities for SWP (top) and CVP (bottom).

Chipps Island Trawl Survey

Photo 9 Chipps Island Trawl: The Chipps Island trawl off the stern of the Research Vessel Whitesel during net retrieval.

The Chipps Island Trawl uses the research vessel Whitesel (40 feet) and a crew of 3 to sample every 2 to 3 days year-round adjacent to Chipps Island at the confluence of the Sacramento and San Joaquin rivers (Photo 9). On each sampling day, 10 surface tows are made using a midwater trawl with a mouth 9.1-m wide by 3.0-m tall and meshes that graduate from 10 cm at mouth to 0.8 cm at the cod end. Tows alternate among 3 trawling lanes in the north, south, and middle of the channel. Fishes captured ≥ 25-mm fork length (with some exceptions). Macro-invertebrates are identified and enumerated. All Chinook salmon and a subset of each other fish species are measured to the nearest millimeter fork length. All are returned to the water, except Chinook salmon possessing an adipose fin clip, which are retained for later recovery and reading of an embedded coded wire tag. Volume filtered is estimated based on flow meter readings and knowledge of the net mouth area during towing. See Appendix B 12 for additional information.

Sacramento and Mossdale Trawl Surveys

Photo 10 Sacramento and Mossdale Trawls: Midwater trawl being retrieved by Sacramento Trawl Survey crew on the Research Vessel Silverside.

The Sacramento and Mossdale trawls employ either one (Sacramento Trawl only) or 2 vessels, depending upon the trawl used. Two vessels (27 feet and 23 feet) and a total crew of 4 are used when a Kodiak Trawl is towed—October through March at Sacramento and year-round at Mossdale. Only a single vessel (27 foot) and a crew of 3 are used when a midwater trawl is towed—April through September at Sacramento (Photo 10). Regardless of net used, 10 surface tows are made 3 days per week year-round. Sampling is increased during important migration periods. The Kodiak trawl has a mouth 7.6-m wide by 1.8-m tall and meshes graduated from 5 cm at the mouth to 0.6 cm at the cod end followed by a live box. The midwater trawl has a mouth 4.6-m wide and 1.8-m tall with mesh size graduated from 20 cm at mouth to 0.6 cm at the cod end. Fishes captured ≥ 25 mm fork length (with some exceptions) and macro-invertebrates are identified and enumerated. All Chinook salmon and a subset of each other fish species are measured to the nearest millimeter fork length. All are returned to the water, except Chinook salmon possessing an adipose fin clip, which are retained for later recovery and reading of an embedded coded wire tag. Volume filtered is estimated based on flow meter readings and knowledge of the net mouth area during towing. See Appendices B 13 and B 14 for additional information.

Adult Sturgeon Tagging Survey

Photo 11 Adult Sturgeon Tagging: Sturgeon are removed from the trammel net at the stern of the Research Vessel Striper II.

Adult Sturgeon Survey uses one of 2 research vessels—the Striper II (32 feet) and the New Alosa (42 feet)—equipped with a net reel to safely and efficiently deploy and retrieve the long trammel nets (Photo 11). Field sampling occurs for 2 years in a row then skips 2 years. During survey years, a single crew of 3 to 4 persons works 5 days a week for the months of September and October setting a net in regions of San Pablo Bay where capture of white sturgeon is likely. Some August sampling occurred recently to gather information on green sturgeon. A 200-fathom (1,200 feet) by 2-fathom deep trammel net is deployed, drifted with the current for a short period of time then retrieved; a set (including 10 minutes to lay out, drift fishing, and retrieval) can take up to an hour. The four 50-fathom, 3-layer panels are composed of 6-, 7-, or 8-foot stretch mesh inner layer, sandwiched between outer layers of 24-, 28-, and 32-inch mesh, respectively. All legal sized white sturgeon (46 feet to 72 feet) are measured (nearest centimeter total length), uniquely tagged (including systematic inclusion of reward tags), and released after collection of a fin ray to determine age. All others and green sturgeon are measured and released. Other species are only identified and enumerated. Capture of previously tagged fish is recorded as part of the data used to calculate population size. See Appendix B 15 for more information.

Adult Striped Bass Tagging Survey

Adult Striped Bass Survey sets drift gill nets and large fyke traps during the spring spawning migration to capture striped bass ≥ 18 inches for tagging and for recovery of previously tagged fish. Tagging has occurred annually except for a brief period in the mid- to late-1990s when it occurred every other year. To tag striped bass, 2 research vessels equipped with net reels—the Striper II (32 feet), Splittail (25 feet), or New Alosa (42 feet)—deploy 600-foot drift gill nets (4-, 4.5-, 5-, and 5.5-inch stretch mesh) near the confluence of the Sacramento and San Joaquin rivers 5 days per week during April and May of tagging years; also, 12 fyke traps are fished daily, April through May in the vicinity of Knights Landing on the Sacramento River (Photo 12). The 10-foot diameter by 20-foot long fyke traps are covered in 2-inch square mesh, 11-gauge galvanized chain link fencing material with 2-inch square mesh polyethylene netting covering the 2 throats and one end of the traps. All legal sized (≥ 18 inches total length) striped bass captured are uniquely tagged—including systematic inclusion of reward tags—measured, sexed, and have scales removed before release. All tagged fish are aged from annuli counts on scales. Mark-recapture population estimates are stratified by sex and age to determine factors affecting bass abundance and survival and current population status. Other fish captured by both gears are identified and counted, but are not included in the database. See Appendix B 16 for more information.

Photo 12 Adult Striped Bass Survey: Gill net retrieval.

3 General Highlights

The following bulleted items are major findings from questionnaire responses. They are divided by sections and themes used in this report. For more comprehensive discussion of results, please read the full summary of the sections and review the original survey responses in Appendix B.

Basic Information and Program Element Description

- The most common sampling design is "multiple, fixed location" (9 surveys). The other sampling designs are "fixed regional strata, random location" (1 survey); "single, fixed location" (4 surveys, salvage combined); and "flexible location" (2 surveys).
- DFG conducts most of the surveys, followed by USFWS.
- Survey intervals range from daily to annual.
- Surveys range from 3 to 12 months in duration.
- Gear type varies substantially throughout the program. The only shared gear types are midwater trawls (4 surveys), otter trawls (2 surveys), beach seines (2 surveys), and louvered fish screens (2 surveys).

Budgets, Staffing, and Resources

- Collaboration among the surveys occurs between agencies (primarily DFG and USFWS boat operators and vessels) and among surveys within agencies (DFG and USFWS biologists can lead several surveys each).

Progress toward IEP Goals

- Five surveys (Fall Midwater Trawl, Townet Survey, 20 mm Survey, Spring Kodiak Trawl, and SWP and CVP Salvage) are required fish monitoring elements under the USFWS 2004 OCAP Biological Opinion. Four additional surveys (Beach Seine, Chipps Island Trawl, Sacramento Trawl, and Mossdale Trawl) have a soft mandate as part of a real-time monitoring requirement in the 2004 Biological Opinion from NOAA Fisheries.

- Surveys mostly address the goal of monitoring the distribution and abundance of special status species, sport fishes, forage fishes, and invasive species.
- Predictably, the surveys mostly do not address the goals of monitoring water quality, hydraulics, lower trophic levels, or benthic organisms.
- Most surveys are trying to meet IEP's goal of determining the relationships between variables monitored by IEP.
- Most programs monitor how fish abundance and distribution are affected by water project operations, use of environmental water, and ecosystem restoration. No survey directly addresses agricultural diversions.

Strengths for Determining Status and Trends of Fishes

- Most surveys have long, consistent historical data sets.
- Several surveys make data available rapidly, providing near real-time dissemination via the Internet.
- Over half the surveys sample open water in channel and shoal habitats > 2-m deep.
- Three surveys sample entrance and exit points of the Delta for age-0 anadromous fish.
- Six surveys provide broad geographic coverage; as a whole, sampling covers all California Bay-Delta Authority (CBDA) regions in the estuary and Delta and extends into the lower Sacramento and San Joaquin rivers (see Figure 1).
- Most surveys exhibit substantial integration of field personnel and sharing of resources, boats, lab space, and equipment.
- Twelve surveys most effectively target age-0 fish and use information to assess relative year-class strength.
- Sampling and data collection for 12 surveys are now focused on multiple species and away from emphasizing single species.
- Rapid data availability and multiple species focus have led to more intensive data use in water management decisions, species research, and species status reviews:

  1) Delta smelt catch data from Summer Townet Survey, 20 mm Survey, and Spring Kodiak Trawl; Chinook salmon catch data from Sacramento, Mossdale, and Chipps Island trawls and the Beach Seine Survey; and both species numbers in SWP and CVP Salvage surveys are used to make real-time decisions on Delta Cross Channel gate closures (in the case of Chinook salmon catches), on water export rates, and use of Environmental Water Account (EWA) assets.

  2) Striped bass data from Townet, Fall Midwater Trawl, Bay Study otter trawl, and SWP and CVP Salvage have been used at different times to investigate the population dynamics of age-0 fish.

  3) Splittail abundance and distribution data from 7 different IEP fish surveys were used to investigate species status and need for listing.

  Some of these data also support traditional DFG needs to monitor sport fish population status—e.g., sturgeon and striped bass—and develop appropriate fishing regulations.

Weaknesses for Determining Status and Trends of Fishes

- Five surveys sampling at single locations and 2 geographically limited surveys are susceptible to interpreting a shift in fish distribution as a change in abundance.
- Few surveys target larval (1) or adult (2 to 3) fishes due to effort and expense.
- Only 3 surveys target or effectively sample off-channel habitat (i.e., < 2-m deep shoals, marshes, floodplains), particularly those with vegetation or hard structure.
- Only 2 surveys attempt calculation of population size (Adult Sturgeon and Adult Striped Bass); most trawl surveys lack information on gear efficiency necessary to begin the process.
- Most surveys do not attempt to quantify variability in data used for abundance index calculation (i.e., no estimate of precision of abundance index), which confounds natural variability and what we can reasonably do with the data.

Continually Assess and Improve Program Elements to Support Management Priorities

- Eight surveys report proposing or conducting field or analytical studies to assess current or new sampling methods.
- Eleven of 16 surveys reported some effort to review and improve monitoring element processes, and 8 listed quality control and quality assurance examples.
- Nine projects reported using historical information to change program element design or suspected that current analyses might result in a future design change.
- One survey was recently implemented (Spring Kodiak Trawl in 2002) to improve distributional information on mature delta smelt, and another (NBA Survey) was modified in 2005 to improve larval delta smelt distributional information. Both were in response to management needs for information.

Data Products, Availability, and Reporting

- Data are publicly available for all, but readily available for 81% (13 of 16) of the fish monitoring program elements. Nearly 70% (9 of 16) of these program elements use the Bay-Delta Tributaries Database (BDAT) as the public data repository. Data for the remaining surveys are available through their lead biologist.
- Some level of Web page reporting is used by 75% (12 of 16) of the fish monitoring program elements. Six program elements use Web-based reporting extensively to disseminate data and summary information in near real-time.
- Between 1994 and 2003, IEP Newsletter articles were the major form of written communication (mean = 7.2 articles/program element), followed by peer-reviewed journal articles (mean = 2.8 articles/program element). Only 25% (4 of 16) of the fish monitoring program elements have used technical reports as a means for written reporting during the last 10 years.
- Species-specific information was the most common topic of written communication followed by status and trends reporting.
- On average, the same number of "other products" was produced as peer-reviewed journal articles. Other products include written reports and popular articles, oral and poster presentations, theses and dissertations, and workshop summaries.
- Staff from all fish monitoring program elements plan on producing several written and oral products between 2004 and 2007 (mean = 5.1 products/program element). Most commonly cited products were journal articles or IEP Newsletter articles.

Customer Needs and Uses

- Questionnaire responses generally report that customers are very satisfied with the quality of the monitoring data; responses ranged from no complaints to positive feedback.
- The most valuable aspect of many surveys is the longevity, combined with temporal and spatial consistency of the sampling.
- The types of customer-use most frequently cited in questionnaire responses include environmental documentation, project analysis, regulatory, and research applications.
- Program elements with geographically broad-to-narrow systematic sampling range (Group 1) frequently serve all customer types: IEP, CALFED, sport fish, and regulatory agencies, as well as other government, academic, and consultant entities and nongovernmental organizations (NGOs).
- The relatively broad stratified random survey (Group 2) serves IEP agencies and sport fish management entities interested in long-term abundance distribution trends and life history information.
- Single-location, temporally systematic sampling program elements (Group 3) convey information to IEP, CALFED, and regulatory agencies, as well government, academic, and consultant entities and NGOs with a focus on environmental documentation.
- The flexible location sampling (Group 4) primarily serves IEP, sport fish management, and regulatory agencies (particularly those interested in long-time-series fish population data) as primary customers, with academics and research-focused NGOs serving as additional customers.

Recommended Actions

- Most elements reported that new, alternative, or more frequent analytical work is appropriate.
- Staff of elements monitoring status of juvenile and adult non-salmonid sport fishes reported that technical reports are necessary to evaluate and improve element effectiveness and efficiency.

4 Budgets, Staffing, and Resources

The following is a synopsis of annual staffing and budget information provided in element questionnaires or from IEP planning data. Budget data presented here for DFG fish surveys may differ from those presented in the questionnaires. Our data reflect a complete cost accounting for field and lab personnel that has not been captured previously and include higher benefit and overhead rates than were used by most survey respondents.

To develop costs by staff level, we categorized personnel and augmented dollar amounts for each category to account for benefits and overhead at the 2004 level. We augmented operations and equipment costs to account for overhead. Budgets include all funding sources for each program element. Categories were filled across agencies as follows: supervisor—GS-12 biologist, senior biologist and professor; journey—GS-11 biologist and associate biologist; intermediate—GS 9 biologist, assistant biologist and graduate researcher; technician—GS 5-7 biological science technicians and USBR technicians; laboratory—laboratory assistant, senior laboratory assistant, supervising laboratory assistant, and contracted laboratory technicians; vessel operators—WG 9 small craft operators, fish and wildlife technicians (DFG), and mates; temporary—fish and wildlife scientific aids, office technicians, and key punch operators.

Some budget and staff effort data were omitted from questionnaire responses or were not obtained in time to be included in this report. Omissions included costs associated with supervision of the Suisun Marsh Survey—although they were estimated very roughly—and costs and effort associated with DWR's portion of fish salvage. No adjustments were made to compensate for these omissions in most results; however, a proportional estimate of IEP versus non-IEP funding of the Suisun Marsh Survey was included based upon an e-mail.

To assess how surveys allocated staff effort, questionnaire respondents tallied personnel time (days) for all classifications into task categories, such as field work, lab work, and analysis/writing, assuming 20 work days per month. We summed results by task category to provide total day estimates for each. For our summaries all vessel maintenance time was allocated to field work, and Web page work was combined with data analysis/report writing. The overhead category captured time not otherwise allocated, including training and meetings and staff supported but not directly participating in the survey—those on disability or sick leave, office support staff, for example. Finally, we presented IEP funding as a proportion of total survey funding.

Costs and proportion of total cost by staff category varied considerably across surveys and were strongly influenced by the fish life stage targeted and by how each survey assigned staff duties, which varied by lead agency (Table 2A). Use of laboratory personnel was low or nonexistent unless larvae or small fishes were commonly returned for identification—Bay Study, Townet, 20 mm, NBA, for example—or fish aging and tagging data processing was routinely conducted—Adult Sturgeon and Adult Striped Bass, for example. Technicians were used differently across surveys. The 4 USFWS surveys and the Salvage surveys used technicians as field lead persons. DFG and Suisun Marsh surveys used intermediate or journey level biologists as field lead persons. DFG personnel classified as technicians were used as and categorized as either vessel operators or laboratory staff based on duties (see Table 2A). Temporary help was used to varying degrees by all surveys except the 4 surveys run by USFWS, which because of year-round sampling were run entirely by permanent personnel. Temporary personnel were particularly important to the Resident Fishes and Adult Striped Bass surveys, both year-round surveys, where they conducted the majority of the field sampling and all the angler creel surveys to gather striped bass harvest data, respectively (see Table 2A). The proportion of cost accounted for by biological staff categories reflects both the size of the survey staff and to a lesser degree the biological staff splitting time across surveys. DFG and USFWS supervisors all split time across surveys. This was an uncommon occurrence for journey and intermediate biologists.

The total survey budgets were positively related to the frequency and annual duration of sampling and secondarily to the need for processing samples in the laboratory (Table 2B). Year-round surveys (Beach Seine, Bay Study, Salvage, Chipps Island, Sacramento Trawl, and Mossdale Trawl) or those with a year-round component, such as creel census for Adult Striped Bass, were relatively expensive and somewhat similar to one-another in total budget (see Table 2B). Two exceptions, the Suisun Marsh and Resident Fishes surveys, were both run year-round on very limited budgets, using well trained student volunteers or temporary help for tasks completed by permanent staff on other surveys. Additional savings for the Suisun Marsh Survey resulted from UC Davis paying for supervision costs (not disclosed), the graduate researcher operating the sampling vessel, and extremely low staff benefits ($\leq$ 1.75% for graduate researcher and student assistants) compared to other surveys. Salvage was the most expensive survey even without including costs for DWR personnel conducting salvage operations at the State facility (this cost information was never received) (see Table 2B).

The need for laboratory staff and facilities also added to total budgets. Even though the 20 mm Survey ran for about half a year, its total costs rose to the level of year-round surveys because laboratory and temporary staff needed to rapidly identify larval fish and report results (see Table 2B). The NBA Survey also had considerable laboratory and associated temporary help costs, but total budget was held down by limited reporting requirements and nearly automated reporting via the Internet, which reduced the need for biologist and supervisor time.

Expenditures for biologists and supervisors generally reflected actual effort expended on each project. But in a few cases, these expenditures reflected decisions based on ease of budgeting. For example, the journey and intermediate biologists on Townet were similarly funded, thus budgeted together even though the journey-level biologist did analyses for both the Townet and Fall Midwater Trawl surveys reviewed here and the previously terminated Striped Bass Egg and Larva Survey, not part of this review (see Table 2B).

Reported staff time allocations across tasks varied considerably by survey and did not always follow dollar allocations. Generally, field work received the largest time allocation (Table 3A and Table 3B). For surveys targeting larval fish (20 mm and NBA) or adult fish (Adult Sturgeon and Adult Striped Bass), lab work received the highest or second highest time allocation. Data management occupied a substantial (> 10%) fraction of staff time in only 7 of 16 surveys, though some allocating little or no time to this task may have underestimated or accounted for it differently—Adult Sturgeon and Adult Striped Bass, for example. Data analysis and report-writing generally comprised less than 20% of staff time (see Table 3A and Table 3B). An extreme exception was the Townet Survey where almost half of the staff time went to analysis and reporting; however, this high proportion complemented the dollar budget and not actual work, which included substantial but unaccounted time for analysis and writing about Fall Midwater Trawl data and about a historical survey that was not part of this review.

Project management generally required less than 10% of overall project time, but this time was estimated differently by different respondents (see Table 3A and Table 3B). For the delta smelt projects (Spring Kodiak, 20 mm, and NBA), all the senior biologist’s time was allocated to program management even though considerable time was spent on data analysis, writing, and Web page management, as well as meetings that might have been considered “other” and summarized into overhead (the “other” category was seldom used by any of the respondents). Supervisor time was similarly allocated, though less time was spent on nonmanagerial tasks, for Fall Midwater Trawl, Townet, Juvenile Sturgeon, Resident Fishes, Adult Sturgeon, and Striped Bass surveys. Alternately, supervisor-level biologist time spent on analysis and writing was reflected in allocations for Bay Study and Beach Seine surveys and Chipps Island, Sacramento, and Mossdale trawls (See appendices). Overhead represented a minimal fraction of time except for Bay Study, where much of it resulted from a boat operator expending vacation and sick leave before retirement; thus, the Bay Study budget (see Table 2A and Table 2B) reflected the staff time needed to conduct the field work plus an additional boat operator on leave.

Table 2A Survey costs (percent) by staff category

(11x17 format)

Table 2B Survey costs (dollars) by staff category

(11x17 format)

Table 3A Survey personnel time (percent) by task category

(11x17 format)

Table 3B Survey personnel time (days) by task category

(11x17 format)

Six of 16 elements were funded exclusively through IEP, one was funded directly by USBR and DWR, and 9 elements were funded jointly by IEP and DFG (Figure 2). Among jointly funded elements, IEP contributed between 29% and 91% of the funding. Funds from DFG came from the Striped Bass Stamp Program, the Sportfish Restoration Act, and Proposition 50.

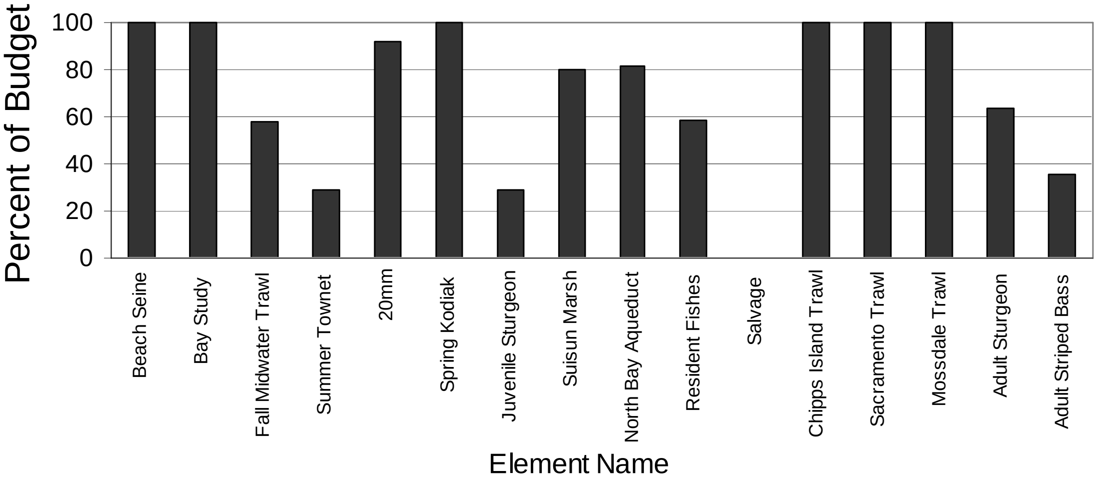

Figure 2 IEP funding as a percentage of total element budget

5 Goals, Strengths, and Weaknesses for Determining Status and Trends of Fishes

Information presented in this section complements the summary discussion in Customer Needs and Use (section 9). This section discusses examples of integration, whereas section 9 highlights the applications that result from the program element data and information integration.

Progress toward IEP Goals

Appendix A lists most of the current IEP mission, goals, and objectives statements as presented to the questionnaire recipients in spring 2004. Table 4 shows goals addressed by each survey. The responses generally reflect 2004 survey protocols and may not capture historical methodologies, goals, or targets, some of which have changed over time. A notable exception is new information related to monitoring requirements that are included under 2004 OCAP Biological Opinions by USFWS and NOAA Fisheries (see below). This information was not available at the time of the survey, but was added by the authors of this report. Additional changes to program requirements, goals, and targets will almost certainly occur in future years. Hence, this summary represents a “snapshot” of the progress of each program toward the current priorities.

Introduction and Interpretation Based on Survey Objectives

Of the 16 surveys, 11 have one or more mandates for their continued operation (see Table 1). Here we discuss only the most recent mandates, even though some surveys such as SWP and CVP Salvage have a long history of mandates: (1) State Water Resources Control Board Decision 1485, (2) NMFS 1993 BO for Sacramento winter-run Chinook salmon, (3) 2000 NMFS BO for spring-run Chinook salmon and steelhead, (4) 1986 DWR/DFG Four Pumps Agreement, (5) 2002 DWR/DFG Salvage Operations Agreement, and (6) 2004 USBR/DFG Salvage Monitoring Agreement.

Five fish monitoring elements—Fall Midwater Trawl, Townet Survey, Spring Kodiak Trawl, 20 mm Survey, and SWP and CVP Salvage—are required under the 2004 OCAP Biological Opinion, which USFWS issued for the operation of the State and federal water projects. These monitoring elements are required parts of the project description of the SWP and CVP to help minimize take of delta smelt. Although the NBA Survey was required under the 1995 OCAP Biological Opinion, the survey is scheduled to be replaced in 2005 by a Delta-wide larva sampling pilot effort, with resultant gear and protocols incorporated into an expanded 20 mm Survey.

NOAA Fisheries 2004 OCAP Biological Opinion for Chinook salmon and steelhead trout was not as explicit as that of the USFWS. Under its terms and conditions the NOAA OCAP requires, "Reclamation and DWR shall continue the real-time monitoring of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead in the lower Sacramento River, the lower San Joaquin River and the Delta …" and "… continuous real-time monitoring must be conducted between October 1 and May 31 of each year commencing in 2004." Although not specifically identified, the 4 USFWS surveys—Beach Seine and Sacramento, Mossdale, and Chipps Island trawls—all target the salmonids in question and provide the required data, so are in a sense mandated.

Most surveys report that they contribute to resource management goals of determining the relationships between fish populations and environmental variables monitored by IEP. In particular, surveys monitor environmental trends in conjunction with special status species—delta smelt, splittail, and salmonids, for example—and sport fish species—sturgeon, striped bass, American shad, and catfish, for example. Predictably, the surveys mostly do NOT address the goals of monitoring water quality, hydraulics, lower trophic levels, or benthic organisms. Exceptions include conductivity, water temperature, and Secchi depth taken by most surveys; dissolved oxygen measurements recently implemented by Suisun Marsh; plankton sampling in conjunction with 20 mm sampling; identification and enumeration of jelly fishes (Bay Study and Fall Midwater Trawl), shrimps (Bay Study, Suisun Marsh, Fall Midwater Trawl, and USFWS Beach Seine), Cancer crabs (Bay Study), and the Chinese mitten crab (Bay Study, Suisun Marsh, SWP and CVP Salvage, and USFWS Beach Seine).

Most also reported that their programs monitor how fish abundance and distribution are affected by water project operations, use of environmental water, and ecosystem restoration. None of the surveys directly addresses effects of agricultural diversions on fishes.

All 16 long-term fish monitoring surveys were established with goals for monitoring abundance or distribution trends of a particular species or group of species, except fish counts made at the fish salvage facilities. Salvage counts were originally intended to quantify fish saved from entrainment and returned to the Delta, initially for striped bass and Chinook salmon; however, they represent some of the largest annual collections of several species of concern among IEP surveys, including winter-run Chinook

Table 4 Goals addressed by each survey

(11x17 format)

(This page is blank to accommodate large format Table 4) salmon, delta smelt, and splittail. Salvage counts have proven useful to scientists investigating abundance trends and managers investigating potential water export effects on fisheries. For these reasons, salvage counts—or more specifically, salvage rates—have been incorporated into IEP long-term monitoring.

Based upon species and habitat sampling goals, different sampling strategies are used for migratory and resident species. Although all fishes move in search of food, some also change habitats seasonally or ontogenetically. Some sampling designs take advantage of these movements to count individuals; for example, the open water surveys take advantage of the ontogenetic movements from shallow to deeper waters of many of the transient species. Seasonal trawling at Chipps Island, Sacramento River, and Mossdale takes advantage of known Chinook salmon and steelhead migratory patterns to capture juveniles that must pass to reach the ocean. Repeated trawling at single locations allows these surveys to index the total number of juveniles emigrating in a year.

In the sections following we group the surveys by general sampling strategy, discuss the limitations of each sampling strategy to address questions related to trends in abundance and distribution, and present results of the effectiveness of each survey in capturing species.

General Strengths and Weaknesses of Survey Designs

Surveys in Group 1 sample fishes from the same set of locations periodically year after year (see Table 1 on Page 4). Absent a major physical change to the sampling location, the sampling gear is assumed to work approximately the same over time, reducing the effect of varying location characteristics on how well the gear captured fishes. Also, occupying the same locations improves the likelihood of successfully deploying and retrieving gear as boat operators become familiar with the conditions and obstructions and avoid or adapt to them. This type of sampling produces relative abundance estimates that are assumed to be strongly related to changes in absolute population size. However, because Group 1 survey sites were not originally picked at random, they may inadvertently bias results—i.e., they may represent particularly good or poor habitats. For this reason, generalizations from individual survey abundance to target population abundance should be made with caution. Surveys in this group can also identify shifts in species distribution between survey intervals and years; the broader the survey range the less likely a shift in distribution will be interpreted as a change in abundance.

The Resident Fishes Survey (Group 2, Table 1 on Page 4) is the only current survey selecting at random sample elements (500 m segments of shoreline to electrofish) for each sampling interval. Random selection of sampling elements allows inferences concerning the populations of shoreline fishes targeted and collected well (see Appendix B 10, Delta Resident Shoreline Fishes Survey). With substantial caveats regarding the effectiveness of electrofishing on particular fish species of interest, this survey can produce abundance indices directly related to the population size for the geographic range sampled. Random selection of sample elements (shoreline reaches) does not allow location-to-location distribution comparisons. However, it strengthens spatial comparisons across regional strata, which have remained consistent since the re-initiation of the survey in 1995. Since electrofishing draws fishes out from among obstructions, this gear is well suited to random site selection because underwater obstructions and vegetation, common along shorelines, pose fewer problems for electrofishing than for trawls or seines.

Single location sampling surveys (Group 3, Table 1 on Page 4) provide valuable indices of abundance for migratory species funneling past the site, assuming that sampling encompasses most or all of the migratory period and sampling gear is appropriate for the species/life stage. Current year-round sampling ensures migratory periods are completely sampled. High sample volumes for several surveys enhance the likelihood of detecting a rare fish species. Such surveys also provide valuable abundance information for nonmigratory fishes if auxiliary information indicates that the sampling location is centrally located within the species' range and that changes in catch are unrelated to shifts in distribution. Without such life history or supplementary distributional information, however, single-site abundance estimates should be suspect.

The geographically flexible, temporally narrow sampling surveys (Group 4, Table 1 on Page 4) use mark-recapture methodology to estimate population size. Mark-recapture studies under the best conditions can provide population estimates and measures of precision of the estimate. Data can also be used to estimate total mortality, or fishing mortality if anglers are interviewed or induced to return tags through rewards (interviews and reward tags are current practices). However, mark-recapture studies are data intensive for an unbiased estimate. Moreover, assumptions necessary for estimation are often difficult or impossible to test, or they may be known to be invalid. In such cases, the resulting real and potential biases should be acknowledged and discussed.

Survey Effectiveness by Life Stage for Species and Habitat

Long-term fisheries monitoring employs a great variety of gear, from nets designed to retain 5 to 6 mm larvae, to nets or traps that can retain 120-cm striped bass or 310-cm white sturgeon. Half the surveys use towed nets that were most effective for fish during their first year of life. Late-fall Chinook salmon were not included among species of interest in our questionnaire, but surveys effectively tracking fall Chinook salmon abundance and distribution will be equally effective for late-fall fish (Table 5).

As of 2003, only the NBA Survey continued to use gear targeting larvae. Three other surveys previously used ichthyoplankton nets: the Bay Study, 1980 to 1989; the Striped Bass Project, 1968 to 1995; and Suisun Marsh, 1994 to 2002. Other surveys employ gear that successfully retains early- to late-stage larvae and salmonid fry well: Beach Seine (fry only), Townet, 20-mm Survey, Suisun Marsh beach seine, Chipps Island (fry only), Sacramento Trawl (fry only), and Mossdale Trawl (fry only) (categorized as "L" in Table 5). The USFWS surveys—Beach Seine and Chipps Island, Sacramento, and Mossdale trawls—only keep record of fish ≥ 25 mm, with few exceptions, so true larvae are no longer identified and enumerated, but salmonid fry continue to be. One or more surveys reported effectively monitoring all Species of Concern at the larva/fry stage except coastal steelhead, green sturgeon, and starry flounder (see Table 5). For these 3 species, early life-stages are rarely present within the sampling range of any of the 16 surveys.

Sport fishes are also well sampled at this life stage, except for white sturgeon (whose larvae probably rear upstream) and catfish (whose larvae rear near structure in benthic habitats). However, larvae and fry are not well sampled across all habitats of interest. In particular, nearshore vegetated, nearshore other structures, marsh, floodplain, and benthic habitats are not well sampled for larvae and fry (categorized as "L" in Table 5). The USFWS Beach Seine captures many late-stage larvae, but due to the copious numbers and identification challenges in the field, USFWS imposed a minimum size of reporting (≥ 25 mm) in 1995. This minimum threshold did not affect collection or reporting of salmon fry data. The USFWS Beach Seine remains the best gear and survey for assessing fry distribution and entry into the Delta for all Chinook salmon races.

Table 5 Fish monitoring surveys rated excellent or good for abundance and distribution by groups/species or habitats

	Survey															
	Group 1 Multiple fixed location sampling								Group 2 Fixed strata, random location		Group 3 Single, fixed location sampling				Group 4 Flexible location sampling	
Species of Concern	BSeine	Bay Study	FMWT	TNS	20 mm	Spr Kod	Juv Sturg	Suis M	NBA	Res Fish	Salvage	Chipps	Sac T	Moss	AdSturg	AdBass
Winter-run Chinook	J										J	J, A	J, A			
Spring-run Chinook	L, J										J	J, A	J, A			
CV steelhead	L, J										J, A	L, J, A				
Coastal steelhead																
Delta smelt	A	J, A	J, A	L, J	L, J	A		A	L		J, A	J, A				
Splittail	J							J, A			J, A	J, A		J		
Longfin smelt		J, A	J, A	L	L			J	L			J, A				
Grn sturg																
Starry flounder		J, A						J								
Fall-run Chinook	L, J	J									J	L, J, A	L, J	L, J		
Striped bass		J, A	J, A	L, J	L, J			J, A	L		J					A
Wht. sturg							A								A	
Catfish				L				J, A		A	J					
American shad		J	J	L	L	J			L		J	L, J				
Lrgmouth bass										J, A						

L = larvae and fry (larvae); J = age 0 and smolts (juveniles); A = age 1, age 2+ (adults)
NS = nearshore

	Survey															
										Group 2 Fixed strata, random location						
	Group 1 Multiple fixed location sampling										Group 3 Single, fixed location sampling				Group 4 Flexible location sampling	
Species of Concern	BSeine	Bay Study	FMWT	TNS	20 mm	Spr Kod	Juv Sturg	Suis M	NBA	Res Fish	Salvage	Chipps	Sac T	Moss	AdSturg	AdBass
Table 5 continued from previous page																
Surfperch		J						A							A	
NS <2m	L, J							J, A		J, A						
NS vegetated	L, J									J, A						
NS, other structures										J, A						
NS open water			J, A			J				J, A				L, J, A		
Pelagic		J, A	J, A	L	L	J, A			L		J	L, J, A	L, J, A	L, J		
Marsh								J, A								
Floodplain	L, J, A															
Mud, benthic		J, A						J, A								
Detection/ tracking of new invasions	Variable detection good tracking			L		J, A	L		Poor to excellent detection; poor tracking							

L = larvae and fry (larvae); J = age 0 and smolts (juveniles); A = age 1, age 2+ (adults)
NS = nearshore

Age-0 and smolt-sized fishes are well monitored by 12 of the 16 surveys (categorized as “J” in Table 5). All species of concern are well sampled at this stage, except for coastal steelhead and green sturgeon. Delta smelt are particularly well sampled. Except for white sturgeon and catfish, all sport fishes are similarly well sampled (see Table 5). Shoreline fishes larger than 20 to 30 mm become vulnerable to capture by the Resident Fishes Survey, so largemouth bass and sunfishes inhabiting nearshore vegetated and nearshore structured habitats are well sampled at this stage. Also, Bay Study and Suisun Marsh otter trawl sampling effectively captures this life stage, improving abundance and distribution information for benthic habitats. Marsh and floodplain habitats remain poorly sampled by IEP surveys. Suisun Marsh only samples a small proportion of marsh habitat in San Francisco Estuary.

Age-1 or yearling fishes (categorized as “A” in Table 5) are captured effectively by 10 of 16 surveys, but the species-overlap among surveys diminishes for fishes at this age. For example, the Beach Seine and Townet surveys become ineffective for Chinook salmon and for striped bass of this age, respectively. Nonetheless, the same 7 of 9 species of concern are still well sampled by one or more surveys (see Table 5). Sport fishes of interest are less well sampled in part because fall-run Chinook, American shad, and surfperches of this age are rare in the estuary. Most surveys do not sample frequently enough to catch them when available. Habitats sampled effectively remained the same as for age-0 fishes, except that the Beach Seine Survey lost effectiveness for age-1 fishes, and sampling redundancy in nearshore habitats decreased.

As fishes reach and surpass age-2 (also categorized as “A” in Table 5), most trawl surveys become ineffective at capturing them. However, surveys targeting older juvenile and adult sturgeon or striped bass are effective, particularly the Juvenile Sturgeon Tagging, Adult Sturgeon Tagging, and Adult Striped Bass Tagging (Table 5). Several trawl surveys—Bay Study, Fall Midwater, Suisun Marsh, and Chipps Island, and Sacramento River—reportedly collect smaller species that compose some of this category, longfin smelt and starry flounder, for example. In addition, Salvage remains effective for age-2 or adults of some species of concern. The Resident Fishes Survey continues to sample well those species inhabiting all nearshore habitats (see Table 5).

None of the 16 IEP long-term monitoring surveys sample coastal steelhead (i.e., from tributaries west of Carquinez Strait within the estuary), green sturgeon, or catfish well. Starry flounder, white sturgeon (adults only), largemouth bass, and all other sunfishes and surfperches are only monitored well by single surveys. The Suisun Marsh Survey includes Tule perch among the surfperches, which is the basis for its high surfperch rating (see Table 5).

This section reviews only the best sampled species-life-stages and habitats and shows that the IEP fish monitoring surveys as a group are gathering high quality abundance and distribution data for almost all the species and habitats of concern. The surveys together provide a broader and more complete view of the estuarine fish community than that provided by any single survey. Additional valuable information on survey sampling effectiveness can be found in individual survey questionnaire responses (see Appendix B for complete life-stage sampling ratings).

Missing Data and Effects

Missed sampling was inconsistently reported across surveys and difficult to interpret for some surveys, particularly for some surveys that varied locations sampled, months sampled, or sampling frequency within a month over time, USFWS Beach Seine, for example. For this section, we only identify instances when entire monthly or annual sampling intervals were missed. Appendix B contains additional information on missing data and effects for each of the surveys.

Sampling did not occur during entire months or years for 9 of 16 surveys (Table 6). Missed survey months or years most often resulted from actions to save money (Bay Study and Adult Striped Bass, for example) or boat breakdowns (Fall Midwater Trawl and Suisun Marsh, for example).

Missing data had significant effects, including

- the inability to calculate annual abundance indices for missed years and reduced sample sizes for water-year-type effects analyses, etc. (see blanks in Table 6);
- the challenge to calculate indices with missing survey months, for example, Suisun Marsh, or to calculate abundance indices from data limited to sub-optimal months, for example, Bay Study, or from index fabrication based upon patterns from similar years, for example, Fall Midwater Trawl (see gray fill, Table 6); and
- the reduction in precision of population estimates because recapture samples occur 2 years post-marking rather than one, for example, Adult Striped Bass (see Table 6), or at even more infrequent intervals, for example, Adult Sturgeon (see Table 6).

Proportions of Field Effort by California Bay-Delta Authority Region

Sampling for long-term fisheries monitoring surveys occurred in all CBDA monitoring regions, though only one survey sampled in upstream Sacramento and Upstream San Joaquin River regions and 2 sampled in Central and South San Francisco Bay Region (Table 7, see Figure 1 on Page 6 for map of CBDA regions). Sampling effort was high in all Delta regions and Suisun Bay and Marsh, and San Pablo Bay and Napa River regions. This was reflected in historical changes in sampling design in response to the need for information on fish species and fish communities near and downstream of the southern delta water export facilities, and more focus on species of concern, such as juvenile Chinook salmon, striped bass, and delta smelt, all of which migrate through or rear within the regions.

Table 6 Long-term fisheries monitoring survey durations

Survey	1959 to 1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Group 1																																							
BSeine												▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Bay Study																▨	▨	▨	▨	▨	▨	▨	▨	▨	■	■	■	■	■	■	■	■	▨	▨	▨	▨	■	▨	▨
FMWT			▨	▨	■	▨	▨	▨	▨		▨	■	▨	▨		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
TNS	▨		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	■	▨	▨	▨	▨	▨	▨	■	▨
20 mm																															▨	▨	▨	▨	▨	▨	▨	▨	▨
SprKod																																						▨	▨
JuvSturg																											▨				▨	▨	▨	▨	▨	▨	▨	▨	
SuisM																■	▨	▨	■	■	■	■	▨	▨	■	■	▨	▨	▨	▨	▨	▨	▨	■	▨	▨	▨	▨	▨
NBA																																▨	▨	▨	▨	▨	▨	▨	▨
Group 2																																							
ResFish																															▨		▨		▨		▨	▨	▨
Group 3																																							
Salvage															▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Chipps												▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
SacT												▨	▨	■	■	■	■							▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Moss																																▨	▨	▨	▨	▨	▨	▨	▨
Group 4																																							
AdSturg			▨	▨						▨					▨					▨	▨		▨			▨							▨	▨			▨	▨	
AdBass					▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		▨		▨		▨		▨	▨

Notes: Gray fill: Years that survey monitoring took place
Dark fill: Years in which one or more months were missed
Blank: Years in which no sampling occurred for survey

Variations in sampling station number or location are not recognized in this table.

Table 7 Station number and proportions of IEP long-term fish monitoring survey stations within each CBDA monitoring region

	Survey and total station number															
	Multiple, fixed location sampling									Fixed strata, random location	Single, fixed location sampling				Flexible location sampling	
CBDA/ IEP Monitoring Regions	BSeine	Bay Study	FMWT	TNS	20 mm	SprKod	JuvStg	SuisM	NBA	Res Fish	Salvage	Chipps	SacT	Moss	AdSturg	AdBass
	57	52	116	32	41+5[a]	39	21	21	8	20	2	1	1	1	n/a	n/a
Upstream Sac River	11 (19%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Delta	6 (11%)	2 (4%)	10 (9%)	1 (3%)	2 (5%)	6 (15%)	0	0	8 (100%)	3 (15%)	0	0	1 (100%)	0	0	0
East Delta	4 (7%)	0	5 (4%)	2 (6%)	1 (2%)	5 (13%)	0	0	0	5 (25%)	0	0	0	0	0	0
Central & West Delta	14 (25%)	10 (19%)	33 (28%)	14 (44%)	17 (39%)	13 (33%)	6 (30%)	0	0	8 (40%)	0	0	0	0	0	1 (100%)
South Delta	9 (16%)	0	2 (2%)	0	2 (5%)	1 (3%)	0	0	0	4 (20%)	2 (100%)	0	0	1 (100%)	0	0
Upstream San Joaquin R	3 (5%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suisun Bay & Marsh	0	10 (19%)	41 (35%)	13 (41%)	13 (32%)	13 (33%)	12 (55%)	21 (100%)	0	0	0	1 (100%)	0	0	0	0
San Pablo Bay & Napa River	4 (7%)	10 (19%)	25 (22%)	2 (6%)	7+5[a] (17%)	1 (3%)	3 (15%)	0	0	0	0	0	0	0	1 (100%)	0
Central & South SF Bay	6 (11%)	20 (38%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Stations sampled during years with high flows only.

Shifts in Sampling Area

Shifts in sampling area have occurred in 6 of 9 surveys in Group 1 (geographically systematic sampling surveys, Table 8). No shift occurred for the Resident Fishes Survey (Group 2), and only a single survey—the Sacramento Trawl—reported a shift among those in Group 3 (Table 8). Sampling locations for Group 4 were never static, so this question is not applicable.

Changes in station density and range most often occurred within a couple years of survey initiation or when a management question or a new species of concern exposed a sampling limitation that additional sampling could remedy.

Reasons for such shifts include:

- adding stations to more effectively sample target species or habitats based upon current information and management need: Beach Seine 1977 to 1981; Bay Study 1988, 1991, 1994; Fall Midwater Trawl 1968 to 1978; Suisun Marsh 1994, for example (see Table 8);
- adding or dropping stations coincident with outflow-induced distributional shifts of target species: historically, Fall Midwater Trawl and recently, Townet, 20 mm, for example;
- adding stations to improve sampling for new special status species: Beach Seine 1992 to 1994 for winter-run Chinook and Fall Midwater Trawl 1990 to 1992 for delta smelt, for example;
- removing stations to save money and reduce redundancy across surveys: for example, Beach Seine in 1983, which was redundant with Bay Study at the time; Fall Midwater Trawl in 1980 because stations were redundant with Bay Study and not important for striped bass; and Townet 1996 to 1998 due to money savings and stations often not important for striped bass (see Table 8).

Although the Chipps Island Trawl survey considered moving downstream to reduce incidental take of delta smelt, no funds have been available to investigate the effects and feasibility of such a move. Also, net modification (from 1/4-inch to 5/16-inch cod end mesh, June 2001) has reduced take of small delta smelt.

Table 8 Changes in sampling station density, range and location, and the years of occurrence for IEP long-term fish monitoring surveys

	Survey station					
Survey (start year)	Current number	Added within range	Added extending range	Removed within range	Removed reducing range	Shifted
		Survey Group 1: Multiple, fixed location sampling				
BSeine (1977)	57	• 6 (1977-81) East & Central Delta, • 8 (1992-94) Central Delta & Sac R • 1 (1997) So Delta	• 11 (1977-81) SJ Delta, SPB, SFB • 9 (1992-4) So Delta, SJR, • 9 (1996-7) SPB, SFB • 1 (2002) SJR	• 1 (1979) North Delta	• 5 (1983) SFB, SPB	
Bay Study (1980)	52	• 6(1988) South – Suisun Bay	• 1 (1988), 4 (1991), 6 (1994) all in SJ Delta			
FMWT (1967)	116	• 21 (1968-1978) Suisun Bay and Delta	• 24 (1968) SF Bay • 16-18 (1990-92) No Delta, Mok R		• 27 (1980) SFB	
TNS (1959)	32	• 4 (1961-62)	• 3 (1961) East & So Delta • 1 (1967) SPB, • 2 (1974) SPB, • 1 (1983) SPB, • 2 (1995) SPB		• 5 (1996-1998) SPB	
20 mm (1995)	41	• 5 added in high flow years in SPB		• 3 (1995) West Delta, SPB, Napa R		
SprKod (2002)	39					
JuvSturg (1991)	21					
SuisM (1980)	21		• 2 (1994) Eastern Suisun Marsh	• 6 ca (1981)		
NBA (1995)	8					

Survey (start year)	Survey station: Current number	Added within range	Added extending range	Removed within range	Removed reducing range	Shifted
Table 8 continued from previous page						
Survey Group 2: Fixed strata, random location						
Res Fish (1995)	20					
Survey Group 3: Single, fixed location sampling						
Salvage (1979)	2					
Chipps (1976)	1					
SacT (1976)	1					• To rm 55 from rm 43 (1988), • to rm 35 & 36 (1990) and • return to rm 55 (1991)
Moss (1996)	1					

Note: This table not applicable to Survey Group 4.
Mok R = Mokelumne River
SFB = San Francisco Bay
SJR = San Joaquin River
SPB = San Pablo Bay

Current Integration and Future Opportunities

USFWS and DFG each report considerable personnel and equipment integration (for example, research vessel) among their own surveys and with surveys of the other agency. UC Davis also reports personnel and equipment integration across several Suisun Marsh surveys other than fisheries. USFWS and DFG boat operators are almost completely interchangeable among their own agency's surveys. DFG operators can run all USFWS trawl surveys, and one USFWS operator can run Townet and 20 mm, but knowledge of DFG survey station locations and gear deployment techniques requires substantial time and training. Similarly, biological lead persons for USFWS and DFG are interchangeable for 2 or more surveys. USFWS and DFG share lab space and some key entry duties.

The USFWS Beach Seine and Sacramento, Chipps Island, and Mossdale trawls integrate data on salmonid catch, length, and distribution from locations throughout the rivers and Delta, including data from SWP and CVP Salvage surveys. USFWS survey data and SWP and CVP Salvage survey data on Chinook salmon races of concern, some of which are conveyed on an almost real-time basis via the Internet, have been used by water and resource managers when making decisions on export levels. USFWS surveys request, collect, and process fin-clipped salmon for coded wire tag recoveries; Bay Study, Fall Midwater Trawl, Spring Kodiak, and Salvage annually return some coded-wire tagged Chinook salmon for tag recovery. USFWS surveys also provide biological samples (otoliths, tissue samples for DNA) to DFG, DWR, NOAA Fisheries, and academic researchers.

