Proposed modifications to the Lower Mokelumne River Project, California: FERC Project No. 2916-004. Final environmental impact statement (Listing Multiple Pages).

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FERC/FEIS-0067

FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF HYDROPOWER LICENSING

FINAL ENVIRONMENTAL IMPACT STATEMENT

PROPOSED MODIFICATIONS TO THE LOWER MOKELUMNE RIVER PROJECT, CALIFORNIA

FERC Project No. 2916-004

(Licensee: East Bay Municipal Utility District)

Division of Project Compliance and Administration
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, DC 20426

November 1993

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COVER SHEET

a. Title: Proposed Modifications to the Lower Mokelumne River Project, California, FERC Project No. 2916-004.

Proceeding to consider modifications to an existing hydropower project for the conservation and development of fish and wildlife resources. This project includes Pardee and Camanche Dams on the Mokelumne River which are currently licensed to East Bay Municipal Utility District for hydropower production.

b. Final Environmental Impact Statement (FEIS)

c. Lead Agency: Federal Energy Regulatory Commission

d. Cooperating Agency: None

e. Abstract: Chinook salmon and steelhead trout populations in the lower Mokelumne River have experienced recent declines and fish kills associated, in part, with discharges from Camanche Dam. The California Department of Fish and Game and the California Sportfishing Protection Alliance have asked the Commission to investigate and correct these problems. A wide range of different mitigation actions has been proposed by parties participating in the scoping of this proceeding, and staff has evaluated these proposed actions in this assessment. The staff is recommending a combination of flow and non-flow modifications to the existing license, including new minimum flow and minimum pool elevation requirements at Camanche Reservoir, ramping rates on dam releases, interim attraction and out-migrant spike flows, instream habitat improvements, and a series of studies and monitoring to determine feasible means for solving off-site fish passage problems.

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g. Copies of the FEIS are available for public review at the San Francisco Regional Office of FERC.

h. This FEIS has been prepared by the Commission's staff in connection with a proceeding to consider modifications of facilities and operation of the Lower Mokelumne River Project. Proposed modifications are for the specific purpose of conserving anadromous fisheries in the lower Mokelumne River. This final statement is being made available to the public on or about November 1, 1993, as required by the National Environmental Policy Act of 1969 and the Commission's Regulations Implementing the National Environmental Policy Act of 1969 (52 FR 47897; 47910-47911; December 17, 1987).

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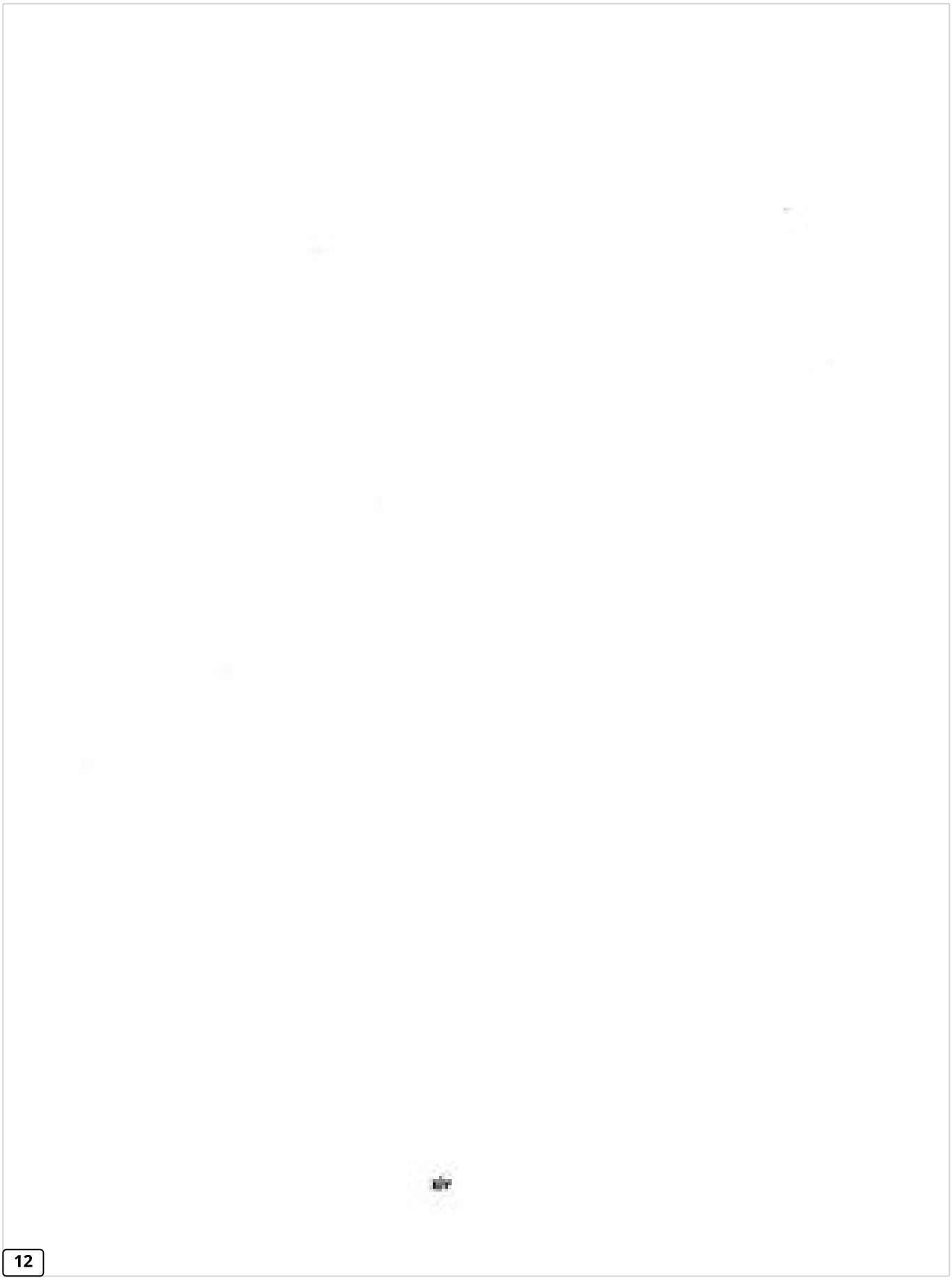

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LIST OF ACRONYMS AND ABBREVIATIONS

AMD	Acid Mine Drainage
BMP	Best Management Practices
CCWD	Contra Costa Water District
CDFG	California Department of Fish and Game
CDWA	Central Delta Water Agency
CDWR	California Department of Water Resources
cfs	Cubic feet per second
COE	U. S. Army Corps of Engineers
Commission	Federal Energy Regulatory Commission
CRWQCB	California Regional Water Quality Control Board
CSMR	Committee to Save the Mokelumne River
CSPA	California Sportfishing Protection Alliance
DEIS	Draft Environmental Impact Statement
DO	Dissolved oxygen
EBMUD	East Bay Municipal Utility District
EPA	U.S. Environmental Protection Agency
EVS	EVS Consultants
FEIS	Final Environmental Impact Statement
FWS	U.S. Fish and Wildlife Service
GPD	Gallons per day
IFIM	Instream Flow Incremental Methodology
JVID	Jackson Valley Irrigation District
LHS	Life-stage habitat scores
LMRMP	Lower Mokelumne River Management Plan

LMRP	Lower Mokelumne River Project
MGD	Million gallons per day
MRFF	Mokelumne River Fish Facility
MRM	Mokelumne River Mile
MSL	Mean sea level
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
NSJWCD	North San Joaquin Water Conservation District
PFMC	Pacific Fishery Management Council
PG&E	Pacific Gas and Electric Company
PHABSIM	Physical Habitat Simulation
State Board	State Water Resources Control Board
staff	Staff of the Office of Hydropower Licensing, FERC
TAF	Thousand acre-feet
THM	Trihalomethane
cWUA	temperature-modified weighted usable area
USGS	United States Geological Survey
WID	Woodbridge Irrigation District
WSMP	Water Supply Management Plan
WUA	Weighted Usable Area

EXECUTIVE SUMMARY

This final environmental impact statement (FEIS) has been prepared for the Federal Energy Regulatory Commission (Commission) to consider modifications to the existing Lower Mokelumne River Project (LMRP) (FERC Project No. 2916-004) in California. The potential need for project modifications is related to the protection of anadromous salmon and steelhead in the Lower Mokelumne River. The LMRP is a multipurpose, multiple-reservoir system that was licensed in 1961 to the East Bay Municipal Utility District (EBMUD) of Oakland, California. In addition to producing hydroelectricity, the project supplies almost all of the drinking water for the East Bay service area (approximately 1.3 million people). The LMRP facilities are located on the mainstem of the Mokelumne River in the Central Valley of California and the foothills of the Sierra Nevada Mountains, about 35 miles southeast of Sacramento and 75 miles northeast of Oakland. The facilities include Pardee Dam and Reservoir (construction completed in 1929), Camanche Dam and Reservoir (construction completed in 1964), the Mokelumne aqueducts, and a series of terminal storage reservoirs in the East Bay area. Penn Mine, an abandoned copper and zinc mine, is located partially within the LMRP project boundary on the southeast shore of Camanche Reservoir.