Similar to USFWS, DFG integrates data from several of its surveys, as well as with information from the SWP and CVP Salvage surveys in order to reduce delta smelt entrainment. The NBA, 20 mm, and Townet surveys track distribution of larval and juvenile delta smelt, providing near real-time information for water export management decisions and fisheries regulators. Townet and Fall Midwater Trawl calculate abundance to determine delta smelt year-class strength, and Bay Study is occasionally used for distribution information. The relatively new Spring Kodiak Trawl tracks distribution of maturing and mature delta smelt, providing near real-time catch information used by water managers to reduce adult entrainment and to infer whether the next generation might hatch near the export pumps.

Information from juvenile delta smelt salvage has also proven very useful for predicting near-future salvage levels and to instigate changes in water export rates. Catch data from the Chipps Island Trawl has been used to track delta smelt abundance. The importance of survey data in delta smelt management has been emphasized by inclusion of the Fall Midwater Trawl, Townet, 20 mm, and Spring Kodiak Trawl surveys in the current OCAP. All the aforementioned surveys except NBA have also contributed data and delta smelt specimens to UC Davis researchers investigating early life history, reproductive development, and behavior in front of diversion screens. In the future, near real-time spawner distribution information from the Kodiak Trawl surveys could allow researchers to locate and possibly characterize delta smelt spawning habitat in the wild.

The rapid dissemination of information through the Realtime Monitoring process via the Internet has helped water management decision-making. Fish Salvage (DWR, USBR, DFG), USFWS Beach Seine, Sacramento, Mossdale, and Chipps Island Trawl surveys, and 20 mm and Spring Kodiak Trawl surveys all contribute information either daily or weekly to this process.

Three of 4 surveys originally designed to provide sequential striped bass life history information remain; the Striped Bass Egg and Larva survey was discontinued in 1995. The Townet Survey provides an index of initial recruitment in summer, which was compared against the fall index from the Fall Midwater Trawl to assess how well the cohort survived the summer. Agency and academic researchers have analyzed this survival index in relation to environmental and human induced conditions to assess relative effects of each. Striped bass numbers were next assessed by the Adult Striped Bass Survey as they entered the sport fishery (≥ 18”). Using mark-recapture methodology stratified by age and sex allowed the Adult Striped Bass Survey to estimate adult population size, and through use of age-fecundity data, estimate annual egg production. Egg production estimates have been integrated with environmental (for example, flow) and human induced (for example, entrainment loss) factors to model patterns of juvenile recruitment. Here again SWP and CVP Salvage survey data provide important information.

The Bay Study has provided data and specimen collection for a variety of agency and academic researchers. It has contributed striped bass data to DFG Adult Striped Bass Tagging Survey and academic researchers, delta smelt data to the Delta Smelt Project, splittail data to the Splittail Investigations project, juvenile sturgeon data to the Juvenile Sturgeon Year-class Strength Survey Project, returned fin-clipped Chinook salmon to the USFWS, and ongoing collections for various species (lampreys, cusk-eels, cottids, etc.) to Robert Lea who has been investigating taxonomic questions for DFG. In return, Robert Lea has provided confirming species identification checks. In addition, fish samples have been collected for Bob Spies (Lawrence Livermore Labs) and Don Watson (University of California Berkeley) among other researchers and graduate students. Bay Study has also coordinated with the Lower Estuary Zooplankton Sampling Project and provided crew and the Research Vessel Longfin as a sampling vessel for the Zooplankton project. The Bay Study noted that the USFWS Beach Seine Survey now samples into San Pablo and Central San Francisco bays at locations historically sampled by both surveys, and plans to use this inshore lower estuary sampling to further investigate the life history and abundance trends of jacksmelt and surfperches. Bay Study respondents noted that much potential exists for integration using other project data sets to answer questions about lower estuary species.

Several studies contribute information to assist the White Sturgeon Population Dynamics Program, and program staff worked with other researchers to investigate whether green sturgeon in the estuary warranted listing as a threatened or endangered species. Bay Study and the Juvenile Sturgeon surveys provided information on year-class strength of juveniles which was incorporated with adult population and mortality estimates to evaluate the efficacy of fishing regulations for protecting white sturgeon. Project staff, in coordination with other agency and academic researchers, reviewed green sturgeon catch data and provided recommendations to the listing agency. The Adult Sturgeon Tagging project has worked with DFG, other agency and academic researchers to capture white sturgeon for telemetry studies. Tagged fish have been tracked by both project personnel for identification of potential spawning grounds and other DFG personnel looking at fish migratory behavior near diversion points (Delta Cross Channel Studies, etc.).

IEP surveys already display a high level of integration with one another and with academic researchers. Generally, all surveys were willing to expand such integration. One way this might occur is through calculation of estuary-wide forage fish biomass indices. Several DFG surveys—Townet, Fall Midwater Trawl and Bay Study—have developed length-weight relationships for common estuarine fishes and shrimps and plan to estimate regional and temporal biomass trends for benthic and pelagic forage species.

6 Interpretation of Strengths and Weaknesses for Individual Surveys

This section presents strengths and weaknesses for each of the 16 surveys, related to their abilities to address a principal goal of determining trends in abundance and distribution for target fish species (see Goal 1, Table 4). Information developed for this section came from questionnaire responses, data reports, and review team member knowledge and interpretation and has been reviewed by questionnaire respondents for accuracy.

A potentially large, survey-independent weakness exists for monitoring the trends in abundance and distribution of naturally spawned (wild) Chinook salmon in the lower river system. Recent (2002 to 2003) rough estimates by USFWS suggest that the number of hatchery-produced juvenile Chinook salmon caught in the Chipps Island Trawl far outnumbered the naturally spawned fish. Since the 2 groups are impossible to distinguish visually as large juveniles in the absence of a hatchery fin clip, the true number of wild juveniles caught, as well as the timing and lower river distribution, remains unknown, making protection and management problematic. A constant fractional mark applied to hatchery fish could be used to distinguish them from wild fish for proper management.

Summary by Survey

Delta Juvenile Fishes Monitoring Beach Seine

Strengths

- Long-term, some sampling since 1976
- Very broad geographic distribution of sampling locations, including Sacramento and San Joaquin River sites and San Pablo and San Francisco Bay sites not sampled by any other survey
- Relatively effective for Chinook salmon fry and small nearshore fishes, particularly Cyprinidae
- One of 2 surveys effective in capturing small nearshore fishes
- Sampling currently year-round
- Rapid data turnaround, particularly in spring

Weaknesses

- Year-round sampling only consistent since about 1992
- Many sites are boat ramps, which may not be representative of available habitat and may bias catch results
- Changes in months sampled over time substantially diminish possible inter-annual comparisons of catch trends
- Historical data for fishes < 25 mm suspect due to species identification problems

Bay Study

Strengths

- Long-term, sampling since 1980
- Very broad geographic distribution from western Delta through South San Francisco Bay
- Year-round monthly sampling with 2 sampling gears
- Only survey sampling open water in Central and South San Francisco bays
- Only survey sampling demersal fishes effectively outside of Suisun Marsh

Weaknesses

- Missing winter sampling from late-1980s through mid-1990s constrains some abundance calculations from using all the months of most effective capture
- Abundance and distribution data compiled and reported 3 months into the next year

Fall Midwater Trawl

Strengths

- Very long-term, sampling since 1967
- Broad geographic distribution of sample locations, from San Pablo Bay through the Delta and into the lower Sacramento and San Joaquin rivers
- Relatively dense distribution of sample locations
- Relatively effective for juvenile pelagic fishes, such as striped bass, delta smelt, and longfin smelt
- Relatively rapid data turnaround, indices within a week of survey end

Weaknesses

- No sampling and no indices for 2 years; one year missing 2 months and another missing one month where indices were estimated from previous data patterns
- Almost all sampling within the Delta conducted in channels, whereas sampling in Suisun and San Pablo bays also includes sampling shoal areas (2 to 6 m deep)
- Sampling (September to December) often encompasses an environmental transition from low to high outflow and high to low water temperatures in November and December; timing of transition influences fish vulnerability and the abundance pattern observed

Summer Townet

Strengths

- Very long-term, sampling since 1959
- Limited missing data
- Broad geographic distribution, San Pablo Bay through the Delta, including Suisun Marsh
- Currently, twice monthly sampling through 6 surveys, June through August (addresses first bullet under weaknesses)
- Effective for pelagic fishes, such as young striped bass and open water species about 30 mm long available during sampling period
- Relatively rapid data turnaround, indices calculated within a week of survey

Weaknesses

- Historically, irregular starting date and variable number of surveys conducted annually limits utility of data to investigate trends for species whose spawning period, spawning locations, and early behavior are different from those of striped bass
- Three years, one not sampled, where no striped bass index could be calculated
- Only conducted during 1 to 3 months in summer

20 mm Survey

Strengths

- Broad geographic distribution
- Consistent twice monthly sampling frequency provides extensive information for fish about 20 mm long
- Effectively targets late-stage larval and juvenile delta smelt, and other open water pelagic species, such as striped bass
- Rapid data turnaround, 24 hours to 2 days via Web page

Weaknesses

- Relatively short-term survey, only since 1995; survey just beginning to develop abundance trend information
- Relies on intensive lab work involving a relatively large number of personnel to ensure a short turnaround on information (see Table 3A)

Spring Kodiak Trawl

Strengths

- Relatively effective for detecting distribution of maturing and ripe delta smelt
- Rapid data turnaround, same day via phone
- Several non-target species, particularly Chinook salmon juveniles, relatively effectively captured

Weaknesses

- Relatively short-term sampling history, only since 2002 (much less effective Spring Midwater Trawl dates back to 1990 and 1967 to 1972 with some survey months not sampled during both periods)

Juvenile Sturgeon Population

Strengths

- Only survey targeting juvenile white sturgeon to assess year-class strength before they enter the fishery
- Gear and bait identified that are highly selective for sturgeon

Weaknesses

- Limited duration, functional since 1991 with data gaps; not yet known whether year-class strength estimates are valid based on regression analysis with subsequent adult estimates
- Irregular sampling history at location of sampling and annual effort levels
- Historically, bait availability was an issue

Suisun Marsh Survey

Strengths

- Long-term, sampling since 1980
- Only long-term sampling program assessing fish abundance in and use of marsh habitat
- Effective at capturing demersal fishes and multiple age-classes of fishes in small channels
- Effectively tracked trends in abundance within the marsh—such trends were often different from those of the estuary as a whole
- Somewhat complementary to the Bay Study's otter trawl sampling

Weaknesses

- Under-samples pelagic fishes in deep channels and sloughs relative to small sloughs
- Some variability in sampling sites during early years of survey

North Bay Aqueduct Survey

Strengths

- Rapid data turnaround, about one day via Web page
- Only survey that targeted larval delta smelt

Weaknesses

- Limited geographic range
- Sampling gear not very effective at capturing larval delta smelt
- Sampling locations limit value of data in describing distribution of larval delta smelt
- Intensive lab work and high chemical use and handling required

Shoreline Resident Fishes

Strengths

- Samples throughout Delta
- One of only 3 surveys effectively sampling shallow water (< 2 m)
- Only survey that effectively samples fishes associated with dense vegetation or other structure
- Samples fishes older than age-0 well

Weaknesses

- Relatively short-term survey, reinitiated in 1995
- Gear efficiency adversely affected by salinity and turbidity

State Water Project and Central Valley Project Fish Salvage

Strengths

- Long-term sampling, since 1975 for striped bass and Chinook salmon
- Extremely large volumes of water sampled; species counts can be high even for uncommon species
- Rapid data turnaround, about one day via Web page
- Sampling year-round
- Captures multiple age groups well, including age-0

Weaknesses

- For single location sampling, salvage facilities do not intercept fishes from an exclusive migratory corridor, so changes in abundance of migratory species cannot be distinguished from changes in migratory path without supplementary distribution information
- For single location sampling, changes in abundance of nonmigratory species cannot be distinguished from changes in distribution without supplementary distributional information
- Sampling dependent upon water export pumping
- Fish identification a problem for some species up to the early 1980s, and for delta smelt until 1993
- Data available for period prior to 1979, but not entered into database and not available via the Web
- Proportion of samples in which fish identified and enumerated varied over time. At CVP facility, fish identified to species during every sample beginning November 1992 and at SWP facility beginning July 1992; prior to this time, fish identified at 0100 and 1300 and sporadically during other samples; historically, daily salvage estimates extrapolated based on these 2 samples

Chipps Island Trawl

Strengths

- Long-term sampling, since 1976
- Perhaps most effective IEP survey at capturing emigrating juvenile salmonids and documenting annual recruitment trends from Central Valley, including winter- and spring-run Chinook salmon and steelhead
- Relatively useful, in conjunction with non-IEP coded wire tag studies, assessing salmonid survival through differing migratory paths within Delta, and in indexing or estimating numbers passing
- Rapid data turnaround, about one day via Web page
- Emigrating fish must pass sampling site
- Captures pelagic, non-target species, such as splittail, delta smelt, and American shad
- Complements Beach Seine Survey data

Weaknesses

- For single location sampling, changes in abundance of nonmigratory species cannot be distinguished from changes in distribution without supplementary distribution information
- Samples year-round since 1994, but long-term data only available for spring
- Potential for high take of delta smelt may at times necessitate reducing sampling
- June 18, 2001, change in cod-end mesh from 1/4 inch to 5/16 inch may have affected catches of small fishes and thus their trends

Sacramento Trawl

Strengths

- Long-term sampling, since 1976
- Captures emigrating juvenile salmonids including winter- and spring-run Chinook salmon
- Detects salmonid entry into Delta
- Rapid data turnaround, about one day via Web page
- Complements Beach Seine sampling
- All emigrating and anadromous fish in Sacramento River must pass site unless weirs spilling into Yolo Bypass

Weaknesses

- For single location sampling, changes in abundance of migratory species confounded when weirs spill into the Yolo Bypass, providing an alternate migration route
- For single location sampling, changes in abundance of nonmigratory species cannot be distinguished from changes in distribution without supplementary distribution information
- Low fish catches in summer and fall when few fishes emigrate and water is clear
- Sampling gaps in the late 1970s through late 1980s
- Catch efficiency may be function of water clarity, which is highly variable in Sacramento River and changes substantially at this location seasonally, confounding quantification of emigration patterns and relative population levels, etc.
- Long-term sampling data only available for spring months
- Sampling not comparable year-round due to gear change: Midwater trawl used part of the year (April to September) and Kodiak trawl used remaining months (October to March)
- Kodiak trawl personnel- and boat-intensive

Mossdale Trawl

Strengths

- Reasonably effective at capturing emigrating juvenile salmonids and documenting annual recruitment trends from San Joaquin River tributaries
- Detects salmonid entry into the Delta and proximity to the water export facilities
- Rapid data turnaround, about one day via Web page
- All emigrating fish must pass site
- Complements Beach Seine Survey data
- Moderately effective at capturing emigrating juvenile splittail and American shad

Weaknesses

- For single location sampling, changes in abundance of nonmigratory species cannot be distinguished from changes in distribution without supplementary distribution information
- Few migratory species in San Joaquin River besides fall-run Chinook salmon and some steelhead
- Summer, fall (only since 1995), and early winter sampling catches very few fish; Kodiak trawl personnel- and boat-intensive relative to numbers caught

Adult Sturgeon Tagging

Strengths

- Only survey collecting information on population trends of adult white and green sturgeon
- Only survey collecting information on adult white sturgeon mortality rates
- Data collected in manner allowing estimation of absolute population size and precision of estimate

Weaknesses

- Accurate and relatively precise population estimates are data intensive, needing high numbers of tagged individuals in population and good numbers of recaptures
- Mark-recapture estimate assumptions difficult-to-impossible to test; some assumptions violated
- Specificity of sampling severely limits utility of data for non-target species

Adult Striped Bass Tagging

Strengths

- Only survey collecting information on adult striped bass population trends
- Data collected in manner allowing estimation of absolute population size and precision of estimate

Weaknesses

- Recent biennial sampling reduced precision of estimate
- Accurate and relatively precise population estimates are data intensive, needing high numbers of tagged individuals in population and good numbers of recaptures
- Mark-recapture estimate assumptions difficult-to-impossible to test; some assumptions violated
- Specificity of sampling severely limits utility of data for non-target species.

7 Continually Assess and Improve Program Elements to Support Management Priorities

All projects have proposed or recently conducted assessments or made improvements to their survey, although questionnaire respondents may not have acknowledged all efforts (for example, the development of more elaborate Web page data display for the 20 mm Survey). Responses focused primarily on reviewing and improving monitoring element processes that would improve accuracy of data and speed of data availability, but not adversely affect data comparability. This was not unexpected. The main objective of long-term monitoring has been to gather comparable data over time, which has been accomplished by using the same net design and fishing methods. The need for consistent gear and methods limits changes that could affect comparability. For this reason there are few examples of fishing gear or methods modifications.

One example of a gear revision, the Spring Kodiak Trawl survey, resulted from the 2001 review of a 1994 special study and compatibility of a gear change—midwater trawl to a Kodiak trawl—in detecting the distribution of ripe adult delta smelt (spawners). In the 1994 study, samples of delta smelt catch per cubic meter of water filtered were compared for repeated concurrent tows of a traditional midwater trawl, a Chipps Island trawl and a Kodiak trawl. The Kodiak trawl catch per cubic meter averaged more than 100 times higher than that of the midwater trawl. Because the Spring Midwater Trawl project goal was to determine distribution and, in particular, the numbers and proportion of adult delta smelt near the water export pumps, improved detection by the Kodiak trawl better addressed the goal. However, the feasibility of a geographically broad Kodiak trawl survey was not investigated and approved until fall 2001. Initiated in winter 2002, the survey detects adult delta smelt use of the Delta and provides timely information (same day via phone) to inform water management decisions. Survey personnel continue to work on field and lab processes to shorten reporting time and automate its Web presentation.

Appendix B contains questionnaire responses about assessments and improvements made to each survey. In part because of staff and equipment integration, responses were often similar or the same for projects within the same program—for example, Beach Seine, Chipps Island, Sacramento Trawl, and Mossdale Trawl in the USFWS Salmon Program or Bay Study, Fall Midwater Trawl, and Townet in the DFG Long-term Monitoring Program.

Five surveys report assessing or planning to incorporate new variables. The Suisun Marsh survey recently incorporated measurement of dissolved oxygen to its data collection. The Spring Kodiak Trawl survey has worked on improving its recognition and ranking of delta smelt maturity status. Bay Study, Fall Midwater Trawl, and Townet surveys have worked together to gather length-weight information for common estuarine fish species with the goal of developing a forage biomass index.

Eight surveys report proposing or conducting field or analytical studies to assess current or new sampling methods, including the Kodiak Trawl Survey's midwater-Kodiak trawl comparison already discussed. The Fall Midwater Trawl survey has proposed to use a Didson camera (sonar) to image the mouth size, shape, and movement of its net during deployment. This is to be part of a larger gear deployment comparison between research vessel Longfin and the research vessel New Alosa, reported by the Bay Study and Townet, that will also use time-depth recorders (new technology) to confirm whether current methods of judging net depth (i.e., cable out and cable angle) are accurate or should be revised. Townet staff has been analyzing trends in young striped bass diet data and will assess its usefulness in exploring life history questions and possibly explaining abundance patterns. The Suisun Marsh project proposed to study effects of bottom trawling on benthic fauna, but the proposal was not funded. The project has also tried collecting fish with various other gears (for example, block nets) and has added beach seine sampling to its monthly surveys. The SWP and CWP Fish Salvage surveys are assessing current sampling methods and developing new ones, such as covering louvers during the day to improve salvage. Finally, the Chipps Island Trawl survey reported that minor modifications to sampling methods are evaluated frequently. For example, a mid-1990s study on increasing mesh size to reduce delta smelt by-catch without changing salmonid capture efficiency resulted in changing the cod-end mesh size of the net used at that location.

Only 4 studies reported conducting or proposing any analytical studies to evaluate current or new analytical methods. The Bay Study reported on the collaborative work of a UC Davis “postdoc” and staff to develop alternative index calculations (for example, presence-absence) and use of nonparametric Friedman’s ANOVA to test for differences in measures of abundance and distribution. This nonparametric ANOVA will be a useful tool for all surveys. The Suisun Marsh Survey’s publication record attests to its continued efforts to incorporate new analytical methods, and it has also worked with the Bay Study postdoc. Finally, both Adult Sturgeon and Adult Striped Bass projects propose to work with a statistician to validate current methods of calculating confidence intervals for population estimates.

Respondents reported only 3 examples of new technology or gear use, including changes to the Juvenile Sturgeon Year-class Strength Survey bait based on a selectivity study, which stretches the intended definition of new technology or gear. To ensure the gear is fishing as intended, use of time-depth recorders could become a regular part of quality control for 3 surveys. The most recent example of a technology update involves the Townet Survey use of Web technology for a near real-time display of species, density, and length-frequency distribution (similar to the Web technology of the 20 mm survey).

Eleven of 16 surveys reported some effort to review and improve monitoring element processes, and half (8 surveys) listed quality control and quality assurance examples. The USFWS hired a biologist experienced in taxonomy to improve and review fish identification for their 4 surveys. USFWS reports that implementation of a minimum length for reporting improved correct identification and quickened processing. The Bay Study implemented a quality check and reporting program to assess whether fish, shrimps, and crabs were effectively separated from debris, identified, and measured correctly in the field. Townet again reported that its review of young striped bass diet data may result in new procedures if analyses indicate value to reinstating this task.

As a new project, the Spring Kodiak Trawl is still revising field and lab processes to make net deployment safer and easier, to consistently rank delta smelt gonad maturity, and to expedite data processing for the Web. The goal is to reduce information dissemination time. The Salvage survey has also instituted new studies to improve efficiency of data transfer and dissemination. Finally, Shoreline Resident Fishes, Adult Sturgeon Tagging, and Adult Striped Bass Tagging surveys reported being involved in an internal review intended to improve quality assurance/quality control data process rates, and facilitate data analyses.

Nine projects reported using historical information to change program element design or suspected that current analyses might result in a future design change. The USFWS implemented a minimum length for reporting fish caught based upon review of historical data that suggested questionable identification of < 25 mm individuals. USFWS also noted that a program review led to changes in 2000 and cited as examples reduced sampling effort at Chipps Island from 3 days to 2 days per week in May and June and the increase to year-round sampling at Mossdale. A UC Davis postdoc has reviewed Bay Study and Fall Midwater Trawl data for longfin smelt and suggests changes to current data aggregation and analyses steps that could improve abundance calculation; Suisun Marsh researchers also referred to this work. The Townet Survey based a recent 6-survey per year standardization in part on analyses of historical data that suggested additional striped bass cohorts might enter the population after the traditional index was set, particularly in cool-water years. The Kodiak Trawl Survey reiterated that the survey's initiation was based, in part, on use of historical information confirming the gear's superiority for capturing adult delta smelt. Historical information was also used by the NBA Survey to determine if sampling effort could be reduced and still meet the criteria of the Delta Smelt Biological Opinion. Finally, the Resident Fishes Survey proposes to produce a comprehensive data report with an evaluation of data biases and estimation errors, statistical power analyses, and recommended changes. No time frame was presented for this report.

8 Data Availability and Reporting

This portion of the fish monitoring program element review focuses on data availability and reporting. All 16 fish monitoring program elements provided information used in this summary. Both past and future efforts were queried, although respondents were asked to only consider past reporting efforts over the last 10 years (1994 to 2003).

Data Availability and Use of the World Wide Web

Data from 11 of the16 fish monitoring program elements (69%) are readily available to the public via the Web, although all data are available upon request (Table 9). Data from the entire period of record are generally posted by those program elements with publicly available data. About 62% (8 of 13) of the program elements with publicly available data use the Bay-Delta Tributaries Database (BDAT) as the public data repository. The remaining 3 program elements store data that can also be accessed through a FTP site linked to the DFG Web page. Fall Midwater Trawl and Summer Townet store data on both the BDAT and on computers within DFG offices. The SWP and CVP Salvage surveys store data on BDAT, but DFG staff also maintains a dedicated FTP site on the DFG Web page to facilitate the high volume of requests for these data.

Twelve of the 16 program elements (75%) reported some level of reporting on the World Wide Web (see Table 9), although the Bay Study reported its Web-based information is out of date. Web page information includes study design and metadata information—sampling site maps, sampling gear, and frequency—as well as tabular and graphical data summaries of organism abundance and distribution. The Beach Seine and 20 mm surveys, Spring Kodiak Trawl, NBA Survey, and Chipps Island, Sacramento, and Mossdale trawls use Web-based reporting extensively to disseminate data and summary information in near real time. DFG staff distributes weekly SWP and CVP ESA fish salvage data summaries via e-mail between December and June.

Table 9 Summary of IEP fish monitoring survey data availability and reporting between 1994 and 2003

Survey	Data publicly available on Web site	Data storage locations	Web page reporting	Number of journal articles	Number of technical reports	Number of newsletter articles	Other products[1]	New products planned by 2007[1]
Survey Group 1: Multiple, fixed location sampling								
BSeine	Yes	BDAT[2]	Yes	2	0	4	7	5+
Bay Study	No	DFG offices	Yes	12	2	20	25	20
FMWT	Yes	BDAT & DFG office	Yes	11[3]	1	24	3	9
TNS	Yes	BDAT & DFG office	Yes	7[4]	1	23	3[5]	8
20 mm	Yes	DFG office & FTP site	Yes	3	0	18	2	Yes (no specifics given)
SprKod	Yes	DFG office & FTP site	Yes	0	0	2	0	4
JuvSturg	No	DFG office	No	0	0	0	0	2
SuisM	Yes	BDAT	No	15	0	5	5	10
NBA	Yes	DFG office & FTP site	Yes	2	0	20[6]	2[7]	3+
Survey Group 2: Fixed strata, random location								
ResFish	No	DFG offices	No	0	1	7	0	2
Survey Group 3: Single, fixed location sampling								
Salvage	Yes	BDAT & DFG FTP site	Yes	7[8]	22[8]	9	5+	6
Chipps	Yes	BDAT	Yes	3[9]	2	4[9]	7[9]	8+
SacT	Yes	BDAT	Yes	1[10]	0	4[9]	7[9]	8+[10]
Moss	Yes	BDAT	Yes	1[10]	0	4[9]	7[9]	8+[10]
Survey Group 4: Flexible location sampling								
AdSturg	No	DFG office	No	2	0	0	1	2
AdBass	No	DFG office	Yes	2	0	2	0	2
Mean (Range)	---	---	---	4.3 (0-15)	1.7 (0-22)	9.1 (0-24)	4.6 (0-23)	6.1+ (2-20)

[1] Other products and new products include written reports and articles, poster and oral presentations, and workshop summaries, including products not reported by questionnaire responses but identified by report authors based on outside knowledge.
[2] BDAT: Bay-Delta Tributaries database, available at WWW.IEP.water.ca.gov.
[3] Five articles are the same as those reported for the Bay Study.
[4] All articles are the same as those reported for the FMWT and three articles are the same as those reported for the Bay Study.
[5] Same products as those reported for FMWT
[6] Eighteen articles are the same as those reported for the 20 mm Survey.
[7] Same products as listed for 20 mm Survey (1 dissertation and 1 thesis).
[8] CVP reference list obtained from www.usbr.gov/pmts/tech_services/tracy_research/tracyfacility/tracyreports/index.html
[9] Same products as reported for the Beach Seine Survey.
[10] Same products as reported for the Chipps Island Trawl

Data publicly available

Group 1: Multiple, Fixed Location Sampling

- Beach Seine. All years in which sampling occurred (1976 to present).
- Bay Study. Not available to the public currently; has been on FTP site. All years in which sampling occurred (1980 to present).
- Fall Midwater Trawl. All years in which sampling occurred (1967 to present); no sampling in 1974 or 1979; incomplete sampling in 1969 and 1976.
- Summer Townet. All years in which sampling occurred (1959 to present).
- 20 mm Survey. All years in which sampling occurred (1994 to present).
- Spring Kodiak Trawl. All years in which sampling occurred (2002 to present).
- Juvenile Sturgeon. Not available to the public. For all years in which sampling occurred (1995 to present).
- Suisun Marsh. All years in which sampling occurred (1979 to present).
- NBA Survey. All years in which sampling occurred (1994 to present).

Group 2: Fixed Strata, Random Location

- Resident Fishes. Not available to the public. Data collected between 1980 and present.

Group 3: Single, Fixed Location Sampling

- SWP and CVP Fish Salvage. Data from 1993 to present are available to public.
- Chipps Island Trawl. All years in which sampling occurred (1976 to present).
- Sacramento River Trawl. All years in which sampling occurred (1988 to present).
- Mossdale Trawl. All years in which sampling occurred (1988 to present).

Group 4: Flexible Location Sampling

- Adult Sturgeon. Data are not available. Data collected between 1954 and present.
- Adult Striped Bass Tagging. Data are not publicly available. Data collected between 1969 and present.

Data locations

Group 1: Multiple, Fixed Location Sampling

- Beach Seine. Data are available through BDAT. Data (with initial quality check) are uploaded weekly. Final quality check data are uploaded within 3 months after field season ends.
- Bay Study. Data from 1980 to present are available upon request to the lead biologist. All data are stored in dBASE and MS Access files at DFG offices. Data are available within 3 months after field season ends in December.
- Fall Midwater Trawl. Data are uploaded to BDAT with duplicate data set maintained at DFG and are available upon request to the lead biologist.
- Summer Townet. Data are uploaded to BDAT with duplicate data set maintained at DFG and are available upon request to the lead biologist.
- 20 mm Survey. All data are stored in an MS Access database at DFG offices and are available within 72 hours of sampling. Historical data are available via DFG FTP site.
- Spring Kodiak Trawl. Data are stored at DFG offices and generally available 2 days after a survey is completed. Historical data are available via DFG FTP site.

- Juvenile Sturgeon. All data are kept at DFG offices and are not available except upon request to the lead biologist. Data are stored on a server and on several personal computers. Most data are available within one month of field sampling, although age data may take longer.
- Suisun Marsh. All data are uploaded to BDAT and generally available within 5 months of field sampling.
- NBA Survey. All data are stored in an MS Access database at DFG offices and are available within 72 hours of sampling. Historical data are available via DFG FTP site.

Group 2: Fixed Strata, Random Location

- Resident Fishes. Data are not available to the public, except upon request to the lead biologist. Data are stored on a server and several personal computers at DFG.

Group 3: Single, Fixed Location Sampling

- SWP and CVP Fish Salvage. Data are stored in BDAT and also available at the DFG FTP site. Data are generally available 3 to 6 months after sampling occurs.
- Chipps Island Trawl. Data are available through BDAT. Data (with initial quality check) are uploaded weekly. Final quality check data are uploaded by November of each year.
- Sacramento RiverTrawl. Data are available through BDAT. Data (with initial quality check) are uploaded weekly. Final quality check data are uploaded by November of each year.
- Mossdale Trawl. Data are available through BDAT. Data (with initial quality check) are uploaded weekly. Final quality check data are uploaded by November of each year.

Group 4: Flexible Location Sampling

- Adult Sturgeon. All data are kept at DFG offices and are not available except upon request to the lead biologist. Data are stored on a server and several personal computers. Most data are available within one month of field sampling, although age data may take longer.
- Adult Striped Bass Tagging. All data are kept at DFG offices, stored on a server and several personal computers and are not available except upon request to the lead biologist. Most data are available within a month of field sampling, although age data may take longer.

Web page reporting

Group 1: Multiple, Fixed Location Sampling

- Beach Seine. All salmon coded wire tag recovery data are posted on a DFG page. Beach seine real-time data are posted on the DFG real-time Web page.
- Bay Study. On Web is outdated information on abundance indices and life history information.
- Fall Midwater Trawl. Annual abundance indices for 5 species of fish are available in tabular and graphical format.
- Summer Townet. The survey has Web-based data presentations of program data. These include bubble plots and length frequencies of the most frequently sampled fish.
- 20 mm Survey. Fish catch-per-unit-effort density data, fish length data, and zooplankton CPUE density data for each survey are available via a DFG Web page.
- Spring Kodiak Trawl. The DFG Web page includes bubble plots of delta smelt distribution and maturity status.
- Juvenile Sturgeon. None
- Suisun Marsh. None
- NBA Survey. Fish CPUE density data, weighted entrainment, and catch summary.

Group 2: Fixed Strata, Random Location

- Resident Fishes. None

Group 3: Single, Fixed Location Sampling

- SWP and CVP Fish Salvage. April-June data are reported on the real-time monitoring Web page.
- Chipps Island Trawl. All salmon coded wire tag recovery data are posted on a DFG Web page.
- Sacramento RiverTrawl. All salmon coded wire data are posted on a DFG Web page.
- Mossdale Trawl. All salmon coded wire tag recovery data are posted on a DFG Web page.

Group 4: Flexible Location Sampling

- Adult Sturgeon. None
- Adult Striped Bass Tagging. Some static plots are posted on DFG Web page.

Past Reporting

All fish monitoring program elements provided information on the production of written documents over the last 10 years (1994 to 2003). Written documents included journal articles, IEP technical reports, IEP Newsletter articles, and other types of products—other agency reports, popular articles, poster presentations, and workshop summaries, for example. This review queried the level of staff involvement in the production of journal articles, technical reports, and IEP Newsletter articles. Responses were examined to determine if the document was entirely produced by IEP staff, produced by others outside IEP with IEP staff as co-authors, or produced entirely by others outside IEP. The document citation was used to determine the level of staff involvement in the production of written documents.

The type and number of written products varied widely among fish monitoring program elements (see Table 9 and details below). With the exception of the CVP Salvage Survey, technical reports were rarely used to report program element information. In contrast, IEP Newsletter articles were the dominant form of written communication used by almost all monitoring program elements. With the exception of the Shoreline Resident Fishes and Juvenile Sturgeon Year-Class Strength surveys, all program elements reported production of at least one peer-reviewed journal article between 1994 and 2003. Most of these articles were produced with program element staff as co-authors. The Suisun Marsh monitoring program reported the largest number of journal articles (15) followed by Bay Study (12), and Fall Midwater Trawl (11), and Summer Townet surveys (7).

As documented in earlier sections, several fish monitoring program elements have existed for more than 20 years; however, results presented here were standardized to consider only written products prepared over the last 10 years (1994 to 2003). A more complete listing of written documents produced from IEP efforts and funding, including the fish monitoring program elements, is available at http://www.iep.ca.gov/report/.

Reporting topics for journal articles, technical reports, or IEP Newsletter articles generally fell into 4 categories: status and trends, program element sampling design, species-specific information, or invasive species. Species-specific articles were most common, focusing either on sport fish (striped bass, sturgeon, or American shad for example) or species of special concern (splittail, surfperch, delta smelt, or Chinook salmon, for example).

The fish monitoring program elements reported producing a number of "other products." In fact, on average the number of other products was the same as peer-reviewed journal articles (Table 9). The type of other products generally fell into 8 categories: (1) progress reports, (2) popular articles, (3) graduate theses and dissertations, (4) consultant technical reports, (5) contributions to biological opinions,

(6) posters, (7) workshop summaries, and (8) agency-sponsored San Francisco Bay planning reports. Clearly, a substantial amount of staff effort has gone into the production of other products.

Staff from all 16 fish monitoring program elements plans to produce several written or oral products between 2004 and 2007 (Table 9). Most commonly cited products were journal articles or IEP Newsletter articles. Historical numbers of written products suggest the plans for new products proposed by several program elements are overly optimistic.

The following sections supplement Table 9 and describe the number of documents—as well as their authorship and content—produced by each monitoring program from 1994 through 2003. The number of documents produced before 1994 is also noted below if the information was provided in the questionnaire; pre-1994 documents are not included in Table 9. Where evident we noted when the same documents were reported by more than one monitoring program (Table 9 footnotes). Multiple references to the same documents commonly occurred when data from several monitoring programs were used in trend analyses (e.g., in splittail status articles).

Journal articles

Group 1: Multiple, Fixed Location Sampling

- Beach Seine. Program staff produced a single article between 1994 and 2003, and a single article was produced by outside staff in 1997. Three articles were produced by staff before 1994. Except for a 1997 article on splittail, all articles deal with salmon.
- Bay Study. Twelve articles were produced—program staff produced 2 articles; staff as co-authors produced 5, and others outside the program produced 5. Three articles each focused on splittail, introduced species and flow-abundance relationships, 2 on striped bass and 1 food-web pathways for selenium. Staff produced 2 articles before 1994.
- Fall Midwater Trawl. Eleven articles were produced—program staff produced 2 articles, staff as co-authors produced 6 articles, and 3 articles were produced by authors outside the project. Six articles (55%) focused on striped bass, 2 articles (18%) on splittail, 1 on delta smelt (9%), 1 on isohaline position, and 1 (11%) on shrimp. Staff produced 3 articles before 1994.
- Summer Townet. Seven articles were produced— these are encompassed by those reported under Fall Midwater Trawl. Staff produced 3 articles before 1994.
- 20 mm Survey. Three articles were produced—program staff produced 2 articles and staff as co-author produced 1.
- Spring Kodiak Trawl. None
- Juvenile Sturgeon. None
- Suisun Marsh. Fifteen articles were produced – program staff produced 8 articles and coauthored 5 articles. Two were produced outside the project. Six articles (40%) focused on trends in native and introduced species and three each (20%) focused on fish diets, invasive species and splittail life history and biology. Eight articles were produced before 1994.
- NBA Survey. None

Group 2: Fixed Strata, Random Location

- Resident Fishes. None

Group 3: Single, Fixed Location Sampling

- SWP and CVP Fish Salvage. Seven articles were produced—program staff produced 2 articles; staff as co-author produced 3 articles; and staff outside the program produced 2 articles.
- Chipps Island Trawl. Three articles were produced—2 reported under Beach Seine survey and an additional splittail article.
- Sacramento River Trawl. One article was produced—reported under Beach Seine survey.
- Mossdale Trawl. One article was produced—reported under Beach Seine survey.

Group 4: Flexible Location Sampling

- Adult Sturgeon. Program staff produced one article on white sturgeon and were coauthors on a second. Six articles were produced before 1994.
- Adult Striped Bass Tagging. Program staff produced 2 articles as co-authors. Staff produced 5 articles before 1994.

Technical reports

Group 1: Multiple, Fixed Location Sampling

- Beach Seine. None
- Bay Study. Two reports were produced—staff produced 1 report and co-authored a second. Staff produced one report before 1994 and an outside researcher produced another.
- Fall Midwater Trawl. One report was produced—program staff contributed to one IEP annual report in 1994, and three prior to 1994.
- Summer Townet. Two reports were produced—reported under Fall Midwater Trawl.
- 20 mm Survey. None
- Spring Kodiak Trawl. None
- Juvenile Sturgeon. None
- Suisun Marsh. None. One report was produced before 1994.
- NBA Survey. None

Group 2: Fixed Strata, Random Location

- Resident Fishes. One report, which focused on white catfish, was produced.

Group 3: Single, Fixed Location Sampling

- SWP and CVP Fish Salvage. Twenty-two reports were produced—all on CVP fish salvage.
- Chipps Island Trawl. Two reports were produced and focused on salmon and delta smelt.
- Sacramento RiverTrawl. None
- Mossdale Trawl. None

Group 4: Flexible Location Sampling

- Adult Sturgeon. None
- Adult Striped Bass Tagging. None

Newsletter articles

Group 1: Multiple, Fixed Location Sampling

- Beach Seine. Program staff produced 4 articles—all dealt with salmon.
- Bay Study. Program staff produced 20 articles—8 (40%) focused on status and trends of Bay species, 6 (30%) on status and trends of splittail and longfin smelt, 4 (20%) on crabs, 1 (5%) on surfperch, and 1 (5%) on jellyfish.
- Fall Midwater Trawl. Program staff produced 24 articles—9 (38%) summarized survey data, 9 (38%) focused on striped bass, 2 (8%) focused on American shad, 2 (8%) focused on delta smelt, and 2 (8%) considered striped bass and American shad.
- Summer Townet. Program staff produced 23 reports—12 articles (52%) summarized survey data, 10 articles (44%) focused on striped bass, and 1 article (4%) focused on delta smelt.
- 20 mm Survey. Program staff produced 18 articles—all dealt with delta smelt.
- Spring Kodiak Trawl. Program staff produced 2 articles—1 article dealt with survey design, and 1 article dealt with survey results.
- Juvenile Sturgeon. None
- Suisun Marsh. Five articles were produced—2 were on introduced species, 1 article on fish diets, 1 on mysid shrimp, and 1 on fish physiology.
- NBA Survey. Twenty articles were produced—those reported under 20 mm survey plus 2 articles that focused on NBA survey.

Group 2: Fixed Strata, Random Location

- Resident Fishes. Seven articles were produced—4 on resident fishes survey, 2 on largemouth bass, and 1 on resident fishes in shallow-water habitats.

Group 3: Single, Fixed Location Sampling

- SWP and CVP Fish Salvage. Nine articles were produced—8 on fish salvage status and trends and 1 on Chinese mitten crabs.
- Chipps Island Trawl. Four articles were produced—reported under Beach Seine survey.
- Sacramento RiverTrawl. Four articles were produced—reported under Beach Seine survey.
- Mossdale Trawl. Four articles were produced—reported under Beach Seine survey

Group 4: Flexible Location Sampling

- Adult Sturgeon. None
- Adult Striped Bass Tagging. Two articles were produced—both by others outside the program.

Other products

Group 1: Multiple, Fixed Location Sampling

- Beach Seine. Seven products produced—6 annual progress reports and 1 program review report. Three products were produced before 1994.
- Bay Study. Twenty-five products were produced—4 theses, 1 dissertations, 2 popular articles, 5 consultant technical reports, 7 agency technical reports, and 5 agency-sponsored reports for bay planning. A single fishing regulation change memo was submitted to Fish and Game Commission.
- Fall Midwater Trawl. Three products were produced—1 striped bass workshop summary and 2 posters.
- Summer Townet. Three products were produced—reported under Fall Midwater Trawl
- 20 mm Survey. Two products were produced—1 dissertation and 1 thesis.
- Spring Kodiak Trawl. None
- Juvenile Sturgeon. None
- Suisun Marsh. Five products were produced—1 dissertation, 1 thesis, 1 abstract, and 2 books.
- NBA Survey. Two products were produced—reported under 200 mm Survey (1 dissertation and 1 thesis).

Group 2: Fixed Strata, Random Location

- Resident Fishes. None

Group 3: Single, Fixed Location Sampling

- SWP and CVP Fish Salvage. Five-plus products were produced—1 technical report, 1 biological assessment, 1 biological opinion, and numerous DAT recommendations. Four products were produced before 1994.
- Chipps Island Trawl. Seven products were produced—reported under Beach Seine survey.
- Sacramento River Trawl. Seven products were produced—reported under Beach Seine survey.
- Mossdale Trawl. Seven products were produced—reported under Beach Seine survey.

Group 4: Flexible Location Sampling

- Adult Sturgeon. One product was produced—DFG comments to NOAA-Fisheries on green sturgeon listing.
- Adult Striped Bass Tagging. None

New products planned by 2007

Group 1: Multiple, Fixed Location Sampling

- Beach Seine. Five-plus products are planned—1 journal article, various Newsletter articles, and various presentations (workshops and professional meetings).
- Bay Study. Twenty projects are planned—11 journal articles, 1 technical report, 4 newsletter articles (3 status and trends edition), 1 thesis, and 3 oral presentations at professional meetings.
- Fall Midwater Trawl. Nine products are planned—5 journal articles, 1 IEP technical report, and 3 Newsletter articles (annual status and trends edition).
- Summer Townet. Eight products are planned—3 journal articles, 2 IEP technical reports, and 3 Newsletter articles (annual status and trends edition).
- 20 mm Survey. Products are planned, but no specifics were given.
- Spring Kodiak Trawl. Four-plus products are planned—1 journal article using Kodiak trawl data, 1 Newsletter article, and 2-plus oral presentations.
- Juvenile Sturgeon. Two products are planned—1 technical report and 1 newsletter article.
- Suisun Marsh. From 10 to 22 products are planned—5 to 10 journal articles, 1 to 4 Newsletter articles, and 4 to 8 oral presentations at professional meetings.
- North Bay Aqueduct. Three-plus products are planned—NBA technical report and Newsletter articles.

Group 2: Fixed Strata, Random Location

- Resident Fishes. Two products are planned—1 journal articles and 1 comprehensive retrospective technical report.

Group 3: Single, Fixed Location Sampling

- SWP and CVP Fish Salvage. Six products are planned—1 journal articles, 1 technical report, 3 status and trends Newsletter articles, and 1 presentation.
- Chipps Island Trawl. Eight-plus products are planned—4 journal articles, 4 Newsletter articles (3 status and trends), and several oral presentations at IEP and professional meetings.
- Sacramento River Trawl. Eight-plus products are planned—reported under Chipps Island Trawl.
- Mossdale Trawl. Eight-plus products are planned—reported under Chipps Island Trawl.

Group 4: Flexible Location Sampling

- Adult Sturgeon. Two products are planned—1 comprehensive retrospective technical report and 1 newsletter article.
- Adult Striped Bass Tagging. Two products are planned—1 comprehensive, retrospective technical report and 1 IEP Newsletter article.

9 Customer Needs and Use

For purposes of this survey, a customer is defined as an entity or person who uses data or results that are generated from a fish monitoring survey. Survey responses assume that 2 or more requests per year constitute frequent use, an annual request is moderate use, and less than annual is rare use. Table 10 shows how frequently various customers use data from the 16 different surveys.

Questionnaire responses generally report that customers are very satisfied (i.e., from no complaints to positive feedback) with the quality of the monitoring data. Customers are, however, overwhelmed by the quantity of data. Another problem for customers has been data gaps and the lack of year-round sampling in past years for some surveys. Special study data are sometimes difficult to access electronically and, therefore, not readily available to the public.

The most valuable aspect of many surveys is the longevity, combined with temporal and spatial consistency of the sampling. Some customers emphasized the added value of surveys by including species other than the usual IEP targets. One of the more challenging aspects, both in the past and the future, is how to maintain the above consistency of sampling—especially for species that do not have traditional human-assigned values.

The types of customer use most frequently cited in questionnaire responses include environmental documentation, project analysis, regulatory, and research applications. Long-term abundance and distribution trends, coupled with life history information, inform water operation decisions, EWA actions, and species status or recovery criteria. Survey data also inform site-specific information and project impact assessment, particularly regarding potential impacts to threatened salmonids in the Bay-Delta. E.g., data is used to manage water exports and ensure that all pumping is in compliance with the ESA take limits of listed species. Academic institutions, in addition to regulatory agencies, use fish monitoring data to supplement graduate and post-doctoral work on fish ecology.

As discussed in the following sections, each of the 4 identified survey groups (as previously defined in Table 1) serve different primary customers who used data and information generated by monitoring surveys.

Survey Group 1

Surveys with geographically broad-to-narrow systematic sampling range frequently serve all customer types: IEP, CALFED, sport fish, and regulatory agencies, as well as other government, academic, NGO, and consultant entities (see Table 10). Survey Group 1 includes Beach Seine, Bay Study, Fall Midwater Trawl, Summer Townet, 20 mm Survey, Spring Kodiak Trawl, Juvenile Sturgeon, Suisun Marsh, and North Bay Aqueduct.

Table 10 Frequency of use of data and information by customer

Customer[a]	Frequent use (2 or more/year)	Moderate use (annually)	Rare use (less than once a year)
IEP agencies+			
USFWS	BSeine, Bay Study, 20 mm, NBA	TNS	
DFG	BSeine, Bay Study, TNS, SuisM, Chipps, SacT, Moss, Salvage, AdBass	FMWT, JuvSturg, AdSturg	ResFish
DWR	BSeine, 20 mm, SuisM, NBA, Salvage, Chipps, SacT, Moss, AdBass	TNS	FMWT, ResFish, AdSturg, JuvSturg
USBR	BSeine,, 20 mm, Salvage	SuisM	
USGS	SuisM, Salvage	Bay Study, ResFish	BSeine, 20 mm, Chipps, Moss, SacT
NOAA Fisheries		Bseine, Chipps, Moss, SacT	
USACE		20 mm	
EPA	Salvage	20 mm	
CALFED programs			
DFG (ERP Restoration Planning)	Bay Study, TNS, SuisM		
DAT/WO Mossdale	Bay Study, SprKod, Salvage , Chipps, SacT, Moss		
EWA	BSeine, Bay Study, Salvage, Chipps, SacT, Moss		
ESA Programs	Salvage		
Through-Delta PWT		BSeine,, Chipps, SacT, Moss	
DCC PWT		Chipps, SacT, Moss	
Sport fish management entities			
DFG	AdBass	BSeine, Bay Study, FMWT, TNS, JuvSturg, ResFish, AdSturg	
Regulatory agencies			
EPA		SuisM	
DFG	BSeine, Bay Study, Chipps, SacT, Moss, AdBass	FMWT, JuvSturg, AdSturg,	
NOAA Fisheries	Bay Study, Salvage	BSeine, JuvSturg, Chipps, SacT, Moss, AdBass	SuisM
USFWS	BSeine, Bay Study, SuisM, NBA, Chipps, SacT, Moss, Salvage	FMWT, TNS, JuvSturg, AdSturg, AdBass	

Customer[a]	Frequent use (2 or more/year)	Moderate use (annually)	Rare use (less than once a year)
Table 10 continued from previous page			
SWRCB			Bay Study, JuvSturg, AdSturg, AdBass
RWQCB			
Other government, academic, NGO, or consultant entities			
Other government agencies[b]	NBA	Bay Study, SuisM	BSeine, Bay Study, 20 mm, Chipps, SacT, Moss, AdBass
NGO[b]	BSeine, Bay Study, SuisM, Salvage, Chipps, SacT, Moss	TNS, AdBass, SuisM	Bay Study, FMWT, Salvage
Private consultants[b]	Bay Study, SuisM, Salvage	BSeine,, FMWT, TNS, 20 mm, Chipps, SacT, Moss, Salvage	FMWT, TNS Chipps, SacT, Moss
Academic institutions[b]	Bay Study, FMWT, SuisM, Salvage	20 mm, SprKod, AdBass, Salvage	BSeine, Chipps, Moss, SacT
MWD of SoCal	Salvage		
CUWA	Salvage		
CDM		Salvage	

a. Not all consultant entities that use survey data or information are listed. The questionnaire only requested the name of the consultant entity where frequent use of data or information occurs.

b. This table consolidates multiple responses for other government agencies, nongovernment agencies (NGOs), private consultants, and academic institutions into each category, thus monitoring surveys may appear in more than 1 column.