Chinook salmon and steelhead trout in the lower Mokelumne River have experienced recent population declines and fish kills associated, in part, with discharges from Camanche Dam. Other stresses, such as irrigation diversions and acid mine drainage, have been affecting the fishery resources in the lower river for most of this century. The current LMRP license includes articles that allow the Commission to prescribe releases from the project and to order project modifications as necessary for "the conservation and development of fish and wildlife resources." The California Department of Fish and Game (CDFG) and the California Sportfishing Protective Alliance asked the Commission to investigate and correct fishery impacts in the river. In January 1992, CDFG issued its "Lower Mokelumne Fisheries Management Plan" in which it recommended significant changes in LMRP operations. EBMUD also issued its own management plan for the lower river which also recommends modified project operation. The California State Water Resources Control Board (State Board) initiated a water rights hearing in November, 1992, to address these problems and alternative plans. The Commission's proceeding is designed to complement the State Board's hearing so that information generated by both proceedings may be shared in a timely manner.

Consistent with the Commission's responsibility under the Federal Power Act and with the authority defined in Articles 12 and 15 of EBMUD's license, this proceeding is limited to actions directly related to the fish and wildlife resources in the Lower Mokelumne River. A large number of different mitigation actions were identified during the scoping process for this assessment, and those that are within the scope of this proceeding are evaluated in this FEIS. Generally, four sets of mitigation alternatives are considered in the FEIS, each of which is comprised of a series of actions to improve conditions for naturally spawning salmon and trout in the lower river. The recommendations made by CDFG represent a comprehensive set of solutions that can be considered as the proposed action. The plan that EBMUD has developed is another alternative approach that is considered. A third alternative considered is staff's own recommendations that have been developed independently during the course of this assessment. The fourth alternative is a minimum flow regime proposed by the U.S. Fish and Wildlife Service (FWS) in their comments on the draft environmental impact statement. In addition to the CDFG, EBMUD, staff, and FWS alternatives, the no-action alternative is also considered in the FEIS. All appropriate alternatives are evaluated in terms of: 1) the benefits that would be accrued to anadromous fishery resources in the lower Mokelumne River; and 2) the costs each action would impose on EBMUD's water supply system.

The alternatives evaluated include both flow and non-flow mitigation. The flow-related actions considered in the FEIS are mitigation that would directly alter the LMRP reservoir operations and consequently have potential impacts to EBMUD's water supply system. Flow mitigation actions include minimum flow requirements from Pardee and/or Camanche dams, minimum pool elevations in the reservoirs, constraints on the rate of change of releases from the dams (i.e., ramping rates), and short-term increases in flows (pulse flows) to stimulate and facilitate upstream and downstream migrations of anadromous fish. The non-flow actions that are considered do not directly affect reservoir operations, but are intended to benefit the natural reproduction cycle of salmon and trout in the lower river. The non-flow actions considered in the FEIS include habitat enhancement measures (e.g., spawning gravel replenishment), hydraulic improvements to Woodbridge Dam and Lake Lodi that are downstream from Camanche Dam, improved fish ladders and fish screens, and water quality improvements at Camanche Dam. Improvements at Woodbridge Dam and Lake Lodi are critical to successful mitigation efforts. Although these are outside the LMRP boundary, it is not likely that the natural reproduction of chinook salmon can be improved in the lower river without eliminating the serious barriers to migration that exist in the vicinity of Lake Lodi which lies between Camanche Dam and the Sacramento-San Joaquin Delta.

Because of the implications that minimum release requirements have to the EBMUD water supply system, this issue is the most important difference among the alternatives considered. A 1961 agreement between EBMUD and CDFG that was incorporated in the LMRP license provides for 15 thousand acre-ft (TAF) of water to be released in normal and wet water years from Camanche Dam for downstream fish resources. The CDFG alternative would increase these minimum releases significantly to between 98 and 262 TAF/yr depending on the water year type. EBMUD's alternative provides between 28 and 118 TAF for fish resources, and staff's alternative provides between 51 and 160 TAF, depending also on water year type. The FWS alternative would require releases of 121 TAF in dry or critically dry water years and 193 TAF in normal or wet years. In comparison to these different release requirements that are considered, EBMUD's current (1990-normalized) water demand is approximately 247 TAF, and the median unimpaired flow of the Mokelumne River into the LMRP is approximately 700 TAF. In addition to the differences in total annual release, there are also significant differences in the seasonal patterns of the minimum flows and in the definition of water year types among the alternatives considered in the FEIS.

The assessment approach used in the FEIS accounts for and protects existing water rights in the lower river. However, the minimum flow regimes recommended by CDFG, FWS, and staff would all produce some water supply deficit to EBMUD in dry water years. Under an upper-bounding, three-year drought and staff's estimate of EBMUD's future (2020) water demand, the CDFG minimum flows would produce a supply deficit of approximately 145 TAF/yr with an annual replacement cost to EBMUD of $20 million. EBMUD's minimum flows would produce no deficit under the same low-flow and future demand scenario. Staff's minimum flows would produce a equivalent deficit of 10 TAF/yr and a replacement cost of between $12.6 and $18.1 million depending on EBMUD's mode of replacement. The FWS minimum flow alternative would produce deficits and replacement costs similar in magnitude to the CDFG alternative.

Increased minimum flows at Camanche Dam would produce important environmental benefits, because they would increase available habitat and water temperatures for chinook salmon and steelhead trout. The flows required by CDFG and staff would produce the most benefit to chinook spawning, increasing the median physical habitat available by more than 50% compared to no action. The flows proposed by EBMUD would provide benefits to fry and juvenile habitat, but would have significantly less benefit to spawning. When the effects of improved habitat availability from minimum flows are combined with the benefits of decreasing water temperatures and stabilizing flows with ramping rates, the natural conditions in the river would be significantly better compared to the no-action alternative.

Water temperatures downstream of Camanche Dam could be maintained at lower levels throughout the summer months of hot, dry years if minimum pool elevations were required at Camanche Reservoir, but these requirements could also have additional adverse impacts on EBMUD's water supplies. The costs to EBMUD's water supply system would occur mostly in dry years and be roughly proportional to the volume withheld (e.g., 238 TAF for the CDFG alternative or 156 TAF for the staff alternative). However, these costs would also depend on the implementation strategy that was ultimately adopted. If deficit sharing were implemented as staff recommends, then costs to EBMUD's system could be minimized. For example, staff's alternative allows for the minimum pool elevation of Camanche Reservoir to be reduced from 190 to 175 ft in the second or third consecutive dry water year. The benefits and costs of other flow-related actions are even more difficult to quantify. There is little disagreement over the need for ramping rates among alternatives, but the biological response to this mitigation is poorly understood. Evidence for a biological response to attraction flows is also lacking. Therefore, staff recommends interim measures combined with monitoring to evaluate the effectiveness of the proposed mitigation.

Non-flow mitigation actions have important advantages, because they do not incur direct effects on the operation of EBMUD's water supply system. The overall cost of these actions can be high, however. Staff has not estimated the cost of all the non-flow alternatives in the FEIS because of lack of specific design information. Improvements in the hydraulics of Lake Lodi are the most important non-flow action that can be taken. Staff encourages that EBMUD participate in a cooperative effort to resolve the fish passage problems at Woodbridge Dam and Lake Lodi. If improvements cannot be made in this area in the near future (e.g., within 5 years), the recommendations in the FEIS may have to be reconsidered.

Based on the analyses presented in the FEIS, the staff recommends a combination of flow and non-flow modifications to the existing license: we recommend new minimum flow and minimum pool elevation requirements at Camanche Reservoir, ramping rates on dam releases, experimental attraction and out-migrant pulse flows in the fall and spring, and instream habitat improvements. A series of studies and monitoring are also recommended to determine feasible means for solving off-site fish passage problems. Staff's final recommendations are based on an independent analysis of an extensive record of studies and testimony, including the exhibits and testimony presented at the State Water Resources Control Board's water rights hearing on the lower Mokelumne. This record supports the need for project modification and the fact that such modifications can be made in an acceptable manner without significant adverse impacts to municipal water supplies. However, there is a high degree of uncertainty in the present and future water uses and regulatory actions within and outside the Mokelumne River basin. If and when new information is obtained as a result of the many proposed and ongoing monitoring and regulatory proceedings, these license modifications may be reconsidered.

1. INTRODUCTION

The Federal Energy Regulatory Commission (Commission) is conducting a proceeding to determine whether modifications in the facilities or operations of the Lower Mokelumne River Project (LMRP) (FERC Project No. 2916-004) are needed for the conservation and development of fish and wildlife resources. The licensee for this existing project is East Bay Municipal Utility District (EBMUD). The LMRP facilities are located in central California (Figures 1.1-1 and 1.1-2) and include two large, multipurpose reservoirs (Camanche and Pardee Reservoirs) that were licensed for hydropower operations in 1961. Modifications to this project may constitute a major federal action significantly affecting the quality of the human environment, as defined by the National Environmental Policy Act (NEPA) of 1969 (Pub. L. 91-190) and the Commission's regulations for NEPA compliance (18 C.F.R. Part 380). Therefore, the Commission's staff (staff) prepared this Environmental Impact Statement (EIS) to support any decision that may be made by the Commission to modify project facilities or operations.

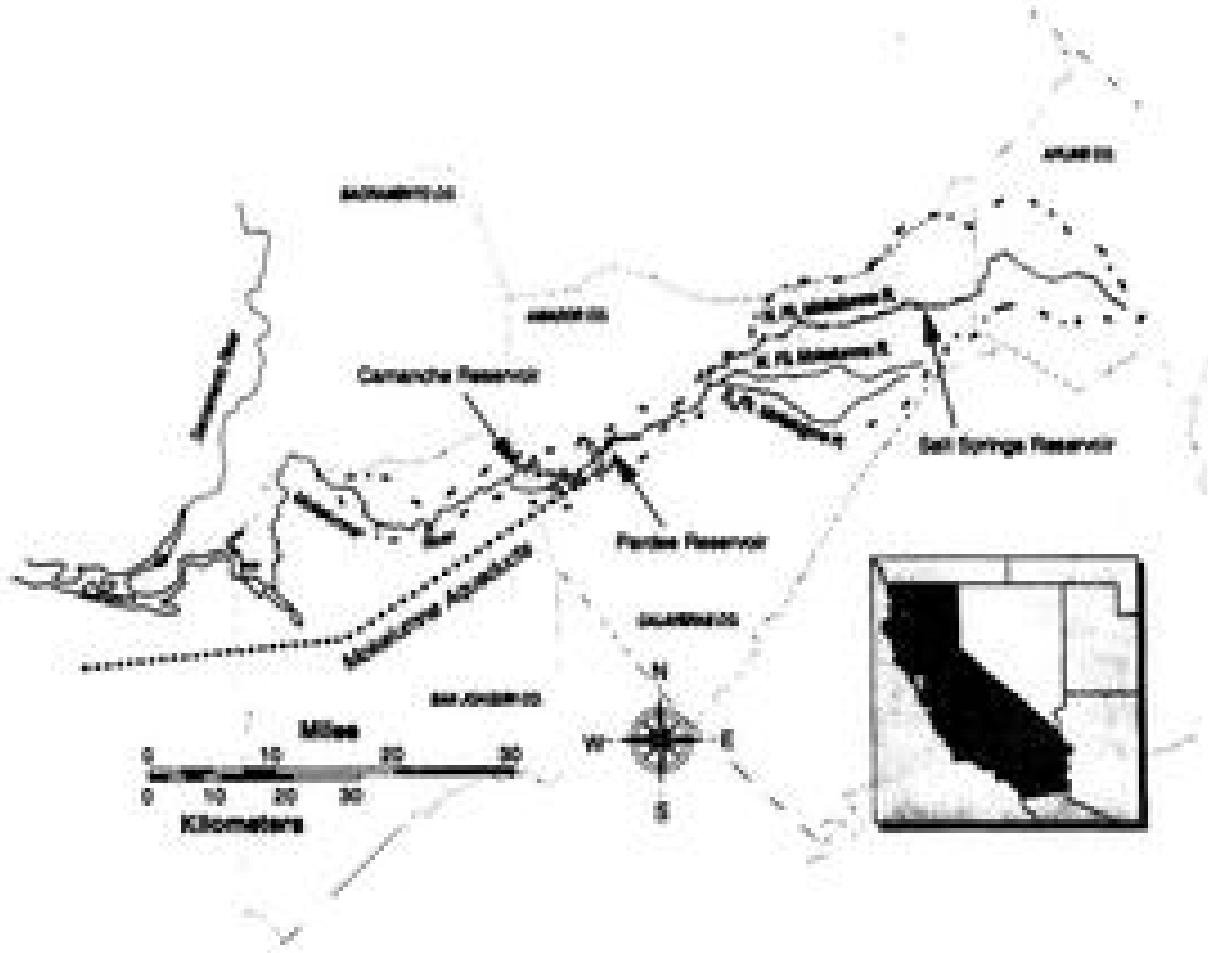


Figure 1.1-1. Location of the Camanche and Pardee Reservoirs and the Mokelumne River Basin in central California. (Source: The staff 1993.)

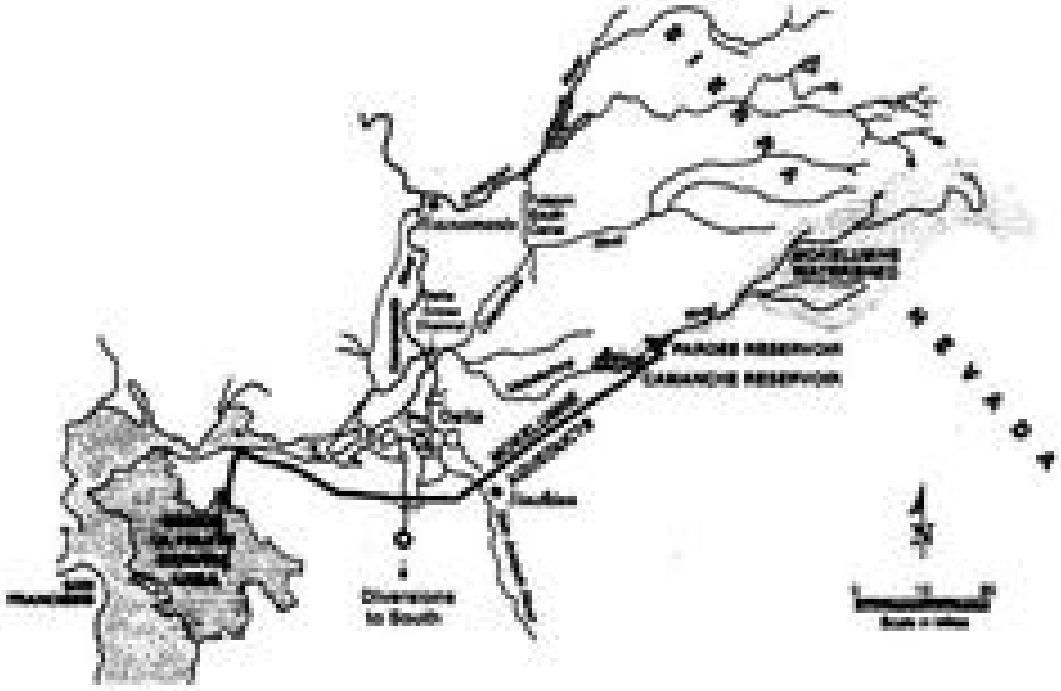


Figure 1.1-2. Central California area showing the relationship between the Mokelumne Watershed and the service area of East Bay Municipal Utility District. (*Source:* EBMUD 1991.)