- Other government agency responses include Caltrans, California Department of Parks and Recreation, California Coastal Conservancy, National Park Service, Solano County Water Agency, and ESD Oak Ridge National Laboratory.
- NGO responses include the San Francisco Estuary Institute, Bay Institute, Marine Science Institute, Point Reyes Bird Observatory, San Joaquin River Group, Fish First, Save the Bay, SuisM Agencies, and Montezuma Wetlands.
- Consultant responses include Hanson Environmental Inc, Stillwater Sciences, Jones and Stokes, BJ Miller, Tenera Environmental, URS Greiner Woodward Clyde (and many subconsultants), SP Cramer & Associates, Natural Resource Scientists Inc., Entrix, Eco-Logic Engineering, Mirant Energy.
- Academic institution responses include requests for data and information by graduate students and professors at these universities for theses and other studies, such as grant funded research. Lists requests made within the past 3 years. Universities named in survey responses include UC Davis, San Francisco State University, Cal State Fresno, Cal State Long Beach, San Diego State University, UC Berkeley, UC Los Angeles, and UC Santa Cruz.

Appendix B contains unabridged responses.

These IEP fish monitoring surveys track long-term abundance and distribution trends for special status species (e.g., delta smelt, splittail, salmonids) and sport fish species (e.g., striped bass) as well as other common fishes. Surveys also provide species-specific life history and population status information across seasons and years; in cases almost 50 years. Customers generally expressed satisfaction with the quality of these monitoring data. Customers also recognized challenges and areas for improvement. Specifically, they emphasized the need to maintain sampling consistency, ensure year-round sampling (i.e., prevent data gaps), and organize data in readily available and presentable formats that do not overwhelm customers.

Monitoring surveys provide population abundance and distribution data on salmonids and species of concern in the Delta. The information aids environmental documentation and analysis of project water operations, EWA actions, and recovery criteria. Project impact assessment requires and includes site-specific information to predict the potential impact on species due to the operation of the CVP and SWP. Survey data also inform Delta-wide management decisions and facilitates regulatory management decisions.

USFWS, DFG, NOAA-Fisheries, and other regulatory agencies use 20 mm, North Bay Aqueduct, and Bay Study data among other to regulate water exports, assess project impacts, and set annual take limits in accordance with the ESA (see Table 10). NOAA uses Bay Study salmon and steelhead data to set take limits in its biological opinions, such as for Tenera Power Plant near-field sampling and SFO expansion sampling and to assess project impacts, such as for sand mining and in-Bay dredge spoil disposal. Data are used in conjunction with other sources of information to assess fish distribution and abundance during times of specific actions (e.g., EWA asset use or Vernalis Adaptive Management Plan). The information helps estimate abundances of salmonids, delta smelt, and splittail, which contributes to determining the ESA listings for various species.

Consultants, academic researchers, and NGO staff used data from the Survey Group 1 in their research of the Estuary. In particular, long-term trends in fish abundance help determine the status of delta smelt, splittail, longfin smelt, and other species of concern. Information aids on-going efforts to better understand or develop life history information, population estimates, and conceptual/quantitative ecological models. These monitoring data provide a way for students, agency biologists, and visitors to experience the estuary, learn about its fishes, and obtain training in sampling procedures. The data have been a source of graduate degrees, international journal publications, and Peter Moyle's reference book, “Inland Fishes of California.” Such understanding promotes the protection of listed species, while simultaneously providing biological understanding to develop innovative management approaches that balance California's diverse water demands.

Survey Group 2

The relatively broad stratified random survey serves IEP agencies and sport fish management entities interested in long-term abundance and distribution trends, and in life history information (see Table 10). This is the only survey capable of monitoring trends in shore-line fishes such as largemouth bass and sunfish. Resident Fishes Survey constitutes Group 2.

USGS accesses this survey information to evaluate long-term abundance and distribution trends, life-history information, population status, recruitment rates, project impact assessment, and ecological analyses (e.g., influences of exotic species). Other customers, including DFG and DWR, rarely use Resident Fishes Survey data (i.e., less than once per year).

Survey Group 3

Single location, temporally systematic sampling surveys convey information to IEP, CALFED, and regulatory agencies, as well government, academic, NGO, and consultant entities with a focus on environmental documentation (see Table 10). Survey Group 3 includes SWP and CVP Fish Salvage, Chipps Island Trawl, and Sacramento River Trawl and Mossdale Trawl surveys.

Customers integrate information from the Chipps Island Trawl, Sacramento River Trawl, and Mossdale Trawl survey with the Beach Seine Survey to assess population abundance, distribution, and life history of various fishes (e.g., salmon and splittail) in the Sacramento and San Joaquin rivers and San Francisco Estuary. Data from these surveys support environmental documentation and project analysis. They provide real-time distribution and abundance information, while helping to assess interrelationships of environmental variables and fish movement.

Fish survival data, largely derived from non-IEP mark-recapture studies, are used extensively. IEP sampling recovers marked fish and supplements analyses to evaluate water project effects and management alternatives for the EWA and through-Delta and Delta Cross Channel project work teams. Many different agencies, consultants, and institutions use salvage data extensively in a broad variety of ways, including study design, and fish abundance trends. The data are essential for determining abundance and distribution of listed species for water operations/EWA actions. Monitoring surveys have been used extensively to determine water project impacts on various species and the relative success of EWA and water operations management actions. The data also have been used extensively to design fish facility studies and determine their impacts on listed species. Regulatory agencies use the data to determine timing and patterns of fish migration through the Delta, create take limits in biological opinions and OCAPs, and establish guidelines for regulating water exports. The Data Assessment Team uses some of these data on a near real-time basis to inform water operations decisions and EWA actions.

Research applications include the comparison of hydroacoustic gear with trawl sampling estimates of population abundances and understanding the influence of specific facilities such as the Delta Cross Channel gates on fish emigration and entrainment. Data help estimate abundances of salmonids, delta smelt, and splittail. These abundance estimates help determine ESA listings for various species.

Survey Group 4

The flexible location sampling primarily serves IEP, sport fish management, and regulatory agencies (particularly those interested in long time-series fish population data), with academics and research-focused NGOs serving as additional customers (Table 10). Survey Group 4 includes Adult Sturgeon and Adult Stripped Bass Tagging

The unique and long time-series of these data contribute to environmental documentation, project analyses, and research. However, abundance estimates derived from striped bass and sturgeon tagging contain much uncertainty. This imprecision limits the utility of the estimated long-term abundance and distribution trends, population status, harvest rates, recruitment rates, and project impact assessment for adult striped bass and adult sturgeon.

Research applications include the exploration of project impacts on populations of long-lived fishes. Analyses of ecological processes probe the influence of El Nino and the degree of density-dependent growth and survival during early life stages on adult population size. Other data uses include the development of striped bass models for management and recovery of striped bass on the East Coast.

10 Comments and Recommended Actions

The following is a synopsis of information provided in Section VI of completed questionnaires (i.e., Comments regarding the most valuable or challenging etc. aspects of the survey). Because element strengths described in the questionnaires are typically a subset of those in Section 5 Goals, Strengths, and Weaknesses for Determining Status and Trends of Fishes, strengths are not summarized here.

Staff of most elements said that new, alternative, or more frequent analytical work is appropriate. Staff of elements monitoring status of sub-adult and adult non-salmonid sport fishes (i.e., sturgeon and striped bass) reported that technical reports are necessary to document project methods and results, and to evaluate and improve element effectiveness and/or efficiency.

Recommended Actions by Survey

Delta Juvenile Fishes Monitoring Beach Seine (USFWS): Analyze degree to which sampling locations and methods give results that are representative of available habitat and target populations, incorporate random sampling, sample other habitat by using different gear.

Bay Study (DFG): Increase efficiency of post-data-collection phases, use indices that allow calculation of confidence intervals, re-calculate area and volume of habitat, make IEP Technical Report #63 available as PDF, add new graphic representation of data to Web.

Fall Midwater Trawl (DFG): Log actual depth of net during deployment.

Summer Townet (DFG): None.

20 mm Survey(DFG): None.

Spring Kodiak Trawl (DFG): Improve maturity data.

Juvenile Sturgeon Population (DFG): Conduct and report on a thorough technical review, where the review will identify potential means and feasible means to improve efficiency, precision, and accuracy.

Suisun Marsh (UC Davis): Add Midwater trawl, reduce reliance on volunteers to improve efficiency.

North Bay Aqueduct (DFG): None.

Shoreline Resident Fishes (DFG): Conduct and report on a thorough technical review, where the review will identify potential means and feasible means to improve efficiency, precision, and accuracy.

SWP and CVP Fish Salvage (DWR) : Increase access to data via Web. Increased analytical capacity. Add trained biologist(s) or biological technician(s) to on-site staff, so fish identification and processing are less suspect.

Chipps Island Trawl (USFWS): Assess limitations of current data by experimenting with alternative gear, conduct new analyses on extant data, and produce more peer-reviewed publications.

Sacramento River Trawl (USFWS): Analyze the degree to which sampling method gives results that are representative of target populations, evaluate diel effects on catch.

Mossdale Trawl (USFWS): Analyze the degree to which sampling method gives results that are representative of target populations, evaluate diel effects on catch.

Adult Sturgeon Population (DFG): Conduct and report on a thorough technical review, where the review will identify potential means and feasible means to improve efficiency, precision, and accuracy.

Adult Striped Bass Population (DFG): Conduct and report on a thorough technical review, where the review will identify potential means and feasible means to improve efficiency, precision, and accuracy.

Appendix A Fish Monitoring Program Element Review Letter, Process, and Timeline

I IEP Fish Monitoring Program Elements considered in this review and lead entity:

1. Fall Mid-water Trawl Survey (FMWT); DFG
2. Summer Tow-net Survey (TNS); DFG
3. Bay Study; DFG
4. 20 mm Survey; DFG
5. SWP and CVP Fish Salvage; DWR and USBR
6. Beach Seine Survey; FWS
7. Chipps Island Trawl; FWS
8. Sacramento River and Mossdale Trawls; FWS
9. Suisun Marsh Fish Community Survey; UCD
10. Resident Fishes Survey; DFG
11. North Bay Aqueduct Survey; DFG
12. Spring Kodiak Trawl Survey; DFG
13. Adult Sturgeon Tagging; DFG
14. Adult Striped Bass Tagging; DFG;
15. Juvenile Sturgeon Year-class Strength; DFG

II Review Foundation:

The review foundation describes issues important to completing the review.

a. Core Team:

The core team will lead completion of the review and synthesis of information gathered during the review. The IEP Management Team selected the core team based on individual knowledge and willingness to commit to the effort. Core team members for this review are:

Ted Sommer (DWR)
Paul Cadrett (FWS)
Randy Baxter (DFG)
Marty Gingras (DFG)
Zach Hymanson (BDA)

b. Management Motivation and Needs:

The basis for IEP monitoring program element reviews comes from Herrgesell et al., 1993[1], which identifies a five-year review cycle for all IEP monitoring program elements. However, the IEP Management Team recently identified two main concerns: 1) the IEP is falling behind in the review of its monitoring program elements; and 2) limitations in staff and funding are requiring IEP managers to make difficult decisions that will substantially affect its monitoring program elements and special studies.

The fish monitoring program elements constitute a substantial portion of IEP's overall monitoring efforts. These program elements represent some of IEP's longest standing monitoring elements, collecting data used by scientists and resource managers throughout the San Francisco Estuary. Given their importance and prominence, IEP management[2] has requested a management-level review of its fish monitoring program elements to develop objective and relevant information that can help in the ongoing management and implementation of the IEP. In addition, IEP management expects information from this review will help in making future decisions about conducting more in-depth program element reviews, and in setting overall program priorities and resource commitments. Finally, IEP management is completing a strategic plan, which together with this management-level review will provide essential information for longer-term program planning and review activities, including addressing critical gaps in existing program elements.

c. Review Goal:

The core team has developed the following goal for a management-level review of the IEP fish monitoring program elements, based on our understanding of IEP management motivation and needs:

> *Gather and synthesize project-specific information to educate IEP management about its fish monitoring program elements and how the project products are used, and to help managers in making decisions about longer-term program priorities and resource commitments.*

The core team expects to achieve the review goal through the compilation and synthesis of program element-specific information obtained from detailed questionnaires completed by program element staff and supervisors. IEP management believes the completion and synthesis of information from questionnaires would be the most expedient and cost-effective approach to completing a management-level review.

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[1] Herrgesell P.L., M. A. Kjelson, J. Arthur, L. Winternitz, and P. Coulston. 1993. A Review of the Interagency Ecological Study Program and Recommendations for its Revision. A report prepared for the Coordinators of the Interagency Ecological Study Program.

[2] For purposes of this document, IEP management refers to the IEP Management Team, the IEP Coordinators, or both groups.

This synthesis will focus on the identification of program element strengths and weaknesses, and the ability of each program element to meet customer needs, which will be identified during the completion of the questionnaire.

d. Review Products:

The core team expects the following products from this review:

- Program element-specific data and information from each questionnaire
- A compilation and synthesis of questionnaire data, leading to summary information for all IEP fish monitoring program elements
- Program element-specific information on costs and effort
- A final report that includes the above products and possibly recommendations for management consideration

e. Review Constraints:

The core team assumes the following a priori constraints for this review:

- There is a level budget (based on 2003 expenditures) for each fish-monitoring program element. However, as an aid to long-tem IEP planning, the review may include recommendations that could increase program element costs (e.g., an expansion to fill a critical gap in information). The review may also include recommendations for cost or resource savings (e.g., a reduction to reduce redundancy). These types of recommendations are expected to help achieve the goal and management needs for this review, but there is no expectation that IEP management will necessarily adopt these recommendations.
- Mandated monitoring (i.e., monitoring required to meet regulatory obligations or special funding commitments such as sport fish stamps) is among IEP’s highest priorities.
- Preserving the continuity of long-term data is a high priority in evaluating ideas or recommendations for program element modifications.
- This management-level review will be based on data and analyses completed by staff that is already fully committed. Program element questionnaires will serve as the main source of data for this review. We expect minimal or no new technical analyses will be completed as part of the review.
- This review will take about one year to complete, and will rely on existing staff and resources for completion of all work. This approach is consistent with previous IEP reviews, which were completed using existing staff and funding. The review process is designed to minimize impacts on staff time for individual monitoring programs. We estimate the total staff time per monitoring program element to complete the questionnaire should not exceed 40 hours and would be mostly limited to one month (March 2004). This

estimate assumes that most of the information asked for in the questionnaire is readily available within the individual monitoring programs. Each review core team member will dedicate 5-10% of his time to analyze the questionnaires and prepare a review synthesis in 2004.

III Review Process and Timeline:

The core team recommends the following steps to complete a management-level review of the IEP fish monitoring program elements. Unless otherwise noted, we estimate each step in the process can be completed by the end of the month listed in parentheses. Adjustments to the timeline may be necessary as staff commitments and priorities change over the course of the review.

1. Core team develops draft program element questionnaire. (September 2003)
2. IEP Management Team (MT) reviews draft questionnaire. This includes select MT members reviewing the draft with their staff. The core team will use the comments to revise the questionnaire. (MT meeting October 17, 2003. Additional MT staff comments and core team revision completed by October 31, 2003)
3. Questionnaire test run: To assess the clarity and utility of the questionnaire, selected staff will complete the questionnaire. Test run results will be used to refine the questions and will serve as an example for others filling out the final questionnaire (November 2003)
4. Develop final questionnaire (including instructions for completing the questionnaire and information on how the questionnaire will be used). The final questionnaire along with the supporting instructions and information will be sent to the MT via email for a quick (one-week turn-around) final check (January 2004)
5. Distribute questionnaire to staff at a briefing by the core team on purpose and use. (February 2004)
6. Receive completed questionnaires from staff (April 1, 2004)
7. Core Team completes initial compilation and synthesis of questionnaire data. Information from the parallel IEP strategic planning process will be considered as appropriate. (May 2004)
8. Share initial results with MT and staff for review and comment. The MT will provide direction to the core team on whether the report should include recommendations and the nature of those recommendations. (June 2004)
9. Revise initial results based on input from step 8. Present initial results at an IEP forum: staff presents program element summaries and the core team presents initial synthesis. IEP Coordinators will be invited to participate in this forum. (Summer 2004)
10. Revise synthesis and prepare draft final report (Fall 2004).
11. Present report to IEP MT and Coordinators (Fall 2004)

IV IEP Mission, Goals, and Objectives:

This section of the questionnaire lists the most current IEP mission, goals, and objectives statements. Please refer to this section when asked questions that require you to consider IEP mission, goals, and objectives.

a. Draft Mission:

In collaboration with others provide ecological information and scientific leadership for use in management of the San Francisco Estuary

b. Draft Goals:

To address specific priority management questions by providing information on:

1. the status and trends of the ecological resources of the San Francisco Estuary; and
2. the factors and processes that influence the ecological resources of the Estuary.

c. Objectives for each goal:

Objectives for Goal One:

1. Determine the trends in environmental variables and trends in the distribution and abundance of living resources, including:
    a. Special status species (e.g., delta smelt, splittail, salmonids)
    b. Sport fish species (e.g., sturgeon, striped bass, American shad, catfish)
    c. Forage fish species (e.g., threadfin shad, inland silverside)
    d. Water quality (e.g., salinity, temperature, turbidity, nutrients)
    e. Hydraulics (e.g., flows, currents, water stage, bathymetry)
    f. Lower trophic level species (e.g., phytoplankton, zooplankton, mysids).
    g. Benthic organisms (e.g., bivalves)
    h. Predators (e.g., pikeminnow, centrarchids)
    i. Invasive species (e.g., mitten crabs)
    j. Other aquatic species of interest

2. Continually assess and improve the long-term monitoring programs to support management priorities (e.g. new variables, methods)

Objectives for Goal Two:

1. Determine interrelationships among monitored variables (e.g. effects of hydraulics on early life stages of special status fish species, food web structure, and function).
2. Explain how trends in environmental variables are affected by the following management actions:

   a. Water project design and operations (e.g. exports, reservoir releases/flows, gate operations, fish facility design and operation)
   b. Use of environmental water (e.g., EWA, VAMP, CVPIA-b2)
   c. Ecosystem restoration (e.g., ERP, AFRP)
   d. Agricultural diversions

3. Understand how other environmental factors (e.g., contaminants, climate) affect trends in monitored environmental variables.
4. Evaluate and modify research and analytical priorities to support management needs.

Appendix B Project Staff Responses to IEP Fish Monitoring Program Review Questionnaire

Index

B 1) Delta Juvenile Fishes Monitoring Beach Seine (Beach Seine Survey) (USFWS)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   FWS Delta Juvenile Fishes Monitoring Beach Seine

2. Please provide the name(s) of the person (people) completing this questionnaire

   Paul Cadrett, Larry Hansen, Lia McLaughlin

3. Please list the dates you started and finished this questionnaire.

   4/15 – 5/14

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   USFWS

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   Yes as a part of the Delta Salmon Project Work Team - Delta Juvenile Salmon Monitoring Program Review, July 2000.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   We provide near real time data to the BDAT throughout the year. We participate in IEP workshops and contribute to the IEP newsletter throughout the year. We provide information during DAT calls for salmon when appropriate. In addition we provide daily real time data to the DFG server from April 1 through June 30 each year (available at http://www.delta.dfg.ca.gov/data/rtm2004/)

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

   Beach seine sampling most directly addresses Goal 1, Objectives a, b, c, and i by providing year-round data on relative abundance of specific aquatic species of interest. These data are used in conjunction with environmental data (e.g. flow) available from other sources to evaluate the effects of environmental variables on relative abundance. Goal 1, Objective 2 is also addressed (see responses to Question III and VI). Our program does not directly address Goal 2, but the data we collect are likely useful to other IEP programs which do address this goal.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   None

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   See Figure 1 and Table 1

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)
    b. random
    c. stratified (give number of sites per stratum, and if they were chosen in a random or systematic way)
    d. rotating panel
    e. other:

    Beach seine sample sites were chosen based largely on geographic distribution, accessibility, and longevity of sampling location. We currently sample 57 sites throughout the Sacramento, San Joaquin Rivers and Bays. Seine sites are usually sampled in groups of 5-10 that can typically be reached in one 8-10 hour day.

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Most seine sites are sampled once per week throughout the year. From October to January, 7 sites on the Sacramento River between RM49 and RM80 are sampled 3 times per week. This increase in sampling effort is intended to detect winter run Chinook salmon as the enter the delta to help manage water project operations in order to minimize take of listed species.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    Originally, sampling was designed to estimate the survival and abundance of fall run Chinook salmon throughout the delta during the winter and spring. Since the mid- 1990's sampling has incorporated the rest of the year to better document the abundance of other races of juvenile Chinook salmon, Central Valley steelhead and other delta fishes. (see Figure 1)

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: **standard operating procedures Seine.xls**). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: **Fish Monitoring Resources and Budget FWS Seine.xls**) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis
    - Web page maintenance
    - Reporting & writing
    - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
    - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	Life Stage				
	Larvae/Fry	Smolt/juv	Yearlings	Year 2+	Comments
Species of Concern					
Winter-run Chinook	excellent	good	poor	poor	
Spring-run Chinook	excellent	good	poor	poor	
CV steelhead	excellent	good	poor	poor	
Coastal steelhead	N/A	N/A	N/A	N/A	
Delta smelt	N/A	poor	good	good	
Splittail	good	poor	good	good	
Longfin smelt	N/A	poor	fair	fair	
Green sturgeon	N/A	N/A	poor	poor	
Starry flounder	N/A	N/A	poor	poor	
Sport Fishes					
Fall-run Chinook	excellent	good	poor	N/A	
Striped bass	poor	poor	poor	poor	
White sturgeon	poor	poor	poor	poor	
Catfish	poor	poor	poor	poor	
American shad	poor	poor	poor	poor	
Largemouth bass	poor	poor	poor	poor	
Surfperch	poor	poor	poor	poor	Bay seine only
Habitats					
Nearshore (≤ 2 m depth)	excellent	excellent	excellent	excellent	
Nearshore vegetated	good	good	good	good	
Nearshore, other structures	fair	fair	fair	fair	
Nearshore open water	N/A	N/A	N/A	N/A	
Pelagic	N/A	N/A	N/A	N/A	
Marsh	N/A	N/A	N/A	N/A	
Floodplain	excellent	excellent	excellent	excellent	
Benthic	N/A	N/A	N/A	N/A	
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions	Detection of new invasive species is variable depending on the particular species. Tracking of new invasive species is good since the beach seine sample sites cover a large geographic area.				

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

   See Figure 1 for complete sampling record. Prior to 1994 seine data were not collected year-round or from each region. Analyses of trends prior to 1994 are therefore compromised. Since 1994 seine data have been collected year-round and at more locations.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

   (see figures 1 and 2)

   - **Central & West Delta 25%**
   - **East Delta 7%**
   - **North Delta 11%**
   - **Central & S. San Francisco 11%**
   - **Upstream San Joaquin 5%**
   - **San Pablo Bay & Napa River 7%**
   - **South Delta 16%**
   - **Upstream Sacramento River 19%**

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution or abundance?

   Additional sites were added in the Central, North, and South Delta regions following the listing of winter run Chinook in 1993. Sample sites were added in the San Pablo and San Francisco Bays in 1997 in response to the listing of spring run salmon and a growing interest in non-salmonid resident fishes. The additional sampling locations provide additional information about the timing and distribution of juvenile Chinook salmon and other bay and delta juvenile fishes.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

   The FWS beach seine program is closely integrated with other FWS IEP operations. Data collected as part of the FWS beach seine program are used along with other sampling throughout the area to document the movement of juvenile Chinook throughout the delta. The data collected are also used by IEP member agencies for a variety of analyses. IEP member agencies (e.g., NOAA Fisheries, DFG, and DWR) frequently request biological samples obtained through the beach seine program (otoliths, DNA, and other biological samples.)

6. Please identify and briefly describe any opportunities for additional program element integration.

   The entire FWS monitoring program is highly integrated with other IEP programs. As an agency we remain open to all opportunities for integration.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   In the last few years a QA/QC biologist was added to the staff to improve fish identification and to help quantify our fish ID error rate. In the mid-1990's we determined not to identify fish of less than 25 mm, since we were not confident of identification for that size in the field and our sampling gear does not target fish in this size range.

   b. Field or analytical studies to assess current and new sampling methods

   Minor modifications are evaluated frequently (see section VI #2).

   c. Analytical studies to evaluate current and new analytical methods

   d. Evaluation of new technologies or new gear types

   e. Review and improve monitoring program element processes

   f. Using historical information to change the program element design

   Historical data are used to evaluate the program element design (e.g., in the 2000 review). Changes are incorporated when appropriate and feasible.

   g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   Yes. Data are uploaded to BDAT at least weekly year-round.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   Yes, beach seine data from 1976 to present are available.

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   Data are entered into our local database, QA/QC'd within 2 days and posted on BDAT within 1 week. Final QA/QC of data are usually finished within 3 months of the end of our field season (July 31) and updated on BDAT (final data QC and updated by Nov 1).

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

   Although only late-fall yearlings are tagged with coded wire tags as part of a related IEP program, all coded wire tag recovery data are available at http://www.delta.dfg.ca.gov/usfws/maps**. Real time data are posted to the DFG Real Time Monitoring website at** http://www.delta.dfg.ca.gov/data/rtm2004/**.**

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   Brandes, P.L., and J.S. McLain. 2001. Juvenile chinook salmon abundance, distribution, and survival in the Sacramento-San Joaquin Estuary. Pages 39-138 in R.L. Brown, editor. Contributions to the Biology of Central Valley Salmonids: Fish Bulletin 179, Vol. 2. State of California, The Resources Agency, Department of Fish and Game, Sacramento, CA.

   Kjelson, M.A., and P.L. Brandes. 1989. The use of smolt survival estimates to quantify the effects of habitat changes on salmonid stocks in the Sacramento-San Joaquin rivers, California. Special Publication of Canadian Journal of Fisheries and Aquatic Sciences 105:100-115.

Kjelson, M.A., P.F. Raquel, and F.W. Fisher. 1982. Life history of fall-run juvenile chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento-San Joaquin Estuary, California. Pages 393-411 in V.S. Kennedy, editor. Estuarine comparisons. Academic Press, New York, NY.

Kjelson, M.A., P.F. Raquel, and F.W. Fisher. 1981. Influences of freshwater inflow on chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento-San Joaquin Estuary. Pages 88-108 in R.D. Cross, and D.L. Williams editors. Proceedings of the National Symposium on Freshwater Inflow to Estuaries. Coastal Ecosystems Project, Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.
7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.
8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.
9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.
10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.
11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

Brandes, P.L. 1996. Results of 1996 coded-wire tag smolt survival experiments in the San Joaquin River Delta. Interagency Ecological Program Newlsetter. 9(4):13-16

Brandes, P.L., and Pierce, M.M. 1998. 1997 salmon smolt survival studies in the South Delta. Interagency Ecological Program Newsletter. 11(1):29-38.

McLain, Jeff S. 1998. Relative efficiency of the midwater and Kodiak trawl at capturing juvenile chinook salmon in the Sacramento River. Interagency Ecological Program Newsletter. 11(4): 26-29.

McLain, Jeff S., and Burmester, R. 1999. Juvenile fall-run and winter-run chinook salmon abundance. Interagency Ecological Program Newsletter. 12(2) 35-38.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

    Brandes, P., Perry, K., Chappell, E., McLain, J., Greene, S., Sitts, R., McEwan, D., and Chotkowski, M., Interagency Ecological Program. 2000. Delta Salmon Project Work Team Delta Juvenile Salmon Monitoring Program Review Stockton, CA

    U.S. Fish and Wildlife Service. 1994. 1993 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

    U.S. Fish and Wildlife Service. 1995. 1994 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

    U.S. Fish and Wildlife Service. 1997. 1995 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

    U.S. Fish and Wildlife Service. 1999. 1996 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

    U.S. Fish and Wildlife Service. 2000. 1997/98 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

    U.S. Fish and Wildlife Service. 2000. 1999 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

    Kjelson, M, Greene, S., and Brandes, P.L. 1989. A model for estimating mortality and survival of fall-run chinook salmon smolts in the Sacramento River Delta between Sacramento and Chipps Island. U.S. Fish and Wildlife Service, Stockton, CA. 50pp.

    U.S. Fish and Wildlife Service. 1987. Exhibit 31: The needs of chinook salmon, Oncorhynchus tshawystcha in the Sacramento-San Joaquin Estuary. Presented to the State Water Resources Control Board for the 1987 Water Quality/Water Rights Proceedings on the San Francisco Bay/Sacramento-San Joaquin Delta.

    Contributions to the winter run biological opinion – Brandes

13. What products are planned for the next three years? Consider:

    a. Papers (refereed journal articles)

    Biases in beach seine sampling

    b. IEP technical reports

c. IEP newsletter articles

Newsletter articles as appropriate (status & trends, quarterly update, etc)

A review of published literature on emigration behavior of juvenile Chinook

d. IEP or CALFED workshop presentations

Presentations at IEP and CALFED workshops as appropriate

e. AFS, ERF or other professional meeting presentations

AFS and CALFED Science conference presentations are planned

f. Other

IEP Newletter articles, technical reports (white papers), IEP and CALFED workshop presentation.

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DAT	**X**			**Real time distribution and abundance**
NOAA		**X**		**Long-term abundance of salmonids,**
DFG	**X**			**Abundance of splittail, delta smelt**
USGS			**X**	**Comparison of hydroacoustic gear with trawl**
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
EWA	**X**			**The sampling recovers marked fish used to evaluate water project effects and management alternatives**
Through –Delta PWT		**X**		**Same as above**
DCC PWT		**X**		**Same as above**
Sport Fish Management Entities				

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
Regulatory Agencies				
NOAA		**X**		**We provide valuable data on salmon in the delta to NOAA and other regulatory agencies to assess projects or impacts**
USFWS	**X**			**Same as above**
DFG	**X**			**Same as above**
Outside government, academic, or consultant entities				
SP Cramer		**X**		**The survival data have been used extensively. IEP helped recover marked fish**
Cal Trans			**X**	
UC Davis			**X**	
Romberg Tiburon Center			**X**	
Hanson Environmental		**X**		**Same as above**
Natural Resource Scientists Inc.		**X**		**Same as above**
San Joaquin River Group	**X**			**Same as above**

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:

   See comments in above table

   a. Long-term abundance and distribution trends
   b. Life history information
   c. Population status
   d. Harvest rates
   e. Recruitment rates
   f. Abundance and distribution information for water operations/EWA actions
   g. Recovery criteria
   h. Species status reviews
   i. Site-specific information
   j. Project impact assessment
   k. Other
3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   The beach seine survey is one of the longest running monitoring programs in the area, and data are used by a wide variety of people and organizations. It also provides real-time data to help manage water operations for several months of the year when ESA-listed winter Chinook salmon are typically emigrating.

   Information from the beach seine survey integrates with data collected on the trawls (Sacramento, Mossdale, and Chipps Island), to help assess the populations and life history of various fishes in the Sacramento-San Joaquin Rivers and estuary.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   We would like to look at the monitoring stations and seining methods to assess if this effort is representative of the available habitat and the juvenile fish populations. Some sites have changed dramatically since they were initially chosen and it seems likely that each sampling location needs periodic re-evaluation. We would also like to incorporate random sampling to allow for statistically valid extrapolation of seine.

   Given the number of fish species in the system and the lack of information on many of them, we would like to look at integrating our monitoring work with other research to better understand the life history of native and non-native fishes in the area.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   See #2 above. It would also be helpful to look at other methods of shoreline sampling (e.g., block nets, electro-fishing, push net, cast net) to obtain data from habitats that are not conducive to seining.

4. Do you have any ideas for other useful program element products?

   We would like to produce more peer-reviewed publications to make our data and analyses available to a wider audience.

5. Please provide any other comments you may have.

B 2.a) San Francisco Bay Study Survey (Bay Study Survey) (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1, 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Estuarine and Marine Fish Abundance and Distribution, #2004-011

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Kathy Hieb, CDFG, Stockton, California

3. Please list the dates you started and finished this questionnaire.

   Started: March 22, 2004

   Completed:

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   California Department of Fish and Game

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   Yes, this element has been reviewed previously:

   1. 1990. I need to ask Chuck about this review

   **2. 1996. IEP sponsored workshop. Publication: IEP. 1998. Recommendations regarding comprehensive aquatic monitoring in the Sacramento-San Joaquin Estuary and its tributaries, compiled by
P. Coulston. IEP Technical Report 58, 20 pp.**

   3. 1999 – IEP SAG review, SAG report: “Review of the Bay Program by the Science Advisory Group of the Interagency Ecological Program, October 1999”

6. Provide an overview of the *products* of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

Typical products include:

1. Annually, data bases of station, tow, and fish and crab size and catch data from SF Bay through the western delta. Current data bases include the 1980-2003 data.

2. Annually the status and trends report, which summarizes the annual abundance indices and distribution of at least 20 species of fishes and 5 crabs, is published in the IEP Newsletter.

3. Periodically data and information from this element is used for journal articles, conference presentations, IEP Technical Reports, SWRCB hearing documents, and white papers.

4. Periodically data and information from this element is used for CEQA and NEPA documents, theses, grant proposals, and final project reports produced by entities outside of CDFG.

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists.

The goals and objectives for Goal 1 are most directly addressed by the current program. Current staffing and budget have allowed us to maintain the field sampling program, to complete annual database updates, and to meet IEP reporting requirements, but have severely constrained time available for work on Goal 2 objectives. This program is the only IEP field sampling effort currently sampling lower estuary open water (vs. shoreline) fishes whose abundance and distribution are affected by outflow (e.g., longfin smelt, starry flounder, and Pacific herring).

Goal 1 objectives:

1. Determine the trends in environmental variables and trends in the distribution and abundance of living resources, including:

a. Special status species.

This study collects and indexes age-0 delta smelt, splittail, and longfin smelt. We collect, but do not index, juvenile Chinook salmon and steelhead.

b. Sportfish species.

This study collects and indexes a variety of sportfish species, including Dungeness crab, red rock crab, and brown rock crab, white sturgeon (only IEP study that reliably collects age-0 sturgeon), striped bass, surfperches, jacksmelt, leopard shark, American shad, starry flounder, and California halibut. Also collects and indexes several species collected by sport anglers for bait, including northern anchovy, plainfin midshipman, staghorn sculpin, and yellowfin goby.

c. Forage species.

This study collects and indexes numerous forage species common in the estuary, ranging from pelagic brackish to demersal marine: American shad, Pacific herring, Pacific sardine, northern anchovy, longfin smelt, plainfin midshipman, jacksmelt, topsmelt, shiner perch, other surfperches, bay goby, cheekspot goby, yellowfin goby, *Tridentiger spp*. (chameleon, shimofuri, and shokihaze gobies), Pacific pompano, English sole, speckled sanddab, and California tonguefish. Note that many of these species are forage as age-0 but have sport or commercial value when larger.

d. Water quality.

This study collects salinity, temperature, and water clarity (Secchi) data at each station, ancillary to the fish and invertebrate collections.

h. Predators (of fish).

This study occasionally collects larger piscivores, such as California halibut and striped bass, but the sampling gear is not effective for larger, faster swimming individuals.

i. Invasive species.

This study collects and indexes adult Chinese mitten crabs and yellowfin goby, which are generally agreed to be invasive species. It also collects and indices several introduced species, which may or may not be invasive, depending on who you talk to: American shad, striped bass, chameleon goby, shimofuri goby, and shokihaze goby.

j. Other aquatic species of interest.

This study collects and indexes age-0 of several species that are commercially fished as adults: Dungeness crab, Pacific herring, brown rockfish, several of the surfperches, and English sole. Also, this study collects and indexes several species that support commercial bait fisheries in the estuary, including northern anchovy, plainfin midshipman, staghorn sculpin, and yellowfin goby.

2. This study works to *“assess and improve the long-term monitoring program elements to support management priorities”* on a continual basis, but not formally every year. For example, we constantly work to standardize and improve our data collection, data handling, and analytical methods so we can be more efficient, but this is not a specific objective in the Program Element workplan. Specific examples of past improvements include adding new stations for better geographic coverage of key species’ distributions, reporting more species in the annual Status and Trends report, and including more environmental variables in individual species models.

Current (2004) improvements include: developing Bay Study sampling protocol for another IEP boat, so we can maintain monthly sampling if the primary sample vessel is not available, developing numeric and weight (biomass) community indices for fishes, and developing alternative abundance indices that better reflect the contribution of regions, channels, and shoals to the indices.

Goal 2 objectives:

1. Determine interrelationships among monitored variables.

Assuming that a monitored variable is *only* what we record, we do analyze catch by size or age group and location, depth, salinity, temperature.

2. Explain how trends in environmental variables are affected by:

a. Water project design and operations.

We have developed relationships between and annual abundance and outflow for several estuary-dependent, such as longfin smelt and starry flounder. Also have analyzed water project exports and longfin smelt abundance: there is a negative relationship between outflow and longfin smelt salvage that is also dependent upon their abundance.

b. Use of environmental water

To date, data from this study has not been used in this manner to my knowledge.

c. Ecosystem restoration

To date, data from this study has not been used in this manner to my knowledge, although information from this study has been used to develop CALFED's ERP and to review and asses several restoration projects in the estuary.

d. Agricultural diversions.

To date, data from this study has not been used in this manner to my knowledge, as we sample downstream of most of the diversions.

3. Determine how other environmental factors affects trends in monitored environmental variables. Assuming that "other" variables are those we do not monitor, such as outflow, ocean temperature, upwelling, plankton densities, etc.

In addition to the timing and magnitude of freshwater outflow, several other physical factors may affect abundance. For species that spawn in the ocean, ocean temperatures, nearshore currents including upwelling and the Davidson current, and long-term ocean climate (regime shifts, PDO index) are used in analyses. For some species, we also consider broodstock abundance and condition; broodstock abundance has been used in Pacific herring and longfin smelt models, condition factors in the Pacific herring model.

8. Please list any *substantial* program element objectives that are separate from (in addition to) current IEP goals and objectives.

Relationship between fish community measurements, including numeric and biomass indices, species diversity indices, etc., and environmental variables, such as outflow, ocean temperature and upwelling, and ocean climate change.

9. Please provide a figure or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

Station maps including a key to when stations were added (Word file) and a list of stations latitudes and longitudes are included for the open water, beach seine, and ringnet surveys.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. Systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)

    The original 35 open water stations were located near 17 of the USGS plankton survey stations; these were all channel stations and nearby shoal sites were selected to complement them. Current stations were spaced in an approximately systematic fashion through the estuary; sampling is also temporally systematic (i.e., monthly). In 1988 we added additional channel and shoal stations in South, Central, and San Pablo bays and Carquinez Strait to complement existing stations and establish a more even ratio of channel and shoal stations across embayments. In 1990 and 1994 we added several channel and shoal stations in the lower Sacramento and San Joaquin rivers as key estuary-dependent species moved upstream during the drought.

    Many of the beach seine stations were USFWS seine stations; additional seine stations were selected for regions or embayments with few or no USFWS stations. Locations were constrained by the need for access by land. (I figured this out only when USFWS reinstituted their Bay Seine several years ago. But there is nothing in the original Bay Study study plan about selection of the seine stations, other than a target number of stations per embayment.)

    The ringnet stations were a subset of the CDFG Dungeness Crab Project's ringnet stations. They were selected for accessibility from land and ability to schedule with the beach seine survey. Stations were added 1990 and 1994 to more intensively monitor Dungeness crab in San Pablo and Suisun bays.

    The estuary-wide distribution of stations and year-round monthly sampling allowed us to delimit species use of the estuary in space and time more effectively than any other survey.

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    For the open water survey, sampling frequency is monthly year-round, unless a boat is not available. Monthly sampling was selected as it was believed to be the minimum sampling frequency necessary to monitor abundance of age-0 fishes, especially species that rear in the estuary for 4-6 months. Year-round was selected to monitor juveniles of late-summer and fall spawners and adults of short-lived species, such as longfin smelt.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    Sampling frequency has remained monthly; sampling gaps are identified in II.2.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

    See the file "Bay Study SOP Summary.xls"

Please use the attached Excel spreadsheet to answer the next three questions:

1. What resources are currently required to complete this program element?

   In addition to the resources in the spreadsheet (human resources), a vessel capable of towing an otter trawl in 20+ m of water is required.

2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
   - Supervision/program management
   - Field work
   - Lab processing
   - Data management
   - Data analysis
   - Web page maintenance
   - Reporting & writing
   - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
   - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae	**Age-0**	**Age-1**	**Age-2+**	**Comments**
Species of Concern					
winter-run Chinook		Poor			
spring-run Chinook		Poor			
CV steelhead		Poor			
coastal steelhead		Poor			
delta smelt		Good			
splittail		Fair	Fair	Fair	
longfin smelt		Excellent	Good		
green sturgeon		Poor			
Sport Species					
fall-run Chinook		Good	NA	NA	
striped bass		Excellent	Fair	Poor	
white sturgeon		Fair	poor	NA	
catfish		Fair	Poor	Poor	
American shad		Excellent	NA		
largemouth bass		Poor	Poor	Poor	
Dungeness crab		Excellent	NA	NA	
leopard shark		Fair		Poor	
jacksmelt		Good	NA	Fair	
surfperches		Good	Fair	Fair	
California halibut		Good	Good	Fair	
starry flounder		Good	Good	Fair	
Commercial					
Dungeness crab		Excellent	NA	NA	
Pacific herring		Excellent	Fair	poor	
surfperches		Good	Fair	Fair	
brown rockfish		Fair	Fair	NA	
English sole		Excellent	Poor	NA	

Group/Species	**Life Stage**				
	Larvae	**Age-0**	**Age-1**	**Age-2+**	**Comments**
Pacific herring		Excellent	Fair	poor	
threadfin shad		Fair	Fair		Distributed upstream of sampling
American shad		Excellent	NA		
Pacific sardine		Good	Good	Fair	
northern anchovy		Good	Good	Good	
inland silverside		Poor	Poor		Nearshore, shallow
jacksmelt		Good	Fair	Fair	
topsmelt		Poor	Poor	Poor	Nearshore, very shallow
shiner perch		Excellent	Good	Good	
other surfperches		Good	Fair	Fair	
arrow goby		Poor			
bay goby		Excellent	Excellent	Good	
cheekspot goby		Good	NA	NA	
Tridentiger spp		Good-Fair	Good-Fair		Varies by species
yellowfin goby		Good	Good		Many shallow, in marshes
Pacific pompano			Fair	Fair	Age-0 rare in Bay
English sole		Excellent	Poor	NA	Age-1:Net avoidance, small fraction remain in estuary
speckled sanddab		Excellent	Excellent	Fair	Few age-2+ present
California tonguefish		Excellent	Good	Poor	Rare as age-2+
Invasive Species					
Chinese mitten crab		Poor	Excellent	NA	Assume die at end of age-1
inland silverside		Poor	Poor		inshore
yellowfin goby		Good	Good		Many shallow, in marshes
shimofuri goby		Poor	Poor		Many shallow, in marshes
Habitats (or assemblages?)					
Nearshore ($\leq$ 2 m)					Most of our tows > 3 m water
Vegetated					
Nearshore, other structure					
Nearshore open water					
Tidal Marsh					
Floodplain					
Pelagic – open water (> 2 m)		Excellent-Poor	Excellent-Poor	Good-Poor	Depends on species distribution
Demersal or epibenthic (> 2 m)					
Mud and silt		Excellent-Poor	Excellent-Poor	Good-Poor	Depends on species distribution
Eelgrass		NA	NA	NA	We do not trawl in these habitats, although all are >2m in depth.
Rocky subtidal		NA	NA	NA	
Sand flats		NA	NA	NA	
Benthic (infauna)					

2. Over the sampling period of record what months or years of data are missing?

   Please see the summary tables (Word file) for months sampled by year and gear and number of stations sampled by year and month (survey) for each gear. The months not sampled are readily identifiable.

How do these missing data affect data analysis or the information that can be derived?

When months are not sampled, especially consecutive months such as September to January 1989-1990 and November to January in the early and mid-1990s, we have not been able to calculate abundance indices for some species or age classes these years. This includes topsmelt, a summer spawner that emigrates to the open waters of the estuary in late fall and winter, and age-1 of several species, including longfin smelt.

Not sampling with the midwater trawl from May 1994 to March 1995 resulted in no 1994 index for most pelagic species. For a recent analysis, only the 1994 American shad index could be reliably predicted from another monitoring data set (Fall MWT). For other pelagic species, such as northern anchovy, Pacific herring, jacksmelt, and walleye surfperch, we could not predict a 1994 index from other data sets (Fall MWT, Bay Study otter trawl) or the 1995 age-1 indices. No other monitoring program samples the pelagic fish community of the estuary as extensively as IEP's San Francisco Bay Study.

3. What proportion of monitoring program element field effort occurs in each IEP region?

   South and Central bays – 20/52 = 0.38

   San Pablo Bay – 10/52 = 0.19

   Suisun Bay – 10/52 = 0.19

   West Delta – 10/52 = 0.19

   North Delta – 2/52 = 0.04

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift.

   The study area for the open water survey was extended south in 1988 with the addition of station #140 in South Bay, just south of the Dumbarton Bridge. It was also extended upstream in 1990 and 1994 with the addition of stations in the Sacramento and San Joaquin rivers (see station maps). These extensions were designed to better sample the brackish water portions of the estuary and continue to date.

What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution, or abundance?

With these extensions in sampling area, we better sample the brackish water portions of the estuary in all years. Prior to the addition of station #140, we did not sample the area of South Bay inhabited by estuary-dependent species in most years. Prior to the addition of the upstream stations in 1990 and 1994, several key estuary-dependent species migrated upstream of our study area in summer and fall of low outflow years.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or *synergistically adding value*.

   This program element is one of the few remaining components of the original Delta Outflow/San Francisco Bay Study. The open water survey is also the field collection component of Program Element 2004-012, "Shrimp Abundance and Distribution Survey", another IEP monitoring survey.

   Most of the USFWS lower estuary beach seine stations are the same stations the Bay Study sampled in the 1980s. As the duration of this survey increases, we can analyze their data for nearshore species of interest, such as topsmelt, jacksmelt, and the surfperches. Since the seine survey collects species and sizes of fish that are not common in our open water survey, they have occasionally saved specimens for us.

   In 2003 the Bay Study shared field resources with the lower Estuary Zooplankton Survey, but this survey was cancelled in fall 2003 after sampling only 4 months.

6. Please identify and briefly describe any opportunities for additional program element integration.

   Possibly the USFWS seine survey could better complement the historic Bay Study seine survey with the addition of several stations in Central and San Pablo bays. Abundance trends analyses should be conducted with the historic and current data sets before deciding if more stations are needed.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables.

   Development of length-weight equations for the more common forage species to develop and evaluate biomass indices.

   b. Field or analytical studies to assess current and new sampling methods.

   Field QAQC program and reports, and tow comparison between the *RV Longfin* and *New Alosa* in 2003.

   c. Studies to evaluate current and new analytical methods.

   Alternative index calculation, such as grouping stations by channel and shoal prior to area or volume weighting and including the stations added to the survey in 1988, 1990, and 1994 in the indices (our own and the longfin smelt post-doc).

   d. Evaluation of new technologies or new gear types.

   In a monitoring program, one must work to maintain the same gear and sampling methods over time; for example, our midwater trawl codend mesh has been discontinued and the retrieval rate of the otter trawl changed when the hydraulic system was overhauled. Also, the physical landscape has changed at some

stations; for example, several shoals have changed size and moved, and the substrate has changed at some stations with the establishment of extensive polychaete beds in recent years.

e. Review and improve monitoring program element processes.