1.1 PURPOSE AND NEED FOR ACTION

In certain limited circumstances, the Commission has the authority and the responsibility to reevaluate the operation and facilities of an existing, licensed hydroelectric project. This authority is based on Section 10(a)(1) of the Federal Power Act and, in this proceeding, on Articles 12 and 15 of the LMRP license (see Appendix A). Under Article 15, the Commission is required to determine whether modifications are appropriate for the conservation and development of fish and wildlife resources if the Commission is petitioned by state or federal agencies. The Commission received a report of fish kills at the Mokelumne River Fish Facility (MRFF) located below the LMRP's Camanche Dam from the California Department of Fish and Game (CDFG) (1990 and 1991). The California Sportfishing Protection Alliance (CSPA) and the Committee to Save the Mokelumne River (CSMR) also raised serious concerns with respect to LMRP effects on fish and wildlife, particularly chinook salmon. In January 1992, CDFG issued a plan for managing the Lower Mokelumne River fisheries that describes numerous stresses to chinook salmon resources and recommends modifications to LMRP facilities and operation (CDFG 1991). Subsequent review of relevant information by the Commission's Division of Project Compliance and Administration indicated that complex issues exist involving competition over limited water resources in the Lower Mokelumne River, including anadromous fisheries, hydropower, irrigation, and municipal water supply. Therefore, the Commission initiated this proceeding and this EIS to further investigate the need to modify LMRP facilities and/or operations.

1.2 SCOPE OF THE ENVIRONMENTAL IMPACT STATEMENT

The proceeding to consider LMRP modifications was initiated by a Federal Register notice on July 1, 1991 following several communications between Staff and EBMUD. In response to the reports from CDFG and CDPA, letters were sent to the California State Water Resources Control Board (State Board), CDFG, U.S. Fish and Wildlife Service (FWS), California Regional Water Quality Control Board (CRWQCB)— Central Valley Region, and EBMUD requesting information about project operation and effects on downstream fishery resources. Review of the information received in response to these requests provided substantial evidence that project operation adversely affects both fishery and water quality resources in Camanche Reservoir and in the downstream Mokelumne River. Staff participated in a site visit to the LMRP facilities and the Lower Mokelumne River in late January 1992 to obtain additional information.

Preparation of a Draft EIS began with the issuance of an initial Scoping Document (FERC 1992a) and with a public scoping session held on Thursday, April 9, 1992, in Stockton, California. The purposes of the scoping process were to:

- identify significant environmental and economic issues related to potential changes in project facilities or operations;
- determine what issues should be covered in the EIS; and
- enable appropriate federal, state, and local resource agencies, developers, and other interested parties to effectively understand, participate in, and contribute to the assessment process.

During the scoping session, ten oral statements were received. The session was recorded by a stenographer, and all statements (oral and written) became part of the Commission's public record for Project No. 2916-004. Subsequent to the scoping session, 15 written comments were received by the Commission. Staff used these oral and written scoping comments to clarify the significance of issues and to distinguish between issues needing additional treatment and those that did not merit treatment in the Draft Environmental Impact Statement (DEIS). The results of the scoping process were published in a revised Scoping Document (FERC 1992b) and distributed to interested parties on August 20, 1992.

Scoping comments generally elaborated and clarified the issues identified in earlier communications among the licensee, the Commission, and other interested parties. Comments from the licensee and other water users (i.e., representatives from cities, counties, and water districts) expressed concerns over the proceeding's schedule and its relation to a water rights hearing on the Mokelumne River scheduled by the State Board. Comments from state and federal resource agencies and from conservation groups were strongly in support of the Commission's proceeding and schedule. Considering the documented fisheries-related problems in the Lower Mokelumne River, staff decided not to defer preparation of a DEIS, as some commenters had requested. The schedule for the DEIS was intended to coordinate the Commission's proceeding with that of the State Board. Staff attended planning meetings for the State Board's November hearing and followed that hearing's progress closely.

Based on information generated during the scoping process, staff identified three primary issues to be addressed: 1) water quality and quantity; 2) anadromous fisheries; and 3) socioeconomic issues related to water supply and demand. These issues were limited because of the nature of this proceeding as a compliance action at a licensed hydropower facility with specific license requirements for "conservation and development of fish and wildlife resources" (Appendix A). Substantial changes to current LMRP hydropower operations may affect the ability of the EBMUD to deliver reliable water services at reasonable costs, including water for human consumption, sanitation, and municipal and industrial uses. These services are vital to a major metropolitan area including the cities of Berkeley and Oakland. Some of the

alternatives discussed here would alter current uses of Pardee and Camanche reservoirs for water supply. Therefore, the effects of project operation on both water supply and fishery needs are major issues in this assessment.

The major water quality and quantity issues considered are:

- existing and future water availability and uses;
- water temperatures in reservoirs and in the river below Camanche Dam;
- hydrologic patterns and reservoir operations during wet, normal, and dry water years;
- reservoir and riverine chemical water quality; and
- sediment transport and river hydraulics.

The major fishery issues are:

- fishery management goals and objectives in the Lower Mokelumne River basin, including the most recent management plans produced independently by CDFG (1991) and by EBMUD (EDAW, Inc. 1992c);
- instream flows for fish, providing for upstream migration, spawning, incubation, rearing, and downstream passage;
- effectiveness of fish passage facilities and screens at diversions;
- evaluation of hatchery-stocked fish in the Mokelumne River; and
- acid mine drainage and other water quality influences.

The major socioeconomic issues are:

- economic impacts of reduced or modified water availability on municipal and industrial activities in the East Bay service area;
- costs of modifying water withdrawals in the Lower Mokelumne River basin;
- costs of structural and operational mitigation for fishery and environmental resources; and
- changes in hydroelectric power production, including benefits of increased production due to higher instream flow requirements.

The evaluation of some issues raised during the scoping process is beyond the scope of this proceeding. For example, recreational issues, such as fishing and boating access at both Camanche and Pardee Reservoirs and in the Lower Mokelumne River, are not appropriate for consideration under the limitations of Article 15 unless they are directly related to the modifications recommended to protect the anadromous fisheries in the lower river. Operation of the MRFF by CDFG at Camanche Dam (Section 2.1.2), as it constitutes a component of a statewide hatchery system, is also outside the scope of this proceeding. However, specific agreements between EBMUD and others that affect this hatchery are discussed. Proposals for the Commission to specifically require EBMUD to move its point of water withdrawal from Pardee Reservoir are not an appropriate part of this proceeding. Other issues, such as the cumulative impacts of future development in the upper Mokelumne River basin, are likewise beyond the scope of this proceeding. However, new developments in the upper basin may be taken up under other Commission proceedings or licensing actions in the future.

The Notice of Availability of the DEIS on the LMRP was published in the Federal Register on October 30, 1992. The DEIS was mailed to Federal, state, and local agencies, as well as other interested parties, with a 60-day comment period. This comment period was subsequently extended to March 1, 1993, at the request of several parties. Section 8 of the Final Environmental Impact Statement (FEIS) identifies those agencies and individuals that were sent copies of the DEIS and the FEIS. Twelve comment letters

were received on the DEIS, including extensive comments from the licensee. All comments received on the DEIS and our response to these comments are contained in Appendix H of the FEIS.

A public meeting on the DEIS was conducted on November 30, 1993, in Livermore, California, to allow participants to express their views on the DEIS. A second meeting on the DEIS was tentatively scheduled for June 1-2, 1993, in Oakland, California, but was canceled at the request of the licensee. On July 16, 1993, EBMUD proposed a settlement agreement to the Commission on this proceeding. The details of this settlement agreement have been considered in the FEIS. Although the settlement agreement is not adopted explicitly as EBMUD's proposed alternative in the FEIS, the essential elements of the settlement offer are incorporated into this alternative because these elements were already part of EBMUD's earlier management plans.

All timely letters of comment that address specific analyses in the DEIS were reviewed by staff during preparation of the FEIS. Suggestions for correcting text or data and requests for expanded discussion of a subject have been considered and adopted wherever appropriate. Those editorial changes and suggestions which were practicable and reasonable, and which improved the quality of the FEIS are incorporated herein.

1.3 ASSESSMENT APPROACH

As with other parts of California and other western states, the demand for finite water resources is increasing in the Mokelumne River Basin. Two of the larger demands are: the requirements for native chinook salmon, steelhead trout, and other fish populations and growing requirements for affordable and reliable municipal water supply. This environmental assessment addresses this increasing conflict between water uses.

The Mokelumne River has historically been an important source of naturally spawned chinook salmon and has also been well known for an outstanding steelhead fishery. However, evidence suggests that these anadromous fishes have been substantially reduced in the Mokelumne River as a result of a complex history of problems which include water diversion, surface water storage, and hydroelectric power generation (Figure 1.3-1; Table 1.3-1). Because water development has altered the aquatic habitat of the Mokelumne River, the CDFG has designated the Lower Mokelumne River as a reach of considerable importance for restoration and maintenance of chinook salmon and steelhead trout. A statewide objective established in the Salmon, Steelhead, and Anadromous Fisheries Program Act of 1988 (California Fish and Game Code Section 6900 et seq.) is to increase populations of these fish. As a result of these problems and goals, much resource agency attention has focused on the protection of fisheries in the Lower Mokelumne River. The analyses in this FEIS have therefore focused on the trade-offs between anadromous fisheries downstream from EBMUD's hydropower facilities and water supply economics.