I assume this means sample processing? Our samples are processed on board, with an attempt to maintain processing methods through the years. We added a QAQC program for the field processing several years ago.

f. Using historical information to change the program element design.

g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

Not on BDAT, but data through 1994 on the IEP web page (text files limited to 8,000 records). The Bay Study data is stored in dBASE and Access files at the CDFG Stockton office.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

Approximately 3 months from the end of each calendar year; i.e., the 2003 field and fish data was available to the public in March 2004.

4. Are there web-based data presentations of the program data?

Nothing like the bubble plots. We have intended for 4+ years to update our abundance indices and life history information on the CVBDB web page, but it is a low priority for CDFG.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. *Please focus on listing reports, papers, etc. that directly report program element results or make direct use of program element data.*

5. List the papers (refereed journal articles) produced by staff assigned to the specific monitoring program element.

   Armor, C. and P.L. Herrgesell. 1985. Distribution and abundance of fishes in the San Francisco Bay Estuary between 1980 and 1982. Hydrobiologia 129:211-227.

   Baxter, R.D. 1999. Status of splittail in California. California Fish and Game 85:28-30.

   Greiner, T.A. 2002. Records of the Shokihaze Goby, *Tridentiger barbatus* (Gûnther), Newly Introduced into the San Francisco Estuary. California Fish and Game 88: 68-74.

6. List the papers that were co-authored by program element staff and others outside the program element.

   Matern, S.A., and K.J. Fleming. 1995. Invasion of a third Asian goby, Tridentiger bifasciatus, in California. California Fish and Game 81:71-76.

   Rudnick, D.A., K. Hieb, K.F. Grimmer, and V.H. Resh. 2003. Patterns and processes of biological invasion: The Chinese Mitten Crab in San Francisco Bay. Basic and Applied Ecology 4:249-262.

   Stewart, A.R., S.N. Luoma, C.E. Schlekat, M. A. Doblin, and K.A. Hieb. 2004. Food web pathway determines how selenium affects aquatic ecosystems: A San Francisco Bay case study. Environmental Science and Technology, in press.

7. List the papers produced by scientists outside the program element.

   Jassby, A.D., W. J. Kimmerer, S.G. Monismith, C. Armor, J.E. Cloern, T.M. Powell, J.R. Schubel, and T.J. Vendlinski. 1995. Isohaline position as a habitat indicator for estuarine populations. Ecological Applications 5:272-289.

   Kimmerer, W.J., J.H. Cowan Jr., L.W. Miller, and K.A. Rose. 2000. Analysis of an estuarine striped bass population: Influence of density-dependent mortality between metamorphosis and recruitment. Can. J. Fish. Aquat. Sci. 57: 478-486.

   Kimmerer, W.J., J.H. Cowan Jr., L.W. Miller, and K.A. Rose. 2001. Analysis of an estuarine striped bass population: Effects of environmental conditions during early life. Estuaries 24:556-574.

   Kimmerer, W.J. 2002. Effects of freshwater flow on abundance of estuarine organisms: physical effects or trophic linkages? Marine Ecology Progress Series 243:39-55.

   Kimmerer, W.J. 2002. Physical, biological, and management responses to variable freshwater flow into the San Francisco estuary. Estuaries.25:1275-1290.

8. List the IEP technical reports produced by specific program staff.

   Herrgesell, P., R. Schaffter, and C. Larsen. 1983. Effects of Freshwater Outflow on San Francisco Bay Biological Resources. IEP Technical Report 7, 86 pp.

Orsi, J., editor. 1999. Report on the 1980-1995 fish, shrimp, and crab sampling in the San Francisco Estuary, California. IEP Technical Report 63, 503 pp.

9. List the IEP technical reports where staff was coauthor with others outside the program.

Estuarine Ecology Team. 1997. An Assessment of the Likely Mechanisms Underlying the "Fish-X2" Relationships. IEP Technical Report 52, 24 pp.

10. List the IEP technical reports produced by people other than specific program staff.

Wang, J.C.S. 1986. Fishes of the Sacramento-San Joaquin Estuary and adjacent waters, California: A guide to the early life histories. IEP Technical Report 9.

11. List the IEP Newsletter Articles produced by specific program element staff.

Hieb, K. 1990. Dungeness crabs in San Francisco Bay. IESP Newsletter March 1990, pp 1-2.

Hieb, K. 1996. 1995 Status and Trends, Bay Species. IEP Newsletter Winter 1996, pp 27-28.

Baxter, R. 1996. 1995 Status and Trends, Splittail and Longfin Smelt. IEP Newsletter Winter 1996, pp 28-29.

Halat, K. and K. Hieb. 1996. Invasion of the Estuary by Oriental and European Crabs. IEP Newsletter, Autumn 1996, 9 (4): 21.

Hieb, K. 1997. Chinese Mitten Crabs in the Delta. IEP Newsletter Winter 1997, 10(1): 14-15.

Hieb, K. 1997. 1996 Status and Trends, Green Crab and Chinese Mitten Crab. IEP Newsletter Spring 1997, 10(2): 23.

Baxter, R. 1997. 1996 Status and Trends, Splittail and Longfin Smelt Abundance. IEP Newsletter Spring 1997, 10(2): 35.

Hieb, K. 1997. 1996 Status and Trends, Bay Species. IEP Newsletter Spring 1997, 10(2): 36-37.

Baxter, R. 1998. 1997 Status and Trends, Splittail and Longfin Smelt. IEP Newsletter Spring 1998, 11(2): 39-40.

DeLeón, S. 1998. 1997 Status and Trends, Surfperch Abundance Trends in San Francisco Bay. IEP Newsletter Spring 1998, 11(2): 40-43.

Hieb, K. 1998. 1997 Status and Trends, Bay Species. IEP Newsletter Spring 1998, 11(2): 46-49.

Baxter, R. 1999. 1998 Status and Trends, Splittail and Longfin Smelt Abundance. IEP Newsletter Spring 1999, 12(2): 28-29.

Hieb, K. 1999. 1998 Status and Trends, San Francisco Bay Species Abundance. IEP Newsletter Spring 1999, 12(2): 30-34.

Baxter, R. 2000. 1999 Status and Trends, Splittail and Longfin Smelt. IEP Newsletter Spring 2000, 13(2): 19-21.

Hieb, K. 2000. 1999 Status and Trends, San Francisco Bay Species. IEP Newsletter Spring 2000, 13(2): 22-27.

Baxter, R. 2001. 2000 Status and Trends, Splittail and Longfin Smelt. IEP Newsletter Spring 2001, 14(2): 16-18.

Hieb, K. 2001. 2000 Status and Trends, San Francisco Bay Species. IEP Newsletter Spring 2001, 14(2): 21-27.

Hieb, K. 2002. 2001 Status and Trends, San Francisco Bay Species Abundance and Distribution. IEP Newsletter Spring 2002, 15(2): 15-20.

Hieb, K., T. Greiner, and S. Slater 2003. San Francisco Bay Species 2002 Status and Trends. IEP Newsletter Spring 2003, 16(2): 14-22.

Moreno, A. 2003. Jellyfish of the San Francisco Estuary. IEP Newsletter Spring 2003, 16(2): 56-58.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

Brown, J.A. 2003. An evaluation of the nursery role of estuaries for flatfish populations in central California. Ph.D. Thesis, University of California, Santa Cruz, 139 pp.

California Department of Fish and Game (CDFG). 1987. Delta outflow effects on the abundance and distribution of San Francisco Bay fish and invertebrates, 1980-1985.Exhibit 60, entered by the California Department of Fish and Game for the State Water Resources Control Board 1987 Water Quality/Water Rights Proceeding on the San Francisco Bay/Sacramento-San Joaquin Delta. 345 pp.

CDFG. 1987. Summary of delta outflow effects on San Francisco Bay fish and invertebrates. Exhibit 59, entered by the California Department of Fish and Game for the State Water Resources Control Board 1987 Water Quality/Water Rights Proceeding on the San Francisco Bay/Sacramento-San Joaquin Delta. 37 pp.

CDFG. 1992. Estuary dependent species. Entered by the California Department of Fish and Game for the State Water Resources Control Board 1992 Water Quality/Water Rights Proceedings on the San Francisco Bay/Sacramento-San Joaquin Delta. WRINT-DFG Exhibit 6, 97 pp.

CDFG. 2001 . California’s Living Marine Resources: A Status Report. W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 591 pp. *CDFG Bay Study staff contributed to several sections and Bay Study data and information was used for several other sections.*

CDFG. 2002 . Recommendations to change recreational surfperch regulations. Memo from R. Hight to R. Treanor, Fish and Game Commission, March 2002.

Emmett, R.L., S.A. Hinton, S.L. Stone, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries. Crangon. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. ELMR Report 8.

Fleming, K. 1997. 1993 Tucker trawl pilot study. In: 1993 Annual Report, Interagency Ecological Program for the Sacramento-San Joaquin Estuary, pp 93-94.

Gartside, E.D. 1995. Growth of larval Pacific herring in San Francisco Bay. MA Thesis, San Francisco State University, San Francisco, California, 111 pp.

Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, Calif. S.F. Bay Regional Water Quality Control Board, Oakland, Calif., 209 pp. plus appendices.

Goals Project. 2000. Baylands Ecosystem Species and Community Profiles: Life histories and environmental requirements of key plants, fish, and wildlife. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. P.R. Olofson, ed. S.F. Bay Regional Water Quality Control Board, Oakland, Calif., 402 pp.

Hanson Environmental, Inc. 2003. Assessment and evaluation of the effects of sand mining on the aquatic habitat and fishery populations of Central San Francisco Bay and the Sacramento-San Joaquin Estuary. Prepared for: Hanson Aggregates Mid-Pacific, RMC Pacific Materials, and Jerico Products/Morris Tug and Barge. December 2003 draft report.

Herbold, B., A.D. Jassby, and P.B. Moyle. 1992 . Status and trends of aquatic resources of the San Francisco Bay Estuary. U. S. Environmental Protection Agency San Francisco Estuary Project. 257 pp.

Hieb, K. 1994. Pelagic fish community of the South and Central San Francisco Bay – prey source for wildlife using the Alameda Naval Air Station. In: Alameda Naval Air Station's Natural Resources and Base Closure. Proceedings of a scientific symposium, March 12, 1994, published by the Golden Gate Audubon Society. Pp 85-103.

Hieb, K. and R. Baxter. 1993. Delta Outflow/San Francisco Bay Study. In:1991 Annual Report, Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, pp 101-116. *Includes a summary of freshwater outflow needs for Caridean shrimp, longfin smelt, and starry flounder.*

Hieb, K. and R. Baxter. 1994. Delta Outflow/San Francisco Bay Study. In: 1992 Annual Report, Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, pp 95-106. *Includes results of the 1992 Tucker trawl surveys and the 1992 shallow water nursery habitats sampling.*

Hieb, K., R. Baxter, and K. Fleming. 1997. Delta Outflow/San Francisco Bay Study. In: 1993 Annual Report, Interagency Ecological Program for the Sacramento-San Joaquin Estuary, pp 38-49.

Interagency Ecological Study Program (IESP). 1981. Delta Outflow/San Francisco Bay Study. In: Tenth Annual Report (1980). Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, pp 31-35.

IESP. 1982. Delta Outflow/San Francisco Bay Study. In: Eleventh Annual Report (1981). Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, pp 35-41.

IESP. 1983. Delta Outflow/San Francisco Bay Study. In: Twelfth Annual Report (1982). Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, pp 38-47.

IESP. 1984. Delta Outflow/San Francisco Bay Study. In: Thirteenth Annual Report (1983). Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, pp 44-51.

IESP. 1986. San Francisco Bay. In: 1984 Annual Report of the Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. R. Brown, compiler, pp 93-109. *Includes reports from the biological and hydrodynamic elements.*

IESP. 1987. San Francisco Bay. In: 1985-1986 Report of the Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. R. Brown, compiler, pp 99-124. *Includes reports from the biological and hydrodynamic elements.*

IESP. 1990. Delta Outflow/San Francisco Bay Study. In: 1989 Annual Report. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. P. Herrgesell, compiler, pp 85-95.

IESP. 1991. Delta Outflow/San Francisco Bay Study. In: 1990 Annual Report, Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, pp 91-101. *Includes summaries of the 1991 Tucker trawl and beam trawl surveys.*

Jahn, A. 2004. On the presence/absence of listed salmonids ESUs in Central San Francisco Bay. Prepared for NOAA Fisheries and ACOE, by Port of Oakland, March 2004, 16 pp*. Draft report*.

Kendall, M.L. 1993. Determination of age and settlement date in juvenile speckled sanddabs, *Citharichthys stigmaeus* using daily increments on otoliths. MA Thesis, San Francisco State University, San Francisco, California, 59 pp.

Kimmerer, W.J. 2004. Open-Water Processes of the San Francisco Estuary: from physical forcing to biological responses. San Francisco Estuary and Watershed Science [online serial]. Vol. 2, Issue 1 (February 2004), Article 1.

Life Science, Inc. 2004. Final South Bay Sat Pond Initial Stewardship Project. Environmental Impact Report/Environmental Impact Statement. Prepared for USFWS and CDFG. March 2004. Fish and macroinvertebrate sections prepared by Hanson Environmental.

O'Farrell, M.R. 2001. Year class formation of Pacific herring in San Francisco Bay. MA Thesis, San Francisco State University, San Francisco, California, 73 pp.

San Francisco Estuary Project (SFEP). 1998. State of the Estuary, 1992-1997, San Francisco Bay Sacramento-San Joaquin River Delta Estuary. *Several contributions to Chapter 2, Fish & the Aquatic Ecosystem.*

SFEP. 2000. State of the Estuary 2000. Restoration Primer, San Francisco Bay Sacramento-San Joaquin River Delta Estuary. *Several contributions to "Vital Statistics", Fish and Invasive Species sections.*

SFEP. 2002. State of the Estuary 2002. Science & Strategies for Restoration, San Francisco Bay Sacramento-San Joaquin River Delta Estuary. *Several*

contributions to "Vital Statistics", Fish & Aquatic Organisms and Invasive Species sections.

Tenera Environmental. 2001. Potrero Power Plant Unit 7 Project. Construction and Thermal Impacts and First Quarter Larval Fish Assessment. Prepared for Mirant Potrero, LLC Walnut Creek, CA.

URS and Tenera Environmental. 2002. Potrero Power Plant Unit 7 Project. Biological Assessment. Prepared for Mirant California, LLC. Walnut Creek, CA.

Veldhuizen T. 1998. Monitoring juvenile Chinese mitten crabs in the Sacramento-San Joaquin Delta and Suisun Marsh. Outdoor California 59:22.

Veldhuizen, T. and K. Hieb. 1998. What difference can one crab species make? The ongoing tale of the Chinese mitten crab and the San Francisco Estuary. Outdoor California 59:19-21.

Weber, P.K. 2002. Geochemical markers in the otoliths of Chinook salmon in the Sacramento-San Joaquin River system, California. Ph.D. Thesis, University of California, Berkeley, 123 pp.

13. What products are planned for the next three years? Consider:

a. Papers (refereed journal articles)

Ecology and behavior of longfin smelt (*Spirinchus thaleichthys*) in the San Francisco Estuary: A case study in interpretation and integration of long-term data sets. J.A. Rosenfield and R.D. Baxter, submitted to Transactions of the Am Fish Soc.

Interannual variability in abundance of fish and crustaceans in the San Francisco Estuary. D. Holmgren, K. Hieb, and W. Kimmerer. *Still* in prep for Estuaries.

Plan to include common SF Bay forage fishes in a major, estuary-wide biomass analyses, to be completed with other long-term monitoring staff. Possibly a journal article.

Status of surfperches in SF Estuary. T. Greiner and others.

A paper most likely on gobies or Pacific herring, S. Slater.

A paper on longfin smelt otolith microchemistry and habitat use. Rosenfield and Baxter.

Possibly a paper on longfin smelt larval distribution and juvenile recruitment.

Possibly a paper on the behavior of our otter and midwater trawls during fishing.

b. IEP technical reports

Length-weight relationships for common forage fishes and shrimp of SF Estuary, Gartz, Hieb, and others.

c. IEP newsletter articles

2003 Status and Trends, Bay Species (Spring 2004)

Biomass and numeric forage indices

2004 Status and Trends, Bay Species (Spring 2005)

2005 Status and Trends, Bay Species (Spring 2006)

d. IEP, CALFED workshop, or SOE presentations

Since we have averaged 1 presentation per each of these workshops, I would predict 3 over the next 3 years. Note that we are not planning a presentation or poster for CalFed 2004.

e. AFS, ERF or other professional meeting presentations

None planned for 2004, although in-state presentations are possible in 2005 or 2006.

Out-of-state travel, such as to ERF, will likely not be approved by DFG.

f. Other

Shokihaze goby master's thesis, S. Slater, California State University, Sacramento

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. *Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.*

Customer	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies+				
CDFG	√			a, b, h, i, k
USFWS	√			a, b, i
USGS		√		a, b, i
SWRCB			√	
CALFED Program Agencies				
CDFG	√			a, b
Sport Fish Management Entities				
CDFG		√		a, b, c, d, k (min size)
Regulatory Agencies				
NOAA Fisheries	√			a, h, i, j , k (EFH)
CDFG	√			a, h, i, j (review EIS)
USFWS	√			
Outside government, academic, or consultant entities				
Calif. Dept Parks and Rec			√	
Calif. Coastal Conservancy			√	
CalTrans		√		i, j
National Park Service			√	
Bay Institute	√			a, b (for indicators)
Marine Science Institute		√		
Point Reyes Bird Observatory	√			a, b, i (for analyses of special status bird species)
SFEI	√			a, b, i (for RMP collections, contaminant models)
Cal State Fresno*	√			a, b (mitten crab)
Cal State Long Beach*	√			a, b (yellowfin goby)
San Diego State Univ*	√			a, b (leopard shark)
San Francisco State Univ*	√			a, b, i (several requests – flatfish, herring, forage species for cormorant study)
UC Berkeley*	√			a, b
UC Los Angeles*	√			a, b (gobies, sculpin, bay pipefish, for a genetics study of estuarine fishes)
UC Santa Cruz*				a, b (flatfishes)
Hanson Inc.	√			a, b, i, j (sand mining, SFO, LTMS, power plant ops)
Tenera Environmental	√			a, b, j, i (power plant ops)
URS Greiner Woodward Clyde and *many* subconsultants	√			a, b, i, j. **Very** frequent requests when SFO expansion was planned

\+ Requests from CDFG, USFWS, and USGS often from employees of these agencies working outside of IEP.

*Includes requests for data and information by graduate students and professors at these universities for theses and other studies, such as grant funded research. I've listed requests within the past 3 years.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:
    a. Long-term abundance and distribution trends
    b. Life history information
    c. Population status
    d. Harvest rates
    e. Recruitment rates
    f. Abundance and distribution information for water operations/EWA actions
    g. Recovery criteria
    h. Species status reviews
    i. Site-specific information
    j. Project impact assessment
    k. Other

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

    Generally very satisfied with the quality of the monitoring data, often overwhelmed by the quantity of data. One consistent problem for customers has been lack of year-round sampling in past years – i.e. data gaps. Also, special study results are sometimes difficult for us to access electronically and therefore not readily available to the public.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect?

    The most valuable aspect of this element is the duration and consistency of the sampling, combined with the inclusion of species other than the usual IEP targets. We are just beginning to understand the sources of long-term variations in abundance, such as Pacific Decadal Oscillation. We have observed the first combination of some events, such as above normal outflow and cool ocean temperatures, in the past several years. For those estuary-dependent species which reproduce in the ocean, will the abundance-outflow relationship change in a cool ocean regime?

    The most challenging aspect is to maintain the above consistency of sampling, especially for species that do not have traditional human-assigned values.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   As we strive for continuity in our field collection methods, most improvements are post-data collection. Improvements that increase our efficiency and result in more time for data analyses and report writing include:

   a. Complete transition from dBASE to Access, with programming assistance from DWR (Summer 2004?).

   b. Bay Study data available to the public on the IEP server. To increase our efficiency, the data base must be easy to use, produce reproducible results, and have adequate metadata such that clients do not need to contact CDFG biologists for routine data requests.

   c. Update abundance indices for commonly collected SF Bay species annually on the CVBDB web page, including a graphic and table. Also, review and update species life history summaries and distributions, add important references in a literature link (Summer 2004).

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   a. Change the method we calculate abundance indices, possibly stratify by channel and shoal or post-stratifying by salinity. Goal is abundance indices with confidence intervals, not population estimates.

   b. Recalculate the area and volume for each embayment by channel and shoal, include study area upstream of the confluence of the Sacramento-San Joaquin rivers.

4. Do you have any ideas for other useful program element products?

   a. IEP Technical Report 63 available as a PDF file on the web (by chapter), as it is almost out-of-print (<6 copies remaining).

   b. More useful web products:

      i. Bubble plots or the like for selected Bay species.

      ii. Species lists by embayment and entire study area (common request).

   c. Summarize the program element's special studies, including objectives, methods, and results. Many of these studies remain unpublished, even in the grey literature.

5. Please provide any other comments you may have.

   Due to the study design, abundance indices are probably not sensitive to small changes in the population size; i.e. if a project reduces a population by 10-20%, the indices will not detect this. Since most project impacts are probably in this range, how can we better detect such changes? Also, the study design does not allow us to determine growth or survival rates, so a large part of the "why" question will never be answered.

B 2.b) San Francisco Bay Study Survey (Bay Study Survey) (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1, 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Shrimp Abundance and Distribution, #2004-012

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Kathy Hieb, CDFG, Stockton, California

3. Please list the dates you started and finished this questionnaire.

   Started: March 29, 2004

   Completed:

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   California Department of Fish and Game

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   Yes, this element has been reviewed previously:

   1. 1990. I need to ask Chuck about this review

   2. 1996. IEP sponsored workshop. Publication: IEP. 1998. Recommendations regarding comprehensive aquatic monitoring in the Sacramento-San Joaquin Estuary and its tributaries, compiled by P. Coulston. IEP Technical Report 58, 20 pp.

   2. 1999 – IEP SAG review, SAG report: “Review of the Bay Program by the Science Advisory Group of the Interagency Ecological Program, October 1999”

6. Provide an overview of the *products* of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   Typical products include:

   1. Annually the data bases of shrimp size and catch data, incidence of the brachial cavity parasite *Argeia*, and eggstage of ovigerous shrimp from San Francisco Estuary. Current data bases include the 1980-2002 data. Note that

laboratory processing of samples is now approximately a year behind due to the state hiring freeze and a mandatory temporary help lay-off in August 2003.

2. Annually the status and trends report, which summarizes the annual abundance indices and distribution of 6 species of shrimp, is published in the IEP Newsletter.

3. Periodically data and information from this element is used for journal articles, conference presentations, IEP Technical Reports, SWRCB hearing documents, and white papers.

4. Periodically data and information from this element is used for CEQA and NEPA documents, theses, grant proposals, and final project reports produced by entities outside of CDFG.

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists.

Goal 1 objectives:

1. Determine the trends in environmental variables and trends in the distribution and abundance of living resources, including:

b. Sportfish species.

This study collects and indexes bay shrimp, which are collected by sport anglers for bait.

c. Forage species.

This study collects and indexes bay shrimp, which are important forage for fishes, crabs, birds, and marine mammals of the estuary.

d. Water quality.

This study collects salinity, temperature, and water clarity (Secchi) data at each station, ancillary to the fish and invertebrate collections.

i. Invasive species.

This study collects and indexes *Exopalaemon modestus* and *Palaemon macrodactylus*, which are generally agreed to be invasive species.

j. Other aquatic species of interest.

This study collects and indexes Bay shrimp, which are the second most valuable commercial fishery in the estuary. Currently there are 12-15 active trawlers.

2. This study works to *“assess and improve the long-term monitoring program elements to support management priorities”* on a continual basis, but not formally every year. Please see the Bay Study Fish Questionnaire for the remainder of my response.

Goal 2 objectives:

1. Determine interrelationships among monitored variables.

Assuming that a monitored variable is *only* what we record, we do analyze shrimp catch by size, sex, or age group and location, depth, salinity, temperature.

2. Explain how trends in environmental variables are affected by:

a. Water project design and operations.

We have developed a relationship between and annual abundance of juvenile *Crangon franciscorum*, which is an estuary-dependent species, and outflow. Also working hypotheses for the mechanisms underlying this relationship.

b. Use of environmental water.

To date, data from this study has not been used in this manner to my knowledge.

c. Ecosystem restoration.

To date, data from this study has not been used in this manner to my knowledge, although information from this study has been used to develop CALFED's ERP and review and asses several restoration projects in the estuary.

d. Agricultural diversions.

To date, data from this study has not been used in this manner to my knowledge, as we sample downstream of most of the diversions.

3. Determine how other environmental factors affects trends in monitored environmental variables. Assuming that "other" variables are those we do not monitor, such as outflow, ocean temperature, upwelling, plankton densities, etc.

In addition to the timing and magnitude of freshwater outflow, several other physical factors may affect abundance. For species that reproduce in the ocean, ocean temperatures and long-term ocean climate (regime shifts, PDO index) are used in analyses. Note that shrimp have a relatively short larval period, 30-45 days, and are not likely to be subject to "displacement" by ocean currents as are some of the fish and crabs. Broodstock abundance has been used in the *C. franciscorum* model and is being considered for a *C. nigricauda* model, as we have observed record abundance in recent years.

8. Please list any *substantial* program element objectives that are separate from (in addition to) current IEP goals and objectives.

Relationship between shrimp community measurements, including numeric and biomass indices, and environmental variables, such as outflow, ocean temperature, and ocean climate change.

Questions 9-12 are answered in the Fish Questionnaire, which includes the field sampling for this element. Note that we currently process shrimp only from the otter trawl, but historically processed them from the midwater trawl (though 1988) and beach seine.

9. Please provide a figure or table showing sampling station locations and changes through time.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please

also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

11. What are the sampling frequency and annual sampling period, and why were they chosen?
12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.
13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

    See the file "Bay Study SOP Summary.xls"

Please use the attached Excel spreadsheet to answer the next three questions:

1. What resources are currently required to complete this program element?

    In addition to the resources in the spreadsheet (human resources), a vessel capable of towing an otter trawl in 20+ m of water is required.

2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis
    - Web page maintenance
    - Reporting & writing
    - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
    - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**		
	Age-0	**Age-1**	**Comments**
Commercial and Sport Species			
Bay shrimp	Excellent-Fair	Excellent-Good	Varies by species, as some rear upstream of the study area while others migrate to the ocean as adults.
Forage Species			
Bay shrimp	as above	as above	see above comment
Invasive Species			
Exopalaemon modestus	fair	good	Assume most rear above our study area or in very shallow habitats.
Palaemon macrodactylus	fair	good	Assume most rear in very shallow habitats, some upstream of study area.
Habitats (or assemblages?)			
Nearshore (≤ 2 m)			Most of our tows > 3 m water
Vegetated			
Nearshore, other structure			
Nearshore open water			
Tidal Marsh			
Floodplain			
Pelagic – open water (> 2 m)			NA for shrimp
Demersal or epibenthic (> 2 m)			
Mud and silt	Excellent	Excellent	
Eelgrass	NA	NA	We do not trawl in these habitats, although all are >2 m in depth.
Rocky subtidal	NA	NA	
Sand flats	NA	NA	
Benthic (infauna)			

2. Over the sampling period of record what months or years of data are missing?

Please see the attached summary tables for the Bay Study Fish Questionnaire.

How do these missing data affect data analysis or the information that can be derived?

When months are not sampled, especially consecutive months such as September to January 1989-1990 and November to January in the early and mid-1990s, we have not been able to calculate adult shrimp abundance indices. We have also under sampled juvenile shrimp when there was a strong fall cohort.

This has happened for both *Crangon nigricauda* and *C. nigromaculata*, especially towards the end of the 1987-1992 drought, when they were more common than *C. franciscorum* in the estuary.

3. What proportion of monitoring program element field effort occurs in each IEP region?

South and Central bays – 20/52 = 0.38

San Pablo Bay – 10/52 = 0.19

Suisun Bay – 10/52 = 0.19

West Delta – 10/52 = 0.19

North Delta – 2/52 = 0.04

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift.

The study area for the open water survey was extended south in 1988 with the addition of station #140 in South Bay, just south of the Dumbarton Bridge. It was also extended upstream in 1990 and 1994 with the addition of stations in the Sacramento and San Joaquin rivers (see station maps). These extensions were designed to better sample the brackish water portions of the estuary and continue to date.

What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution, or abundance?

With these extensions in sampling area, we better sample the brackish water portions of the estuary in all years. Prior to the addition of station #140, we did not sample the area of South Bay inhabited by estuary-dependent species, such as *C. franciscorum*, in most years. This was very apparent during the 1987-1992 drought, when the majority of the Bay shrimp trawlers moved from San Pablo Bay to south of the Dumbarton Bridge, where Bay shrimp were concentrated; note that they cannot trawl above the Mothball Fleet, so moving upstream of Suisun Bay with the shrimp during the drought was not an option.

Prior to the addition of the upstream stations in 1990 and 1994, a large portion of juvenile *C. franciscorum* were upstream of our study area in summer and fall of low outflow years. We also better sample the 2 introduced species, *P. macrodactylus* and *E. modestus* with the addition of these stations, although we *E. modestus* is distributed well upstream of our study area.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or *synergistically adding value*.

This program element is one of the few remaining components of the original Delta Outflow/San Francisco Bay Study. The field effort and fish, crab, and jellyfish monitoring is Program Element 2004-011, “Estuarine and Marine Fish Abundance and Distribution”.

Because the Bay Study does not sample upstream of the western delta, shrimp data from the Fall MWT has occasionally been analyzed. Also, shrimp data from UCD's Suisun Marsh survey and the USFWS beach seine is requested annually, as the introduced species *E. modestus* is common at some of their stations. We also have used shrimp data and collections from the TNS and Yolo Bypass studies.

6. Please identify and briefly describe any opportunities for additional program element integration.

Historically, the Fish Monitoring surveys have been reticent to count or speciate invertebrates. With the introduction and rapid expansion of *E. modestus*, we have discussed a request that other IEP studies speciate and enumerate shrimp by 2 categories, non-ovigerous and ovigerous. This is relatively simple in the field, but more time consuming than total counts of *Crangon spp*., *P. macrodactylus*, and *E. modestus*, which is done by Fall MWT and UCD's Suisun Marsh survey. However, USFWS only counts *E. modestus*; I have not recently discussed changes with them.

How can the IEP monitoring programs work together to better sample some taxa and species, especially new introductions that have much broader distributions in the estuary than the trawl programs?

This was an issue with the Chinese mitten crab and *E. modestus*, with no apparent long-term solution. Project leaders can only request the addition of a new taxa to another field program. This approach can work, but possibly only short-term. The addition of jellyfish to several IEP surveys a few years ago is an example of this – the PIs agree to add counts of jellyfish for their respective surveys through the IEP Monitoring PWT, but when several project managers left, this addition was challenged and in some instances, dropped.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to *continually* assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables.

   No new variables are being considered for shrimp at this time. With the current revision of the laboratory processing, some variables, such as presence of stomach contents and egg stage of ovigerous females, may be dropped.

   b. Field or analytical studies to assess current and new sampling methods.

   Field QAQC program and reports and tow comparison between the *RV Longfin* and *New Alosa* in 2003.

   c. Studies to evaluate current and new analytical methods.

   Alternative index calculation, such as grouping stations by channel and shoal prior to area or volume weighting and including the stations added to the survey in 1988, 1990, and 1994 in the indices.

d. Evaluation of new technologies or new gear types.

See Bay Study Fish Questionnaire

e. Review and improve monitoring program element processes.

I assume this means sample processing? If so, the laboratory shrimp processing methods are being reviewed and revised in 2004. The primary goal is to save processing time, as shrimp sample processing is now a year behind due to the hiring freeze. We want to maintain the data continuity for key variables, estimate total counts with a known accuracy and precision, and capture cohort and sex information "as needed" for analyses. This review is should be completed by May 31, 2004.

f. Using historical information to change the program element design.

g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   Not on BDAT, but catch data through 1994 on the IEP web page (8,000 record limit text files). The Bay Study data is stored in dBASE and Access files at the CDFG Stockton office.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   Approximately 3 months after and entire year's data is processed; i.e., the 2002 shrimp samples were completed in January 2004 and the data was available to the public in April 2004.

4. Are there web-based data presentations of the program data?

   Nothing like the bubble plots. We have intended for 4+ years to update our abundance indices and life history information on the CVBDB web page, but it is a low priority for CDFG.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. *Please focus on listing reports, papers, etc. that directly report program element results or make direct use of program element data.*

5. List the papers (refereed journal articles) produced by staff assigned to the specific monitoring program element.

   Hatfield, S.E. 1985. Seasonal and interannual variation in distribution and population abundance of the shrimp Crangon franciscorum in San Francisco Bay. Hydrobiologia 129:199-210.

6. List the papers that were co-authored by program element staff and others outside the program element.

   Stewart, A.R., S.N. Luoma, C.E. Schlekat, M. A. Doblin, and K.A. Hieb. 2004. Food web pathway determines how selenium affects aquatic ecosystems: A San Francisco Bay case study. Environmental Science and Technology, in press.

7. List the papers produced by scientists outside the program element.

   Jassby, A.D., W. J. Kimmerer, S.G. Monismith, C. Armor, J.E. Cloern, T.M. Powell, J.R. Schubel, and T.J. Vendlinski. 1995. Isohaline position as a habitat indicator for estuarine populations. Ecological Applications 5:272-289.

   Kimmerer, W.J. 2002. Effects of freshwater flow on abundance of estuarine organisms: physical effects or trophic linkages? Marine Ecology Progress Series 243:39-55.

   Kimmerer, W.J. 2002. Physical, biological, and management responses to variable freshwater flow into the San Francisco estuary. Estuaries.25:1275-1290.

   Wahle, R.A. 1985. The feeding ecology of *Crangon franciscorum* and *Crangon nigricauda* in San Francisco Bay, California. Journal of Crustacean Biology 5(2):311-326.

8. List the IEP technical reports produced by specific program staff.

   Herrgesell, P., R. Schaffter, and C. Larsen. 1983. Effects of Freshwater Outflow on San Francisco Bay Biological Resources. IEP Technical Report 7, 86 pp.

   Orsi, J., editor. 1999. Report on the 1980-1995 fish, shrimp, and crab sampling in the San Francisco Estuary, California. IEP Technical Report 63, 503 pp.

9. List the IEP technical reports where staff was coauthor with others outside the program.

   Estuarine Ecology Team. 1997. An Assessment of the Likely Mechanisms Underlying the "Fish-X2" Relationships. IEP Technical Report 52, 24 pp.

10. List the IEP technical reports produced by people other than specific program staff.

11. List the IEP Newsletter Articles produced by specific program element staff.

    Hieb, K. 1997. 1996 Status and Trends, Bay Species. IEP Newsletter Spring 1997, 10(2): 36-37.

    Hieb, K. 1998. 1997 Status and Trends, Bay Species. IEP Newsletter Spring 1998, 11(2): 46-49.

    Hieb, K. 1999. 1998 Status and Trends, San Francisco Bay Species Abundance. IEP Newsletter Spring 1999, 12(2): 30-34.

    Hieb, K. 2000. 1999 Status and Trends, San Francisco Bay Species. IEP Newsletter Spring 2000, 13(2): 22-27.

    Hieb, K. 2001. 2000 Status and Trends, San Francisco Bay Species. IEP Newsletter Spring 2001, 14(2): 21-27.

    Hieb, K. 2002. 2001 Status and Trends, San Francisco Bay Species Abundance and Distribution. IEP Newsletter Spring 2002, 15(2): 15-20.

Hieb, K., T. Greiner, and S. Slater. 2003. San Francisco Bay Species 2002 Status and Trends. IEP Newsletter Spring 2003, 16(2): 14-22.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

California Department of Fish and Game (CDFG). 1987. Delta outflow effects on the abundance and distribution of San Francisco Bay fish and invertebrates, 1980-1985.Exhibit 60, entered by the California Department of Fish and Game for the State Water Resources Control Board 1987 Water Quality/Water Rights Proceeding on the San Francisco Bay/Sacramento-San Joaquin Delta. 345 pp.

CDFG. 1987. Summary of delta outflow effects on San Francisco Bay fish and invertebrates. Exhibit 59, entered by the California Department of Fish and Game for the State Water Resources Control Board 1987 Water Quality/Water Rights Proceeding on the San Francisco Bay/Sacramento-San Joaquin Delta. 37 pp.

CDFG. 1992. Estuary dependent species. Entered by the California Department of Fish and Game for the State Water Resources Control Board 1992 Water Quality/Water Rights Proceedings on the San Francisco Bay/Sacramento-San Joaquin Delta. WRINT-DFG Exhibit 6, 97 pp.

CDFG. 2001 . California's Living Marine Resources: A Status Report. W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 591 pp. *CDFG Bay Study staff contributed to several sections and Bay Study data and information was used for several other sections.*

Emmett, R.L., S.A. Hinton, S.L. Stone, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries. Crangon. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. ELMR Report 8.

Hansen, S.R. 2003. Evaluation of the potential for salinity impacts on Bay shrimp associated with circulation of saline pond water during the initial stewardship period. Prepared for USFWS and CDFG. 101 pp.

Hanson Environmental, Inc. 2003. Assessment and evaluation of the effects of sand mining on the aquatic habitat and fishery populations of Central San Francisco Bay and the Sacramento-San Joaquin Estuary. Prepared for: Hanson Aggregates Mid-Pacific, RMC Pacific Materials, and Jerico Products/Morris Tug and Barge. December 2003 draft report.

Herbold, B., A.D. Jassby, and P.B. Moyle. 1992. Status and trends of aquatic resources of the San Francisco Bay Estuary. U. S. Environmental Protection Agency San Francisco Estuary Project. 257 pp.

Hieb, K. and R. Baxter. 1993. Delta Outflow/San Francisco Bay Study. In:1991 Annual Report, Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, pp 101-116. *Includes a summary of freshwater outflow needs for Caridean shrimp, longfin smelt, and starry flounder.*

Hieb, K. and R. Baxter. 1994. Delta Outflow/San Francisco Bay Study. In: 1992 Annual Report, Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, pp 95-106. *Includes results of the 1992 Tucker trawl surveys and the 1992 shallow water nursery habitats sampling.*

Hieb, K., R. Baxter, and K. Fleming. 1997. Delta Outflow/San Francisco Bay Study. In: 1993 Annual Report, Interagency Ecological Program for the Sacramento-San Joaquin Estuary, pp 38-49.

Interagency Ecological Study Program (IESP). 1981. Delta Outflow/San Francisco Bay Study. In: Tenth Annual Report (1980). Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, pp 31-35.

IESP. 1982. Delta Outflow/San Francisco Bay Study. In: Eleventh Annual Report (1981). Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, pp 35-41.

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San Francisco Estuary Project (SFEP). 1998. State of the Estuary, 1992-1997, San Francisco Bay Sacramento-San Joaquin River Delta Estuary. *Several contributions to Chapter 2, Fish & the Aquatic Ecosystem.*

SFEP. 2000. State of the Estuary 2000. Restoration Primer, San Francisco Bay Sacramento-San Joaquin River Delta Estuary. *Several contributions to "Vital Statistics", Fish and Invasive Species sections.*

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Wahle, R.A. 1982. The feeding ecology *of Crangon franciscorum* and *Crangon nigricauda* in San Pablo Bay. MA Thesis, San Francisco State University, San Francisco, California, 78 pp.

13. What products are planned for the next three years? Consider:

a. Papers (refereed journal articles)

Introduction of the shrimp *Exopalaemon modestus* to the San Francisco Estuary, in prep for CDFG Quarterly, T. Brown and K. Hieb.

Interannual variability in abundance of fish and crustaceans in the San Francisco Estuary. D. Holmgren, K. Hieb, and W. Kimmerer. *Still* in prep for Estuaries.

A paper on shrimp population dynamics in San Francisco Estuary.

Plan to include shrimp in a major, estuary-wide biomass analyses, to be completed with other long-term monitoring staff. Possibly a journal article.

b. IEP technical reports

Length-weight relationships for common forage fishes and shrimp of SF Estuary, Gartz, Hieb, and others.

c. IEP newsletter articles

2003 Status and Trends, Bay Species (Spring 2004)

Biomass and numeric forage indices

2004 Status and Trends, Bay Species (Spring 2005)

2005 Status and Trends, Bay Species (Spring 2006)

d. IEP, CALFED workshop, or SOE presentations

Since we have averaged 1 presentation per each of these workshops, I would predict 3 over the next 3 years. In the past some of these types of presentations have included results from the shrimp program element.

e. AFS, ERF or other professional meeting presentations

None planned for 2004, although in-state presentations are possible in 2005 or 2006.

Out-of-state travel, such as to ERF, will likely not be approved by DFG.

f. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible*. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.*

Customer	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies+				
CDFG	√			a, b, i , k
USGS		√		a, b, i
SWRCB			√	
CALFED Program Agencies				
CDFG	√			a, b
Commercial Fishery Management Entities				
CDFG		√		a, b, d, k (closed area)
Regulatory Agencies				
NOAA Fisheries	√			a, i, j, k (EFH)
CDFG	√			a, i, j (review EIS)
RWQCB		√		a, i
Outside government, academic, or consultant entities				
Bay Institute	√			a, b (for indicators)
SFEI	√			a, b, i (for RMP contaminant models)
San Francisco State Univ*	√			a, b
Hanson Inc.	√			a, b, i, j (sand mining, SFO, LTMS, power plant ops)
Tenera Environmental	√			a, j, i (power plant ops)
URS Greiner Woodward Clyde and *many* subconsultants	√			a, b, i, j. **Very** frequent requests when SFO expansion was planned

+ Requests from CDFG and USGS often from employees of these agencies working outside of IEP.
*Includes requests for data and information by graduate students and professors at these universities for theses and other studies, such as grant funded research. I've listed requests within the past 3 years.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:
    a. Long-term abundance and distribution trends
    b. Life history information
    c. Population status
    d. Harvest rates
    e. Recruitment rates
    f. Abundance and distribution information for water operations/EWA actions
    g. Recovery criteria
    h. Species status reviews
    i. Site-specific information
    j. Project impact assessment
    k. Other
3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

    As for the fish and crab data, customers are generally very satisfied with the quality of the monitoring data, but often overwhelmed by the quantity of data. The year lag in shrimp processing and resultant unavailability of recent data has been an issue for several users.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect?

    The most valuable aspect of this element is the duration and consistency of the sampling, combined with the inclusion of species other than the usual IEP targets. We are just beginning to understand the sources of long-term variations in abundance, such as Pacific Decadal Oscillation. We have observed the first combination of some events, such as above normal outflow and cool ocean temperatures, in the past several years. For those estuary-dependent species which reproduce in the ocean, will the abundance-outflow relationship change in a cool ocean regime?

    The most challenging aspect is to maintain the above consistency of sampling, especially for species that do not have traditional human-assigned values.

2. Please provide any comments you may have on ways to improve the monitoring program element.

    To improve our efficiency in the office:

    a. Complete transition from dBASE to Access, with programming assistance from DWR (Summer 2004?).

b. Bay Study data available to the public on the IEP server. To increase our efficiency, the data base must be easy to use, produce reproducible results, and have adequate metadata such that clients do not need to contact CDFG biologists for routine data requests.

c. Update abundance indices for commonly collected SF Bay species annually on the CVBDB web page, including a graphic and table. Also, review and update species life history summaries and distributions, add important references in a literature link (Summer 2004).

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

Sample processing changes for 2004 (2003 samples) have been discussed in III.1.e. (above). Also have discussed possible changes to CDFG web pages, above Additionally:

a. Change the method we calculate abundance indices, possibly stratify by channel and shoal or post-stratifying by salinity. Goal is abundance indices with confidence intervals, not population estimates.

b. Recalculate the area and volume for each embayment by channel and shoal, include study area upstream of the confluence of the Sacramento-San Joaquin rivers.

4. Do you have any ideas for other useful program element products?

a. IEP Technical Report 63 available as a PDF file on the web (by chapter), as it is almost out-of-print (<6 copies remaining).

b. More useful web products:

i. On line id chart for *E. modestus*, as this species is not in any published keys for the estuary.

ii. Bubble plots or the like for selected Bay species.

iii. Species lists by embayment and entire study area (common request).

c. Summarize the program element's special studies, including objectives, methods, and results. Many of these studies remain unpublished, even in the gray literature.

5. Please provide any other comments you may have.

Due to the study design, abundance indices are probably not sensitive to small changes in the population size; i.e. if a project reduces a population by 10-20%, the indices will not detect this. Since most project impacts are probably in this range, how can we better detect such changes? Also, the study design does not allow us to determine growth or survival rates, so a large part of the "why" question will never be answered.

B 3) Fall Midwater Trawl Survey (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Fall Midwater Trawl Survey (FMWT), program element # 2004-003.

2. Please provide the name(s) of the person (people) completing this questionnaire.

   R.G. Gartz, Kelly Souza, Randy Baxter

3. Please list the dates you started and finished this questionnaire.

   START DATE: 03/05/2004; END DATE: 03/17/2004

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   California Department of Fish and Game, Central Valley Bay-Delta Branch.

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   No.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   The FMWT's primary products are annual indices of abundance of striped bass (*Morone saxatilis*, age-0), delta smelt (*Hypomesus transpacificus,* all ages combined), longfin smelt (*Spirinchus thaleichthys*, all ages combined), splittail (*Pogonichthys macrolepidotus*,), and American shad (*Alosa sapidissima*, age-0) and are displayed on web pages (http://www.delta.dfg.ca.gov/data/mwt/Indices/index.asp; http://www.delta.dfg.ca.gov/data/mwt/charts.asp). The FMWT contributes to the Sport Fish Restoration Act (SFRA) reports on an annual basis, and describes the current annual index of striped bass and other species in the annual status and trends addition of the IEP Newsletter. FMWT project staff maintains a local data base with fish catch, fish size, and environmental data. This database is also uploaded to the IEP database (BDAT). FMWT data is used in the delta smelt recovery plan and was part of the splittail recovery plan.

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

   The FMWT most directly addresses goal 1, providing information on the status and trends of the ecological resources of the San Francisco Estuary. The long-running data set enables us to detect trends in environmental variables, distribution, and abundance of special status species, sport fish species, and forage fish species (objectives 1a, 1b, and 1c), as well as gain an understanding in how environmental factors or water management operations affect these trends (goal 2, objective 2).

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   The FMWT is part of the ongoing research into striped bass population dynamics.

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   See Figure 1 for a station map and Table 1 for geographic coordinates.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    The FMWT is a systematic survey based around the life history and distribution of age-0 striped bass and is designed to track them in their first fall of life. The survey is designed to sample enough of the Estuary that encompasses the majority of the current year-class of striped bass in order to calculate an index of abundance that is representative of the size of the year class. The majority of the sampling effort has been concentrated in the following IEP Monitoring Regions: San Pablo Bay & Napa River, Suisun Bay & Marsh, and the Central & West Delta. When FMWT stations were selected in 1967, one station was supposed to represent 10,000 af of water in the area upstream of the Martinez Bridge and 100,000 af of water below the Martinez Bridge. Later, stations were added/subtracted so each station represented roughly 20,000 af, however, this is not a “hard and fast” rule. The FMWT most consistently samples from September to December and uses data from this time period to calculate indices of abundance.

    The systematic nature of the FMWT has advantages and disadvantages. The indexing period has been very consistently sampled (Figure 2) as have the San Pablo Bay & Napa River, Suisun Bay & Marsh, and delta regions. The FMWT is effective at capturing age-0 and some age-1 fishes present September-December. This allows distribution and abundance to be compared from year to year and staff to detect and evaluate trends over time. The disadvantages are that the FMWT samples only the upper estuary and the current fixed sites, thus may not sample a certain specie’s range, or the specie’s range may shift across the limits

of sampling in different environmental conditions; fixed sites may introduce a sampling bias and limit inferences that can be made.

The number of sampling sites occupied monthly has been reduced in Suisun and San Pablo bays since the late 1960s and early 1970s and new stations added and sampled for delta smelt in the early 1990s (Figure 3).

11. What are the sampling frequency and annual sampling period, and why were they chosen?

The FMWT samples each station once a month from September through December. This time period corresponds to first fall of juvenile striped bass and is designed to track the same year class of fish as the midsummer TowNet Survey. This is the last period of time when towed gear is effective for young striped bass.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

The FMWT has nearly always sampled from September through December (Figure 2) with the exception of 1969 and 1976, the indexing period. Sampling has occurred outside the indexing period: from 1967-1978 and from 1991-2001 (Figure 2).

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?

The FMWT requires a vessel that has 2 winches and adequate hydraulics to deploy and retrieve the net, and adequate deck area to handle the net and process fishes. The vessel must also be seaworthy to negotiate areas such as San Pablo Bay in inclement weather. The vessel must also be able to carry 1-2 spare nets and other scientific gear such as measuring boards, sample jars/jugs, etc. The vessel must be able to accommodate the survey crew which consists of 3 people: boat operator, biologist/technician, and a deckhand.