The level of analysis of previous issues is based in part on staff's review of comments received during the scoping process and comments on the DEIS. If preliminary analysis indicated that any of the issues presented in the scoping document had little potential for causing significant impacts, the issue(s) were identified and the reasons for not providing a more detailed analysis were given.

The FEIS is organized into five sections. The introductory section (Section 1) presents the reasons and scope for the assessment. Section 2 identifies the proposed actions, alternative actions, and a general comparison among alternatives. Action alternatives in the FEIS are generally divided into two types: 1) flow-related mitigation consisting of constraints on project operations (e.g., minimum flow requirements or minimum reservoir pool elevations) that would directly affect water availability from the project, and

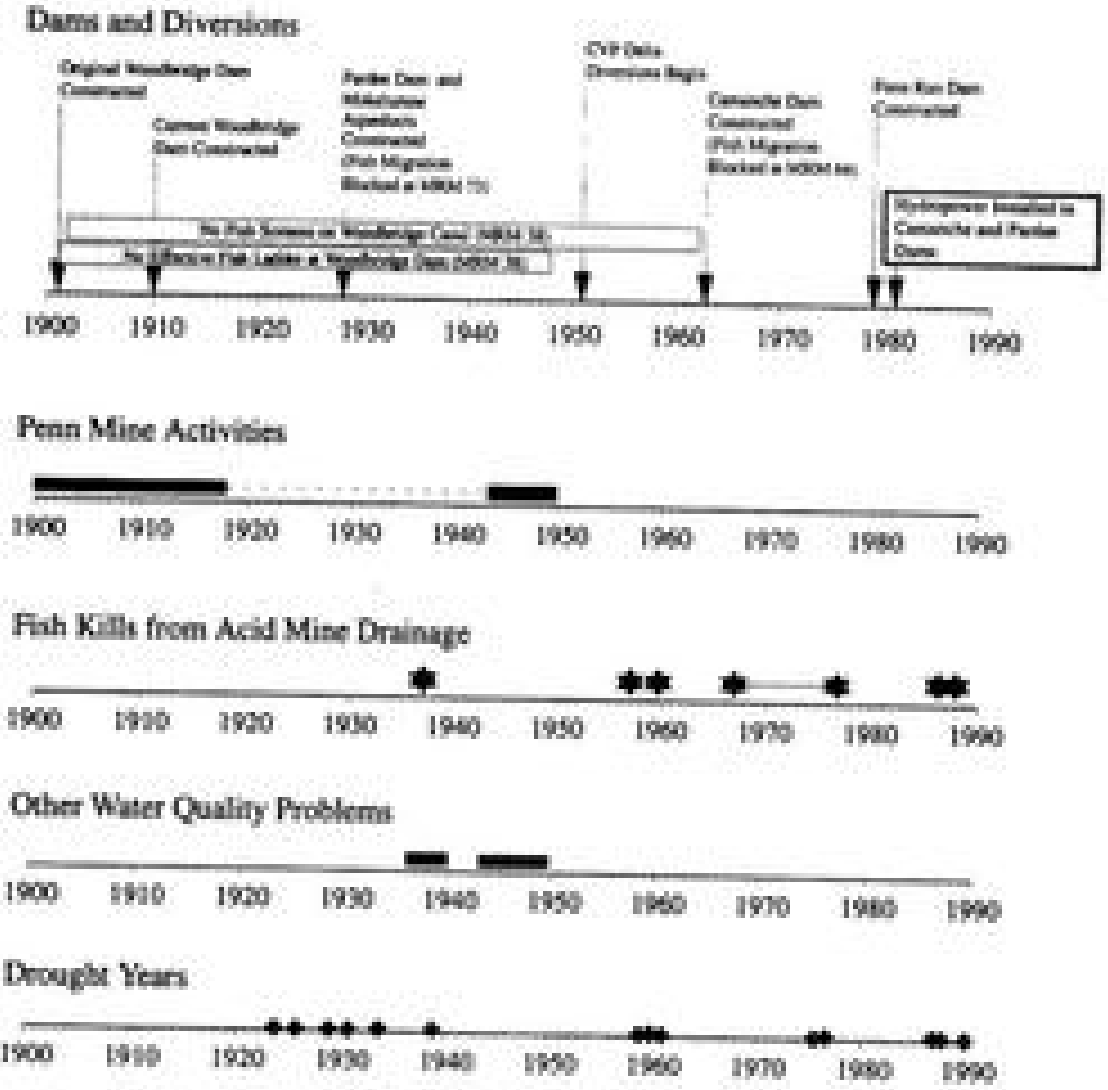


Figure 1.3-1. Chronology of major events in the historical development of the Lower Mokelumne River basin. (Source: The staff.)

2) non-flow-related mitigation involving capital and operating costs but no affect on water supply. Section 3 describes the affected environment, the fish and wildlife resources of concern, and other relevant information supporting the assessment of impacts. Penn Mine and related remediation activities are discussed in Section 3.1.3. Section 4 presents the environmental and economic impacts of each alternative in detail. Finally, Section 5 presents staff's conclusions and final recommendations. Section 5 also contains an explanation of why staff did not adopt all of the recommendations made by fish and wildlife agencies.

Table 1.3-1. Stresses potentially affecting natural reproduction of chinook salmon and steelhead trout in the Lower Mokelumne River. (Source: The staff.)

	Affected life stage of anadromous salmonids			
Impact mechanism	Upstream migration	Spawning	Rearing	Downstream migration
Stream flow	Lack of large and prolonged attraction flows	Stream gravels unsuitable for salmon due to sedimentation and/or compaction Redd superposition due to limited habitat	Suitable habitat restricted to tailwaters reach of river	Lack of proper cues for early emigration Entrainment at WID diversion Bypass/passage at Woodbridge Dam/ Lake Lodi
Physical habitat	Shallow water at some locations below Woodbridge Dam	Small areas of suitable spawning gravels at low flows	Unsuitable habitat at high flows Poor habitat in Lake Lodi in late spring and summer Stranding during rapid reductions in dam releases	Stream flow diverted into Woodbridge Irrigation District Canal at Lake Lodi
Temperature	High temperatures early in fall	High temperatures early in fall	High temperatures in Lake Lodi and downstream	High temperatures in Lake Lodi and downstream
Water quality	Low DO and/or elevated toxic metals (e.g., Zn, Cu, etc.) during migration	Low DO and/or elevated toxic metals during incubation	Low DO and/or elevated toxic metals for steelhead juveniles in summer	Low DO and/or elevated toxic metals during outmigration and fall hatchery releases
Migration barrier	Passage problems at Woodbridge Dam	n/a	n/a	Diversion at Woodbridge Irrigation District Canal Poor bypass/passage efficiency at Woodbridge Dam
Entrainment	n/a	n/a	Diversion at Woodbridge Irrigation District screens Diversion at unscreened intakes	Diversion at Woodbridge Irrigation District Diversion at unscreened intakes
Predation	Uncontrolled fishing catches	Uncontrolled fishing catches Redd disturbance by fishermen	Increased prey (traps, etc.) Predation traps in Lake Lodi and at Woodbridge Irrigation District screens	Increased prey (traps, etc.) Predation traps in Lake Lodi and at Woodbridge Irrigation District screens

2. PROPOSED ACTIONS AND ALTERNATIVES

The action under consideration in this assessment is to modify existing LMRP hydropower facilities and/or operations for the explicit purpose of conserving fish and wildlife resources in the Lower Mokelumne River (the Lower Mokelumne River is defined here as the Mokelumne River from tidal influence upstream to Camanche Dam). The specific alternatives considered in this FEIS are limited to those that would directly benefit the naturally reproducing chinook salmon population in the Lower Mokelumne River. The restricted scope of this compliance proceeding is explained in Section 1.