Laboratory facilities are required for the processing of specimens that are returned; usually in formalin, a toxic preservative that does not require refrigeration. Specimens that are processed include fish that can not be identified to species in the field and specimens that are requested for various studies. Laboratory facilities entail significant support in terms of equipment (microscopes, sinks, fume hoods, etc), proper waste disposal (for toxic preservatives such formalin and alcohol), and adequate storage for preservatives, etc.

Other items necessary for the FMWT are (but not limited to): storage space for nets, equipment and data sheets (for archival purposes), office space and supplies for the FMWT staff, berthing for vessels used by the FMWT, fuel for vessels and vehicles used by the FMWT.

2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.

   See spreadsheet 'Fish Monitoring Budget and Resources'.

3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:

   See spreadsheet 'Fish Monitoring Budget and Resources'.

II Program Element strengths and weaknesses in fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

	Life Stage				
Group/Species	**Larvae/Fry**	**Smolt/ age -0**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	poor	fair	poor	poor	
Spring-run Chinook	poor	poor	poor	poor	
CV steelhead	poor	poor	poor	poor	
Coastal steelhead	poor	poor	poor	poor	
Delta smelt	poor	fair	fair	N/A	
Splittail	poor	fair	poor	poor	
Longfin smelt	poor	good	good	poor	
Green sturgeon	poor	poor	poor	poor	
Starry flounder	poor	poor	poor	poor	
Sport Fishes					
Fall-run Chinook	poor	poor	poor	poor	Timing off
Striped bass	poor	poor	good	poor	
White sturgeon	poor	poor	poor	poor	
Catfish	poor	poor	poor	poor	
American shad	poor	good	good	poor	
Largemouth bass	poor	poor	poor	poor	
Surfperch	poor	poor	poor	poor	
Habitats					
Nearshore (< 2 m depth)	poor	poor	poor	poor	
Nearshore vegetated	poor	poor	poor	poor	
Nearshore, other structures	poor	poor	poor	poor	
Nearshore open water	Good	Good	Good	Good	
Pelagic	Good	Good	Good	Good	
Marsh	N/A	N/A	N/A	N/A	
Floodplain	N/A	N/A	N/A	N/A	
Benthic	poor	poor	poor	poor	
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions					Able to detect invasion of *E. modestus*

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

No sampling was done in 1974 or 1979. November in 1969 was significantly under-sampled; there is no way to reconstruct events during these years. The months of September and December were not sampled in 1976. Indices of abundance have been estimated for 1969 and 1976; however, this practice is not recommended.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

Proportion of current effort is as follows: As of 2003, a total of 116 stations are sampled per month. Out of these 116 stations, 100 are sampled for the purpose of writing indices of abundance (Index Stations), and the remaining 16 are sampled for the purpose of gaining spatial distributional information on delta smelt (Delta Smelt Stations).

	Index Stations		Delta Smelt Stations		Totals	
IEP Region	# of Stations	Percentage of Effort	# of Stations	Percentage of Effort	# of Stations	Percentage of Effort
San Pablo Bay and Napa River	24	21	1	1	25	22
Suisun Bay and Marsh	41	35	0	0	41	35
Central and West Delta	33	28	0	0	33	28
North Delta	0	0	10	9	10	9
East Delta	0	0	5	4	5	4
South Delta	2	2	0	0	2	2
Totals	100	86	16	14	116	100

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution, or abundance?

The majority of sampling effort occurs within a group of core stations known as the "index block". The index block contains 117 stations (there are a total of 175 stations in the FMWT database) with the majority located in the following IEP Monitoring Regions: San Pablo Bay and Napa River, Suisun Bay & Marsh, and the Central & West Delta (Figure 1). The number of stations sampled in the index block has varied over time (Figure 3) and currently the FMWT samples 100 stations within the index block. Stations within index block have been sampled every year since 1967 with the exception of 1974 and 1979 when the FMWT had no field activities.

The FMWT has sampled and continues to sample in other IEP Monitoring Regions. The FMWT sampled in the Central & South San Francisco Bay Region from 1967-1978. The FMWT ceased sampling in the Central & South San Francisco Bay Region in 1980 and responsibility for monitoring it was transferred to the San Francisco Bay Study. The FMWT did not sample outside of the index block from 1980-1990 (no sampling was conducted during 1974 or 1979). The FMWT sampled in the North Delta region from 1990 to the present, namely in the Mokelumne and Sacramento Rivers to increase the spatial coverage for delta smelt (Gartz 2000). However, sampling effort outside the index block is only a fraction of the sampling that occurs in the index block (Figure 3).

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

The FMWT is highly integrated with the Townet Survey (TNS) as the FMWT follows the TNS to continue the monitoring of age-0 striped bass as they grow and a different gear is need to catch them effectively. Both surveys share equipment laboratory space, field staff, lab staff, vehicles, and boats. Data from the FMWT and TNS are highly correlated and used in assessing the recovery of delta smelt. The FMWT provides specimens for the DFG Striped Bass Hatchery Evaluation Program, CDFG’s Length-Weight Study and various other entities. Previously, the FMWT has provided a platform for researchers from UC Davis to gather specimens and tissue samples from delta smelt.

6. Please identify and briefly describe any opportunities for additional program element integration.

Currently, the FMWT is collecting specimens for the DFG Length-Weight Study and FMWT staff is participating in the calculation and evaluation of biomass indices. Striped bass Indices from the FMWT have been compared with indices from the San Francisco Bay Study.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

The FMWT is investigating reporting biomass indices of selected species in addition to the current indices of abundance. Biomass indices take into account the non-linear nature of growth that traditional indices cannot. The possibility of using condition indices (i.e., how “well” fish are) is also being investigated.

b. Field or analytical studies to assess current and new sampling methods

The FMWT is investigating the possibility of using sonar and other devices to determine the actual depth that the net is fishing and to develop a useful quantitative measure or set of measures (e.g., cable angle and boat speed) that would indicate the actual depth that the net is fishing. Other aspects of this investigation would be determining the actual area of the mouth of the net and possibly an insight into the "patchiness" of the Estuary's pelagic fishes on the scale of 10-100's or meters.

c. Analytical studies to evaluate current and new analytical methods

The FMWT will investigate if biomass indices are better explain trends in abundance as opposed to traditional indices. The possibility of using condition indices is also being investigated.

d. Evaluation of new technologies or new gear types

The FMWT is investigating the possibility of using sonar and time-depth recording devices to determine the actual depth that the net is fishing and to develop a useful quantitative measure or set of measures that would indicate the actual depth that the net is fishing. Other aspects of this investigation would be determining the actual area of the mouth of the net and possibly an insight into the "patchiness" of the Estuary on the scale of 10-100's or meters.

e. Review and improve monitoring program element processes

No investigations are planned to alter the sampling protocol or the current station schedule. A written description of the FMWT sampling methods and fish data is in preparation and is expected to be ready for IEP Management Team review in the summer of 2004.

f. Using historical information to change the program element design

No investigations are planned in this regard. However, results of the Longfin Smelt post-doc analyses may be used to evaluate, support or modify project design.

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   Data has been exported to the BDAT and is also available by contacting project staff at 4001 N. Wilson Way, Stockton, CA 95205.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   All years in which sampling occurred have been exported to the BDAT.

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   Collection of field data ends in mid December and is exported to the BDAT and posted on the CVBDB web page by early January of the following year.

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots,"

   Yes, on the CVBDB web page there are indices of relative abundance available in tabular and graphic format.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   Foss, S.F. and L.W. Miller. 2004. Growth and growth rate variability of larval striped bass in the San Francisco Estuary, California. Pages 203-217 in Early Life Histories of Fishes in the San Francisco Estuary and Watershed, F Feyrer, L.R. Brown, R.L. Brown, and J.J Orsi, eds. American Fisheries Society, Bethesda, MD, 295 pages.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

   Arnold, J.D. and H.S. Yue. 1997. Prevalence, relative abundance, and mean intensity of plerocercoids of *Proteocephalus spp.* In young striped bass in the Sacramento-San Joaquin Estuary. California Fish and Game, Volume 83, Number 3, pages 105-117.

   Arnold, J.D. and G.L. Hendrickson. 1997. Bacterial shell disease in crangoniod shrimp. California Fish and Game, Volume 83, Number 3, pages 118-127.

   Gartz, R.G., L.W. Miller, R.W. Fujimura, and P.E. Smith. 1999. Measurement of larval striped bass (*Morone saxatilis*) net avoidance using evasion radius estimation to improve estimates of abundance and mortality. Journal of Plankton Research, Volume 21, Number 3, pages 561-580.

   Kimmerer, W.J., J.H. Cowan, Jr., L.W. Miller, and K.A. Rose. 2000. Analysis of an estuarine striped bass (*Morone saxatilis*) population: influence of density-dependent mortality between metamorphosis and recruitment. Canadian Journal of Fisheries and Aquatic Sciences, Volume 57, pages 478-486.

   Kimmerer, W.J., J.H. Cowan, Jr., L.W. Miller, and K.A. Rose. 2001. Analysis of an estuarine striped bass population: effects of environmental conditions during early life. Estuaries, Volume 24, Number 4, pages 557-575.

   Moyle, P.B., B Herbold, D.E. Stevens, and L.W. Miller. 1992. Life history of delta smelt in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society, Volume 121, pages 67-77.

   Stevens, D.E., D.W. Kohlhorst, L.W. Miller, and D.W. Kelly. 1985. The decline of striped bass in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society, Volume 114, pages 12-30.

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

   Jassby, A.D., W.J. Kimmerer, S.G. Monissmith, C. Armor, J.E. Cohne, T.M. Powell, J.R. Schubel, and T.J. Vendlinski. 1995. Isohaline position as a habitat indicator for estuarine populations. Ecological Applications, Volume 5, Number 1, pages 272-289.

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.

   Interagency Ecological Program. 1994. 1992 annual report, interagency ecological studies program for the Sacramento-San Joaquin Estuary, P.L. Herrgesell, complier.

   Interagency Ecological Program. 1993. 1991 annual report, interagency ecological studies program for the Sacramento-San Joaquin Estuary, P.L. Herrgesell, complier.

   Interagency Ecological Program. 1991. 1990 annual report, interagency ecological studies program for the Sacramento-San Joaquin Estuary.

   Interagency Ecological Program. 1986. 1984 annual report or the interagency ecological studies program for the Sacramento-San Joaquin Estuary, R.L, complier.

9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.

   None.

10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

    None.

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

    Arnold, J.D. and L.W. Miller. 1997. American shad. IEP Newsletter, Volume 10, Issue 2, page 42.

    Arnold, J.D., S.F. Foss, and L.W. Miller. 1997. Young striped bass. IEP Newsletter, Volume 10, Issue 2, pages 43-44.

    Bryant, M. and K. Souza. 2002. Summer townet survey and fall midwater trawl survey. IEP Newsletter, Volume 16, Issue 2, pages 37-39.

    Fleming, K. 2002. Fall midwater trawl and the delta smelt recovery criteria. IEP Newsletter, Vol. 16, Number 1, pages 5-6.

    Foss, S. and L. Miller. 2001. Growth of larval striped bass in the San Francisco Estuary. IEP Newsletter, Volume 14, Number 4, pages 46-54

    Foss, S.F. and L.W. Miller. 1998. American shad. IEP Newsletter, Volume 11, Issue 2, page 44.

Foss, S.F. and L.W. Miller. 1998. Young striped bass. IEP Newsletter, Volume 11, Issue 2, pages 43-44.

Foss, S.F. and L.W. Miller. 1996. Summer tow-net survey: 1995 young of the year striped bass index. IEP Newsletter, Volume 9, Issue 3, pages 11-15.

Gartz, R. 2001. Fall midwater survey. IEP Newsletter, Volume 14, Number 1, pages 8-9.

Gartz, R. 2000. Monitoring the distribution and migration of delta smelt (*Hypomesus transpacificus*): are additional midwater trawl stations useful? IEP Newsletter, Volume 13, Number 3, pages 31-36.

Gartz, R. 2000. Spring midwater trawl survey, midsummer townet survey, and fall midwater trawl survey. IEP Newsletter, Volume 13, Number 3, page 7.

Gartz, R. 2000. Young-of-the-year striped bass, American shad, and threadfin shad abundance and distribution. IEP Newsletter, Volume 13, Number 2, pages 38-41.

Gartz, R. 2000. 1999 fall midwater trawl survey. IEP Newsletter, Volume 13, Number 1, pages 5-6.

Gartz, R. 1999. Fall midwater trawl survey. IEP Newsletter, Volume 12, Number 4, page 4.

Gartz, R. 1999. Density dependent growth and diet changes in young-of-the-year striped bass (*Morone saxatilis*) in the Sacramento-San Joaquin Delta. IEP Newsletter, Volume 12, Number 1 pages 22-24.

Gartz, R., S. Foss, and L. Miller. 1999. Striped bass and American shad abundance. IEP Newletter, Volume 12, Number 2, pages 42-44.

Miller, L.W. 2000. The tow-net survey index for delta smelt revisited. IEP Newsletter, Volume 13, Number 1, pages 37-44.

Miller, L. 1998. Fall midwater trawl survey results. IEP Newsletter, Volume 11, Number 1, pages 4-5.

Miller, L. 1997. Fall midwater trawl survey. IEP Newsletter, Volume 10, Number 4, page 4.

Miller, L. 1996. Low striped bass, high American shad fall midwater trawl indices. IEP Newsletter, Volume 9, Number 1, page 3.

Orsi, J. 1996. Young striped bass. IEP Newsletter, Volume 9, Issue 1, page 36.

Miller, L.W. and S.F. Foss. 1996. Low striped bass index for 1996. IEP Newsletter, Volume 9, Issue 4, pages 23-26.

Souza, K. and M. Bryant. 2002. Townet survey and fall midwater trawl survey. IEP Newsletter, Volume 15, Number 2, pages 21-24.

Souza, K. 2001. 2000 midwater trawl survey. IEP Newsletter, Volume 14, Number 2, pages 27-29.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written

contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

Department of Fish and Game. 1987. Factors affecting striped bass abundance in the Sacramento-San Joaquin River system. Exhibit 25, entered by the California Department of Fish and Game for the State Water Resources Control 1987 Water Quality/Water Rights Proceeding on the San Francisco Bay and Sacramento-San Joaquin Delta. Interagency Ecological Program Technical Report 20.

In house workshop on striped bass population dynamics – Fall 2003

Summary of Interagency Ecological Program/COMPECH Striped Bass Workshop, Stockton, CA., August 10-11, 1998.

Posters:

Gartz, R. 2004. Use of cleithra and photo-documentation. Presented at the IEP Annual Workshop, 2004

Gartz, R. 2000. Year class modeling of striped bass (*Morone saxatilis*) in the Sacramento-San Joaquin Estuary using pseudo cohorts. Presented at CALFED 2000 and the IEP Annual Workshop, 2001.

13. What products are planned for the next three years? Consider:

    a. Papers (refereed journal articles)

An investigation of how the actual position and movement of age-0 striped bass (from larval stage to fall of first year of life) influences survival. This paper will utilize data from the Egg and Larval Survey (ELS), Townet Survey (TNS), FWMT, and egg and adult population estimates.

Condition indices of age-0 striped bass. This project will investigate the usefulness of condition indices in describing striped bass population dynamics. One of the particularly attractive aspects of condition indices is that they have the potential to address density dependent mortality. This project is only an investigation pilot project that will or will not recommend their use as the actual weight of the fish is needed and therefore fish would have to be weighed each year.

Biomass indices. A multi-authored technical report that will describe development of biomass indices for benthic and pelagic forage species, investigate patterns in forage composition and investigate if biomass indices can better explain trends in abundance, than traditional indices, when related to environ mental variables (such as delta outflow).

Depth of the midwater trawl net. This research is in the early planning stages, but our intention is to determine the actual depth of the midwater trawl net (net) while it is fishing using sonar and a time-depth measurement device.

Changes in the diet composition of age-0 striped bass collected from the FMWT survey. This paper will address whether or not shifts in feeding incidences have occurred and if striped bass are utilizing introduced zooplankton. Work is in progress and a draft date has been set for August 2004.

b. IEP technical reports

FMWT Summary Report. This is an extensive report dealing with the history, prevalent species, size of prevalent species, indices of abundance, and recommendations for researchers.

c. IEP newsletter articles

Articles will be submitted to the "Status and Trends" issue detailing FMWT activities for that year and articles will be submitted to the Winter Issue for "Quarterly Highlights".

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

General Notes: FMWT products (indices) are available on the internet. Therefore some "customers" may not be known. The most recent FMWT indices for selected species are published in the "Status and Trends" issue of the IEP Newsletter.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies CDFG striped bass investigations	√			a,b,
CDFD – delta smelt investigations		√		a,b,
CDFG longfin smelt investigations		√		a,b,
CDFG splittail investigations		√		a,b,g, h
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
Sport Fish Management Entities				
Sport Fish Restoration Act		√		a, c

Table continued on next page

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
Regulatory Agencies				
USFWS		√		a, c, g, h, j
CDFG		√		a, c, g, h, j
Outside government, academic, or consultant entities				
UC Davis John Muir Inst	.√			a, b (delta smelt)
UC Davis – longfin smelt post-doc	√			a, b
Jones & Stokes		√		
Hanson Environmental			√	
Bay Institute			√	
Entrix			√	

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:

   Frequent and moderate users primarily use FMWT data for: long-term abundance and distributions trends, life history information, population status, and recovery information for delta smelt.

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

   No complaints have been received concerning FMWT data.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   The FMWT most valuable assets are: its longevity and its temporal and spatial consistency. The most challenging aspect of the FMWT has been to maintain consistency in sampling. The only changes planned are to correct deviations that have occurred. The FMWT carries on monitoring of striped bass and delta smelt from the TNS in regards to their life history. The FMWT spatially and temporally partially intersects with the San Francisco Bay Study (SFBS) in the upper estuary and fall months, and the SFBS uses the same midwater trawl design and protocol as the FMWT. However, the FMWT samples more intensively and may more

accurately describe trends in distribution and abundance of selected pelagic fishes than the SFBS.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   An analysis of the actual depth of the net during tows and the micro distribution of fish ahead of and entering the net while it is fishing would be helpful in assessing current data. This would better help relate what catch in the FMWT database means in the environment.

   Depending upon the results from the condition indices analysis (see above), including weighing selected species on a routine basis may provide better insights into the ability of the pelagic environment to support juvenile fishes during their first year.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.
4. Do you have any ideas for other useful program element products?
5. Please provide any other comments you may have.

B 4) Summer Townet Survey (Townet Survey) (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Summer Townet Survey (TNS)

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Marade Bryant, R.G. Gartz, and Randy Baxter

3. Please list the dates you started and finished this questionnaire.

   March 3, 2004 to March 27, 2004

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   California Department of Fish and Game

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   No

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   The TNS maintains a database, cataloging data from 1959 to the present. TNS data are available on BDAT and from DFG Stockton. Products from the TNS include (but are not limited to): an annual SFRA report; annual indices of abundance for age-0 striped bass and abundance indices, by survey, determined for delta smelt (Status and Trends Newsletter); reports for State Water Resources Control Board documenting various flow effects on abundance and survival of age-0 striped bass; part of survival index used in X2 analyses. Delta smelt data from the TNS has been used on DAT calls.

7. Which of the goals and objectives are <u>most directly addressed</u> by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

   From its beginning in 1959, the TNS has had 2 objectives. They are to: 1) Determine if there is a relationship between spawning success of striped bass (as indicated by the abundance of age-0 bass) and recruitment to the fishery, and 2) Identify environmental factors affecting striped bass abundance. We are able to see trends from our data. As interest in delta smelt grew, the TNS began calculating abundance indices for them.

   Given the above, the TNS supports the following IEP Goals and Objectives:

   Goal 1, Objectives 1a, 1b; 1a) trends in TNS abundance indices for delta smelt and splittail form part of status reporting by DFG to USFWS; 1b) striped bass TNS abundance indices and their trends have been used in reporting to the State Water Resources Control Board (1978, 1992) and in peer reviewed literature (e.g., age-0 striped bass survival in X2 papers).

   Goal 2, Objectives 1, and 2a: 1) very similar to original goal of project; 2a) has been target of many analyses over time reported to the State Board.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   The TNS supports Sport Fish Restoration Activities in regards to tracking recruitment of age-0 striped bass.

   Townet data is part of the Delta Smelt Biological opinion for operation of Mallard and Rock slough water diversions.

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   See Figure 1 for station locations and Table 1 for coordinates and changes through time.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)

    The TNS is systematic in its monitoring. Stations were selected to represent a given volume of water (Chadwick 1964). Station locations are constant and sampled at regular, predetermined intervals, every two weeks. This system may miss some fish if they are in another part of the Estuary, but allows for distribution to be analyzed from year to year as the station locations are fixed.

The TNS focused on striped bass historically and terminated when striped bass surpassed a mean length of 38.1 mm, possibly missing late recruitment of other cohorts or other species. Beginning in 2003, the TNS conducted 6, every-other-week surveys (June-August) to standardize sampling and allow assessment of late striped bass recruitment and better census other, later-spawning species.

b. random

c. stratified (give number of sites per stratum, and if they were chosen in a random or systematic way)

d. rotating panel

e. other

11. What are the sampling frequency and annual sampling period, and why were they chosen?

Currently, the TNS samples 5 days every other week starting in early June through late-August. Each 5-day period of sampling is called a survey, and 6 surveys are completed each year (as of 2003, see item 12). This time frame was chosen to target juvenile striped bass at a mean length of 38.1-mm (FL) to set an annual index of abundance (Turner and Chadwick 1972). To calculate an index, sampling must occur prior to and after age-0 striped bass reach a mean length of 38.1 mm. This mean is usually reached in July, but has been reached as early as June 22 and as late as August 30.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

There have been some changes in scheduling for the TNS.

From 1959-2002, between 2 and 5 surveys were completed, depending on when the 38.1-mm index was set. The start date for any given year was based on striped bass size (roughly 1 inch at Antioch), generally occurring in June. The TNS would continue until the average size of striped bass exceeded 38.1 mm (FL). After that, no more surveys were conducted unless they were specifically requested. Surveys were conducted and scheduled to occur during or close to neap tides; regardless of weekends and holidays.

Starting in 2002, the TNS switched to Monday through Friday sampling due to increased boat traffic, as sampling on the weekends was deemed unsafe by the TNS staff.

Starting in 2003, the TNS standardize its start time to the first or second week in June and conducts 6 surveys regardless of mean size of striped bass in the catch.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?

    The TNS requires a vessel that has adequate hydraulics to deploy and retrieve the net, which weighs roughly 83 pounds (dry), and the adequate deck area to handle the net and process samples. The vessel must also be seaworthy enough to negotiate areas of the upper Estuary from eastern San Pablo Bay and the Carquinez Straits into the Delta. The vessel must also be able to carry 1-2 spare nets and other scientific gear such as measuring boards, sample jars/jugs, etc. The vessel must be able to accommodate the survey crew which consists of 3 people: boat operator, biologist/technician, and a deckhand.

    Laboratory facilities are also required for the processing of larval/juvenile specimens that are returned, usually in formalin, a toxic preservative that does not require refrigeration. Specimens processed are fish that can not be identified to species in the field and specimens that are required for various studies, such as the length-weight and striped bass diet studies. Laboratory facilities entail equipment (microscopes, sinks, fume hoods, etc), proper waste disposal (for toxic preservatives such formalin and alcohol), adequate storage for preservatives, and adequate storage for process samples.

    The majority of vessels used by the TNS are currently berthed in Antioch (plans are to berth the vessels in Rio Vista when the new facility is built). However, laboratories and offices are located in Stockton. At least 2 vehicles are required for transportation of TNS personal; one of these must be an open bed pickup to transport formalin.

    Other items necessary for the TNS are (but not limited to): storage space for nets, equipment and data sheets (for archival purposes), office space and supplies for the TNS staff, berthing for vessels used by the TNS, fuel for vessels and vehicles used by the TNS.

2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.

3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:

    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis
    - Web page maintenance
    - Reporting & writing
    - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
    - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

    See spreadsheet: TN Fish Monitoring Resources and Budgets - Final 3

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	Poor	Poor	Poor	Poor	
Spring-run Chinook	Poor	Poor	Poor	Poor	
CV steelhead	Poor	Poor	Poor	Poor	
Coastal steelhead	Poor	Poor	Poor	Poor	
Delta smelt	Good	N/A	Poor	N/A	
Splittail	Poor	Poor	Poor	Poor	
Longfin smelt	Good/Fair	N/A	Poor	Poor	Fish downstream
Green sturgeon	Poor	Poor	Poor	Poor	
Starry flounder	Poor	Poor	Poor	Poor	
Sport Fishes					
Fall-run Chinook	Poor	Poor	Poor	Poor	
Striped bass	Good	N/A	Poor	Poor	
White sturgeon	Poor	Poor	Poor	Poor	
Catfish	Good		Poor	Poor	
American shad	Good	Poor	Poor	Poor	
Largemouth bass	Poor	N/A	Poor	Poor	
Surfperch	Poor	Poor	Poor	Poor	
Habitats					
Nearshore (≤ 2 m depth)	Poor	Poor	Poor	Poor	
Nearshore vegetated	Poor	Poor	Poor	poor	
Nearshore, other structures	Poor	Poor	Poor	Poor	
Nearshore open water	Fair	Poor	Poor	poor	Few stations
Pelagic	Good	Poor	Poor	Poor	
Marsh	Poor	Poor	Poor	Poor	
Floodplain	Poor	Poor	Poor	Poor	
Benthic	Poor	Poor	Poor	Poor	
Other assemblage (ID in comment cell)	Poor	Poor	Poor	Poor	
Detection and tracking of new invasions					

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

   In 1966 no sampling was done due to transitioning of boats.

   The TNS 38.1-mm Index was estimated in 1995, due to high outflow and cool temperatures which caused a prolonged spawning period, resulting in continued recruitment during all five surveys, which kept the mean length below 38.1-mm (Foss and Miller, 1995).

   In 2002, twelve stations were not sampled during the 5th survey due to boat breakdowns, which made calculating an index unfeasible that year.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

   Upstream Sacramento River = 0

   North Delta = 3%

   East Delta = 6% (Station 912, San Joaquin River, could also be considered to be in the South Delta Region)

   South Delta = 0

   Upstream San Joaquin River = 0

   Central and West Delta = 44%

   Suisun Bay and Marsh = 41%

   San Pablo Bay and Napa River = 6%

   Central and South San Francisco Bay = 0

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution or abundance?

   In 1974 survey 3, additional stations in San Pablo Bay were sampled. One tow was completed at 326, 322, 302, 301a (midway between stations 301 and 302), 312, 315, 328, and 329. 1974 was an above average water year, so the additional stations in San Pablo were added to see if striped bass were being carried out of the Suisun Bay & Marsh Region farther than normal.

   In 1977, station 713 was sampled in Cache Slough on two dates. The tow started at Ryer Island Ferry and continued upstream. Only one tow was completed on each date.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

   The TNS is integrated with the FMWT Survey. Our striped bass age-0 indices are highly correlated. We share resources such as flowmeters, EC meters, vehicles/vessels, staff, and miscellaneous items needed for fieldwork. Both surveys share the same laboratory space and biologists can lead either survey.

   The indices derived, together have been used to produce a survival index of age-0 striped bass that has a positive relationship to outflow.

   Data from the TNS and FMWT are part of the delta smelt recovery plan. Both surveys have provided the ability for other programs, namely delta smelt, to collect specimens for research questions outside the prevue of the TNS or FMWT.

   Some integration between the TNS and the 20-mm Survey. The sample seasons areas for the 2 surveys do overlap to some extent with the 20-mm Survey sampling many of the same stations as the TNS (the 20-mm has more stations to better determine the spatial distribution of delta smelt). From June to early July, data is available weekly (one week from TNS, the next week from 20-mm) for larval/juvenile fish in the Delta. Both surveys use similar nets, the biggest difference is the mesh size. The smallest mesh on the TNS net is 2.54 mm while for the 20-mm Survey it is 1.6 mm. The range of sizes of fish that both surveys catch does overlap with the TNS being more efficient at catching fish over 30 mm and the 20-mm Survey being better at catching fish below 15 mm.

6. Please identify and briefly describe any opportunities for additional program element integration.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   Data from the TNS are being used to evaluate length-weight relationships, biomass indices, and condition factors.

   b. Field or analytical studies to assess current and new sampling methods

   Methods are being investigated to accurately determine the depth of the net during tows to ensure bottom to surface sampling during an oblique tow.

   Diet data are being analyzed to investigate historic trends and determine if and how such data should be collected in the future. No stomach samples were taken in 2003.

   c. Analytical studies to evaluate current and new analytical methods

   None are currently planned

d. Evaluation of new technologies or new gear types

None are currently planned

e. Review and improve monitoring program element processes

Analysis of young bass diet data may lead to a recommendation to change processing, if we decide to re-instate stomach sampling.

Fish species density by station and length frequency by survey are now (2004) available on the web.

f. Using historical information to change the program element design

Apparent protracted spawning of striped bass during years with cool springs and/or high flows and the desire to enhance the utility of the TNS for other species led to the standardization of the program element to 6 surveys per year (more if the 38.1 mm index has not been reached).

g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   Yes

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   Yes

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   The TNS field data for the entire season is usually posted to the IEP website by the end of September.

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

   The TNS has web-based data presentations of the program data. These include bubble plots and length frequencies of the most caught fish from the TNS.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   Chadwick, H.K. 1964. Annual abundance of young striped bass, *Roccus saxatilis*, in the Sacramento-San Joaquin Delta, California. California Fish and Game 50:69-99.

Foss, S.F. and L.W. Miller. 2004. Growth and growth rate variability of larval striped bass in the San Francisco Estuary, California. Pages 203-217 in Early Life Histories of Fishes in the San Francisco Estuary and Watershed, F Feyrer, L.R. Brown, R.L. Brown, and J.J Orsi, eds. American Fisheries Society, Bethesda, MD, 295 pages.

Turner, J.L., and H.K. Chadwick. 1972. Distribution and abundance of young-of-the-year striped bass, *Morone saxatilis*, in relation to river flow in the Sacramento-San Joaquin Estuary. Transactions of the American Fisheries Society 101:442-452.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

Arnold, J.D. and G.L. Hendrickson. 1997. Bacterial shell disease in crangoniod shrimp. California Fish and Game, Volume 83, Number 3, pages 118-127.

Arnold, J.D., and H.S. Yue. 1997. Prevalence, relative abundance, and mean intensity of plerocercoids of *Proteocephalus* sp. in young striped bass in the Sacramento-San Joaquin Estuary. California Fish and Game 83:105-117.

Gartz, R., L. Miller, R.W. Fujimura, and P.E. Smith. 1999. Measurement of larval striped bass (*Morone saxatilis*) net avoidance using evasion radius estimation to improve estimates of abundance and mortality. Journal of Plankton Research 21:561-580.

Kimmerer, W.J., J.H. Cowan, Jr., L.W. Miller, and K.A. Rose. 2000. Analysis of an estuarine striped bass (*Morone saxatilis*) population: influence of density-dependent mortality between metamorphosis and recruitment. Canadian Journal of Fisheries and Aquatic Sciences, Volume 57, pages 478-486.

Kimmerer, W.J., J.H. Cowan, Jr., L.W. Miller, and K.A. Rose. 2001. Analysis of an estuarine striped bass population: effects of environmental conditions during early life. Estuaries, Volume 24, Number 4, pages 557-575.

Stevens, D.E., D.W. Kohlhorst, L.W. Miller, and D.W. Kelley. 1985. The decline of striped bass in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 114:12-30.

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

Jassby, A.D., W.J. Kimmerer, S.G. Monissmith, C. Armor, J.E. Cohne, T.M. Powell, J.R. Schubel, and T.J. Vendlinski. 1995. Isohaline position as a habitat indicator for estuarine populations. Ecological Applications, Volume 5, Number 1, pages 272-289.

Moyle, P.B., B Herbold, D.E. Stevens, and L.W. Miller. 1992. Life history of delta smelt in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society, Volume 121, pages 67-77.

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.

Interagency Ecological Program. 1994. 1992 annual report, interagency ecological studies program for the Sacramento-San Joaquin Estuary, P.L. Herrgesell, complier.

Interagency Ecological Program. 1993. 1991 annual report, interagency ecological studies program for the Sacramento-San Joaquin Estuary, P.L. Herrgesell, complier.

Interagency Ecological Program. 1991. 1990 annual report, interagency ecological studies program for the Sacramento-San Joaquin Estuary.

Interagency Ecological Program. 1986. 1984 annual report or the interagency ecological studies program for the Sacramento-San Joaquin Estuary, R.L Brown, complier.

9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.

10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

Arnold, J.D., S.F. Foss, and L.W . Miller. 1997. Young striped bass. IEP Newsletter, Volume 10, Number 2, page 43.

Bryant, M. 2003. Highlights – Summer Townet Survey. IEP Newsletter, Volume 16, Number 4 Fall 2003 (this one I couldn't find)

Bryant, M. 2003. Summer townet survey. IEP Newsletter, Volume 16, Number 1. pages 3-4.

Bryant, M. 2002. Townet survey. IEP Newsletter, Volume 15, Number 1, pages 5.

Bryant, M. 2001. Townet survey. IEP Newsletter, Volume 14, Number 4, pages 9-11.

Bryant, M. and K. Souza. 2003. Summer townet survey and fall midwater trawl survey. IEP Newsletter, Volume 16, Number 2, pages 37-39.

Foss, S. 1999. Striped bass abundance: midsummer townet survey. IEP Newsletter, Volume 12, Number 4, page 3.

Foss, S. 1998. Summer townet survey. IEP Newsletter, Volume 11, Number 4, pages 2-3.

Foss, S.F. and LW. Miller. 1998. Young striped bass. IEP Newsletter, Volume 11, Number 2, pages 43-44.

Foss, S.F. and L.W. Miller. 1996. Summer tow-net survey: 1995 young-of-the-year striped bass index. IEP Newsletter, Volume 9, Number 3, pages 11-15.

Gartz, R. 2001. Townet survey. IEP Newsletter, Volume 14, Number 1, pages 10-12.

Gartz, R. 2000. Townet survey. IEP Newsletter. Volume 13, Number 4, 8-9.

Gartz, R. 2000. Spring midwater trawl survey, midsummer townet survey, and fall midwater trawl survey. IEP Newsletter, Volume 13, Number 3, page 7.

Gartz, R. 2000. Young-of-the-year striped bass, American shad, and threadfin shad abundance. IEP Newsletter, Volume 13, Issue 2, pages 38-41.

Gartz, R. 1999. Density dependent growth and diet changes in young-of-the-year striped bass (*Morone saxatilis*) in the Sacramento-San Joaquin Estuary. IEP Newsletter, Volume 12, Number 1, pages

Gartz, R., S.Foss, and L. Miller. 1999. Striped bass and American shad abundance. IEP Newsletter, Volume 12, issue 2, pages 42-44.

Miller, L.W. 2000. The townet survey abundance index for delta smelt revisited. IEP Newsletter, Volume 13, Number 1, pages 37-44.

Miller, L. 1999. Young fish investigations. IEP Newsletter, Volume 12, Number 3, page 10.

Miller, L. 1997. Summer tow-net survey. IEP Newsletter, Volume 10, Number 4, page 4.

Miller, L. 1995. No striped bass 38-mm index for 1995. IEP Newsletter, Volume 8, Number 4, page 4.

Miller, L.W. and S.F. Foss. 1996. Low striped bass index for 1996. IEP Newsletter, Volume 9, Number 4, pages 23-26.

Orsi, J. 1996. Young striped bass. IEP Newsletter, Volume 9, Number 1, page 36.

Souza, K. and M. Bryant. 2002. Townet survey and fall midwater trawl survey. IEP Newsletter, Volume 15, Number 2, pages 21-24.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

Department of Fish and Game. 1987. Factors affecting striped bass abundance in the Sacramento-San Joaquin River system. Exhibit 25, entered by the California Department of Fish and Game for the State Water Resources Control 1987 Water Quality/Water Rights Proceeding on the San Francisco Bay and Sacramento-San Joaquin Delta. Interagency Ecological Program Technical Report 20.

In house workshop on striped bass population dynamics.

Summary of Interagency Ecological Program/COMPECH Striped Bass Workshop, Stockton, CA., August 10-11, 1998.

Posters:

Gartz, R. 2004. Use of cleithra and photo-documentation. Presented at the IEP Annual Workshop, 2004

Gartz, R. 2000. Year class modeling of striped bass (*Morone saxatilis*) in the Sacramento-San Joaquin Estuary using pseudo cohorts. Presented at CALFED 2000 and the IEP Annual Workshop, 2001.

13. What products are planned for the next three years? Consider:

    a. Papers (refereed journal articles)

    Age-0 Striped Bass Diets in the San Francisco Estuary (1973-2002) by Marade E. Bryant and Jane D. Arnold

    An investigation of how the actual position and movement of age-0 striped bass (from larval stage to fall of first year of life) influences survival. This paper will utilize data from the Egg and Larval Survey (ELS), Townet Survey (TNS), FWMT, and egg and adult population estimates.

    Forage Fish Biomass indices. A multi-authored paper that will investigate if biomass indices can better explain trends in abundance, than traditional indices, when related to environ mental variables (such as delta outflow).

    b. IEP technical reports

    Depth of the townet. This research is in the early planning stages, but our intention is to determine the actual depth of the townet net (net) while it is fishing.

    TNS Summary Report. This is an extensive report dealing with the history, prevalent species, size of prevalent species, indices of abundance, and recommendations for researchers.

    c. IEP newsletter articles

    Status and Trends articles and other quarterly highlights articles

    d. IEP or CALFED workshop presentations

    e. AFS, ERF or other professional meeting presentations

    f. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies DFG – Striped bass	√			a,b, c, e,
DFG – Delta Smelt	√			a, f, g, h
DWR		√		a,c,h
USFWS		√		a,c,f, h
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
DFG	√			i
USFWS	√			i
Sport Fish Management Entities				
Sport Fish Restoration Act		√		a, e
Regulatory Agencies				
USFWS		√		f (Mallard, Rock sl. Ops)
Outside government, academic, or consultant entities				
Jones and Stokes		√		a, c, h, i, j
Eco-Logic Engineering			√	a, c, h, i, j
Entrix			√	a, c, h, i, j
Hanson Environmental			√	a, c, h, i, j
Mirant Energy		√		i, j

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:
   a. Long-term abundance and distribution trends
   b. Life history information
   c. Population status
   d. Harvest rates
   e. Recruitment rates

f. Abundance and distribution information for water operations/EWA actions
g. Recovery criteria
h. Species status reviews
i. Site-specific information
j. Project impact assessment
k. Other

Young striped bass data from the TNS has been used for long-term abundance and distribution trends, life history information, population status, abundance and distribution information for water operations (DFG 1987).

Delta smelt catch and distribution data from the TNS are used by the Delta Smelt Project and the US Fish and Wildlife Service (USFWS) in a fashion similar to 20mm data: location of fish relative to the pumps for DAT calls; abundance trends over time for USFWS status review;

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

One of the most valuable aspect of the TNS is its longevity (it has been in operation since 1959), and its spatial consistency (Table 1). We have been able to see long-term abundance trends of age-0 striped bass and delta smelt. The most challenging aspect is to keep sampling consistent from year to year.

2. Please provide any comments you may have on ways to improve the monitoring program element.

Long-term monitoring programs should be periodically supplemented with temporally and methodically similar surveys where sampling locations are selected probabilistically (e.g., a stratified random sampling program) to identify effects (biases) of fixed sampling locations on results.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

See # 2 above.

4. Do you have any ideas for other useful program element products?
5. Please provide any other comments you may have.

B 5) (Delta Smelt) 20 mm Survey (20 mm Survey) (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   20 mm Survey

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Ryan Mayfield, Michael Dege, and Kevin Fleming

3. Please list the dates you started and finished this questionnaire.

   3/4/04-3/17/04

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   Department of Fish and Game

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   No.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   20-mm database, 20-mm metadata file, 20-mm data file format, 20-mm web page,

   Publications and reports - Lott (1998), Aasen et al. (1999), Dege and Brown (2004), - IEP newsletter status and trends reports,

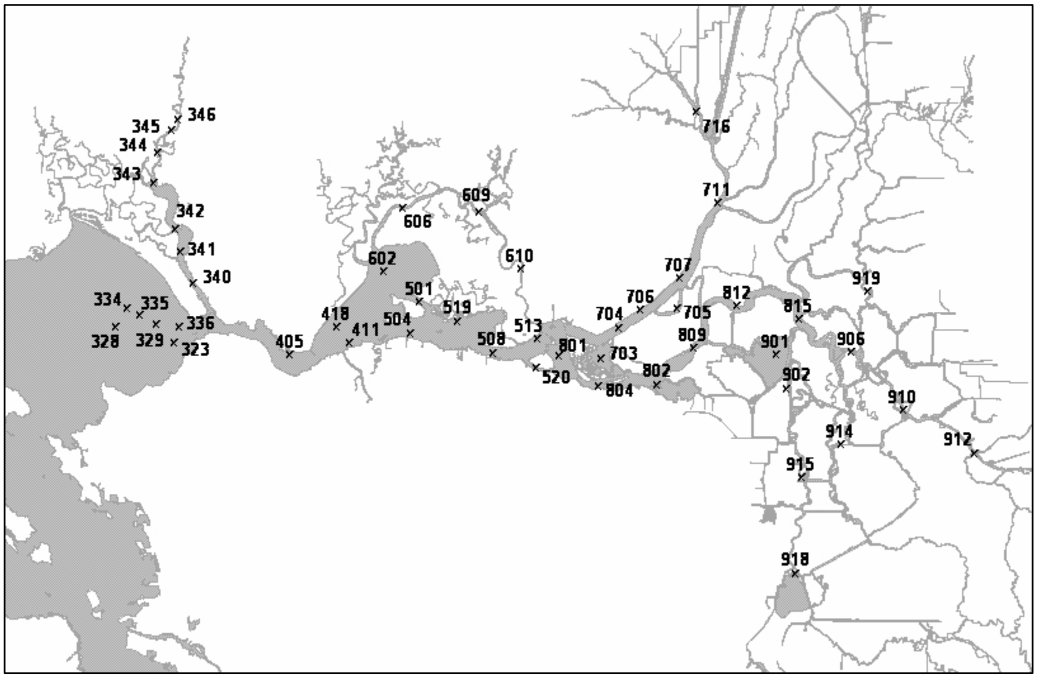
   Water project contributions - updates for weekly DAT calls during season,

   Workshop and conferences - Calfed Delta Smelt Workshops, IEP Annual Workshops, IEP Monitoring Workshops, Calfed Science Conferences, and American Fisheries Society Larval Fish Symposium.

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

The 20mm Survey monitors post larval-juvenile delta smelt distribution throughout their historical spring range in the Sacramento-San Joaquin Delta and San Francisco Estuary.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.
9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.



Station	LatD	LatM	LatS	LonD	LonM	LonS
323	38	2	53.9	122	16	58.1
328	38	3	37.1	122	21	0
329	38	3	49	122	18	14.4
330	38	3	49	122	18	14.4
334	38	4	35	122	20	16.8
335	38	4	16	122	19	26.4
336	38	3	39.9	122	16	40.8
340	38	5	57.4	122	15	48.4
341	38	7	38.1	122	16	43.6
342	38	8	45.1	122	17	6.3
343	38	11	8.9	122	18	39.5
344	38	12	44.9	122	18	25.8
345	38	13	54.4	122	17	33.9
346	38	14	27.3	122	17	7.3
405	38	2	22.9	122	9	1.8
411	38	3	4.7	122	4	59.9
418	38	3	53.3	122	5	52.1
501	38	5	17.6	122	0	12.9
504	38	3	39.8	122	0	49.4
508	38	2	43.8	121	55	7.7
513	38	3	29.9	121	52	4.8

Station	LatD	LatM	LatS	LonD	LonM	LonS
519	38	4	20.3	121	57	34.9
520	38	1	58.1	121	52	9.5
602	38	6	50.4	122	2	46.3
606	38	10	10.1	122	1	32.4
609	38	10	1.9	121	56	16.8
610	38	7	7.7	121	53	21.1
703	38	2	31.9	121	47	42.8
704	38	4	9	121	46	31
705	38	5	13.6	121	42	33
706	38	5	6.7	121	45	2.5
707	38	6	48.6	121	42	27
711	38	10	43.7	121	39	55.1
716	38	15	29.8	121	41	29.9
801	38	2	37.3	121	50	38.4
802	38	1	15	121	43	49.4
804	38	1	5.5	121	47	49.2
809	38	3	9	121	41	21.1
812	38	5	25.1	121	38	25.8
815	38	4	48	121	34	11.3
901	38	2	53.8	121	35	42.9
902	38	1	9.1	121	34	55.9
906	38	3	6.1	121	30	32.4
910	38	0	6.5	121	26	55.3
912	37	57	57.6	121	22	2.3
914	37	58	17.4	121	31	12
915	37	56	33	121	33	48.6
918	37	51	33.5	121	34	7.7
919	38	6	17.3	121	29	31.2

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)

    Typically forty-one stations (Figure 2) are sampled on this Survey, which span from eastern San Pablo Bay to the Sacramento Deep Water Channel (Cache Slough) and San Joaquin Rivers (Stockton). There are several shallow-water sites such as, Horseshoe Bend, Frank's Tract, Sherman Island, and the upper Napa River that may be utilized by delta smelt as rearing habitat. The entire delta smelt distribution is covered in nine distinct geographical ranges: south Delta, San Joaquin River, lower San Joaquin River, lower Sacramento River, Montezuma Slough, Chipps Island at the confluence of the San Joaquin and Sacramento rivers, Suisun and Honker Bays, Napa River, and San Pablo Bay.

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Annually there are approximately 8-10 surveys that run on a fortnightly basis from late March to July, depending on delta smelt distribution and outflow conditions. Sampling frequency was based on management of water operations.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred. A strong presence of delta smelt in the south delta may warrant additional survey(s), which focus on that area.

    During periods of high delta smelt abundance in the south Delta and high entrainment at the CVP and SWP which lead to exceeding ESA take limits additional surveys (weekly) and 24-hour turn-around have been implemented in addition to the normal fortnightly sampling.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis
    - Web page maintenance
    - Reporting & writing
    - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
    - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	Poor	Poor	Poor	Poor	
Spring-run Chinook	Poor	Poor	Poor	Poor	
CV steelhead	Poor	Poor	Poor	Poor	
Coastal steelhead	Poor	Poor	Poor	Poor	
Delta smelt	Excellent	Poor	Poor	Poor	
Splittail	Fair	Poor	Poor	Poor	
Longfin smelt	Excellent	Poor	Poor	Poor	For portion of range
Green sturgeon	Poor	Poor	Poor	Poor	
Starry flounder	Poor	Poor	Poor	Poor	
Sport Fishes					
Fall-run Chinook	Poor	Poor	Poor	Poor	
Striped bass	Excellent	Poor	Poor	Poor	
White sturgeon	Poor	Poor	Poor	Poor	
Catfish	Fair	Poor	Poor	Poor	
American shad	Excellent	Poor	Poor	Poor	
Largemouth bass	Poor	Poor	Poor	Poor	
Surfperch	Poor	Poor	Poor	Poor	
Habitats					
Nearshore (≤ 2 m depth)	Poor				
Nearshore vegetated	Poor				
Nearshore, other structures	Poor				
Nearshore open water	Fair				
Pelagic	Excellent				
Marsh	Fair				
Floodplain	Poor				
Benthic	Poor				
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions	Good				

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived? No sampling occurs from, usually, mid-late July- early-mid March. The months that are not sampled do not affect data analysis of the fish of primary concern.

Year	Sampled	Not Sampled
1995	Apr-Aug	Jan-Mar, Sep-Dec
1996	Apr-Jul	Jan-Mar, Aug-Dec
1997	Apr-Jul	Jan-Mar, Aug-Dec
1998	Apr-Jul	Jan-Mar, Aug-Dec
1999	Apr-Jul	Jan-Mar, Aug-Dec
2000	Mar-Jul	Jan-Feb, Aug-Dec
2001	Mar-Jul	Jan-Feb, Aug-Dec
2002	Mar-Jun	Jan-Feb, Jul-Dec
2003	Mar-Jul	Jan-Feb, Aug-Dec

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.

   San Pablo & Napa River: 20%

   Suisun Bay & Marsh: 30%

   Central & West Delta: 40%

   North Delta: 4%

   South Delta: 4%

   East Delta: 2%

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution or abundance?

   High freshwater outflows during a sampling season may warrant the following additional stations to be sampled in East San Pablo Bay: 328, 329, 334, 335, and 336. A strong presence of delta smelt in the south delta may warrant additional survey(s), which focus on that area. Station 802 at Big Break near Antioch, station 341 lower Napa River and station 330 in San Pablo Bay were discontinued after the first sampling season (1995) due to problems with net snags and water hazards.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources,

data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

This survey is not integrative with any other survey(s).

6. Please identify and briefly describe any opportunities for additional program element integration.

N/A

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   N/A

   b. Field or analytical studies to assess current and new sampling methods

   N/A

   c. Analytical studies to evaluate current and new analytical methods

   N/A

   d. Evaluation of new technologies or new gear types

   N/A

   e. Review and improve monitoring program element processes

   N/A

   f. Using historical information to change the program element design

   N/A

   g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   No, the data is stored on a Microsoft Access database in Stockton, California.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   N/A

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   48-72 hours.

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

   Yes:

   Fish Length Frequency - *http://www.delta.dfg.ca.gov/data/20mm/Length_frequency.asp?syear=2003*

   Fish CPUE Density Map - *http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp*

   Zooplankton CPUE Density Map - *http://www.delta.dfg.ca.gov/data/20mm/CPUE_zoomap.asp*

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   Aasen, G.A., D.A. Sweetnam and L.M. Lynch. 1998. Establishment of the wakasagi, in the Sacramento-San Joaquin estuary. California Fish and Game 84: 31-35.

   Sweetnam, D.A. 1999. Status of delta smelt in the Sacramento-San Joaquin Estuary. California Fish and Game 85: 22-27.

   Sweetnam, D.A. and D.E. Stevens. 1991. Delta smelt study plan. California Department of Fish and Game.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

   American Fisheries Society Symposium 39: Early Life History of Fishes in the San Francisco Estuary and Watershed: Effect of Outflow on Spring and Summertime Distribution and Abundance of Larval and Juvenile Fishes in the Upper San Francisco Estuary. Michael Dege and Larry Brown.

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

   N/A

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.

   N/A

9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.

   N/A

10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

    N/A

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

    Dege, M. 2001. Delta smelt egg deposition study. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Summer 2001.

    Dege, M. 2001. North bay aqueduct and 20-mm surveys. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Fall 2001.

    Fleming, K. 2000. Delta Smelt. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 2000.

    Mayfield, R. and M. Dege. 2003. North bay aqueduct and 20-mm surveys.

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    Sweetnam, D.A. 1997. Delta smelt investigations. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 1997.

    Sweetnam, D.A. 1996. Delta smelt. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 1996.

    Sweetnam, D.A. 1995. Field identification of delta smelt and wakasagi. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 1995.

    Sweetnam, D.A. 1999. Delta smelt investigations. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 1999.

    Sweetnam, D.A. 1999. Delta smelt investigations. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 1999.

Sweetnam, D.A. 1998. Delta smelt investigations. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 1998.

Sweetnam, D.A. 1998. Delta smelt studies program. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 1998.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

Mager, R. 1996. Gametogenesis, reproduction, and artificial propagation of delta smelt, Hypomesus transpacificus. Ph.D Dissertation. University of California, Davis. California, USA. 125pp.

Nobriga, M. L. 1998. Trends in the food habits of larval delta smelt, Hypomesus transpacificus, 1991-1994. M.S. Thesis, California State University, Sacramento. California, USA.

13. What products are planned for the next three years? Consider:

a. A technical report and IEP newsletter articles.
b. Papers (refereed journal articles)
c. IEP technical reports
d. IEP newsletter articles

Yes

e. IEP or CALFED workshop presentations

Yes

f. AFS, ERF or other professional meeting presentations
g. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
USFWS	X			
DWR	X			
USBR	X			
USGS			X	
USACE		X		
USEPA		X		
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
Sport Fish Management Entities				
Regulatory Agencies				
Caltrans			X	
Outside government, academic, or consultant entities				
UC Davis		X		
Stillwater Sciences		X		
Jones and Stokes		X		
BJ Miller (consultant)		X		
SFSU		X		

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:

   Abundance and distribution information for water operations/EWA actions and Recovery criteria.

   Long-term abundance and distribution trends, Life history information, Abundance and distribution information for water operations/EWA actions, and Recovery criteria.

   USFWS, USBR, and DWR (frequent use) – to manage water exports and limit take on this ESA species. Abundance and distribution data is used to predict the potential impact on this species due to the operation of the CVP and SWP. Data is also used in conjunction with other sources for direct (EWA assets) and indirect actions (VAMP) to limit take at these facilities.

   Other customers (moderate use) – primarily use data in other restoration programs, project impacts, and data analysis (review).

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element. The customers are satisfied.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   The most valuable aspect of this program element is that it provides data that helps to protect a listed species and balance California's water resources. The most challenging part is doing all this on a recent-time basis. There are no immediate plans for changes for this program element.

   This project slightly overlaps with Spring Kodiak Trawl (March and April), which targets adult delta smelt spawning. This program slightly overlaps (June and July) Summer Townet Survey, which continues to catch juvenile/ sub-adult delta smelt after the 20-mm sampling season ends.

2. Please provide any comments you may have on ways to improve the monitoring program element.
3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.
4. Do you have any ideas for other useful program element products?
5. Please provide any other comments you may have.

B 6) Spring Kodiak Trawl Survey

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   California Department of Fish and Game's Spring Kodiak Trawl Survey (Program element #: 2004-088).

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Kelly Souza

3. Please list the dates you started and finished this questionnaire.

   Start date: 03/10/2004

   Completion date: 03/17/2004

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   This program element has always been conducted by the California Department of Fish and Game.

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   No, this monitoring program has not undergone a technical review in the past. However, in 2002, it was reevaluated by project staff and the IEP management team and changed in a manner that enabled us to better detect our target species, delta smelt. For a description and relevance of the change refer to IEP Newsletter Volume 15 Number 3, *Revision of California Department of Fish and Game's Spring Midwater Trawl and Results of the 2002 Spring Kodiak Trawl*.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc

   The SKT in-house data base is managed by project staff that contributes annually to the Summer issue of the IEP Newsletter. Catch data is reported weekly in DAT calls and bubble-plots of delta smelt distribution and maturity status are posted to the CVBDB web site on a bimonthly basis throughout the duration of the field survey.

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

   The goal most directly addressed by the current program is (#2): addressing specific management questions by providing information on the factors and processes that influence the ecological resources of the Estuary. Objective 4 of goal 2 directly applies to the program element in that an existing survey, the Spring Midwater Trawl (SMWT), was evaluated and modified into a Kodiak trawl so that we could improve the detection of our target species in order to provide water export facility operators up-to-date information regarding delta smelt distribution in relation to the south delta projects. Additionally, some variables monitored may enhance our knowledge regarding spawning requirements of delta smelt.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   Map of station locations attached as Figure 1.

   Geographic coordinates attached as Table 1.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    The SKT survey uses the same suite of stations as Townet Survey (TNS) and 20mm survey, with the exception of 8 additional north delta stations added to increase the spatial distribution into areas of potential spawning habitat for delta smelt. The thirty original TNS stations, would be characterized as stratified sampling, and “were selected to sample the area between upper San Pablo Bay and Isleton on the Sacramento River and Mossdale on the San Joaquin River as extensively as could be done in 5 days with one boat (Chadwick, 1964).”

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Starting in mid January, sampling is conducted every other week and continues until mid April, with the option of sampling into May of cooler water years if spawning is delayed. These months were selected because they overlap with delta smelt spawning. Typically, due to boat and boat operator constraints, the weeks chosen to sample are those that won’t conflict with the sampling regime of CDFG’s 20-mm survey.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    In the 3 years that SKT has been conducted, sampling frequency was increased from once per month to twice a month. This change occurred after the pilot season of the SKT (2002) in an effort to reduce the possibility that spawning pulses went undetected.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?

   Field activities require two boat operators, a biologist, and one scientific aid. A boat equivalent to the *Scrutiny* outfitted with winches suitable to fish a Kodiak trawl with 100 ft of cable is needed as the power boat. A 24 ft Kvichak or suitable replacement is needed as the chase boat. The field survey requires 7 days per month to complete. Laboratory duties require one lab technician with the ability to properly determine maturity stage of delta smelt returned from the field, and sufficient knowledge of ACCESS to keypunch and QA/QC the data. Post survey processes typically take 2 - 4 days.

2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) <u>not</u> the State or Federal fiscal year.

   The current annual budget for this program element is $49, 480.

3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:

   - Supervision/program management
   - Field work
   - Lab processing
   - Data management
   - Data analysis
   - Web page maintenance
   - Reporting & writing
   - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
   - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt/age0**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	Poor	Fair	Poor	Poor	
Spring-run Chinook	Poor	Fair	Poor	Poor	
CV steelhead	Poor	Poor	Fair	Poor	
Coastal steelhead	Poor	Poor	Fair	Poor	
Delta smelt	Poor	N/A	Excellent	Poor	
Splittail	Poor	N/A	Fair	Poor	
Longfin smelt	Poor	N/A	Good	Poor	
Green sturgeon	Poor	N/A	Poor	Poor	
Starry flounder	Poor	N/A	Poor	Poor	
Sport Fishes					
Fall-run Chinook	Poor	Fair	Poor	Poor	
Striped bass	Poor	N/A	Poor	Poor	
White sturgeon	Poor	N/A	Poor	Poor	
Catfish	Poor	N/A	Poor	Poor	
American shad	Poor	Good	Poor	Poor	
Largemouth bass	Poor	N/A	Poor	Poor	
Surfperch	Poor	N/A	Poor	Poor	
Habitats					
Nearshore (≤ 2 m depth)	Fair	Fair	Fair	Fair	
Nearshore vegetated	N/A	N/A	N/A	N/A	
Nearshore, other structures	N/A	N/A	N/A	N/A	
Nearshore open water	Good	Good	Good	Good	
Pelagic	Excellent	Excellent	Excellent	Excellent	
Marsh	N/A	N/A	N/A	N/A	
Floodplain	N/A	N/A	N/A	N/A	
Benthic	N/A	N/A	N/A	N/A	
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions					

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

   There are no missing months or years of data.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

   East delta = 0.128

   South delta = 0.025

   Central & west delta = 0.333

   North delta = 0.153

   Suisun Bay & Montezuma = 0.333

   San Pablo Bay & Napa = 0.025

   Central and south Bay = 0

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution or abundance?

   No shifts have occurred in the sampling area.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

   Much of the equipment used to conduct the SKT survey is shared by other CDFG Long-term Monitoring Projects, such as Midwater Trawl Survey, Townet Survey, and 20-mm survey. This includes field sampling equipment, boats, boat operators, field, and laboratory staff.

   Data from the SKT survey is sometimes integrated with catch data from the 20-mm survey since both projects employ roughly the same suite of stations. Theoretically, 20-mm is sampling the offspring from spawning adults caught during the SKT and inferences can be made about spawning areas.

6. Please identify and briefly describe any opportunities for additional program element integration.

   Unsuccessful attempts have been made to integrate the SKT program element with outside entities that have interest in determining the spawning contribution of 2-yr old delta smelt and answering other fecundity and histopathology questions.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   Efforts to learn and recognize maturity status of delta smelt is a new variable that has been incorporated into the SKT and was not previously obtained from any other existing CDFG survey. In order to assess our ability to correctly identify maturity stages of delta smelt, we were hoping to have UC Davis verify our results by measuring nuclear migration. This proposal has not been funded though.

   b. Field or analytical studies to assess current and new sampling methods

   None currently planned, however we consider our new sampling methods more successful than the previous sampling design since we have reduced the proportion of stations with zero-catch.

   c. Analytical studies to evaluate current and new analytical methods

   None currently planned.

   d. Evaluation of new technologies or new gear types

   After the pilot season of the SKT survey (2002) we informally evaluated our method of net deployment and made changes which allow us to sample in a manner safer and easier for the crew.

   e. Review and improve monitoring program element processes

   Uploading bubble-plots of delta smelt maturity status and distribution to the CVBDB on a bimonthly basis, 2 days post survey is a significant improvement made to this program element process.

   f. Using historical information to change the program element design

   When the program element design was changed from a midwater trawl to a Kodiak trawl, we used information from a special study conduced by IEP in 1994 which evaluated the efficiency of 3 types of nets. Data from this previous study enables us to change our sampling gear and better detect our target species, delta smelt.

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   The SKT database is not on the BDAT, it is stored at CVBDB, Stockton, Ca.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   The database is not available on the BDAT.

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   Generally 2 days are needed from the end of field collection to posting of data on the CVBDB web page. However, should holidays or unanticipated leave by project staff occur, more time could be needed.

4. Are there web-based data presentations of the program data?

   Yes, on the CVBDB web page there are bubble-plots of delta smelt distribution and maturity status.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   None.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

   None.

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

   None

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.

   None

9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.

   None

10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

    None

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

    Summer 2002. Revision of California Department of Fish and Game's Spring Midwater Trawl Survey and the Results of the 2002 Spring Kodiak Trawl Survey, by Kelly Souza.

    Summer 2003. 2003 Spring Kodiak Trawl, by Kelly Souza.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

    None that I know of.

13. What products are planned for the next three years?

    Bennett, Bill. In preparation. The Population Ecology of Delta Smelt in the San Francisco Estuary.

    There will likely be contributions to conferences such as CAL-FED, Asilomar, or AFS. In addition, an annual article to the summer issue of the IEP Newsletter will be completed.

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
	DAT			
		OPEC		
Sport Fish Management Entities				
Regulatory Agencies				
Outside government, academic, or consultant entities				
		John Muir Inst.		

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:

The John Muir Institute of the Environment requests SKT information in an effort to better understand or develop life history information, population estimates, and a conceptual model of delta smelt ecology.

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

   I believe that they are satisfied with the information they receive and the manner in which the survey is carried out.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   I believe the most valuable aspect of this program element is the ability to make distribution and maturity status of delta smelt available in a timely manner so that water export facility operators are aware of the potential to entrain adult delta smelt and their offspring.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   Verifying our ability to accurately recognize maturity stage data would be beneficial to this program element.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.
4. Do you have any ideas for other useful program element products?
5. Please provide any other comments you may have.

B 7) Juvenile Sturgeon Year-Class Strength Survey

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Juvenile Sturgeon Year Class Strength

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Marty Gingras

3. Please list the dates you started and finished this questionnaire.

   5-26-04

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   DFG- CVBDB.

5. Has this monitoring program element been reviewed in the past? If so, when?

   I don’t know.

6. Provide an overview of the products of this monitoring program element.

   A database containing fields for species, size, age, capture location, capture date, capture gear, and associated physical and environmental parameters for each juvenile sturgeon captured. An index of sturgeon year-class strength is produced from the data. Reports are prepared and potential management actions are evaluated. Information is distributed to the public at conferences, through the popular press, on the CVBDB web site, etc.

7. Which of the goals and objectives are most directly addressed by the current program element?

   Status and trends of the ecological resources of the San Francisco Estuary, sport fishes in particular. Information from this work forms the scientific basis for management of a popular fishery.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   This work speaks to the effectiveness of the CVPIA Anadromous Fish Restoration Plan.

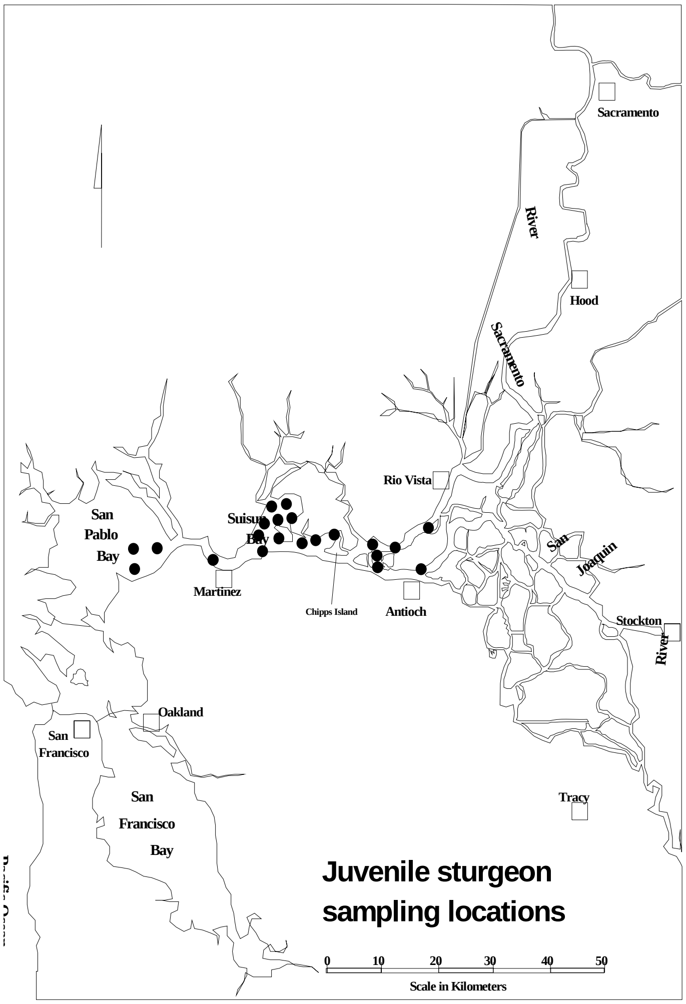
9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   Fish are sampled systematically at locations from the western delta into San Pablo Bay.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. Systematic

    From the western delta into San Pablo Bay, baited setlines are used to capture age 1-7 juvenile sturgeon. These lines are fished for approximately 24 hours at each of approximately 21 locations, to ensure capture of juvenile sturgeon and to delimit their distribution. Sampling is annual, for approximately 2 weeks each month June-August. Each line includes an 1800-ft ground tackle with approximately 100 gangions attached. Each gangion includes a halibut snap, a 3-foot leader, and a single baited hook. Up to four lines are fished at a time. Bait has included lamprey, threadfin shad, mud shrimp, ghost shrimp, bay shrimp and pickled squid.



Juvenile sturgeon sampling locations

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Sampling is annual, for approximately 2 weeks each month June-August. Annual sampling is required to reduce the need for back-calculation of birth-years and associated assumptions

about annual mortality. Timing and duration of sampling each year is based on experience showing reasonable catchability.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    Not applicable.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis
    - Web page maintenance
    - Reporting & writing
    - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
    - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook					
Spring-run Chinook					
CV steelhead					
Coastal steelhead					
Delta smelt					
Splittail					
Longfin smelt					
Green sturgeon			Fair	Fair	
Starry flounder					
Sport Fishes					
Fall-run Chinook					
Striped bass					
White sturgeon			Good	Good	
Catfish					
American shad					
Largemouth bass					
Surfperch					
Habitats					
Nearshore (≤ 2 m depth)					
Nearshore vegetated					
Nearshore, other structures					
Nearshore open water					
Pelagic					
Marsh					
Floodplain					
Benthic					
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions					

2. Over the sampling period of record what months or years of data are missing?
3. What proportion of monitoring program element field effort occurs in each IEP region?

Approximately 15% in San Pablo Bay/Napa River, 30% in central/west delta, and 55%in Suisun Bay/marsh.

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift.

   No shifts.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements.

   White sturgeon population dynamics can be described by integrating information from this element, information from the adult sturgeon tagging study, and Bay Study trawling.

   This element also collects and interprets data on green sturgeon, and the data were quite useful when green sturgeon were being considered for FESA listing.

6. Please identify and briefly describe any opportunities for additional program element integration.

   None are obvious to me.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   Not ongoing or anticipated for at least two years.

   b. Field or analytical studies to assess current and new sampling methods

   Not ongoing or anticipated for at least two years.

   c. Analytical studies to evaluate current and new analytical methods.

   Not ongoing or anticipated for at least two years.

   d. Evaluation of new technologies or new gear types.

   Recent work on bait selectivity, but no other work anticipated for at least two years.

   e. Review and improve monitoring program element processes.

   Currently reviewing all processes. Some changes are likely, and will likely improve QA, QC, data processing rate, and ease of analysis.

   f. Using historical information to change the program element design.

   Comprehensive data report (a retrospective) with an evaluation of biases and errors, and recommended changes.

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database?

   No. At present, data is stored on a server and on several PC’s at CVBDB in Stockton.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   N/A

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   This is highly variable and depends primarily on the time necessary to assign ages to sampled fish by interpretation of fin ray annuli. However, meaningful data (excluding ages) can – and should – be posted within a month of collection.

4. Are there web-based data presentations of the program data?

   No.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.

9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.

10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

13. What products are planned for the next three years? Consider:

a. Papers (refereed journal articles)

b. IEP technical reports

Comprehensive (retrospective) data report with an evaluation of biases and errors.

c. IEP newsletter articles

Updated estimates and interpretation relative to recent estimates.

d. IEP or CALFED workshop presentations

e. AFS, ERF or other professional meeting presentations

f. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element?

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DFG		**X**		
DWR			**X**	
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
Sport Fish Management Entities				
DFG		**X**		
Regulatory Agencies				
DFG		**X**		
NMFS		**X**		
USFWS		**X**		
SWRCB			**X**	
Outside government, academic, or consultant entities				

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers.

   DFG: Long-term abundance trends, population status, harvest rates, recruitment rates, and project impact assessment.

   DWR: Long-term abundance trends, population status, recruitment rates, and project impact assessment.

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

   All recognize the value of contributing to what could become a long time series, and that validity of the index has yet to be proven.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   The white sturgeon are the basis of a valuable recreational fishery in California. Due to their life history, they are also extremely vulnerable to overharvest and habitat loss. To the maximum feasible extent, it is thus prudent to manage sturgeon on a rigorously rational basis. This study uses reasonably sound methods and is "best available science", but lacks the scale (read, lacks the budget) necessary to develop information necessary to prudently manage sturgeon.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   Although we can't be certain without the results of cost:benefit analyses and simple modeling to determine likely effects of changes to the element, it seems very likely that validity of the recruitment index can be substantially improved by increasing sampling effort and by reducing errors in the assignment of ages to sampled fish.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

4. Do you have any ideas for other useful program element products?

   No.

5. Please provide any other comments you may have.

   Budget resources historically allocated to this element have been very small relative to (1) the probability of mismanaging sturgeon and (2) future (likely) costs due to any mismanagement of sturgeon. Additional funding and staff resources via the IEP and/or the new Bay-Delta Sport Fish Enhancement Stamp should be applied here, if only for a limited term.

B 8) Suisun Marsh Fish Community Survey (Suisun Marsh Survey) (UC Davis)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Suisun Marsh Fish Monitoring Program

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Peter Moyle and Robert Schroeter

3. Please list the dates you started and finished this questionnaire.

   16 April

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   UC Davis

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   No but we issue annual reports.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   This project has basically involved monthly sampling in SM since January 1979 (systematic sampling since January 2000). The data is available on the IEP website. The project is a centerpiece of the estuarine research program of Peter Moyle. It has produced many peer reviewed publications, annual reports, conference talks, public presentations, workshops etc. Besides supporting the PhD research of 7 students, it has involved literally hundreds of volunteers assisting in the sampling, including UCD students and agency biologists. It is one of the standard monitoring programs of the estuary so the information is used in making water management decisions, as well as decisions regarding the status of native species and the impacts of biological invasions. It is also a key element in monitoring what goes on in Suisun Marsh itself, e.g., effects of tidal gate operation, duck club water discharges, etc.

7. Which of the goals and objectives are <u>most directly addressed</u> by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

Both goals are addressed. We monitor the fish and macroinvertebrates of Suisun Marsh and my research program addresses the factors and processes that regulate their distribution and abundance.

Under objectives we address directly under Goal I: 1a, b, c, d, f (mysids), h, I, j, 2; and under Goal II: 1, 2a, c, d (if duck clubs count as agriculture), 3, 4 (the program has led to my being involved in Suisun Marsh committees).

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

None I can think of

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

The figure is present in all our annual reports and most of the publications.

Current Sampling Sites (1994-present)

Slough	Site	Latitude	Longitude
Suisun	SU1	38° 13’ 2.0” N	122° 01’ 43.1” W
Suisun	SU2	38° 12’ 8.2” N	122° 02’ 22.7” W
Suisun	SU3	38° 08’ 22.0” N	122° 04’ 22.7” W
Suisun	SU4	38° 07’ 36.0” N	122° 04’ 51.4” W
Peytonia	PT1	38° 13’ 38.1” N	122° 03’ 4.5” W
Peytonia	PT2	38° 13’ 18.0” N	122° 02’ 34.5” W
Boynton	BY1	38° 12’ 40.0” N	122° 03’ 12.5” W
Boynton	BY3	38° 12’ 41.3” N	122° 02’ 38.3” W
Cutoff	CO1	38° 11’ 33.6” N	122° 01’ 35.5” W
Cutoff	CO2	38° 11’ 21.7” N	122° 01’ 13.1” W
Spring Branch	SB1	38° 12’ 2.8” N	122° 01’ 48.5” W
Spring Branch	SB2	38° 11’ 57.1” N	122° 01’ 53.5” W
Goodyear	GY1	38° 06’ 8.3” N	122° 05’ 36.2” W
Goodyear	GY2	38° 06’ 27.5” N	122° 05’ 52.1” W
Goodyear	GY3	38° 07’ 55.8” N	122° 05’ 10.4” W
Montezuma	MZ1	38° 05’ 36.6” N	121° 53’ 9.5” W
Montezuma	MZ2	38° 07’ 5.2” N	121° 53’ 18.5” W
Nurse	NS2	38° 11’ 0.3” N	121° 55’ 32.6” W
Nurse	NS3	38° 10’ 19.6” N	121° 55’ 41.8” W
Denverton	DV2	38° 12’ 10.6” N	121° 54’ 23.2” W
Denverton	DV3	38° 11’ 55.0” N	121° 54’ 53.9” W

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

a. systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)

Our basic design is to conduct representative sampling of the tidally influenced fish habitats of Suisun Marsh that are readily accessible by boat. The sampling is focused on fishes that are readily captured by otter trawl and 10 m seines. The gear and stations have remained relatively constant although we have added some sampling stations as needed. The program is very effective at capturing the fishes in shallow (< 2 m at low tide) sloughs and is less effective in sampling large deep sloughs and pelagic habitats.

b. random

c. stratified (give number of sites per stratum, and if they were chosen in a random or systematic way)

d. rotating panel

e. other

11. What are the sampling frequency and annual sampling period, and why were they chosen?

Monthly, every year since 1980. We are interested both in long-term trends in distribution and abundance and in factors affecting seasonal distribution and abundance.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

No change

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Questions are often not clear so copy of annual report attached as well which has the details.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis

- Web page maintenance
- Reporting & writing
- Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
- Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

O = not present or not appropriate

NOTE: larval sampling was part of the program for 5 years but is not included here because it is not part of the sustained program

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	P	P	P	P	
Spring-run Chinook	P	P	P	P	
CV steelhead	0	0	0	0	
Coastal steelhead	P	P	P	P	
Delta smelt	P	0	G	0	
Splittail	E	0	E	G	Fry = YOY
Longfin smelt	F	0	F	F	
Green sturgeon	0	0	P	P	
Starry flounder	F	0	G	P	
Sport Fishes					
Fall-run Chinook	F	P	0	P	
Striped bass	E	0	E	F	Fry =YOY
White sturgeon	P	0	P	P	
Catfish	G	0	G	F	
American shad	P	0	F	P	
Largemouth bass	E	0	E	P	Not present but we would get them if they were
Surfperch **(tule perch)**	E	0	E	E	
Habitats					
Nearshore ($\leq$ 2 m depth)	E	E	E	G	Species dependent
Nearshore vegetated	P	P	P	P	
Nearshore, other structures	P	P	P	P	
Nearshore open water	F	F	F	F	
Pelagic	P	P	P	P	Entire water column sampled in shallw slougs
Marsh	E	E	E	E	
Floodplain	N/A				
Benthic	E	E	E	E	
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions	E	E	E	E	

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

   There are a few months of data missing, mostly from early sampling years due to boat malfunction but for the most part the missing data have not had a major impact on analyses

   In 1994 we added two new sampling sites (Denverton Slough and Nurse Slough).

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

   All effort is in Suisun Marsh

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution or abundance?

   We added sites in Denverton and Nurse Sloughs in 1994 to expand coverage of the marsh. This area has some distinct differences from the rest of the marsh (e.g., more white catfish, high catches of juvenile salmon). Effect has been positive, with more coverage we get a more realistic picture of what is going on with the fish.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

   The basic boat and crew are also used for sampling invertebrates (new study) and larval fish (past study), as well as to collect samples of fish for other programs (e.g., splittail for USGS and UCD selenium studies, fish of various species for UCD physiological studies).

6. Please identify and briefly describe any opportunities for additional program element integration.

   We are always open to working with other groups and to having others come along on our sampling trips to collect additional samples.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

    a. Assess and incorporate new variables

    We added regular dissolved oxygen measurements a few years ago in response to observations of anoxia. We add new species as they appear in our trawls and seines.

    b. Field or analytical studies to assess current and new sampling methods

    We have planned studies to evaluate trawl impacts which have not been funded. In the past, we have periodically tried other kinds of gear for suitability (e.g. , pelagic trawls, purse seines, electrofishers). Our present program uses two very different kinds of gear (seines, trawls).

    c. Analytical studies to evaluate current and new analytical methods

    We publish our results on a regular basis which usually requires looking at the latest analytical techniques. Dr. Jon Rosenfield is a postdoc who is evaluating the effectiveness of all the major estuarine sampling programs, including Suisun Marsh.

    d. Evaluation of new technologies or new gear types

    See b

    e. Review and improve monitoring program element processes

    I don't know what this means.

    f. Using historical information to change the program element design

    Not sure what is meant here. Our program dates from 1979, so that is practically historical.

    g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

    I assume this means the IEP website. Yes.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

    All

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

    Varies but 2-5 months is usual.

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

   Not that I aware of.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

A bibliography is appended. It is probably incomplete. We have relatively few technical reports and newsletter articles because we prefer peer-reviewed articles. Our findings are also summarized in our annual report.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.
6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.
7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.
8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.
9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.
10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.
11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.
12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.
13. What products are planned for the next three years? Consider:
    a. Papers (refereed journal articles)

    5-10

    b. IEP technical reports

    what ever is required

c. IEP newsletter articles

1-4

d. IEP or CALFED workshop presentations

2-4/year

e. AFS, ERF or other professional meeting presentations

2-4/year

f. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

This is a difficult exercise for us because we do not keep track of who uses the data from the IEP website. The list below is minimal. It would have been helpful to have a complete list of all the agencies involved in CALFED. We don't really think of our program as having "customers" because we are interested in doing systematic repeatable scientific studies. These result in graduate degrees and publications. The students who obtain the degrees may end up working for an agency or teaching students about what they learned in the marsh.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DWR	X			
CDFG	X			
USGS	X			
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
ERP	X			
Sport Fish Management Entities				

Customer*	**Frequent use of data or information**	**Moderate use of data or information**	**Rare use of data or information**	**Comment**
Regulatory Agencies				
USFWS	X			
Bureau of Reclamation		X		
NOAA Fisheries			X	
USEPA		X		
Outside government, academic, or consultant entities				
Montesuma Wetlands	X			
Other UCD, Academia	X			
Private consultants	X			
Suisun Marsh agencies		X		

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the <u>frequent</u> customers identified in the table above <u>and selected, important moderate use</u> customers.

   Our program is one of the seven principal monitoring programs for fish, so anyone who compares programs or who is interested in long term trends in fish abundance uses our data set. For example, the data set has been used by USFWS, DWR, and CDFG to determined status of splittail, delta smelt, longfin smelt and other species.

Example uses include:

   a. Long-term abundance and distribution trends
   b. Life history information
   c. Population status
   d. Harvest rates
   e. Recruitment rates
   f. Abundance and distribution information for water operations/EWA actions
   g. Recovery criteria
   h. Species status reviews
   i. Site-specific information
   j. Project impact assessment
   k. Other

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   There are several intersecting values of our program. First, it is one of the standard fish monitoring programs in the Estuary so the data are used by many people and used to compare with other data sets. Second, it has been a way for many students, agency biologists, and visitors to experience the estuary and its fishes and to obtain some training in sampling fish. For a few, it has been a source of graduate degrees. Third, it has been a major source on information on native fishes, leading to reviews of their status. Fourth, it has been a source of publications in international journals, providing some awareness of the extent of research and monitoring in our estuary to the outside world. Fifth, it has led to a better understanding of aquatic environments in Suisun Marsh *per se,* information which is now being shared and integrated into planning for the future of the Marsh. Sixth, it has been a source of information incorporated into my book, *Inland fishes of California*, widely used as a reference on California fishes.

   We are always open to change if warranted. Ideally we should add some midwater trawling to the mix of sampling, but this would require a larger boat, more time, and new gear. We may add new sites for sampling if needed, especially in relation to tidal marsh restoration programs.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   We are gradually moving towards more paid help and less reliance on volunteers because it improves the efficiency of sampling and ability to plan better. This depends on funding, of course. We have integrated the studies with those of larval fish and , on going, aquatic invertebrates. These extra studies have proved to be very time consuming but it might be worth considering repeating them at regular intervals (e.g., 5 years).

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   We have been pretty responsive to suggestions for change in the past and will continue to be.

4. Do you have any ideas for other useful program element products?

   See #2

5. Please provide any other comments you may have.

   Suisun Marsh Bibliography

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B 9) North Bay Aqueduct Survey (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   North Bay Aqueduct Survey (NBA)

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Ryan Mayfield, Michael Dege, and Kevin Fleming

3. Please list the dates you started and finished this questionnaire.

   3/10/04-3/17/04

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   California Department of Fish and Game

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   No?

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g., DAT calls), workshop and conference contributions, outreach activities, etc.

   NBA Access database, IEP newsletter status and trends reports (1996-), daily updates during the spring and summer seasons to the NBA web page (*http://www.delta.dfg.ca.gov/data/NBA/*), and provides real-time data for the operation of the North Bay Aqueduct pumping facility (SWP)as required by the 1995 USFWS Biological Opinion (delta smelt).

   The NBA sample stations are a subset of a broad egg and larval survey (E&L Survey) that the Department directed from 1967-1995 and new stations to meet the Delta Smelt Biological Opinion.

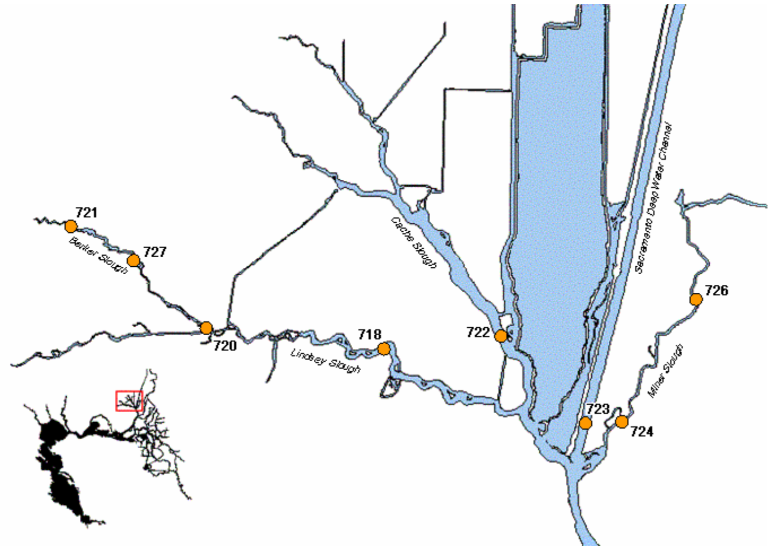
7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

This monitoring survey focuses on the hydraulic effects and the influence of the North Bay Aqueduct pumping facilities on larval delta smelt (a special status species).

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

Water quality measurements for temperature, salinity are turbidity are conducted at each sampling station.

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.



Station	LatD	LatM	LatS	LonD	LonM	LonS
718	38	15	29.90	121	43	28.20
720	38	15	38.50	121	46	27.10
721	38	16	58.40	121	48	53.20
722	38	15	35.00	121	41	34.00
723	38	14	33.00	121	40	11.00
724	38	14	33.00	121	39	34.00
726	38	16	9.00	121	38	24.00
727	38	16	33.00	121	47	45.00

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)

    Ichthyoplankton samples are collected at fixed stations in Barker Slough (720, 721 and 727), Lindsey Slough (718), Cache Slough (722), Miner Slough (724 and 726) and the Sacramento DeepWater Channel (723). A single 10-minute stepped-oblique (bottom to top) tow is made at each station.

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Sampling at Barker and Lindsey sloughs occurs every two days, while sampling for the remaining sloughs occurs every four days. The annual sampling season begins on February 15 and ends on July 15. It is during this time period when delta smelt have been known to spawn and larval fish are present.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    No changes.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis
    - Web page maintenance
    - Reporting & writing
    - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)

- Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	Poor	Poor	Poor	Poor	
Spring-run Chinook	Poor	Poor	Poor	Poor	
CV steelhead	Poor	Poor	Poor	Poor	
Coastal steelhead	Poor	Poor	Poor	Poor	
Delta smelt	Excellent	Poor	Poor	Poor	
Splittail	Fair	Poor	Poor	Poor	
Longfin smelt	Excellent	Poor	Poor	Poor	
Green sturgeon	Poor	Poor	Poor	Poor	
Starry flounder	Poor	Poor	Poor	Poor	
Sport Fishes					
Fall-run Chinook	Poor	Poor	Poor	Poor	
Striped bass	Excellent	Poor	Poor	Poor	
White sturgeon	Poor	Poor	Poor	Poor	
Catfish	Fair	Poor	Poor	Poor	
American shad	Excellent	Poor	Poor	Poor	
Largemouth bass	Fair	Poor	Poor	Poor	
Surfperch	Poor	Poor	Poor	Poor	
Habitats					
Nearshore (≤ 2 m depth)	Poor				
Nearshore vegetated	Poor				
Nearshore, other structures	Poor				
Nearshore open water	Fair				
Pelagic	Excellent				
Marsh	Fair				
Floodplain	Poor				
Benthic	Poor				
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions	Good				

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

   No sampling occurs from mid-July to mid-February every year. The months that are not sampled do not affect data analysis of the fish of primary concern.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.

   North Delta: 100%

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution or abundance?

   There have been no shifts in the sampling area.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

   This survey is not integrative with any other survey(s).

6. Please identify and briefly describe any opportunities for additional program element integration.

   Restoration projects associated with Prospect Island.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   N/A

   b. Field or analytical studies to assess current and new sampling methods

   N/A

   c. Analytical studies to evaluate current and new analytical methods

   N/A

d. Evaluation of new technologies or new gear types

N/A

e. Review and improve monitoring program element processes

N/A

f. Using historical information to change the program element design

Evaluation of historic delta smelt catch data to determine if sampling effort can be reduced, but still meet criteria of the delta smelt Biological Opinion.

g. Other

N/A

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

No, the data is stored on a Microsoft Access database at Dept. of Fish and Game (Stockton, California) and is currently posted on the project's web page: http://www.delta.dfg.ca.gov/data/NBA/

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

N/A

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

Usually within 72 hours during the season.

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

Yes, at the following web pages:

CPUE Map

http://www.delta.dfg.ca.gov/data/NBA/CPUE_map.asp?CreateMap=yes

Weighted entrainment estimates

http://www.delta.dfg.ca.gov/data/NBA/table.asp?type=nba

Catch summary

http://www.delta.dfg.ca.gov/data/NBA/catchsummary.asp?type=species

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   Aasen, G.A., D.A. Sweetnam and L.M. Lynch. 1998. Establishment of the Wakasagi, in the Sacramento-San Joaquin Estuary. California Fish and Game 85(4)161-169.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

   N/A

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

   Nobriga, M. Larval Delta Smelt Diet Composition and Feeding Incidence: Environmental and Ontogenetic Influences. 88: 149-164.

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.

   N/A

9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.

   N/A

10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

    N/A

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

    Dege, M. 2001. Delta smelt egg deposition study. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Summer 2001.

    Dege, M. 2001. North bay aqueduct and 20-mm surveys. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Fall 2001.

    Fleming, K. 2000. Delta Smelt. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 2000.

    Mayfield, R. and M. Dege. 2003. North bay aqueduct and 20-mm surveys.

    Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Fall 2002/Winter 2003.

McIntire, H. 1999. Delta smelt update. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Summer 1999.

McIntire, H. 1999. Delta smelt update. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Fall 1999.

Rockriver, A. and K. Fleming. 2000. Delta smelt investigations. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 2000.

Rockriver, A. 2000. Delta smelt. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 2000.

Rockriver, A., and M. Dege. 2000. Delta smelt. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Summer 2000.

Rockriver, A. 2000. Larval fish sampling at North Bay Aqueduct. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Fall 2000.

Rockriver, A. 2001. Delta smelt. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 2001.

Rockriver, A. and M. Dege. Delta smelt monitoring. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Summer 2001.

Sweetnam, D.A. 1995. Field identification of delta smelt and wakasagi. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 1995.

Sweetnam, D.A. 1996. Delta smelt. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 1996.

Sweetnam, D.A. 1997. Delta smelt investigations. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 1997.

Sweetnam, D.A. 1998. Delta smelt investigations. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 1998.

Sweetnam, D.A. 1998. Delta smelt studies program. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 1998.

Sweetnam, D.A. 1999. Delta smelt investigations. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 1999.

Sweetnam, D.A. 1999. Delta smelt investigations. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 1999.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

Mager, R. 1996. Gametogenesis, reproduction, and artificial propagation of delta smelt, Hypomesus transpacificus. Ph.D Dissertation. University of California, Davis. California, USA. 125pp.

Nobriga, M. L. 1998. Trends in the food habits of larval delta smelt, Hypomesus transpacificus, 1991-1994. M.S. Thesis, California State University, Sacramento. California, USA.

13. What products are planned for the next three years? Consider:

IEP newsletters.

a. Papers (refereed journal articles)

N/A

b. IEP technical reports

NBA Technical Report

c. IEP newsletter articles

Yes (IEP updates)

d. IEP or CALFED workshop presentations

N/A

e. AFS, ERF or other professional meeting presentations

N/A

f. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
USFWS	X			
DWR	X			
SCWA	X			
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
Sport Fish Management Entities				
Regulatory Agencies				
Outside government, academic, or consultant entities				

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the <u>frequent</u> customers identified in the table above <u>and selected, important moderate use</u> customers. Example uses include: Long-term abundance and distribution trends, Life history information, Population status, Recovery criteria, Site-specific information, and Project impact assessment.

   USFWS – Take limits for delta smelt (Endanger Species Act) DWR – To be in compliance with the ESA take limits during operation of the North Bay Aqueduct pumping plant (SWP).

   SCWA – Solano Count Water Agency, stakeholder of SWP water.

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element. The customers are satisfied.

   Posting real-time (72-hour turnaround) data to our web site allows customers to take prompt necessary actions to minimize take.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   The most valuable aspect of this program element is that it provides data that helps to protect a listed species and balance California's water resources. The most challenging part is doing all this on a recent time basis. There are no immediate plans for changes for this program element. This program overlaps the 20 mm survey and Spring Kodiak Trawl survey which are somewhat complementary.

2. Please provide any comments you may have on ways to improve the monitoring program element.
3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.
4. Do you have any ideas for other useful program element products?
5. Please provide any other comments you may have.

B 10) Delta Shoreline Resident Fishes Survey (Resident Fishes Survey) (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Resident Fishes (shoreline)

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Marty Gingras

3. Please list the dates you started and finished this questionnaire.

   4-28-04

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   DFG- CVBDB

5. Has this monitoring program element been reviewed in the past? If so, when?

   I don’t know.

6. Provide an overview of the products of this monitoring program element.

   Data on catch per unit effort of fishes sampled using a boat-mounted electroshocker, and site-specific water quality conditions during sampling. Relatively minor data on adult largemouth bass harvest rate from return of tags applied to a cohort of about 400 adult largemouth bass tagged in the spring. Reports are prepared and potential management actions are evaluated. Information is infrequently distributed to the public through the popular press, conferences, and the IEP Newsletter.

7. Which of the goals and objectives are most directly addressed by the current program element?

   Status and trends of the ecological resources of the San Francisco Estuary, sport fishes in particular. Some data from this work can be compared to data from similar studies conducted during the 1980’s and the 1990’s, which may document changes in habitat availability, habitat use, species composition, and relative abundance.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   None.

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   Not applicable. Monthly sampling stations are selected at random from several large geographic areas.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. Systematic:

    Fixed 500 m-long sites during 1995, 1997, and 1999

    b. Stratified:

    Beginning in 2001, twenty 500 m-long sites are to be sampled each month. Sites are selected at random from each of five geographic areas. The number of sites per area varies from 3-5, based on relative abundance of certain fishes during the 1980's.

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Samples are collected every month. Up to three (but typically only 2) sites are sampled each day until all sites are complete. I found no record explaining why this frequency was selected.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    I'm not sure.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:

- Supervision/program management
- Field work
- Lab processing
- Data management
- Data analysis
- Web page maintenance
- Reporting & writing
- Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
- Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook					
Spring-run Chinook					
CV steelhead					
Coastal steelhead					
Delta smelt					
Splittail					
Longfin smelt					
Green sturgeon					
Starry flounder					
Sport Fishes					
Fall-run Chinook					
Striped bass					
White sturgeon					
Catfish				Good	
American shad					
Largemouth bass			Good	Good	
Surfperch					
Habitats					
Nearshore (≤ 2 m depth)			Good		
Nearshore vegetated			Good		
Nearshore, other structures			Fair		
Nearshore open water			Fair		
Pelagic					
Marsh					
Floodplain					
Benthic					

Group/Species	Life Stage				
	Larvae/Fry	Smolt	Yearlings	Year 2+	Comments
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions			Fair	Fair	

2. Over the sampling period of record what months or years of data are missing?

   Gaps of several years between iterations of this sort of work conducted in the 1980's, 1990's and 2000's. Several gaps of several months during the 2000's. These gaps are of little consequence, because the fundamental character of the data supports limited hypothesis testing.

3. What proportion of monitoring program element field effort occurs in each IEP region?

   South – 20%, West – 15%, North – 15%, East - 25%, Central – 25%

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift.

   No shifts.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements.

   No integration.

6. Please identify and briefly describe any opportunities for additional program element integration.

   None obvious with extant program elements.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   Not ongoing or anticipated for at least two years.

   b. Field or analytical studies to assess current and new sampling methods

   Not anticipated.

   c. Analytical studies to evaluate current and new analytical methods

   Not anticipated.

   d. Evaluation of new technologies or new gear types

   Not anticipated.

   e. Review and improve monitoring program element processes

   Currently reviewing all processes. Substantial changes are likely, and will likely improve QA, QC, data processing rate, and ease of analysis.

f. Using historical information to change the program element design

Comprehensive data report (a retrospective) with an evaluation of biases and errors, statistical power analyses, and recommended changes.

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database?

   No. At present, data is stored on a server and on several PC's at CVBDB in Stockton. I'm preparing a process to begin routing data to BDAT.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   N/A

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   Highly variable, depending primarily on availability of temporary help. However, data can – and should – be posted within a month of collection.

4. Are there web-based data presentations of the program data?

   No.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   N/A

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

   N/A

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

   N/A

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.

   N/A

9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.

   N/A

10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

    N/A

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

    Mike Chotkowski. 1999. List of Fishes Found in San Francisco Bay-Delta Shallow Water Habitat. Interagency Ecological Program Newsletter 12(3) 12-18

    Nina Kogut. 2000. Resident Fish Surveys. Interagency Ecological Program Newsletter 13(2) 27-10

    Dennis Michniuk, Greg Silver. 2002. Resident Fish Surveys. Interagency Ecological Program Newsletter 15(2) 24-27

    Dennis Michniuk. 2003. Resident Fish Surveys. Interagency Ecological Program Newsletter 16(2) 23-27

    Ken Miller. 1997. Delta Resident Fishes. Interagency Ecological Program Newsletter 10(2) 6

    Raymond G. Schaffter. 2000. Mortality Rates of Largemouth Bass in the Sacramento-San Joaquin Delta, 1980 Through 1984. Interagency Ecological Program Newsletter13(4) 54-60

    Raymond Schaffter. 1998. Growth of Largemouth Bass in the Sacramento-San Joaquin Delta. Interagency Ecological Program Newsletter 11(3) 27-30

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

    Kevan Urquhart. 1987. Associations between Environmental Factors and the Abundance and Distribution of Resident Fishes in the Sacramento-San Joaquin Delta. Exhibit 24, State Water Res. Ctrl Board 1987 Water Quality/Water Rights Proceeding

13. What products are planned for the next three years?

    Comprehensive data report (a retrospective) with an evaluation of biases and errors, and recommended changes, power analyses, and hypothesis tests (e.g., ANOVA).

    a. Papers (refereed journal articles)

    USBR/Larry Brown is leading an effort to use (in part) these data in papers that will speak to the value of various potential habitat restoration projects.

    b. IEP technical reports

    Comprehensive (retrospective) data report with an evaluation of biases and errors.

c. IEP newsletter articles
d. IEP or CALFED workshop presentations
e. AFS, ERF or other professional meeting presentations
f. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DFG			X	
DWR			X	
USBR – Larry Brown		X		
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
Sport Fish Management Entities				
DFG			X	
Regulatory Agencies				
Outside government, academic, or consultant entities				

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:
    a. **USBR – Larry Brown: Long-term abundance and distribution trends, life history information, population status, recruitment rates, project impact assessment, ecological analyses (e.g., influence of exotic species).**

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

   All recognize the relatively long time series is potentially valuable.