A large number of different mitigation measures have been proposed by different parties for solving the fisheries problems in the Lower Mokelumne River (Table 2.1-1). Initially, our definition of possible actions was based on relevant parts of the "Lower Mokelumne River Fisheries Management Plan" that was issued by the CDFG in January 1992 (CDFG 1991). The CDFG recommendations constitute a feasible starting point; they are comprehensive and address the major issue of conservation of naturally spawning chinook salmon in the Mokelumne River. EBMUD proposed their own set of actions to address fisheries problems called the "Lower Mokelumne River Management Plan (LMRMP)" (EDAW, Inc. 1992c). The EBMUD plan is part of a Draft Environmental Impact Report/Environmental Impact Statement (EDAW, Inc. 1992a) issued in support of the District's long-term water supply management planning (see Section 3.1.4 for details on this and other related proceedings). The elements of both these plans are incorporated into the action alternatives defined in this section. In addition to these CDFG and EBMUD plans, the FWS recommended its own minimum flow regime in its comments on the DEIS (see Appendix H). The FWS recommendations are considered as a separate alternative in the FEIS, as are staff's recommendations that are based on our independent analysis of the issues. Another alternative considered is to make no modification to the LMRP operations or facilities (i.e., the no action alternative).

Some actions recommended by CDFG and others involve changes that cannot be implemented through unilateral actions by the Commission or that go beyond the scope of fish and wildlife resources referred to in License Article 15 (Appendix A). Those CDFG recommendations that pertain directly to naturally spawning salmonids have been used to define the proposed action to be considered in this FEIS. Actions that will require more than Commission authority are also discussed in the FEIS so that cumulative effects to fish resources can be considered.

This second section of the FEIS contains an overview of the existing LMRP facilities and operations and the alternative approaches considered to modify it. Section 2.1 describes existing LMRP facilities and operations. Sections 2.2 and 2.3 describe the flow and non-flow alternatives that have been considered, including proposals from CDFG, FWS, EBMUD, the Commission's staff, and other participants in the scoping process.

The specific modifications to LMRP operations and facilities are separated into two categories, ones that require flow-related changes to project operation and others that involve non-flow-related actions or modifications to facilities. Flow alternatives include new constraints on operation that would directly affect downstream flow regimes (e.g., new minimum flow requirements), as well as operational constraints that would indirectly affect downstream releases (e.g., new rule curves to maintain higher pool elevations in the reservoirs). Non-flow alternatives are modifications to project facilities or operation, or to riverine habitats downstream of Camanche Dam, that would not substantially change the volume or timing of flows released from the reservoirs (e.g., stream gravel rehabilitation, improvements in fish passage facilities, construction of new fish hatcheries, or selective withdrawals).

Table 2.1-1. Mitigation measures considered for the conservation and development of naturally reproducing salmonids in the Lower Mokelumne River below Camanche Reservoir. (Source: The staff.)

Impact mechanism	Salmonid life history stage*			
	Upstream migration	Spawning	Rearing	Downstream migration
Flow/water quality conditions	- Flow spikes - Turbidity enhancement	- Gravel enhancement - Turbidity enhancement	- Minimum flow at CR - Improve LL/WD ramping rate	- Flow spikes - Screens - Improve LL/WD
Physical habitat	- Channel clearing in low water minimum flow at CR	- Minimum flow at CR - Gravel enhancement - Ramping rate	- Minimum flow at CR - Improve LL/WD ramping rate	- Improve LL/WD
Water temperature	- Minimum flow at CR - Minimum pool at CR - Minimum flow at PR	- Minimum flow at CR - Minimum pool at CR - Minimum flow at PR	- Minimum flow at CR - Minimum pool at CR - Minimum flow at PR - Improve LL/WD	- Minimum flow at CR - Minimum pool at CR - Minimum flow at PR - Improve LL/WD
Water quality	- Hypolimnetic oxygenation - Selective withdrawal - PM remediation - CR remediation	- Hypolimnetic oxygenation - Selective withdrawal - PM remediation - CR remediation	- Hypolimnetic oxygenation - Selective withdrawal - PM remediation - CR remediation	- Hypolimnetic oxygenation - Selective withdrawal - PM remediation - CR remediation
Migration barriers	- Improve LL/WD	n/a	n/a	- Screens - Improve LL/WD
Entrainment	n/a	n/a	- New screens - Improved Woodbridge Irrigation District screens	- Screens - Improve LL/WD - Hypolimnetic oxygenation
Predation	- Fishing regulations and enforcement	- Fishing regulations and enforcement	- Hypolimnetic oxygenation - Improve LL/WD	- Screens - Improve LL/WD - Hypolimnetic oxygenation

* CD = Camanche Dam; FD = Pardee Dam; LL = Lake Lodi; WD = Woodbridge Dam; PM = Penn Mine; CR = Camanche Reservoir

The no action alternative of maintaining current operating conditions is discussed along with each mitigation alternative. Staff's final recommendations for project modifications are a combination of flow and non-flow alternatives that gives the best balance between benefits to salmonid resources and costs to the licensee, EBMUD. Lastly, Section 2.4 presents a general comparison of the major alternatives with respect to expected benefits and costs.

2.1 DESCRIPTION OF THE PROJECT

The existing LMRP is a multipurpose system of surface reservoirs and aqueducts owned and operated by EBMUD. The project is operated for purposes of water supply, flood control, hydropower production, and recreation. EBMUD is a publicly owned utility formed in 1923 to provide water supply and wastewater treatment services to municipalities in the East San Francisco Bay Area. EBMUD's service area now covers approximately 320 square miles and includes all or parts of the cities of Alameda, Albany, Berkeley, Danville, El Cerrito, Emeryville, Hayward, Hercules, Lafayette, Moraga, Oakland, Orinda, Piedmont, Pinole, Pleasant Hill, Richmond, San Leandro, San Pablo, San Ramon, and Walnut Creek (EDAW, Inc. 1992a).

Almost all of EBMUD's water supply comes from inter-basin transfers out of the Mokelumne River at Pardee Reservoir. Pardee Dam, completed in 1929, was the first water supply project constructed in the Mokelumne River Basin. Camanche Dam was completed in 1964 downstream from Pardee Dam, primarily to provide additional storage for instream flow to the Lower Mokelumne River and flood control. EBMUD received a FERC license for hydroelectric facilities at both Pardee and Camanche dams in 1981. Although hydropower facilities were constructed and operated at Pardee Dam prior to 1981, those facilities had been excluded from FERC licensing by federal legislation.

2.1.1 Location

The Camanche and Pardee facilities are located in the Sierra Foothills region of California, approximately 35 miles southeast of Sacramento and 75 miles northeast of Oakland (Figure 1.1-2). Pardee Dam (Figure 2.1-1) is at Mokelumne River Mile (MRM) 73 and Camanche Dam (Figure 2.1-2) is approximately nine miles downstream at MRM 64.

Figure 2.1-1. Aerial photograph of Pardee Dam at Mokelumne River Mile 73 looking upstream toward the northeast. (Source: EBMUD 1989.)

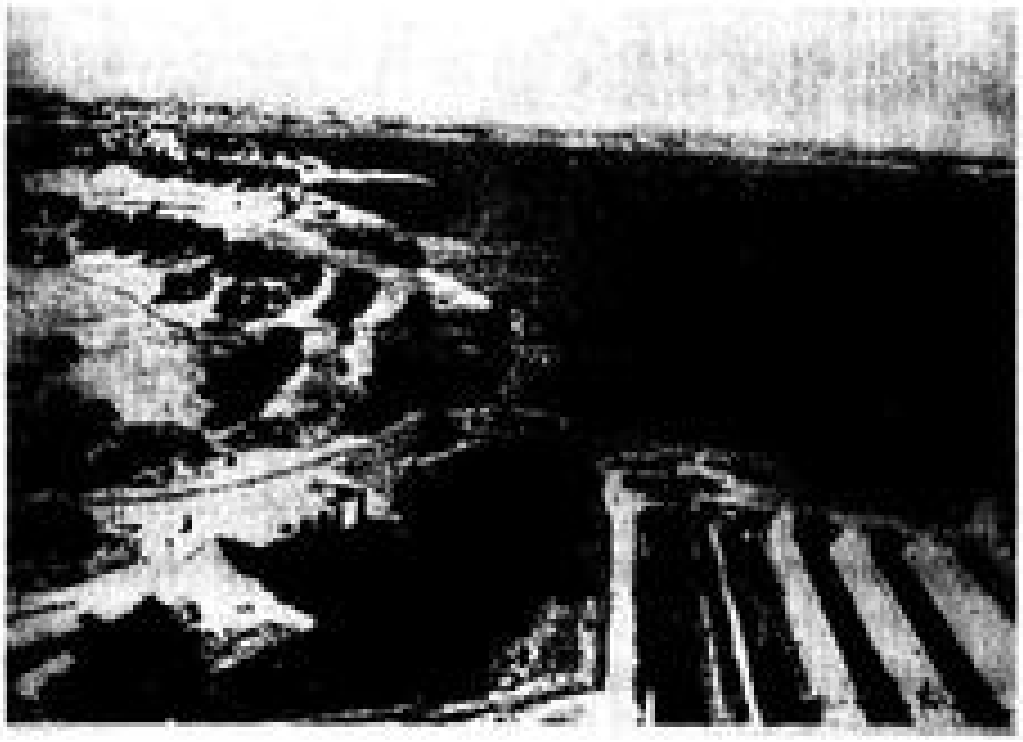


Figure 2.1-2. Aerial photograph of Camanche Dam at Mokelumne River Mile 64 looking upstream toward the northeast on August 25, 1986. (Photograph by Steve D. Wilson.)