VI Comments:

1. Please add any other comments about this program element.

   Given limited staff and financial resources, the character of data provided by this element, and the character of data provided by previous iterations of this element, it wouldn't be unreasonable to suspend the project.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   Sites should be sampled during a much more brief period each month. This is best accomplished by simultaneous use of more than one boat.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   It would be nice to begin collecting data necessary for calculation of condition factor, because the information would better speak to ecological effects of changing habitat (e.g., through restoration or development).

4. Do you have any ideas for other useful program element products?
5. Please provide any other comments you may have.

B 11.a) State Water Project Fish Salvage (SWP Salvage) (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Fish Salvage Monitoring

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Steve Foss

3. Please list the dates you started and finished this questionnaire.

   Begin: March 2, 2004

   End: March 30, 2004

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   Dept. Fish and Game

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   Unknown.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   - MS Access database (data from Jan. 1, 1993 to present)

   - Annual article in IEP Newsletter Status and Trends Issue

   - Weekly participation on DAT calls

   - Frequent presentations at CALFED and IEP conferences, workshops, symposia, and fora

   - Weekly e-mail summary report distributed to interested parties

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may

be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

Goal 2, objective 2 applies most directly to this program element. Many of the modifications to water project operations (EWA, export reduction, etc.) are designed to reduce salvage, so the effect of these operational changes can be directly measured by this program element. Numerous studies have been designed to measure the effect of facility design on fish salvage.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   None.

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    Not applicable.

    a. systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)
    b. random
    c. stratified (give number of sites per stratum, and if they were chosen in a random or systematic way)
    d. rotating panel
    e. other

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Samples of the fish being collected in the holding tanks are usually taken every two hours, but the interval between samples varies due to pumping changes, maintenance needs, special study demands, or person-power constraints. At the Tracy facility, samples are taken every 2 hours, with very few exceptions. At the Skinner facility, samples are taken at least every 2 hours and additionally after every change in export (flow) level. Recommended fish count sample periods are 20 minutes for each two hour water export period but the length of the sample may vary from a few minutes to the complete sample period. Current DWR agreements and biological opinions specify the minimum total count period will be 10 minutes every two hours. The main factors that determine sample length are fish density and time available to process the sample.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

The overall frequency has not changed, but the frequency of samples for which all fish are identifies to species has increased, largely as a result of listing of Winter-run chinook and delta smelt.

At the TFCF, prior to 1992, fish were identified to species only twice per day: at 0500 and 1700. Daily salvage estimates were extrapolated based on these 2 counts. Beginning January 24, 1992, fish were identified to species 4 times per day at 0100, 0500, 1300, and 1700. Beginning April 7, 1992, counts were changed from odd hours to even hours and fish are identified to species at 0200, 0600, 1400, and 1800. Beginning November 17, 1992, fish were identified to species during every count.

At the SDFPF, beginning on July 16, 1992, fish were identified to species during all counts. Prior to this time, fish were identified at 0100 and 1300 and sometimes other counts. Daily salvage estimates were extrapolated based on the 0100 and 1300 counts. Beginning April 7, 1992, counts were changed from even hours to odd hours.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis
    - Web page maintenance
    - Reporting & writing
    - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
    - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	Life Stage				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	poor	good	Fair	poor	
Spring-run Chinook	poor	good	fair	poor	
CV steelhead	poor	good	good	poor	
Coastal steelhead	poor	poor	poor	poor	
Delta smelt	poor	good	good	poor	
Splittail	poor	good	good	poor	
Longfin smelt	poor	poor	fair	poor	
Green sturgeon	poor	poor	poor	poor	
Starry flounder	poor	poor	poor	poor	
Sport Fishes					
Fall-run Chinook	poor	Good	fair	poor	
Striped bass	poor	excellent	fair	poor	
White sturgeon	poor	poor	poor	poor	
Catfish	poor	Good	Fair	poor	
American shad	poor	excellent	fair	poor	
Largemouth bass	poor	poor	poor	poor	
Surfperch	poor	poor	poor	poor	
Habitats					
Nearshore (≤ 2 m depth)	poor	poor	poor	poor	
Nearshore vegetated	poor	poor	poor	poor	
Nearshore, other structures	poor	poor	poor	poor	
Nearshore open water	poor	poor	poor	poor	
Pelagic	poor	good	poor	poor	
Marsh	poor	poor	poor	poor	
Floodplain	poor	poor	poor	poor	
Benthic	poor	fair	poor	poor	
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions	poor	fair	Poor	Poor	

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

   None.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of

field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

100% South Delta.

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution or abundance?

None

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

Salmonid CWT recoveries are processed and managed by FWS and integrated with Delta monitoring surveys CWT recoveries.

Data is combined with other monitoring surveys during RTM and is displayed on the RTM Web site.

6. Please identify and briefly describe any opportunities for additional program element integration.

None.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

a. Assess and incorporate new variables.

Nothing.

b. Field or analytical studies to assess current and new sampling methods.

Staff is involved in design of studies to assess efficiency of current sampling methods and development of new sampling methods.

c. Analytical studies to evaluate current and new analytical methods.

Nothing.

d. Evaluation of new technologies or new gear types.

Staff is involved in design of studies to assess efficiency of current gear and development of new gear.

e. Review and improve monitoring program element processes.

Staff has instituted new processes to improve efficiency of data transfer and dissemination.

f. Using historical information to change the program element design.

Nothing

g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   Yes. Also on DFG FTP site.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   No. 1993-present.

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   3-6 months

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

   Yes – the RTM Web Site from April-June; http://www.delta.dfg.ca.gov/data/rtm2002

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

   Kimmerer, W.J., J.H. Cowan, Jr., L.W. Miller, and K.A. Rose. 2000. Analysis of an estuarine striped bass (*Morone saxatilis*) population: influence of density-dependent mortality between metamorphosis and recruitment. Canadian Journal of Fisheries and Aquatic Science 57:478-486.

   Sweetnam, D.A. 1999. Status of delta smelt in the Sacramento-San Joaquin Estuary. California Fish and Game 85:22-27.

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.

   None.

9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.

10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

   Fish Salvage at SWP and CVP Facilities. Winter 1996. Scott Barrow.

   Fish Salvage Program at SWP and CVP Facilities. Spring 1997. Scott Barrow.

   Fish Salvage at SWP and CVP Facilities. Spring 1998. Jane Arnold.

   Fish Salvage at SWP and CVP Facilities. Spring 1999. Jane Arnold.

   Fish Salvage at the State Water Project and Central Valley Project Facilities. Spring 2000. Steve Foss.

   Fish Salvage at the State Water Project and Central Valley Project Facilities. Spring 2001. Steve Foss.

   Fish Salvage at the State Water Project and Central Valley Project Facilities. Spring 2002. Steve Foss.

   Fish Salvage at the State Water Project and Central Valley Project Facilities. Spring 2003. Steve Foss.

   Siegfried, S. 1999. Notes on the invasion of the Chinese mitten crab (Eriocheir sinensis) and their entrainment at the Tracy Fish Collection Facility. IEP Newsletter 12(2):24-25.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

   D.F.G.1981. The John E. Skinner Delta Fish Protective Facility 1968 - 1980 A Summary of the First Thirteen Years of Operation. Anadromous Fisheries Branch. Anadromous Fisheries Branch Administrative Report No. 81-6.

   Brown, R., S. Greene, P. Coulston, and S. Barrow. 1996. An evaluation of the effectiveness of fish salvage operations at the intake to the California Aqueduct, 1979-1993. Pages 497-518 in J.T. Hollibaugh, editor. San Francisco Bay: the ecosystem. Pacific Division of the American Association for the Advancement of Science, San Francisco, CA.

Arthur, J.F., M.D. Ball, and S.Y. Baughman. 1996. Summary of Federal and State water project environmental impacts in the San Francisco Bay-Delta Estuary, California. Pages 445-495 in J.T. Hollibaugh, editor. San Francisco Bay: the ecosystem. Pacific Division of the American Association for the Advancement of Science, San Francisco, CA.

California Department of Fish and Game (CDFG). 1987. Factors affecting striped bass abundance in the Sacramento-San Joaquin River system. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary Technical Report 20. 149 pages plus appendices.

California Department of Fish and Game (CDFG). 1992. A re-examination of factors affecting striped bass abundance in the Sacramento-San Joaquin estuary. Unpublished testimony to the State Water Resources Control Board.

California Dept. of Water Resources and U.S. Bureau of Reclamation. 1993. Biological assessment: effects of the Central Valley Project and State Water Project on delta smelt.

California Dept. of Water Resources and U.S. Bureau of Reclamation. 1994. Biological assessment: effects of the Central Valley Project and State Water Project on delta smelt.

Numerous DAT export reductions or other decisions were based on salvage data.

The take limits in the Delta Smelt Biological Opinion were based on historical salvage data.

Salvage data was used to determine the status, abundance, and distribution of the Sacramento splittail to determine listing under the ESA.

13. What products are planned for the next three years? Consider:

    a. Papers (refereed journal articles)

    Differences Among Hatchery and Wild Steelhead: Evidence from Delta Fish Monitoring Programs. Steve Foss

    b. IEP technical reports

    Fish Salvage at the State Water Project and Central Valley Project Facilities1981-2000. Steve Foss

    c. IEP newsletter articles

    Annual Status and Trends of Fish Salvage

    d. IEP or CALFED workshop presentations

    Differences Among Hatchery and Wild Steelhead: Evidence from Delta Fish Monitoring Programs. Steve Foss

    e. AFS, ERF or other professional meeting presentations

    f. Other

    Unknown.

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DWR	x			
DFG	x			
USBR	x			
USGS	x			
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
DAT/EWA	x			
Sport Fish Management Entities				
Regulatory Agencies				
USFWS	x			
NOAA	x			
Outside government, academic, or consultant entities				
Hanson Environmental	x			
Jones and Stokes	x			
Metropolitan Water District	x			
US EPA	x			
UC Davis	x			

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
CDM		x		
The Bay Institute	x			
Romburg Tiburon Center	x			
CUWA	x			
Fresno State U.	x			
UC Berkeley	x			
Fish First			x	
Save The Bay			x	

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:

USBR: data used for study design, project impact assessment, and to assess interrelationships of environmental variables and fish movement.

DWR: data used for study design, project impact assessment, abundance and distribution trends and to assess interrelationships of environmental variables and fish distribution.

USGS: data used assess interrelationships of environmental variables and fish movement.

DAT uses the data as the basis for water operations/ EWA actions.

NOAA Fisheries has used the data to create take limits in B.O.s and OCAPS, establish guidelines for water exports, and determine patterns of fish migration through the Delta.

DFG has used the data for study design, abundance and distribution trends and to determine ESA listing for various species.

a. Long-term abundance and distribution trends
b. Life history information
c. Population status
d. Harvest rates
e. Recruitment rates
f. Abundance and distribution information for water operations/EWA actions
g. Recovery criteria
h. Species status reviews
i. Site-specific information
j. Project impact assessment
k. Other

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

   Salvage data is used by many different agencies, consultants, and institutions for a broad variety of uses. The data is essential for determining abundance and distribution of listed species for water operations/EWA actions. The data has been used extensively to determine water project impacts on various species and the relative success of EWA and water operations management actions. The data has also been used extensively to help design fish facility studies and determine their impacts on listed species. Regulatory agencies frequently use the data for biological opinions and OCAPs.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   The most valuable aspect of this program is it's ability to provide useable data rapidly. Data summaries can be produced and distributed to managers often within 12 hours of the end of the day.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   The greatest improvement could be made by increasing the public's accessibility to salvage data in a way that is meaningful to them. An interactive Web site that enables custom queries of the salvage data would not only be beneficial to the user, but would free up staff time to do analysis and publication.

   Although salvage data is used frequently for recent-time water management decisions, in-depth complex analyses of salvage patterns and their relationship to environmental and operational variables is meager. Improved efficiency or additional staff would make such analyses possible.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   There is a mismatch between quality control between the 2 facilities, which results from differences in the type of staff employed. The Tracy facility employs 3 on-site biologists, a fisheries technician, and a fisheries consultant (Johnson Wang), devoted mainly to fish identification, data QA/QC, and facility improvements. Their biological staff provides critical fisheries expertise to assure the quality of the data and function as liaisons to regulatory agency staffs. The Skinner facility, in contrast, employs no biological staff. Fish identification and processing is accomplished by trade workers with no prior training (and often no interest) in the fisheries field. Until DWR hires an on-site biologist, their data quality will be suspect.

4. Do you have any ideas for other useful program element products?

5. Please provide any other comments you may have.

B 11.b) Central Valley Water Project Fish Salvage (CVP Salvage) (USBR)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Fish Salvage Monitoring

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Ron Silva

3. Please list the dates you started and finished this questionnaire.

   Begin: August 27, 2004

   End: August 31, 2004

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   U. S. Bureau of Reclamation

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   Yes, the monitoring program at the TFCF has been reviewed in the past. Statistics and General Sampling Procedures were setup and reviewed when the TFCF first went into operation (1956) by the Original Oversight Group. There was another review in the 1990s by DFG statisticians that found the sampling procedure appropriate. A Tracy Volume Series Report was also produced in the early 2000s that describes the process of fish count expansion and compares numbers with exact counts. The report found the present way of expanding data to be satisfactory for abundant species, but had wider error bars for less common species.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   MS Access database (data from Jan. 1993 to present) Note: TFCF raw data is provided to DFG for expansion and incorporation their database which provides the following benefits:

Analysis by scientists working on bay-delta fish population questions

ESA "take" reporting requirements

Publication in annual IEP Newsletter

DAT call data

Presentations at IEP and CALFED conferences and workshops

Weekly email summary reports

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

Since the CVP and SWP Fish Facility Salvage Programs are the largest, and oldest (encompass the longest running collections within the delta); both goals mentioned are applicable. Goal #1, objective #1 allows the manager to analyze how population trends for special status fish species, sport fish species, forage fish species etc. are changing over the 40 plus years of records. Goal 2, objective 2 also, applies to this program element. Many of the modifications to water project operations (EWA, export reduction, etc.) are designed to reduce special species fish entrainment, so the effect of these operational changes can be directly measured by this program element. Numerous studies have been designed to measure the effect of facility design on fish salvage.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

The research component of the TFCF studies that are being discussed separately, have the primary objective of improving existing or constructing new and improved south Delta fish salvage facilities. This would not necessarily be an IEP objective, but more of a CVPIA & CALFED objective.

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

The TFCF sampling stations have for all practical purposes have been located at the same location inside the collection building of the TFCF for the 45+ years of operation.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)

Monitoring design at the TFCF can best be described as systematic as it is located at a site of special interest (i.e. the TFCF). Statistics and General Sampling Procedures were setup and reviewed when the TFCF first went into

operation (1956) by the Original Oversight Group. There has been no change in the monitoring design strategy over time.

The pros of the monitoring design at the TFCF is that is practical and efficient for the large number of fish salvaged there. The cons are that there is a margin of error that is especially prevalent with the lesser abundant species.

b. random

c. stratified (give number of sites per stratum, and if they were chosen in a random or systematic way)

d. rotating panel

e. other

11. What are the sampling frequency and annual sampling period, and why were they chosen?

At the TFCF, samples of the fish being collected in the holding tanks are taken every two hours, and are of a 10 minute duration. Samples are taken every 2 hours, with very few exceptions. Statistics and General Sampling Procedures were setup and reviewed when the TFCF first went into operation (1956) by the Original Oversight Group.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

The overall frequency of fish counts has not changed, however the number of samples used for expansion of fish estimates has increased. This increase was largely due to the listing of Winter-run Chinook salmon and delta smelt. At the TFCF, prior to 1992, only two of the twelve samples taken per day were used in expansion to represent daily salvage. This use of only a fraction of the samples taken was because of the effort it took to put this data onto the computer, and to analyze it (remember this was the punch card system, with Fortran processing). Beginning January 24, 1992, fish from 4 counts per day were expanded to represent salvage. Beginning November 17, 1992, all twelve counts per day were entered into the calculation of daily salvage.

In a similar fashion, up until 1993 all fish measurements were recorded two times per day, but due to winter-run concerns were expanded to four counts per day. These fish measurements were in total length up until 1993. At that time since winter-run data was in fork length, first salmon then all fish lengths were changed to fork length. This makes comparisons of fish lengths with historical data more complicated. Adjustments to either total length or fork length need to be made for data before or after the 1993 date. For most species this is just a few millimeters difference. For some of the larger fish this difference can be 40 mm.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?

   Use of onsite fish diversion personnel and biologist to collect and disseminate the data to the appropriate personnel is required. QA/QC of the monitoring data is provided by the onsite biologist. A contract with DFG for management of and further dissemination of the data is also required.

   In addition, maintenance of the data collection, storage, and disseminating equipment is required to complete the monitoring program element.

2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.

   Total annual budget for the fish monitoring element of TFCF operations is approx. $190,000. This includes approx. $100,000 for TFCF personnel, $70,000 for DFG fish monitoring contract, and $20,000 for supplies, materials, maintenance, etc.

   The TFCF fish sampling program occurs throughout the year and around the clock, even when no pumping is occurring at the TPP since there is still some tidal entrainment.

3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:

   - Supervision/program management
   - Field work
   - Lab processing
   - Data management
   - Data analysis
   - Web page maintenance
   - Reporting & writing
   - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
   - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	Life Stage				
	Larvae/Fry	Smolt	Yearlings	Year 2+	Comments
Species of Concern					
Winter-run Chinook	N.A.	Excellent	Excellent	N.A.	
Spring-run Chinook	N.A.	Excellent	Excellent	N.A.	
CV steelhead	N.A.	Excellent	Excellent	N.A.	
Coastal steelhead	N.A.	N.A.	N.A.	N.A.	
Delta smelt	Excellent	Excellent	Excellent		
Splittail	Fair	Excellent	Good	Good	
Longfin smelt	Fair	Good	N.A.	Fair	
Green sturgeon	N.A.	Poor	Poor	N.A.	
Starry flounder	N.A.	Poor	Poor	N.A.	
Sport Fishes					
Fall-run Chinook	N.A.	Excellent	Excellent	N.A.	
Striped bass	Fair	Excellent	Excellent	N.A.	
White sturgeon	N.A.	Poor	Poor	N.A.	
Catfish	Fair	Excellent	Excellent	N.A.	
American shad	Fair	Excellent	Good	Poor	
Largemouth bass	N.A.	Excellent	Good	N.A.	
Surfperch	N.A.	N.A.	N.A.	N.A.	
Habitats					
Nearshore (≤ 2 m depth)	N.A.	N.A.	N.A.	N.A.	
Nearshore vegetated					
Nearshore, other structures					
Nearshore open water					
Pelagic					
Marsh					
Floodplain					
Benthic					
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions	Fair	Good	Good	Excellent	

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

None, however, there were (are) periods of time when no data was taken due to non operation of the export pumps.

Prior to 1969 and the construction of San Luis Reservoir, there was no demand for water in the fall/winter. Typically for six months per year the TFCF was not operational, and the louvers were removed from the water for maintenance. After the construction of San Luis Reservoir, water was pumped every month of the year, including fall/winter----until San Luis reaches capacity.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

   100% South Delta

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution, or abundance?

   None

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

   The Skinner and TFCF fish salvage programs are integrated both in respect to sampling and data reporting.

   The “Real Time Monitoring Program” and other programs designed to see if actions could be done to prevent loss of certain fish at the facilities, such as South Delta Barriers and South Delta Hydrodynamic Studies, are closely tied to facility operations and fish salvage monitoring.

   Because the fish facilities are the largest sampling device in the delta, many other programs are tied to sampling efforts at the fish facilities. One example of this is the recovery of coded wire tagged salmon and steelhead used in studies conducted throughout the delta.

   The sampling efforts at the fish facility are also components in the Biological Opinions for delta smelt, winter/spring run salmon, and steelhead.

6. Please identify and briefly describe any opportunities for additional program element integration.

   None

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables.

   Nothing at this time.

b. Field or analytical studies to assess current and new sampling methods.

Nothing at this time.

c. Analytical studies to evaluate current and new analytical methods.

Nothing at this time.

d. Evaluation of new technologies or new gear types.

Field staff is presently involved in studies to compare existing sampling gear with historical gear at the TFCF.

e. Review and improve monitoring program element processes.

DFG and Reclamation staff has instituted new processes to improve efficiency of data transfer and dissemination.

f. Using historical information to change the program element design.

Nothing at this time.

g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   Yes. Data also available on the DFG FTP site.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   No. 1993 to present.

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   3 – 6 months.

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

   Yes. The RTM website from April – June;
   http://www.delta.dfg.ca.gov/data/rtm2002

   There is also some fish count data information available on the Reclamation Tracy Research webpage;
   http://www.usbr.gov/pmts/tech_services/tracy_research/

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   Sweetnam, D.A. 1999. Status of delta smelt in the Sacramento-San Joaquin Estuary. California Fish and Game 85:22-27.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

   Kimmerer, W.J., J.H. Cowan, Jr., L.W. Miller, and K.A. Rose. 2000. Analysis of an estuarine striped bass (*Morone saxatilis*) population: influence of density-dependent mortality between metamorphosis and recruitment. Canadian Journal of Fisheries and Aquatic Science 57:478-486.

   Kate Puckett, Charles Liston, Catherine A. Karp, and Lloyd Hess. Tracy Fish Collection Facility Studies, Volume 4, August 1996: Preliminary Examination of Factors That Influence Fish Salvage Estimates at the Tracy Fish Collection Facility, California, 1993 and 1994.

   Cathy Karp, Lloyd Hess, Judy Lyons, and Charles Liston. Tracy Fish Collection Facility Studies, Volume 8, November 1997; Evaluation of the Subsampling Procedure to Estimate Fish Salvage at the Tracy Fish Collection Facility, Tracy, California, 1993-1996.

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

   Arthur, J.F., M.D. Ball, and S.Y. Baughman. 1996. Summary of Federal and State water project environmental impacts in the San Francisco Bay-Delta Estuary, California. Pages 445-495 in J.T. Hollibaugh, editor. San Francisco Bay: the ecosystem. Pacific Division of the American Association for the Advancement of Science, San Francisco, CA.

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.

   California Department of Fish and Game (CDFG). 1987. Factors affecting striped bass abundance in the Sacramento-San Joaquin River system. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary Technical Report 20. 149 pages plus appendices.

9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.

10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

Fish Salvage at SWP and CVP Facilities. Winter 1996. Scott Barrow.

Fish Salvage Program at SWP and CVP Facilities. Spring 1997. Scott Barrow.

Fish Salvage at SWP and CVP Facilities. Spring 1998. Jane Arnold.

Fish Salvage at SWP and CVP Facilities. Spring 1999. Jane Arnold.

Fish Salvage at the SWP and CVP Facilities. Spring 2000. Steve Foss.

Fish Salvage at the SWP and CVP Facilities. Spring 2001. Steve Foss.

Fish Salvage at the SWP and CVP Facilities. Spring 2002. Steve Foss.

Fish Salvage at the SWP and CVP Facilities. Spring 2003. Steve Foss.

Siegfried, S. 1999. Notes on the invasion of the Chinese mitten crab (Eriocheir sinensis) and their entrainment at the Tracy Fish Collection Facility. IEP Newsletter 12(2):24-25.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

California Department of Fish and Game (CDFG). 1992. A re-examination of factors affecting striped bass abundance in the Sacramento-San Joaquin estuary. Unpublished testimony to the State Water Resources Control Board.

California Dept. of Water Resources and U.S. Bureau of Reclamation. 1993. Biological assessment: effects of the Central Valley Project and State Water Project on delta smelt.

California Dept. of Water Resources and U.S. Bureau of Reclamation. 1994. Biological assessment: effects of the Central Valley Project and State Water Project on delta smelt.

Numerous DAT export reductions or other decisions were based on salvage data. The take limits in the Delta Smelt Biological Opinion were based on historical salvage data. Salvage data was used to determine the status, abundance, and distribution of the Sacramento splittail to determine listing under the ESA.

13. What products are planned for the next three years? Consider:

    a. Papers (refereed journal articles)

    Differences Among Hatchery and Wild Steelhead: Evidence from Delta Fish Monitoring Programs. Steve Foss

    b. IEP technical reports

    Fish Salvage at the State Water Project and Central Valley Project Facilities1981-2000. Steve Foss

c. IEP newsletter articles

Annual Status and Trends of Fish Salvage

d. IEP or CALFED workshop presentations

Differences Among Hatchery and Wild Steelhead: Evidence from Delta Fish Monitoring Programs. Steve Foss

e. AFS, ERF or other professional meeting presentations

f. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DWR	X			
DFG	X			
USBR	X			
USGS	X			
FWS	X			
NMFS	X			
EPA	X			
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
DAT/EWA	X			
Sport Fish Management Entities				
Regulatory Agencies				
(see above IEP Agencies)				

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
Outside government, academic, or consultant entities				
Hanson Environmental		X		
Jones and Stokes		X		
CH2M Hill		X		
UC Davis		X		
CDM			X	
The Bay Institute	X			
Romburg Tiburon Center		X		
CUWA			X	
Fresno St. Univ.		X		
UC Berkeley		X		
Fish First			X	
Save The Bay			X	
San Luis & Delta-Mendota Water Authority			X	

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the <u>frequent </u>customers identified in the table above <u>and selected, important moderate use</u> customers. Example uses include:
    a. Long-term abundance and distribution trends
    b. Life history information
    c. Population status
    d. Harvest rates
    e. Recruitment rates
    f. Abundance and distribution information for water operations/EWA actions
    g. Recovery criteria
    h. Species status reviews
    i. Site-specific information
    j. Project impact assessment
    k. Other

    USBR: data used for study design, project impact assessment, and to assess interrelationships of environmental variables and fish movement.

    DWR: data used for study design, project impact assessment, abundance and distribution trends and to assess interrelationships of environmental variables and fish distribution.

USGS: data used assess interrelationships of environmental variables and fish movement.

DAT uses the data as the basis for water operations/ EWA actions.

NOAA Fisheries has used the data to create take limits in B.O.s and OCAPS, establish guidelines for water exports, and determine patterns of fish migration through the Delta.

DFG has used the data for study design, abundance and distribution trends and to determine ESA listing for various species.

San Luis & Delta-Mendota Water Authority has used the data to study population level effects and take impacts at the export pumps.

Consultants, Universities, and Environmental organizations use the data for specific studies/documents being produced by these institutions for several of the aforementioned agencies or for themselves.

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

Salvage data is used by many different agencies, consultants, and institutions for a broad variety of uses. The data is essential for determining abundance and distribution of listed species for water operations/EWA actions. The data has been used extensively to determine water project impacts on various species and the relative success of EWA and water operations management actions. The data has also been used extensively to help design fish facility studies and determine their impacts on listed species. Regulatory agencies frequently use the data for biological opinions and OCAPs.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

The most valuable aspect of this program is it's ability to provide useable data rapidly. Data summaries can be produced and distributed to managers often within 12 hours of the end of the day.

2. Please provide any comments you may have on ways to improve the monitoring program element.

Although salvage data is used frequently for recent-time water management decisions, in-depth complex analyses of salvage patterns and their relationship to environmental and operational variables is meager. It should be a high priority of the IEP to get the maximum analysis from this data, thus improving our understanding of the factors governing fish salvage and protections. This analysis might be performed by existing agencies, consultants, or other yet to be identified groups.

The TFCF 50 year salvage record has to be “mined” for the information it can provide. Such information as successful reproduction of all species, but in particularly native species is tied to water year type. The wetter the year, the larger the population of young-of-the-year fish.

Analysis of adult delta smelt data from the TFCF indicates these adult smelt move with the tides. These small fish can move up to 25 miles a day, by changing their vertical position in the water column. Thus, this smelt can move long distances with the expenditure of little energy. This and similar facts about the behavior of fish can be “mined” from the extensive salvage records.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   There is a mismatch between quality control between the 2 facilities, which results from differences in the type of staff employed. The Tracy facility employs 4 on-site biologists, two fisheries technician, and a fisheries consultant (Dr. Johnson Wang), devoted mainly to fish identification, data QA/QC, and facility improvements. Their biological staff provides critical fisheries expertise to assure the quality of the data and function as liaisons to regulatory agency staffs. The Skinner facility, in contrast, employs no biological staff. Fish identification and processing is accomplished by trade workers with no prior training (and often no interest) in the fisheries field. At one time DWR hired DFG to conduct this work by a trained biological staff. Biological Opinions require BIOLOGIST to be present at the handling of all ESA species. It is apparent that DWR needs to hire a more trained and professional staff of on-site biologist, to meet their requirements under the ESA Biological Opinions.

4. Do you have any ideas for other useful program element products?

   The largest fish sampling devices in the world, are the South Delta salvage facilities. The data from these facilities need more attention from both managers and staff. Threats that new facilities pose are, these new facilities may not be able to provide comparable data to that presently being collected, for long term trend analysis.

5. Please provide any other comments you may have.

B 12) Chipps Island Trawl Survey (USFWS)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   USFWS Chipps Island Trawl

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Paul Cadrett, Larry Hansen, Lia McLaughlin

3. Please list the dates you started and finished this questionnaire.

   4/15 – 5/14

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   USFWS

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   Yes as a part of the Delta Salmon Project Work Team - Delta Juvenile Salmon Monitoring Program Review, July 2000.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   We provide near real time data to the BDAT throughout the year. We participate in IEP workshops and contribute to the IEP newsletter throughout the year. We provide information during DAT calls for salmon when appropriate, in addition we provide daily real time data to the DFG server from April 1 through June 30 each year (available at http://www.delta.dfg.ca.gov/data/rtm2004/)

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

   Sampling at Chipps most directly addresses Goal 1, Objectives a, b, c, and i, by providing year-round data on relative abundance of specific aquatic species of

interest. These data are used in conjunction with environmental data (e.g. flow) available from other sources to evaluate the effects of environmental variables on relative abundance. Goal 1, Objective 2 is also addressed (see responses to Question III and VI). Our program does not directly address Goal 2, but the data we collect is likely useful to other IEP programs which do address this goal.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   None

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   See Figure 1 and Table 1

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. systematic (e.g., at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)

    The Chipps Island trawl is positioned below the confluence of the Sacramento and San Joaquin Rivers just downstream of the delta. The trawl location was chosen in order to capture out migrating and marked juvenile Chinook salmon as they exit the delta.

    b. random

    c. stratified (give number of sites per stratum, and if they were chosen in a random or systematic way)

    d. rotating panel

    e. other

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Originally, sampling at Chipps Island was designed to estimate the survival and abundance of fall run Chinook salmon exiting the delta during the spring. Since the mid- 1990's sampling has incorporated the rest of the year to better document the abundance of other races of juvenile Chinook salmon, central valley steelhead and delta fishes. (see Figure 1)

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    See question 11 above.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: **standard operating procedures Chipps Island.xls**). Please restrict your descriptions to your routine monitoring

procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: **Fish Monitoring Resources and Budget FWS Chipps Island.xls**) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
   - Supervision/program management
   - Field work
   - Lab processing
   - Data management
   - Data analysis
   - Web page maintenance
   - Reporting & writing
   - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
   - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	N/A	good	Good	poor	
Spring-run Chinook	N/A	good	Good	poor	
CV steelhead	good	good	Good		
Coastal steelhead	N/A	N/A	N/A	N/A	
Delta smelt	good	N/A	Good	good	
Splittail	good	N/A	Good	good	
Longfin smelt	good	N/A	Good	good	
Green sturgeon	N/A	N/A	N/A	N/A	
Starry flounder	fair	N/A	Fair	Fair	
Sport Fishes					
Fall-run Chinook	good	good	Good	good	
Striped bass	fair	fair	Fair	Fair	
White sturgeon	poor	poor	Poor	poor	
Catfish	poor	poor	Poor	poor	
American shad	Good	good	good	poor	

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Largemouth bass	poor	poor	poor	poor	
Surfperch	poor	poor	poor	poor	
Habitats					
Nearshore (< 2 m depth)	N/A	N/A	N/A	N/A	
Nearshore vegetated	N/A	N/A	N/A	N/A	
Nearshore, other structures	N/A	N/A	N/A	N/A	
Nearshore open water	good	good	good	good	
Pelagic	N/A	N/A	N/A	N/A	
Marsh	N/A	N/A	N/A	N/A	
Floodplain	N/A	N/A	N/A	N/A	
Benthic					
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions	Detection of invasives is poor to excellent depending on the species. Tracking of new invasions is poor since the trawl is conducted in one location.				

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

   See Figure 1 for complete sampling record. Original sampling at Chipps Island was primarily during the spring (April – June) to index fall run Chinook, seasonal data are limited to the time period after 1993.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

   The Chipps Island sampling occurs exclusively in the Suisun Bay and Marsh region.

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution or abundance?

   The sampling area has not changed over the term of the program element. In the mid 1980's an effort was made to ensure that sampling was distributed across the channel, at this time channel lanes (north, middle, and south) were established. To decrease the take of delta smelt, there has been interest in moving the

sampling site to Carquinez Straits. To date we have not received the funding necessary to determine the effects and feasibility of moving the sampling location.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

The Chipps Island trawl is closely integrated with other FWS IEP operations and the data collected at this location are used along with other sampling throughout the estuary to document the timing of juvenile Chinook emigration through the delta. Because of the year-round sampling effort at Chipps Island, physical resources are difficult to share among other IEP monitoring projects. The Whitesel has been used by other projects when available. Other IEP agencies (NOAA Fisheries, DFG, and DWR) frequently request biological samples obtained through the Chipps Island trawling (otoliths, DNA, and other biological samples.)

6. Please identify and briefly describe any opportunities for additional program element integration.

The entire FWS monitoring program is highly integrated with other IEP agencies. As an agency we remain open to all opportunities for integration.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

a. Assess and incorporate new variables

In the last few years a QA/QC biologist was added to the staff to improve fish identification and to help quantify our fish ID error rate. In the mid-1990's we determined not to identify fish of less than 25 mm, since we were not confident of identification for that size in the field and our sampling gear does not target fish in this size range.

b. Field or analytical studies to assess current and new sampling methods

Minor modifications are evaluated frequently. For instance the size of the mesh of the net was changed in the mid-1990's to catch fewer delta smelt without significantly changing the capture efficiency for juvenile salmon. (See section VI #2)

c. Analytical studies to evaluate current and new analytical methods

d. Evaluation of new technologies or new gear types

e. Review and improve monitoring program element processes

A significant amount of time was dedicated to the review of this program in 2000.

f. Using historical information to change the program element design

One of the recommendations that came out of the 2000 review was decreased sampling at Chipps Island during May and June. This recommendation was

implemented and IEP funded sampling was reduced from 3 days per week to 2 days per week. Functionally, sampling occurs 7 days per week during May and June since funding is provided through other sources.

g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   Data are uploaded to BDAT at least weekly year round.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   Yes, Chipps Island data from 1976 to present is available.

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   Data are entered into our local database, QA/QC'd within 2 days and posted on BDAT within one week. Final QA/QC of data are usually finished within 3 months of the end of our field season (July, 31) and updated on BDAT (final data QC and updated by Nov 1).

4. Are there web-based data presentations of the program data (e.g., the 20-mm delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

   Although only late-fall yearlings are tagged with coded wire tags as part of a related IEP program, all coded wire tag recovery data are available at http://www.delta.dfg.ca.gov/usfws/maps**. Real time data are posted to the DFG Real Time Monitoring website at** http://www.delta.dfg.ca.gov/data/rtm2004/**.**

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   Brandes, P.L., and J.S. McLain. 2001. Juvenile chinook salmon abundance, distribution, and survival in the Sacramento-San Joaquin Estuary. Pages 39-138 in R.L. Brown, editor. Contributions to the Biology of Central Valley Salmonids: Fish Bulletin 179, Vol. 2. State of California, The Resources Agency, Department of Fish and Game, Sacramento, CA.

   Kjelson, M.A., and P.L. Brandes. 1989. The use of smolt survival estimates to quantify the effects of habitat changes on salmonid stocks in the Sacramento-San Joaquin rivers, California. Special Publication of Canadian Journal of Fisheries and Aquatic Sciences 105:100-115.

Kjelson, M.A., P.F. Raquel, and F.W. Fisher. 1982. Life history of fall-run juvenile chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento-San Joaquin Estuary, California. Pages 393-411 in V.S. Kennedy, editor. Estuarine comparisons. Academic Press, New York, NY.

Kjelson, M.A., P.F. Raquel, and F.W. Fisher. 1981. Influences of freshwater inflow on chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento-San Joaquin Estuary. Pages 88-108 in R.D. Cross, and D.L. Williams editors. Proceedings of the National Symposium on Freshwater Inflow to Estuaries. Coastal Ecosystems Project, Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior.

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.
7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.
8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.
9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.
10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.
11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

Brandes, P.L. 1996. Results of 1996 coded-wire tag smolt survival experiments in the San Joaquin River Delta. Interagency Ecological Program Newlsetter. 9(4):13-16

Brandes, P.L., and Pierce, M.M. 1998. 1997 salmon smolt survival studies in the South Delta. Interagency Ecological Program Newsletter. 11(1):29-38.

McLain, Jeff S. 1998. Relative efficiency of the midwater and Kodiak trawl at capturing juvenile chinook salmon in the Sacramento River. Interagency Ecological Program Newsletter. 11(4): 26-29.

McLain, Jeff S., and Burmester, R. 1999. Juvenile fall-run and winter-run chinook salmon abundance. Interagency Ecological Program Newsletter. 12(2) 35-38.

12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

Brandes, P., Perry, K., Chappell, E., McLain, J., Greene, S., Sitts, R., McEwan, D., and Chotkowski, M., Interagency Ecological Program. 2000. Delta Salmon Project Work Team Delta Juvenile Salmon Monitoring Program Review Stockton, CA

U.S. Fish and Wildlife Service. 1994. 1993 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

U.S. Fish and Wildlife Service. 1995. 1994 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

U.S. Fish and Wildlife Service. 1997. 1995 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

U.S. Fish and Wildlife Service. 1999. 1996 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

U.S. Fish and Wildlife Service. 2000. 1997/98 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

U.S. Fish and Wildlife Service. 2000. 1999 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

Kjelson, M, Greene, S., and Brandes, P.L. 1989. A model for estimating mortality and survival of fall-run chinook salmon smolts in the Sacramento River Delta between Sacramento and Chipps Island. U.S. Fish and Wildlife Service, Stockton, CA. 50pp.

U.S. Fish and Wildlife Service. 1987. Exhibit 31: The needs of chinook salmon, Oncorhynchus tshawystcha in the Sacramento-San Joaquin Estuary. Presented to the State Water Resources Control Board for the 1987 Water Quality/Water Rights Proceedings on the San Francisco Bay/Sacramento-San Joaquin Delta.

Contributions to the winter run biological opinion – Brandes

13. What products are planned for the next three years? Consider:

    a. Papers (refereed journal articles)

    - **Wild vs Natural Steelhead**
    - **Estimates of hatchery-reared juvenile Chinook captured at Chipps Island and implications for estimating survival of naturally-produced Chinook**
    - **A principal components analysis of CWT recoveries at Chipps Island and the salvage facilities**
    - **Biases in beach seine sampling**
    - **Estimates of trawl efficiency**

    b. IEP technical reports

    c. IEP newsletter articles

- **Newsletter articles as appropriate (status & trends, quarterly update, etc)**
- **A review of published literature on emigration behavior of juvenile Chinook**

d. IEP or CALFED workshop presentations

- **Presentations at IEP and CALFED workshops as appropriate**

e. AFS, ERF or other professional meeting presentations

- **AFS and CALFED Science conference presentations are planned**

f. Other

- **IEP Newletter articles, technical reports (white papers), IEP and CALFED workshop presentation.**

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DAT	**X**			**Real time distribution and abundance**
NOAA		**X**		**Long-term abundance of salmonids,**
DFG	**X**			**Abundance of splittail, delta smelt**
USGS			**X**	**Comparison of hydroacoustic gear with trawl**
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
EWA	**X**			**The sampling recoveries marked fish used to evaluate water project affects and management alternatives**
Through –Delta PWT		**X**		**Same as above**
DCC PWT		**X**		**Same as above**
Sport Fish Management Entities				
Regulatory Agencies				
NOAA		**X**		**We provide valuable data on salmon in the delta to NOAA and other regulatory agencies to assess projects or impacts**
USFWS	**X**			**Same as above**
DFG	**X**			**Same as above**
Outside government, academic, or consultant entities				
SP Cramer		**X**		**The survival data has been used extensively. IEP helped recover marked fish**
Cal Trans			**X**	
UC Davis			**X**	
Romberg Tiburon Center			**X**	
Hanson Environmental		**X**		**Same as above**
Natural Resource Scientists Inc.		**X**		**Same as above**
San Joaquin River Group	**X**			**Same as above**

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the <u>frequent</u> customers identified in the table above <u>and selected, important moderate use</u> customers. Example uses include:

   See comments in above table

   a. Long-term abundance and distribution trends
   b. Life history information
   c. Population status
   d. Harvest rates
   e. Recruitment rates
   f. Abundance and distribution information for water operations/EWA actions
   g. Recovery criteria
   h. Species status reviews
   i. Site-specific information
   j. Project impact assessment
   k. Other

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

   As a program we strive for a high level of customer satisfaction

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   Chipps Island trawl is one of the longest running monitoring programs in the estuary, and data are used by a wide variety of people and organizations. It also provides real-time data to help manage water operations for several months of the year when ESA-listed winter and spring run Chinook salmon are typically emigrating.

   Information from the Chipps Island trawl integrates with data collected on two other trawls (Sacramento and Mossdale) and the beach seine survey, to help assess the populations and life history of various fishes in the Sacramento-San Joaquin Rivers and estuary.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   We would like to look at other trawling methods (e.g., otter trawl, shore line kodiak trawling) to help assess the limitations of the Chipps Island trawl in assessing juvenile fish populations. We would like to evaluate the possibility of using other sampling methods to complement midwater trawling at Chipps

Island. In addition we would like to analyze the sampling effort by time of day and tidal cycle to look at possible differences in catch abundance and composition.

Given the number of fish species in the system and the lack of information on many of them, we would like to look at integrating our monitoring work with other research to better understand the relative abundance and life history of native and non-native fishes in the area.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   See #2 above. We are planning on analyzing capture data of Chinook salmon at Chipps Island to look at 1) the proportion of Chinook that are hatchery-origin versus natural-origin, and 2) the relative composition of coded-wire tagged Chinook captured at Chipps Island compared to those captured at the water pumping facilities.

4. Do you have any ideas for other useful program element products?

   We would like to produce more peer-reviewed publications to make our data and analyses available to a wider audience.

5. Please provide any other comments you may have.

B 13) Sacramento Trawl Survey (USFWS)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   USFWS Sacramento Trawl

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Paul Cadrett, Larry Hansen, Lia McLaughlin

3. Please list the dates you started and finished this questionnaire.

   4/15 – 5/14

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   USFWS

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   Yes as a part of the Delta Salmon Project Work Team - Delta Juvenile Salmon Monitoring Program Review, July 2000.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   We provide near real-time data to BDAT throughout the year. We participate in IEP workshops and contribute to the IEP newsletter throughout the year. We provide information during DAT calls for salmon when appropriate. In addition, we provide daily real time data to the DFG server from April 1 through June 30 each year (available at http://www.delta.dfg.ca.gov/data/rtm2004/)

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

   Sampling at the Sacramento trawl most directly addresses Goal 1, Objectives a, b, c, and i, by providing year-round data on relative abundance of specific aquatic

species of interest. These data are used in conjunction with environmental data (e.g., flow) available from other sources to evaluate the effects of environmental variables on relative abundance. Goal 1, Objective 2 is also addressed (see responses to Question III and VI). Our program does not directly address Goal 2, but the data we collect are likely useful to other IEP programs which do address this goal.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   None

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   See Figure 1 and Table 1

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)

    The Sacramento trawl is positioned in the Sacramento River upstream of the delta. The trawl was originally located here in order to capture out migrating and marked juvenile Chinook salmon as they entered the delta.

    b. random
    c. stratified (give number of sites per stratum, and if they were chosen in a random or systematic way)
    d. rotating panel
    e. other

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Sampling occurs 3 days per week throughout most of the year. Sampling is reduced to 2 days per week in May and June. Originally the sampling at Sacramento was designed to estimate the survival and abundance of fall run Chinook salmon entering the delta during the spring. In the mid 1990's, sampling was expanded to the rest of the year to better document the abundance of other races and species of juvenile salmonids and other delta juvenile fishes (see figure 1).

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    See question 11 above.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: **standard operating procedures**

Sac trawl.xls). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: **Fish Monitoring Resources and Budget FWS Sac trawl.xls**) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis
    - Web page maintenance
    - Reporting & writing
    - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
    - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt/juv**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	poor	good	good	poor	Efficiency increases for larger salmonids with use of Kodiak trawl
Spring-run Chinook	poor	good	good	poor	
CV steelhead	poor	fair	fair	poor	
Coastal steelhead	N/A	N/A	N/A	N/A	
Delta smelt	N/A	N/A	poor	poor	
Splittail	N/A	N/A	poor	poor	

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt/juv**	**Yearlings**	**Year 2+**	**Comments**
Longfin smelt	N/A	N/A	poor	poor	
Green sturgeon	poor	poor	poor	poor	
Starry flounder	N/A	N/A	N/A	N/A	
Sport Fishes					
Fall-run Chinook	good	good	poor	N/A	
Striped bass	poor	poor	poor	poor	
White sturgeon	poor	poor	poor	poor	
Catfish	poor	poor	poor	poor	
American shad	fair	fair	fair	poor	
Largemouth bass	poor	poor	poor	poor	
Surfperch	N/A	N/A	N/A	N/A	
Habitats					
Nearshore (≤ 2 m depth)	N/A	N/A	N/A	N/A	
Nearshore vegetated	N/A	N/A	N/A	N/A	
Nearshore, other structures	N/A	N/A	N/A	N/A	
Nearshore open water	good	good	good	good	
Pelagic	N/A	N/A	N/A	N/A	
Marsh	N/A	N/A	N/A	N/A	
Floodplain	N/A	N/A	N/A	N/A	
Benthic	N/A	N/A	N/A	N/A	
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions	Detection of invasives is poor to excellent depending the species and their vulnerability to the midwater trawl. Tracking of new invasive species is poor since the sampling site is stationary				

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

   See Figure 1 for complete sampling record. Data are limited prior to the mid 1990's. Since about 1995 data have been collected year-round (except for July and August 1998). Analyses of trend data prior to 1995 are difficult because sampling was sparse.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

   The Sacramento trawl occurs exclusively in the North Delta region.

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to

reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution, or abundance?

Trawling on the Sacramento River began in 1976 at river mile 43 (RM43) and remained at this location through 1982. In 1988 trawling was conducted at RM55. Trawling occurred at RM35 and RM36 in 1990. Trawling returned to RM55 in 1991, and (except for some limited sampling at RM36, RM47, RM48, RM50, and RM53) currently remains at RM55.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

The Sacramento River trawl is closely integrated with other FWS IEP operations. Data collected at this location are used, along with other sampling throughout the estuary, to document the timing of juvenile Chinook entry into the delta. Because of the year-round sampling effort at Sacramento, physical resources are difficult to share among other IEP monitoring projects. Other IEP agencies (e.g., NOAA Fisheries, DFG, and DWR) frequently request biological samples obtained through the Sacramento River trawling (otoliths, DNA, and other biological samples.)

6. Please identify and briefly describe any opportunities for additional program element integration.

The entire FWS monitoring program is highly integrated with other IEP programs. As an agency we remain open to all opportunities for integration.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   In the last few years, a QA/QC biologist was added to the staff to improve fish identification and to help quantify our fish ID error rate. In the mid-1990's we determined not to identify fish of less than 25 mm, since we were not confident of identification for that size in the field and our sampling gear does not target fish in this size range.

   b. Field or analytical studies to assess current and new sampling methods

   Minor modifications are evaluated frequently (see section VI #2).

   c. Analytical studies to evaluate current and new analytical methods

   d. Evaluation of new technologies or new gear types

   e. Review and improve monitoring program element processes

   A significant amount of time was dedicated to the review of this program in 2000.

f. Using historical information to change the program element design

Historical data are used to evaluate the program element design (e.g., in the 2000 review). Changes are incorporated when appropriate and feasible.

g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   YES. Data are uploaded to BDAT at least weekly year round.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   Yes, Sacramento Trawl data from 1988 to present are available.