The principal diversion of Mokelumne River water is from the southern arm of Pardee Reservoir into the Mokelumne Aqueducts serving EBMUD's water supply system (Figure 2.1-2). The river flow that is not diverted from Pardee is routed through the sluiceway and/or the hydroelectric facility at Pardee Dam. The Mokelumne River then flows into Camanche Reservoir. The storage capacity in Camanche Reservoir is generally used by EBMUD to satisfy downstream water rights, to provide flood control, and to provide for downstream fish resources, including the MRFF. Principal water rights related to LMRP operations are those held by the North San Joaquin Water Conservation District (NSJWCD) (maximum entitlement of 20,000 ac-ft per year), the Woodbridge Irrigation District (maximum entitlement of 60,000 ac-ft per year, except during critically dry years in which entitlement is 39,000 ac-ft), the Jackson Valley Irrigation District (JVID) (3,850 ac-ft), and downstream riparian and appropriators (see Section 3.2.1 and Appendix G for further details on water rights). As specified in the original FERC license, fishery flows of 15,000 ac-ft per year (9,400 ac-ft during dry years) are released from the project for the MRFF. Camanche releases in excess of 264,000 ac-ft per year are for flood control. The hydropower facilities at both Camanche and Pardee dams make use of downstream releases to produce electricity.

2.1.2 Facilities

The LMRP facilities consist of the two mainstream surface water reservoirs behind Pardee and Camanche dams, the dams themselves, powerhouses, three parallel aqueducts, recreational areas, and a fish hatchery (EBMUD 1992; EDAW, Inc. 1992a).

Pardee Dam and Reservoir

Pardee Dam (Figure 2.1-1) is a 345-ft high, 1337-ft long, concrete gravity-arch structure that impounds a reservoir with a total capacity of 209,950 ac-ft (1,000 ac-ft is alternatively abbreviated as TAF) at spillway crest elevation of 348 ft above mean sea level (MSL). The spillway at Pardee Dam is an ungated, open type structure with a crest length of 800 ft and a discharge capacity of 26,385 cubic feet per second (cfs) at elevation 371.7 ft MSL.

Withdrawals to the Mokelumne aqueducts are made from a multiple-port outlet tower in the south arm of Pardee Reservoir. The most commonly used outlets in the withdrawal tower are a series of three 36-inch x 30-inch openings at four different elevations: 550, 520, 490, and 460 ft MSL. There are also two other outlets at the bottom of the tower at elevations 400 and 395 ft MSL, but these outlets are used by EBMUD only in a low-water emergency. The "dead" storage in Pardee Reservoir below the withdrawal tower outlets is approximately 17 TAF.

The powerhouse at the base of Pardee Dam contains three Francis turbines with a total generating capacity of 28.6 MW. The maximum generating capacity of the turbines at Pardee is 1,100 cfs (375 cfs from two turbines and 350 from another). The total discharge capacity through the turbines and three other sluiceways in Pardee Dam is 5,200 cfs. Discharges into Camanche Reservoir are essentially bottom withdrawals from Pardee Reservoir (either 250 or 325 ft MSL discharge elevations).

Camanche Dam and Reservoir

Camanche Dam (Figure 2.1-2) is a 171-ft high, zoned earth-filled structure with a 2,640-ft long impervious core. Completed in 1964, it was licensed for hydropower production along with Pardee Dam in 1981. Total storage volume of the reservoir is 430,880 ac-ft at a maximum pool elevation of 235.5 ft MSL. The spillway at Camanche is an ungated, open type structure with a total length of 400 ft and a discharge capacity of 182,000 cfs at elevation 260 ft MSL.

In addition to the spillway, there are two main outlet structures at Camanche Dam: a lower-level outlet structure drawing from approximately elevation 100 ft MSL and an upper-level outlet structure with an invert elevation of approximately 201 ft MSL. Epilimnetic releases through the upper-level outlet are practical from Camanche only when total reservoir storage exceeds approximately 210 TAF. There is also a small, floating pumping plant with a total capacity of 35 cfs that discharges into the upper-level outlet. The floating pumping plant can withdraw selectively from depths between 30 and 50 ft below the water surface. This pumping plant was installed in 1990 to help mitigate water quality problems that had been adversely affecting operations of the fish facility. Dam releases through the sluiceways can be routed to the powerhouse or discharged directly to the river. There are Howell-Bunger emission valves on the end of the two main sluiceways at Camanche Dam.

The Camanche powerhouse contains three 3.56 MW Kaplan turbines with a total installed capacity of 10.7 MW. Discharges through the power plant come only from the lower-level outlet and are at times affected by poor water quality. The combined maximum generating capacity of these turbines is 1,200 cfs and the maximum discharge through Camanche Dam from all sources excluding the spillway is 5,000 cfs.

The average annual generating capacity of the Camanche facility is approximately 40 GWh; EBMUD sells this hydroelectricity to PG&E.

The federal government contributed $10.1 million of the $36.7 million construction cost of the Camanche project for flood control benefits in the Mokelumne River. Up to 200 TAF of reservoir storage capacity is reserved for flood control under an agreement between the U.S. Army Corps of Engineers (COE) and EBMUD. According to an agreement between EBMUD and COE, Camanche Reservoir is drawn down to its winter pool elevations between September 15 and November 5 each year (Figure 2.1-3). A certain proportion of the flood control storage volume in Camanche is creditable to upstream storage reservoirs (i.e., Pardee and several Pacific Gas & Electric (PG&E) reservoirs). Camanche and other reservoirs provide flood control benefits to the towns of Lodi, Woodbridge, and Thornton, and to 69,000 acres of agricultural land in the lower basin.

Mokelumne Aqueducts

The vast majority of EBMUD's water supply is withdrawn from Pardee Reservoir through the Mokelumne Aqueducts, which consist of three 82-mile steel pipelines that deliver water to terminal storage reservoirs and treatment plants in the East Bay area. The three aqueducts range in diameter from 65 to 87 in and in age from 5 to 50 years (the first was constructed in 1928 and the third in 1963). The total withdrawal capacity of the aqueducts depends on the elevation of Pardee Reservoir and on whether pumps or gravity feed are used. Maximum capacity via gravity flow is approximately 202 million gallons per day (MGD) (310 cfs or 224 TAF/yr) when Pardee Reservoir is at its maximum pool elevation. Pumping is needed to increase withdrawals above this amount. Pumping can achieve a withdrawal rate of 325 MGD (495 cfs), but this option is not used frequently by EBMUD, in part due to the age and condition of the aqueducts. The aqueducts are buried for most of their length except for where they cross the Sacramento-San Joaquin Delta. A 10-mile segment of the aqueducts, between the towns of Hoh and Byler, is elevated; in this