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   Data are entered into our local database, QA/QC'd within 2 days and posted on BDAT within 1 week. Final QA/QC of data are usually finished within 3 months of the end of our field season (July, 31) and updated on BDAT (final data QC and updated by Nov 1).

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

   Although only late-fall yearlings are tagged with coded wire tags as part of a related IEP program, all coded wire tag recovery data are available at http://www.delta.dfg.ca.gov/usfws/maps. Real time data are posted to the DFG Real Time Monitoring website at http://www.delta.dfg.ca.gov/data/rtm2004/.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

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10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.
11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.

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12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

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U.S. Fish and Wildlife Service. 1987. Exhibit 31: The needs of chinook salmon, Oncorhynchus tshawystcha in the Sacramento-San Joaquin Estuary. Presented to the State Water Resources Control Board for the 1987 Water Quality/Water Rights Proceedings on the San Francisco Bay/Sacramento-San Joaquin Delta.

Contributions to the winter run biological opinion – Brandes

13. What products are planned for the next three years? Consider:

   a. Papers (refereed journal articles)
      - **Wild vs Natural Steelhead**
      - **Estimates of trawl efficiency**

   b. IEP technical reports

   c. IEP newsletter articles
      - **Newsletter articles as appropriate (status & trends, quarterly update, etc)**
      - **A review of published literature on emigration behavior of juvenile Chinook**

   d. IEP or CALFED workshop presentations
      - **Presentations at IEP and CALFED workshops as appropriate**

   e. AFS, ERF or other professional meeting presentations

- **AFS and CALFED Science conference presentations are planned**

f. Other

- **IEP Newletter articles, technical reports (white papers), IEP and CALFED workshop presentation.**

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DAT	**X**			**Real time distribution and abundance**
NOAA		**X**		**Long-term abundance of salmonids,**
DFG	**X**			**Abundance of splittail, delta smelt**
USGS			**X**	**Comparison of hydroacoustic gear with trawl**
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
EWA	**X**			**The sampling recovers marked fish used to evaluate water project effects and management alternatives**
Through –Delta PWT		**X**		**Same as above**
DCC PWT		**X**		**Same as above**
Sport Fish Management Entities				
Regulatory Agencies				
NOAA		**X**		**We provide valuable data on salmon in the delta to NOAA and other regulatory agencies to assess projects or impacts**
USFWS	**X**			**Same as above**
DFG	**X**			**Same as above**

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
Outside government, academic, or consultant entities				
SP Cramer		**X**		**The survival data have been used extensively. IEP helped recover marked fish**
Cal Trans			**X**	
UC Davis			**X**	
Romberg Tiburon Center			**X**	
Hanson Environmental		**X**		**Same as above**
Natural Resource Scientists Inc.		**X**		**Same as above**
San Joaquin River Group	**X**			**Same as above**

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:

   See comments in above table

   a. Long-term abundance and distribution trends
   b. Life history information
   c. Population status
   d. Harvest rates
   e. Recruitment rates
   f. Abundance and distribution information for water operations/EWA actions
   g. Recovery criteria
   h. Species status reviews
   i. Site-specific information
   j. Project impact assessment
   k. Other
3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

Sacramento trawl is one of the longest running monitoring programs in the area, and data are used by a wide variety of people and organizations. It provides real-time data to help manage water operations for several months of the year when ESA-listed winter Chinook salmon are typically emigrating.

Information from the Sacramento trawl integrates with data collected on two other trawls (Mossdale and Chipps Island) and the beach seine survey to help assess the populations and life history of various fishes in the Sacramento-San Joaquin Rivers and estuary.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   We would like to look at other trawling methods (e.g., otter trawl) to help assess if Sacramento trawl catches are representative of the juvenile fish populations. We would also like to evaluate the possibility of using other sampling methods to complement midwater and kodiak trawling at Sacramento. In addition to changes in sampling methods, we would like to look at varying sampling effort by time of day and tidal cycle to look at possible differences in catch abundance and composition.

   Given the number of fish species in the system and the lack of information on many of them, we would like to look at integrating our monitoring work with other research to better understand the life history of native and non-native fishes in the area.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   See #2 above.

4. Do you have any ideas for other useful program element products?

   We would like to produce more peer-reviewed publications to make our data and analyses available to a wider audience.

5. Please provide any other comments you may have.

B 14) Mossdale Trawl Survey (USFWS)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   USFWS Mossdale Trawl

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Paul Cadrett, Lia McLaughlin, Larry Hansen

3. Please list the dates you started and finished this questionnaire.

   4/15 – 5/14

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   USFWS

5. Has this monitoring program element been reviewed in the past? If so, when? Is a review report available? If yes, please give a reference.

   Yes as a part of the Delta Salmon Project Work Team - Delta Juvenile Salmon Monitoring Program Review, July 2000.

6. Provide an overview of the products of this monitoring program element. Products include maintained data bases, reports and publications, contribution to water project operations (e.g. DAT calls), workshop and conference contributions, outreach activities, etc.

   We provide near real time data to the BDAT throughout the year. We participate in IEP workshops and contribute to the IEP newsletter throughout the year. We provide information during DAT calls for salmon when appropriate, in addition we provide daily real time data to the DFG server from April 1 through June 30 each year (available at http://www.delta.dfg.ca.gov/data/rtm2004/)

7. Which of the goals and objectives are most directly addressed by the current program element? Please specify why you think these goals and objectives apply to the program element, as it currently exists. Your answer to this question may be the same as your answer to question 4 above, depending on how the monitoring program has evolved over time.

   Sampling at Mossdale most directly addresses Goal 1, Objectives a, b, c, and i, by providing year-round data on relative abundance of specific aquatic species of

interest. These data are used in conjunction with environmental data (e.g. flow) available from other sources to evaluate the effects of environmental variables on relative abundance. Goal 1, Objective 2 is also addressed (see responses to Question III and VI). Our program does not directly address Goal 2, but the data we collect are likely useful to other IEP programs which do address this goal.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   None

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   See Figure 1 and Table 1

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. systematic (e.g. at or near sites of special interest such as fish facilities, at equal distances along a transect, etc.)

    The Mossdale trawl is located just upstream of entry into the delta before any branching occurs. This sampling location was chosen in order to monitor entry of juvenile salmon into the delta from the San Joaquin River.

    b. random
    c. stratified (give number of sites per stratum, and if they were chosen in a random or systematic way)
    d. rotating panel
    e. other

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Generally sampling occurs 3 days per week year round depending on minimum water flow requirements. Sampling effort is taken over by DFG Region IV during the Spring April – May with some FWS support (see Figure 1).

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    Originally sampling occurred in the winter and early spring to capture the peak out migration of juvenile salmonids. Sampling has increased in response to increasing interest in San Joaquin River salmon and other delta fishes.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: **standard operating procedures Mossdale.xls**). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: **Fish Monitoring Resources and Budget FWS Mossdale Trawl.xls**) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management
    - Field work
    - Lab processing
    - Data management
    - Data analysis
    - Web page maintenance
    - Reporting & writing
    - Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
    - Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt/Juv**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook	N/A	N/A	N/A	N/A	
Spring-run Chinook	N/A	N/A	N/A	N/A	
CV steelhead	poor	poor	poor	poor	
Coastal steelhead	N/A	N/A	N/A	N/A	
Delta smelt	poor	poor	poor	poor	
Splittail	fair	fair	fair	fair	
Longfin smelt	poor	poor	poor	poor	
Green sturgeon	poor	poor	poor	poor	
Starry flounder	N/A	N/A	N/A	N/A	
Sport Fishes					
Fall-run Chinook	good	good	poor	N/A	
Striped bass	poor	poor	poor	poor	
White sturgeon	poor	poor	poor	poor	
Catfish	poor	poor	poor	poor	
American shad	fair	fair	fair	poor	
Largemouth bass	poor	poor	poor	poor	
Surfperch	N/A	N/A	N/A	N/A	

Group/Species	Life Stage				
	Larvae/Fry	**Smolt/Juv**	**Yearlings**	**Year 2+**	**Comments**
Habitats					
Nearshore (≤ 2 m depth)	N/A	N/A	N/A	N/A	
Nearshore vegetated	N/A	N/A	N/A	N/A	
Nearshore, other structures	N/A	N/A	N/A	N/A	
Nearshore open water	good	good	good	good	
Pelagic	N/A	N/A	N/A	N/A	
Marsh	N/A	N/A	N/A	N/A	
Floodplain	N/A	N/A	N/A	N/A	
Benthic	N/A	N/A	N/A	N/A	
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions	Detection of invasives is poor to excellent depending the species and their vulnerability to the kodiak trawl. Tracking of new invasive species is poor since the sampling site is stationary				

2. Over the sampling period of record what months or years of data are missing? (Please provide this information in tabular form if possible, with stations listed as column headings and time –years and months—listed as row headings.) How do these missing data affect data analysis or the information that can be derived?

   See Figure 1 for complete sampling record.

3. What proportion of monitoring program element field effort occurs in each IEP region? Use the attached map to identify the regions sampled and proportion of field effort allocated to each region by your monitoring program element. (Use the following formula to estimate proportional field effort by region: number of sampling sites in a region/total number of sampling sites in the program element.)

   The Mossdale kodiak trawl sampling occurs exclusively in the South Delta region.

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift. Please feel free to reference the information provided in question 9 above as appropriate. What effect(s), positive or negative, have any shifts in coverage had on understanding species migration timing, distribution or abundance?

   The sampling site for the Mossdale trawl has not changed.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements. First, briefly describe the relevant aspect of the program element and then describe the nature of the integration. For purposes of this questionnaire, integration is defined as the sharing of resources, data, or information between two or more program elements reducing duplication of effort or synergistically adding value.

The Mossdale trawl is highly integrated and resources from several agencies (DFG Region IV, DFG Bay Delta, FWS) are required in order to complete the sampling. Other IEP agencies (NOAA Fisheries, DFG, and DWR) frequently request samples obtained through the Mossdale trawling (otoliths, DNA, and other biological samples). Data are reported to BDAT as well as the DFG Real Time Monitoring web page.

6. Please identify and briefly describe any opportunities for additional program element integration.

The entire FWS monitoring program is highly integrated with other IEP agencies. As an agency we remain open to all integration opportunities.

III Program Element strengths and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   In the last few years a QA/QC biologist was added to the staff to improve fish identification and to help quantify our fish ID error rate. In the mid-1990's we determined not to identify fish of less than 25 mm, since we were not confident of identification for that size in the field and our sampling gear does not target fish in this size range.

   b. Field or analytical studies to assess current and new sampling methods

   Minor modifications are evaluated frequently (see Section VI #2).

   c. Analytical studies to evaluate current and new analytical methods

   d. Evaluation of new technologies or new gear types

   e. Review and improve monitoring program element processes

   A significant amount of time was dedicated to the review of this program in 2000.

   f. Using historical information to change the program element design

   One of the recommendations that came out of the 2000 review was increased sampling at Mossdale to determine if juvenile salmonids use the San Joaquin River throughout the year. Due to low flow conditions it is not always possible to sample throughout the summer months.

   g. Other

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database? If not, where is your data stored?

   Data are uploaded to BDAT at least weekly year round.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   Yes, all data collected by the FWS from the Mossdale trawl are available on BDAT.

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   Data are entered into our local database, QA/QC'd within 2 days and posted on BDAT within 1 week. Final QA/QC of data are usually finished within 3 months of the end of our field season (July, 31) and updated on BDAT (final data QC and updated by Nov 1).

4. Are there web-based data presentations of the program data (e.g., the 20-mm Delta smelt survey's "bubble plots," see http://www.delta.dfg.ca.gov/data/20mm/CPUE_map.asp)?

   Although only late-fall yearlings from Coleman NFH are tagged as part of a related IEP program, all coded wire tag recovery data are available at http://www.delta.dfg.ca.gov/usfws/maps. Real time data are posted to the DFG Real Time Monitoring website at http://www.delta.dfg.ca.gov/data/rtm2004/.

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7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.
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12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

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U.S. Fish and Wildlife Service. 2000. 1999 annual progress report: "Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin Estuary". Stockton, CA

Kjelson, M, Greene, S., and Brandes, P.L. 1989. A model for estimating mortality and survival of fall-run chinook salmon smolts in the Sacramento River Delta between Sacramento and Chipps Island. U.S. Fish and Wildlife Service, Stockton, CA. 50pp.

U.S. Fish and Wildlife Service. 1987. Exhibit 31: The needs of chinook salmon, Oncorhynchus tshawystcha in the Sacramento-San Joaquin Estuary. Presented to the State Water Resources Control Board for the 1987 Water Quality/Water Rights Proceedings on the San Francisco Bay/Sacramento-San Joaquin Delta.

Contributions to the winter run biological opinion – Brandes

13. What products are planned for the next three years? Consider:

a. Papers (refereed journal articles)

- **Wild vs Natural Steelhead**
- **Estimates of trawl efficiency**

b. IEP technical reports

c. IEP newsletter articles

- **Newsletter articles as appropriate (status & trends, quarterly update, etc)**
- **A review of published literature on emigration behavior of juvenile Chinook**

d. IEP or CALFED workshop presentations

- **Presentations at IEP and CALFED workshops as appropriate**

e. AFS, ERF or other professional meeting presentations

- **AFS and CALFED Science conference presentations are planned**

f. Other

- **IEP Newletter articles, technical reports (white papers), IEP and CALFED workshop presentation.**

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element? Please use the table that follows to identify the primary customers of data and information from this program element. Add rows under different customer-types as necessary. Please identify the frequency of use (using the column categories) where possible. Assume frequent use is two or more requests per annum, annual requests constitute moderate use, and less than annual is rare.

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DAT	**X**			**Real time distribution and abundance**
NOAA		**X**		**Long-term abundance of salmonids,**
DFG	**X**			**Abundance of splittail, delta smelt**
USGS			**X**	**Comparison of hydroacoustic gear with trawl**
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
EWA	**X**			**The sampling recoveries marked fish used to evaluate water project affects and management alternatives**
Through –Delta PWT		**X**		**Same as above**
DCC PWT		**X**		**Same as above**
Sport Fish Management Entities				
Regulatory Agencies				
NOAA		**X**		**We provide valuable data on salmon in the delta to NOAA and other regulatory agencies to assess projects or impacts**
USFWS	**X**			**Same as above**
DFG	**X**			**Same as above**
Outside government, academic, or consultant entities				
SP Cramer		**X**		**The survival data has been used extensively. IEP helped recover marked fish**
Cal Trans			**X**	
UC Davis			**X**	
Romberg Tiburon Center			**X**	

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
Hanson Environmental		**X**		**Same as above**
Natural Resource Scientists Inc.		**X**		**Same as above**
San Joaquin River Group	**X**			**Same as above**

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers. Example uses include:

   See comments in above table

   a. Long-term abundance and distribution trends
   b. Life history information
   c. Population status
   d. Harvest rates
   e. Recruitment rates
   f. Abundance and distribution information for water operations/EWA actions
   g. Recovery criteria
   h. Species status reviews
   i. Site-specific information
   j. Project impact assessment
   k. Other

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

   As a program we strive for a high level of customer satisfaction.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

   Mossdale trawl data are used by a wide variety of people and organizations. Information from the Mossdale trawl integrates with data collected on two other trawls (Sacramento and Chipps Island) and the beach seine survey, to help assess the populations and life history of various fishes in the Sacramento-San Joaquin Rivers and estuary.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   We would like to look at other trawling methods (e.g., otter trawl) to help assess if Mossdale trawl catches are truly representative of the juvenile fish populations. We would also like to evaluate the possibility of using other sampling methods to complement kodiak trawling at Mossdale. In addition to changes in sampling methods, we would like to look at varying sampling effort by time of day and tidal cycle to look at possible differences in catch abundance and composition.

   Given the number of fish species in the system and the lack of information on many of them, we would like to look at integrating our monitoring work with other research to better understand the life history of native and non-native fishes in the area.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   See #2 above.

4. Do you have any ideas for other useful program element products?

   We would like to produce more peer-reviewed publications to make our data and analyses available to a wider audience.

5. Please provide any other comments you may have.

B 15) Adult Sturgeon Tagging (Adult Sturgeon) (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Adult Sturgeon Tagging.

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Marty Gingras

3. Please list the dates you started and finished this questionnaire.

   5-26-04

4. Which agencies or universities are responsible for carrying out this program element, now and in the past?

   DFG- CVBDB.

5. Has this monitoring program element been reviewed in the past? If so, when?

   I don’t know.

6. Provide an overview of the products of this monitoring program element.

   A database containing release and recapture information, which presently contains over 12,000 records. Estimates of absolute adult white sturgeon abundance (using multiple-census methods) and mortality rate are calculated from the data. Reports are prepared and potential management actions are evaluated. Information is distributed to the public at conferences, through the popular press, on the CVBDB web site, etc.

7. Which of the goals and objectives are most directly addressed by the current program element?

   Status and trends of the ecological resources of the San Francisco Estuary, sport fishes in particular. Information from this work forms the scientific basis for management of a popular and at-risk fishery.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   This work speaks to the effectiveness of the CVPIA Anadromous Fish Restoration Plan.

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.

   Fish are sampled opportunistically throughout San Pablo Bay.

10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.

    a. Systematic:

    In San Pablo Bay during September and October, adult sturgeon are captured in drifting trammel nets, tagged (with individually-numbered plastic disks), and released.

11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Fish capture is scheduled intermittently, usually for two years in a row after skipping two years. Sampling on this schedule was thought to be sufficient for tracking trends, and tagging two successive years is necessary to estimate annual mortality rates.

12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    Not applicable.

13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
   - Supervision/program management
   - Field work
   - Lab processing
   - Data management
   - Data analysis

- Web page maintenance
- Reporting & writing
- Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
- Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook					
Spring-run Chinook					
CV steelhead					
Coastal steelhead					
Delta smelt					
Splittail					
Longfin smelt					
Green sturgeon				Fair	
Starry flounder					
Sport Fishes					
Fall-run Chinook					
Striped bass					
White sturgeon				Good	
Catfish					
American shad					
Largemouth bass					
Surfperch					
Habitats					
Nearshore (< 2 m depth)					
Nearshore vegetated					
Nearshore, other structures					
Nearshore open water					
Pelagic					
Marsh					
Floodplain					
Benthic					
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions					

2. Over the sampling period of record what months or years of data are missing?
3. What proportion of monitoring program element field effort occurs in each IEP region?

   100% San Pablo Bay/Napa River.

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift.

   No shifts.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements.

   White sturgeon population dynamics can be described by integrating information from this element, an index of year-class strength from sampling juvenile sturgeon, and Bay Study trawling.

   This element also collects and interprets data on green sturgeon, and the data were quite useful when green sturgeon were being considered for FESA listing.

6. Please identify and briefly describe any opportunities for additional program element integration.

   None are obvious to me.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables –

   Not ongoing or anticipated for at least two years.

   b. Field or analytical studies to assess current and new sampling methods

   Not ongoing or anticipated for at least two years.

   c. Analytical studies to evaluate current and new analytical methods

   Working with DFG Biometrics to evaluate validity of current confidence intervals and (if appropriate) to select alternative calculation of confidence intervals.

   d. Evaluation of new technologies or new gear types

   Not ongoing or anticipated for at least two years.

   e. Review and improve monitoring program element processes

   Currently reviewing all processes. Some changes are likely, and will likely improve QA, QC, data processing rate, and ease of analysis.

   f. Using historical information to change the program element design

   Comprehensive data report (a retrospective) with an evaluation of biases and errors, and recommended changes.

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database?

   No. At present, data is stored on a server and on several PC's at CVBDB in Stockton.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   N/A

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   This is highly variable and depends primarily on the time necessary to assign ages to sampled fish by interpretation of fin ray annuli. However, meaningful data (excluding ages) can – and should – be posted within a month of collection.

4. Are there web-based data presentations of the program data?

   No.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

   David W. Kohlhorst. 1976. Sturgeon Spawning in the Sacramento River in 1973, as Determined by Distribution of Larvae. California Fish and Game. 62(1):32-40

   David W. Kohlhorst. 1979. Effect of first pectoral fin ray removal on survival and estimated harvest rate of white sturgeon in the Sacramento-San Joaquin estuary. California Fish and Game. 65:173-177

   David W. Kohlhorst. 1980. Recent Trends in the White Sturgeon Population in California's Sacramento-San Joaquin Estuary. California Fish and Game. 66(4):210-219

   David W. Kohlhorst, Lee W. Miller, and James J. Orsi. 1980. Age and Growth of White Sturgeon Collected in the Sacramento-San Joaquin Estuary, California: 1965-1970 and 1973-1976. California Fish and Game. 66(2):83-95

   Lee W. Miller. 1972. White Sturgeon population characteristics in the Sacramento-San Joaquin Estuary as Measured by Tagging. California Fish and Game. 58:94-101

   Lee W. Miller. 1972. Migrations of Sturgeon Tagged in the Sacramento-San Joaquin Estuary. 58:102-106

   Raymond G. Schaffter and David W. Kohlhorst. 1999. Status of White Sturgeon in the Sacramento-San Joaquin Estuary. California Fish and Game. 85(1):37-41

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

   David W. Kohlhorst, L.W. Botsford, J. S. Brennan and G. M. Cailliet. 1991. Aspects of the Structure and Dynamics of an Exploited Central California Population of White Sturgeon (Acipenser transmontanus). P. Williot, Ed. Acipenser, CEMAGREF Publ. 277-293

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.
8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.
9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.
10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.
11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.
12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

    DFG's "Comments to NMFS" Regarding Green Sturgeon Listing", 2002

13. What products are planned for the next three years? Consider:
    a. Papers (refereed journal articles)
    b. IEP technical reports

    Comprehensive (retrospective) data report with an evaluation of biases and errors.

    c. IEP newsletter articles

    Updated estimates and interpretation relative to recent estimates.

    d. IEP or CALFED workshop presentations
    e. AFS, ERF or other professional meeting presentations
    f. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element?

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DFG		X		
DWR			X	
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
Sport Fish Management Entities				
DFG		X		
Regulatory Agencies				
DFG		X		
NMFS				
USFWS		X		
SWRCB			X	
Outside government, academic, or consultant entities				

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the <u>frequent</u> customers identified in the table above <u>and selected, important moderate use</u> customers.
   a. DFG: Long-term abundance trends, population status, harvest rates, recruitment rates, and project impact assessment.
   b. DWR: Long-term abundance trends, population status, recruitment rates, and project impact assessment.

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.
   All recognize the very long time series is unique and valuable. We recognize that imprecision of the abundance estimates substantially limits their utility.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?
   The white sturgeon are the basis of a valuable recreational fishery in California. Due to their life history, they are also extremely vulnerable to overharvest and habitat loss. To the maximum feasible extent, it is thus prudent to manage sturgeon on a rigorously rational basis. This study uses very sound methods and is "best available science", but lacks the scale (read, lacks the budget) necessary to develop information necessary to prudently manage sturgeon.

2. Please provide any comments you may have on ways to improve the monitoring program element.

   Although we can't be certain without the results of cost:benefit analyses and simple modeling to determine likely effects of changes to the element, it seems very likely that precision of abundance estimates and accuracy of annual mortality rates can be substantially improved by increasing sampling effort (i.e., both for tagging and tag recovery).

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.
   With increased sampling effort, it may become feasible to estimate abundance using one of several modern analytical algorithms in lieu of the classic multiple-census method currently used.

4. Do you have any ideas for other useful program element products? **No**.

5. Please provide any other comments you may have.
   Budget resources historically allocated to this element have been very small relative to (1) the probability of mismanaging sturgeon and (2) future (likely) costs due to any mismanagement of sturgeon. Additional funding and staff resources via the IEP and/or the new Bay-Delta Sport Fish Enhancement Stamp should be applied here, if only for a limited term to test feasibility of new analytical algorithms and/or utility of additional sampling effort.

B 16) Adult Striped Bass Tagging (Adult Striped Bass) (DFG)

Questionnaire for IEP Fish Monitoring Program Elements

Please provide answers to the questions below by inserting your answers directly below each question. Save the completed questionnaire as an MS Word file. Use the name of your monitoring program as the name of the file (e.g., 20-mm Survey.doc). Please do the same with the Excel files. We ask that you scan any hard copy documents (e.g., figures with site locations or other supporting materials) and save them in PDF format. Please email all completed documents to Zach Hymanson at Zachary@water.ca.gov by April 1. 2004.

I Basic Information and Program Element Description:

1. What is the name of the monitoring program element you are providing information for?

   Adult Striped Bass Tagging.

2. Please provide the name(s) of the person (people) completing this questionnaire.

   Marty Gingras

3. Please list the dates you started and finished this questionnaire.

   3-11-04 to 4-27-04

4. Which agencies or universities are responsible for carrying out this program element, now and in the past? At present,

   DFG- CVBDB. In the past, DFG - CVBDB/R-2.

5. Has this monitoring program element been reviewed in the past? If so, when?

   I don't know.

6. Provide an overview of the products of this monitoring program element.

   Two databases, one of fish that have been tagged and one of tags that have been recovered. Estimates of absolute adult striped bass abundance (via Petersen method; with confidence intervals), harvest rate, and mortality rate are calculated from the data. Reports are prepared and potential management actions are evaluated. Information is distributed to the public at conferences, through the popular press, on the CVBDB web site, etc.

7. Which of the goals and objectives are most directly addressed by the current program element?

   Status and trends of the ecological resources of the San Francisco Estuary, sport fishes in particular. Information from this work forms the scientific basis for management of a very valuable fishery and has been the basis of much work on processes that influence ecological resources in the Estuary.

8. Please list any substantial program element objectives that are separate from (in addition to) current IEP goals and objectives.

   This work has been required under the terms of an incidental take permit to manage the striped bass fishery.

9. Please provide a figure and/or table showing sampling station locations and changes through time. If you have geographic coordinates for the sampling stations please include those as well.
10. Characterize the original monitoring design strategy for this program element (if known). Chose one or more of the following and add a brief explanation. Please also mention changes in the monitoring design strategy over time. Optionally, you may also comment on the pros and cons of the design of your program element.
    a. Systematic:

    Adult striped bass are captured and tagged only (1) near the confluence of the Sacramento and San Joaquin rivers, and (2) on the Sacramento River near Knights Landing, and only during their spawning run.

    b. Haphazard:

    Tagged (and un-tagged) adult striped bass are observed in the creel of anglers throughout the San Francisco Estuary, with sampling effort being directed in an effort to maximize the number of observed adult striped bass. Adult striped bass are also observed during tagging.
11. What are the sampling frequency and annual sampling period, and why were they chosen?

    Tagging is annual and during the spawning migration, so that the population estimate is of spawners and recruitment can be directly estimated. Creel is observed year-round, to maximize the number of adult striped bass observed and (thereby) reduce the estimate confidence intervals.
12. Has the sampling frequency changed through time? If so, please describe how and when these changes occurred.

    Tagging was annual from 1969 through approximately 1994, then (to save money) in alternate years to 2002. Annual tagging began again in 2003, to address a degradation in abundance estimate quality (e.g., confidence intervals).
13. Please provide a methods overview for this monitoring program element using the attached Excel spreadsheet (file name: standard operation procedures). Please restrict your descriptions to your routine monitoring procedures. Do not include information about occasional additional sampling or special studies sampling.

Please use the attached Excel spreadsheet (file name: resources and budget) to answer the next three questions:

1. What resources are currently required to complete this program element?
2. What is the current annual budget for this program element? Please provide this information for the calendar year (January – December) not the State or Federal fiscal year.
3. What is the current staff effort (days/month) for this program element? Use the following categories in your spreadsheet as appropriate:
    - Supervision/program management

- Field work
- Lab processing
- Data management
- Data analysis
- Web page maintenance
- Reporting & writing
- Regulatory matters (e.g., CESA/FESA review, agency permitting activities, CEQA/NEPA review, etc.)
- Other (e.g. DAT participation, CALFED workshop participation, responding to data requests, etc.)

II Program Element Strengths and Weaknesses in Fulfilling Goal 1, Objective 1:

1. Please identify the ability of this program element to monitor the abundance and distribution of species life stages listed in the table below. Use the following ratings as your estimate of the program element's ability with regards to each life-stage: excellent, good, fair, or poor.

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Species of Concern					
Winter-run Chinook					
Spring-run Chinook					
CV steelhead					
Coastal steelhead					
Delta smelt					
Splittail					
Longfin smelt					
Green sturgeon					
Starry flounder					
Sport Fishes					
Fall-run Chinook					
Striped bass				Varying annually from good to excellent	
White sturgeon					
Catfish					
American shad					
Largemouth bass					
Surfperch					
Habitats					
Nearshore (≤ 2 m depth)					
Nearshore vegetated					
Nearshore, other structures					
Nearshore open water					

Group/Species	**Life Stage**				
	Larvae/Fry	**Smolt**	**Yearlings**	**Year 2+**	**Comments**
Pelagic					
Marsh					
Floodplain					
Benthic					
Other assemblage (ID in comment cell)					
Detection and tracking of new invasions					

2. Over the sampling period of record what months or years of data are missing?

   Adult striped bass were not tagged in 1995, 1997, 1999, and 2001. However, creel has been observed annually. These missing data tend to reduce the quality of the estimates.

3. What proportion of monitoring program element field effort occurs in each IEP region?

   50% Central and West Delta; 50% Upstream Sacramento River.

4. If there have been shifts in the sampling area covered over the term of the program element, please describe what shifts have occurred, when they occurred, why they occurred and the duration of the shift.

   Location of fyke traps used to capture adult striped bass for tagging during spring has twice been moved further upstream. Evidently, the moves were in response to limits/changes to levee access. These changes affect comparisons of (in particular) absolute adult striped bass abundance. Due to several factors (e.g., persistent location spawning areas in Sacramento River, high stability of gill net sites, large geographic coverage of creel survey), the degree of effect is likely small.

5. Please describe any aspects of your monitoring program element that are integrated with other program elements.

   The element is integrated only to the extent that data from this element, FMWT, and TNS are necessary for a thorough understanding of striped bass population dynamics.

6. Please identify and briefly describe any opportunities for additional program element integration.

   This element should solicit data on adult striped bass captured during sampling for other elements, and consider the data equivalent to data from the creel.

III Program Element strength and weaknesses in fulfilling Goal 1, Objective 2:

1. What is the program element staff doing to continually assess and improve the long-term monitoring effort in support of management priorities? Please provide short responses for each of the categories listed below:

   a. Assess and incorporate new variables

   Not ongoing or anticipated for at least two years.

b. Field or analytical studies to assess current and new sampling methods

Not ongoing, but (1) minor work to improve retention of fish in traps is planned, (2) minor work to improve survival of fish sampled via gill nets is planned, and (3) work to test feasibility of new tag-types is planned.

c. Analytical studies to evaluate current and new analytical methods

Working with DFG Biometrics to evaluate validity of current confidence intervals and (if appropriate) to select alternative calculation of confidence intervals.

d. Evaluation of new technologies or new gear types

See b, above.

e. Review and improve monitoring program element processes

Currently reviewing all processes. Substantial changes are likely, and will likely improve QA, QC, data processing rate, and ease of analysis.

f. Using historical information to change the program element design

Comprehensive data report (a retrospective) with an evaluation of biases and errors, and recommended changes.

IV Data Products:

1. Is the data available on the Bay-Delta Tributaries (BDAT) database?

   No. At present, data is stored on a server and on several PC's at CVBDB in Stockton. Data and metadata were on the IEP web site as of several years ago, and I'm preparing a process to begin routing data to BDAT.

2. Are all years of data available on the BDAT? If not, what years are available on the BDAT?

   N/A

3. How much time elapses from collection of field data to posting of data on IEP web page or to a data set that has gone through all quality control steps?

   This is highly variable and depends primarily on the time necessary to assign ages to sampled fish by interpretation of scale annuli. For example, in 2003-2004 we eliminated a several-year backlog of scales. However, meaningful data (excluding ages) can – and should – be posted within a month of collection.

4. Are there web-based data presentations of the program data?

   Some static plots are posted on the CVBDB web site.

Please refer to the IEP Newsletter and Technical Reports bibliography at (http://iep.water.ca.gov/report/iep_bibliography.html) to help you in preparing responses to the following eight questions (questions 5-12). Please consult other bibliographies or resources as appropriate. Please focus on listing reports, papers, etcetera that directly report program element results or make direct use of program element data.

5. List the papers (refereed journal articles) produced since 1994 by staff assigned to the specific monitoring program element. If applicable, also list such papers produced prior to 1994.

D. E. Stevens. 1977. Striped Bass (Morone saxatilis) Year Class Strength in Relation to River Flow in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society106(1) 34-42

D. E. Stevens and others. 1987. Striped Bass

D. E. Stevens; D. W. Kohlhorst; L. W. Miller. 1985. The Decline of Striped Bass in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society. 114

D. E. Stevens; L. W. Miller. 1983. Effects of River Flow on Abundance of Young Chinook Salmon, American Shad, Longfin Smelt, and Delta Smelt in the Sacramento-San Joaquin River System North American Journal of Fisheries Management. 3:425-437

Donald E. Stevens; Harold K. Chadwick. 1987. American Shad and Striped Bass in California's Sacramento-San Joaquin River System American Fisheries Society Symposium. 1:66-78

6. List the papers produced since 1994 that were co-authored by program element staff and others outside the program element, and if applicable such papers produced prior to 1994.

William J. Kimmerer; James H. Cowan, Jr.; Lee W. Miller; Kenneth A. Rose 2000. Analysis of an Estuarine Striped Bass (Morone Saxatilis) Population: Influence of Density-Dependent Mortality between Metamorphosis and Recruitment. Canadian Journal of Fisheries and Aquatic Science 57 478-486

7. List the papers produced by scientists outside the program element since 1994, and if applicable such papers produced prior to 1994.

William J. Kimmerer; James H. Cowan, Jr.; Lee W. Miller; Kenneth A. Rose. 2001. Analysis of an Estuarine Striped Bass Population: Effects of Environmental Conditions During Early Life. Estuaries 24(4) 557-575

8. List the IEP technical reports produced since 1994 by specific program staff, and if applicable such reports produced prior to 1994.
9. List the IEP technical reports produced since 1994 where staff was coauthor with others outside the program, and if applicable such reports produced prior to 1994.
10. List the IEP technical reports produced since 1994 by people other than specific program staff, and if applicable such reports produced prior to 1994.

William A. Bennett. 1997. El Ninos and the Decline of Striped Bass. Interagency Ecological Program Newsletter 10(4) 7-10

William J. Kimmerer. 1997. Flow Effects and Density Dependence in Striped Bass. Interagency Ecological Program Newsletter 10(4) 11-15

11. List the IEP Newsletter Articles produced since 1994 by specific program element staff.
12. List other contributions to scholarly works; regulatory or management actions; angler or public informational articles; academic works (e.g., Ph.D. dissertation or Masters thesis); gray literature; written testimony for water right hearings; written

contributions to biological opinions/consistency determinations; written contributions to listing decisions; DAT interpretations/findings; changes in fishing regulations; EIR/S; or written contributions to CALFED, AFS, or ERF meetings or symposia.

L. W. Botsford; R. G. Kope. 1987. Stock-Recruitment Relationship in Striped Bass

L. W. Botsford; R. G. Kope. 1987. Comparison of Two Indices of Adult Striped Bass Abundance

David W. Kohlhorst. 1992. Testimony of David W. Kohlhorst on the Striped Bass Model State Water Resources Control Board

David W. Kohlhorst; Donald E. Stevens; Lee W. Miller. 1992. A Model for Evaluating the Impacts of Freshwater Outflow and Export on Striped Bass in the Sacramento-San Joaquin Estuary State Water Resources Control Board 1992 Water Rights Phase of the Bay-Delta Estuary Proceedings WRINT-DFG-Exhibit #3

13. What products are planned for the next three years? Consider:
    a. Papers (refereed journal articles)
    b. IEP technical reports

    Comprehensive (retrospective) data report with an evaluation of biases and errors.

    c. IEP newsletter articles

    Updated estimates and interpretation relative to recent estimates, where recent estimates are controversial due to their imprecision and suggestion of a substantial abundance increase.

    d. IEP or CALFED workshop presentations
    e. AFS, ERF or other professional meeting presentations
    f. Other

V Customers and Needs:

For purposes of this survey, a customer is defined as an entity or person who uses the data or results generated by the monitoring program element staff.

1. Who or what entities are the primary customers of the data and information generated by this monitoring program element?

Customer*	Frequent use of data or information	Moderate use of data or information	Rare use of data or information	Comment
IEP Agencies				
DFG	**X**			
DWR	**X**			
CALFED Program Agencies (to support CALFED Program analysis/publications, e.g., EWA, ERP, conveyance, etc.)				
Sport Fish Management Entities				
DFG	**X**			
Regulatory Agencies				
DFG	**X**			
NMFS		**X**		
USFWS		**X**		
SWRCB			**X**	
Outside government, academic, or consultant entities				
SFEI		**X**		
Wim Kimmerer/SFSU		**X**		
William Bennett/UCD		**X**		
ESD-Oak Ridge National Laboratory			**X**	

*Please list the specific agency or entity considered a customer under each customer category. You do not need to list each consultant entity that uses program element data or information, but please list the name of the consultant entity where frequent data or information use occurs.

2. Please identify more specifically how your monitoring program element data or information has been used by each of the frequent customers identified in the table above and selected, important moderate use customers.

   a. DFG: Long-term abundance and distribution trends, population status, harvest rates, recruitment rates, and project impact assessment.

   b. DWR: Long-term abundance and distribution trends, population status, recruitment rates, and project impact assessment.

   c. Academia: Long-term abundance and distribution trends, life history information, population status, recruitment rates, project impact assessment, ecological analyses (e.g., influence of El Nino, degree of density dependent growth and survival)

d. Oak Ridge National Laboratory: Use these data to develop models that are being used in management and recovery of striped bass on the East Coast.

3. Considering the customers you listed above, please provide any information or insights you have regarding customer satisfaction with the monitoring program element.

All recognize the very long time series is unique and valuable, and all comment that broad confidence intervals about the abundance estimate are quite unfortunate.

VI Comments:

1. Please add any other comments about this program element. For example, from your perspective, what is the most valuable aspect of your program element? What is the most challenging aspect? Are there any plans for changes? How does this program element intersect with other IEP monitoring and study program elements?

The exotic, piscivorous, anadromous striped bass are the basis of a very valuable recreational fishery in California, and many organized citizen groups closely monitor and influence striped bass management. To the maximum feasible extent, it is thus prudent to manage striped bass on a rational basis.

Rational management of striped bass in the estuary requires accurate and precise age-specific estimates and/or indices of adult striped bass abundance, not only to develop a robust understanding of population dynamics and how these dynamics are influenced by environmental factors, but also because their management must be consistent with protection of endangered fishes. Fortuitously, understanding striped bass responses to environmental change and variability also provides important insights and hypotheses about the responses of other species for which insufficient data are now (or are likely to be in future) available.

DFG and later the IEP recognized that pursuit of accurate and precise age-specific estimates and/or indices of adult striped bass abundance was prudent and have implemented a myriad of pertinent studies. Prior to the late 1960's, most such effort was in development of abundance indices from various fishery-dependent and fishery-independent sources of catch-per-unit-effort data. By 1967, these studies were thought to be insufficient and management began to explore the feasibility of estimating adult striped bass abundance from ratios of marked to un-marked fish using the Petersen-method (Miller 1967). The method seemed feasible, was implemented in 1969, and has been ongoing since. Since 1994, tagging has been scheduled only in even-numbered years and creel census continued yearly.

Sufficiency of age-specific adult striped bass abundance estimate precision and accuracy were questioned early and at intervals (Stevens 1977, Botsford and Kope 1984, Stevens et al 1985). In particular, 95% confidence intervals for the estimates often greatly exceed 50% of the estimate and cohort abundance often does not vary as predicted by ecological theory (e.g., cohort abundance increases or decreases out of expected proportion). The abundance estimates have nevertheless been the best available information, so significant

management actions and ecological analyses (Stevens et al 1985, Bennett 1997, Kimmerer et al 2000; Kimmerer et al 2001) have been based in large part on them.

Thirty-four (34) years into the study and 26 years after the only available study critique was published (Stevens 1977), it is appropriate to critique the study again and develop prescriptions that when implemented would improve estimate accuracy and precision, and perhaps reduce cost.

Making the Estimates - To estimate adult striped bass abundance, DFG capture striped bass during their spring spawning migration in the San Joaquin River with gill-nets deployed by boat and in the Sacramento River using fyke traps. Crews document, remove at least several scales from, tag, and then immediately release each healthy fish. We monitor fish captured and re-captured during the recreational harvest and subsequent-year tagging. Various laboratory and analytical means are used to minimize biases attributable to aspects of fish behavior and growth (Stevens 1977), chief among them is estimate stratification by age and sex. Estimated cohort abundance is updated for up to five (5) years as seasonal capture data become available.

Estimate Precision - Adult striped bass abundance estimate precision is affected by striped bass abundance and the number of striped bass observed in the experiment (Ricker 1975). The formula for sampling variance is N^2(C-R)/(C+1)(R+2) (Equation 3.8; Ricker 1975). Thus, (1) variance increases with N when R and C are held approximately constant and (2) changes in N have proportionally greater effects on variance than do changes in R and C.

The abundance estimate is calculated using marked and un-marked fish captured after the tagging period, including fish captured during subsequent marking exercises (Stevens 1977). Thus, alternate-year marking will reduce estimate precision unless the creel survey and/or subsequent marking exercises observe sufficient marked and/or unmarked additional fish.

Since 1994, (1) we have reduced R and C by tagging in alternate years, (2) held yearly creel and marking effort approximately constant, and (3) estimated N has increased substantially. If estimated N is reasonably accurate, then more of the variance in estimates since 1994 is attributable to increased N than to tagging in alternate years.

The take-home from these observations is that if allocation of staff and operating expenses is based on trends in observable catch and population size, then management can positively affect estimate precision.

Stakeholders attempt sophisticated analyses using these estimates (e.g., Stevens et al 1985, Kohlhorst 1985, Bennett 1997, Kimmerer et al 2000; Kimmerer et al 2001) and management decisions are made using these estimates, although (perhaps arguably) precision and other attributes that may be related to poor precision (Botsford and Kope ~1984, Stevens et al 1985) of yearly estimates has usually been insufficient for those purposes. For example, slight hints of density-dependent survival of young striped bass and relationships between flow and survival of young striped bass have been based on extrapolation of female abundance estimates to egg production – even though the abundance estimates are very imprecise. Because (for example) consideration of any density- and/or flow-dependent survival of young striped bass is in the best interest of

stakeholders and the species, management should require more precise estimates and/or peer review should identify inappropriate use of imprecise data.

Several facts must be considered to judge the cost of more precise estimates, and foremost of those facts are (1) restoration goals are to double the population, (2) take attributable to sampling severely limits sampling effort, (3) the population appears to be increasing, and (4) observable catch is declining, perhaps due to declines in the number of anglers.

Means and Costs for Increased Precision - Given these facts, implementation of one or more changes to current procedures would demonstrate prudence and likely will improve estimate precision. These are some such changes, ordered in ascending terms of cost:

- **Educate anglers on problems associated with tag-tampering.**
- **Increase the bag limit, thereby differentially increasing the harvest of smaller (more abundant) fish and potential observable creel.**
- **Implement a maximum size limit, thereby increasing the abundance of large (less abundant) fish and potential observable catch during project marking exercises.**
- **Incorporate into the abundance calculation all pertinent catch from non-project scientific sampling, thereby increasing R and C,**
- **Implement a striped bass report card, thereby increasing R and C.**
- **Add significantly to the creel crew, thereby increasing R and C.**
- **Direct creel crew more often to locations where observable catch is relatively great, thereby increasing R and C.**
- **Add significantly to effort during marking exercises, thereby increasing M, R and C.**
- **Add significant new scientific sampling efforts, thereby increasing R and C.**

Estimate Accuracy - The following is a brief exploration of the conditions necessary for accurate estimates as they pertain to our program. Adult striped bass abundance estimate accuracy is affected by many factors. From Ricker (1975), the Petersen method is accurate when:

- **The marked fish suffer the same natural mortality as the unmarked.**
- **The marked fish are as vulnerable to the fishing being carried on as are the unmarked ones.**
- **The marked fish do not lose their mark.**
- **The marked fish become randomly mixed with the unmarked; or the distribution of fishing effort (in subsequent sampling) is proportional to the number of fish present in different parts of the body of water.**
- **All marks are recognized and reported on recovery.**
- **There is only a negligible amount of recruitment to the catchable population during the time the recoveries are being made.**

***Regarding natural mortality*: This condition is believed generally met, and no corrections are applied. Estimates are likely biased high due to differential natural mortality.**

Procedure requires that only healthy-looking fish receive tags and training reinforces the policy. Taggers also document health-looking fish that immediately after release appear unlikely to survive, allowing us to exclude such fish from calculation of the estimates. However, physiological stress from capture and tagging (Cech and Hopkins 1994, Chadwick 1963) undoubtedly increase delayed mortality of tagged fish. Should tagged fish behavior include more frequent or extended ocean residence than the untagged population, then their mortality is likely substantially different (probably greater) than untagged fish.

***Regarding vulnerability*: This condition is not met, but applied corrections (primarily stratification; Stevens 1977) address the major issue of unequal vulnerability between sexes.**

Two relative minor issues regard vulnerability immediately post-tagging and gear selectivity. Tagged fish are less often observed in the creel for some months after tagging (Chadwick 1963) and tagged fish are somewhat more likely to be recaptured in gill nets during tagging. Since a substantial fraction of tag recoveries come from fyke traps and creel many months after application of tags, estimates are likely biased slightly low due to differential vulnerability.

***Regarding mark retention*: This condition is not met, and no corrections are applied. Estimates are likely biased high due to this sort of mark loss.**

Factors affecting mark retention have been tested (Calhoun, Fry, and Hughes 1951, Calhoun 1953, Skinner and Calhoun 1954, and Chadwick 1963). From that work and analyses of tag returns over time, the conditions is met at least the minimum amount of time necessary (about one year) for an estimate (Smith 1978). Some tags are removed from fish captured in the recreational fishery, but this issue will be discussed elsewhere. Because recaptures are from an extended period and estimates are stratified by age, fish tagged relatively young are substantially more likely to lose tags than fish tagged relatively old. If the effect of this reality is sufficient, it will be evident in plots of cohort abundance and precision over time.

***Regarding subsequent distribution of marked fish and/or sampling effort*: This condition is believed generally met, but no corrections are applied. Ricker (1975) wrote that this issue "always tends to" bias estimates high. Analytical tests should be conducted, then appropriate corrections or re-direction of sampling effort should be implemented.**

Should there be distinct striped bass runs and/or differential recreational creel in the Sacramento and San Joaquin systems, and given that substantially more fish are tagged in the Sacramento River, the effect of non-random distribution of marked fish and/or sampling effort on accuracy could be substantial.

***Regarding tag recognition*: This condition is sufficiently met. The external disk tags are very obvious and DFG staff are properly trained. Some tags are removed from fish captured in the recreational fishery (various personal communications). DFG staff are trained to recognize and note tag scars, which allows us to exclude many such fish from calculation of the estimates.**

***Regarding recruitment*: This condition is not met, but corrections are applied (Stevens 1977). Even with applied corrections, the effect on accuracy is likely important. Use of data subject to substantial error should be properly qualified.**

Recall that the estimate is of legal-sized striped bass at the end of tagging, and that tagging concludes approximately June 1 of each year. From previous work, approximately ½ of 3-year old fish are thought to recruit to the fishery after June 1. Thus, the corrected estimate is from (1) deletion of newly recruited fish from the recapture sample during the first subsequent creel survey and (2) subtraction of ½ the "raw" 3-year old estimate.

Given that small fish are substantially more abundant than large fish, the nature of the corrections, and management's desire for an overall abundance estimate that is thought best calculated as the sum of age- and sex-specific estimates, the effect of recruitment on accuracy can be very substantial. It is likely inappropriate to rely much on the overall abundance estimate, opting instead to rely on the estimates of cohort abundance.

Means and Cost For Increased Accuracy - Given the preceding facts and uncertainties, implementation of one or more efforts (including analyses and field procedures) would demonstrate prudence and likely will improve estimate accuracy and/or properly qualify use of the estimates. These are some such changes, ordered in ascending terms of cost:

- **Educate anglers on problems associated with tag-tampering.**
- **Amend field data sheets to collect more information of condition of marked fish, so that we can more rationally exclude unhealthy fish from calculation of the estimates.**
- **Compose a technical report that thoroughly mines available data. Results of the analyses will properly frame many potential modifications to field, analytical, and reporting procedures.**
- **Apply stress-reducing procedures to fish being tagged.**

2. Please provide any comments you may have on ways to improve the monitoring program element.

   See response to question #1.

3. Please list any ideas you have for changes to the program element. Consider sampling methods, design, analysis, overall program element processes, resource allocation, and integration with other monitoring program elements.

   See response to question #1

4. Do you have any ideas for other useful program element products?

   No.

5. Please provide any other comments you may have.

   See response to question #1.