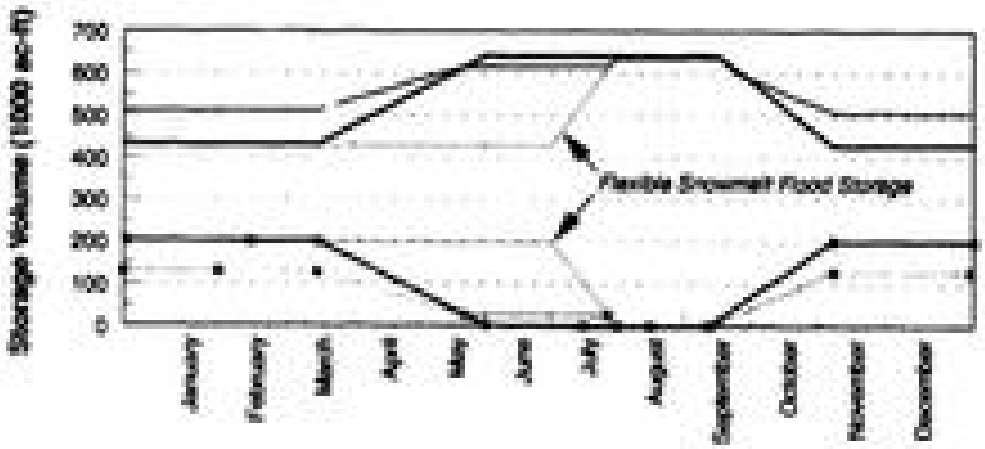
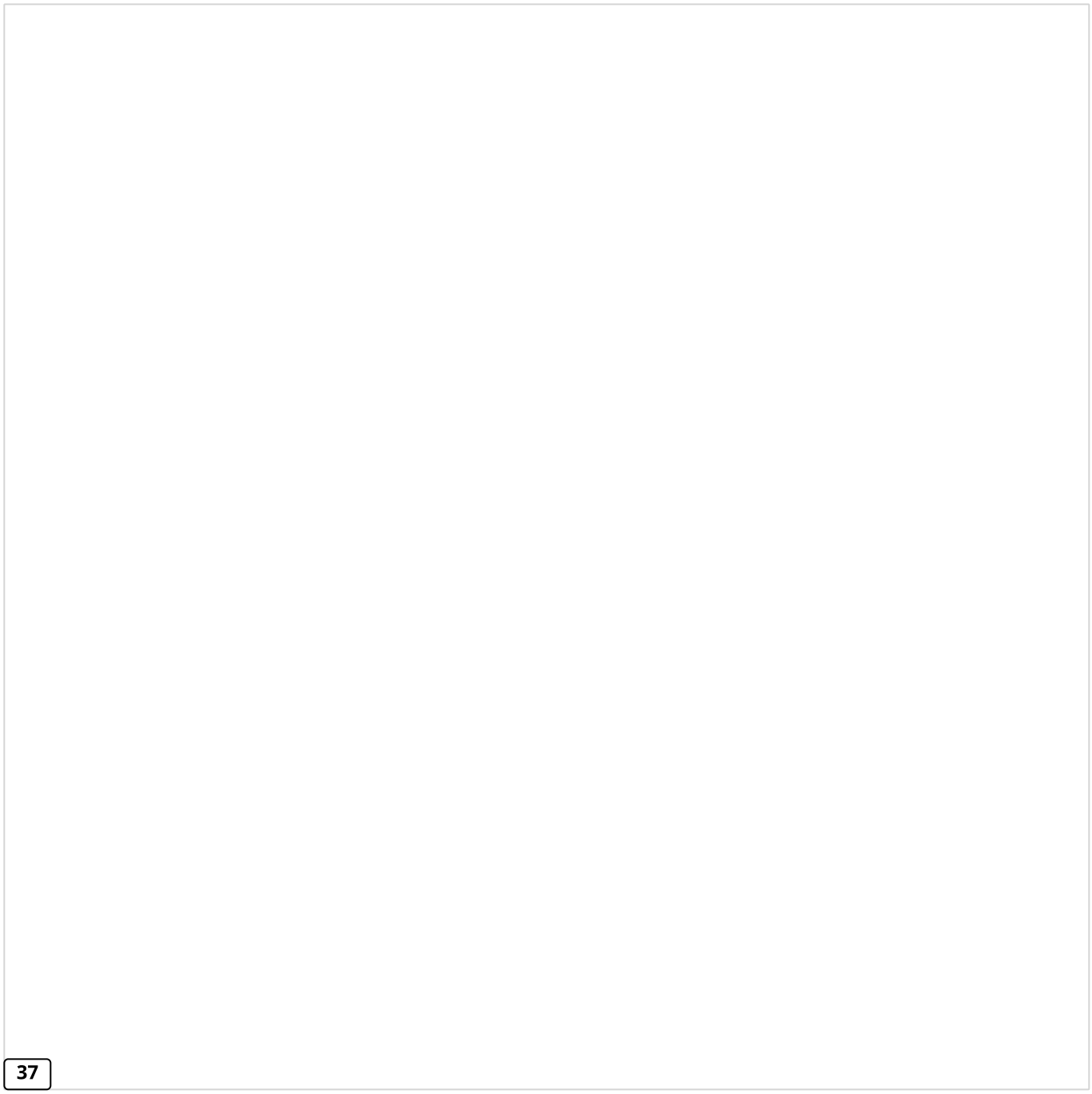


Figure 2.1-3. Combined flood control requirements for Camanche and Pardee Reservoirs in agreement between East Bay Municipal Utility District and the U.S. Army Corps of Engineers. (Upper set of lines is maximum reservoir storage constraints and lower set of lines is minimum empty flood storage requirements.) (Source: The staff.)



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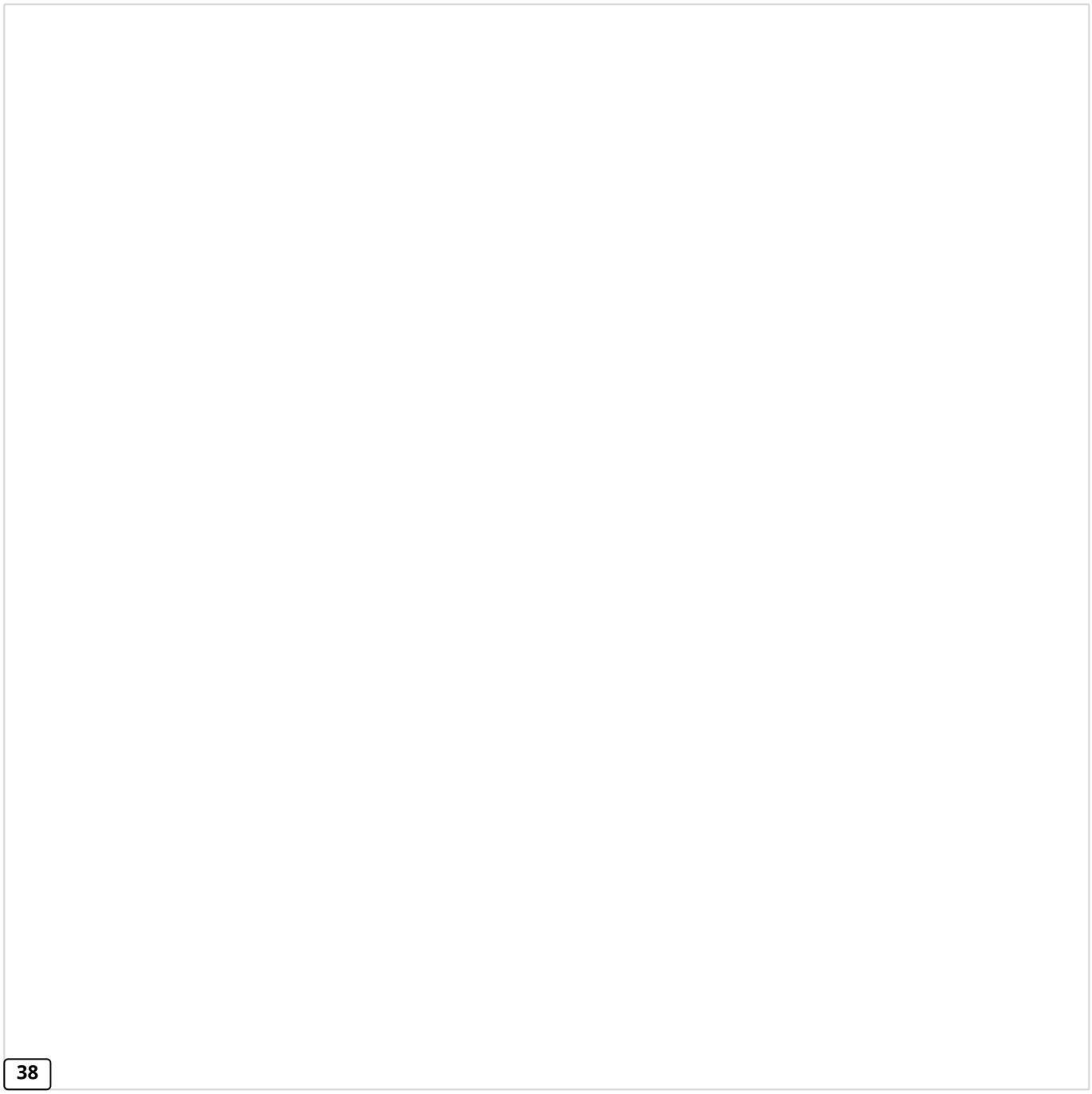

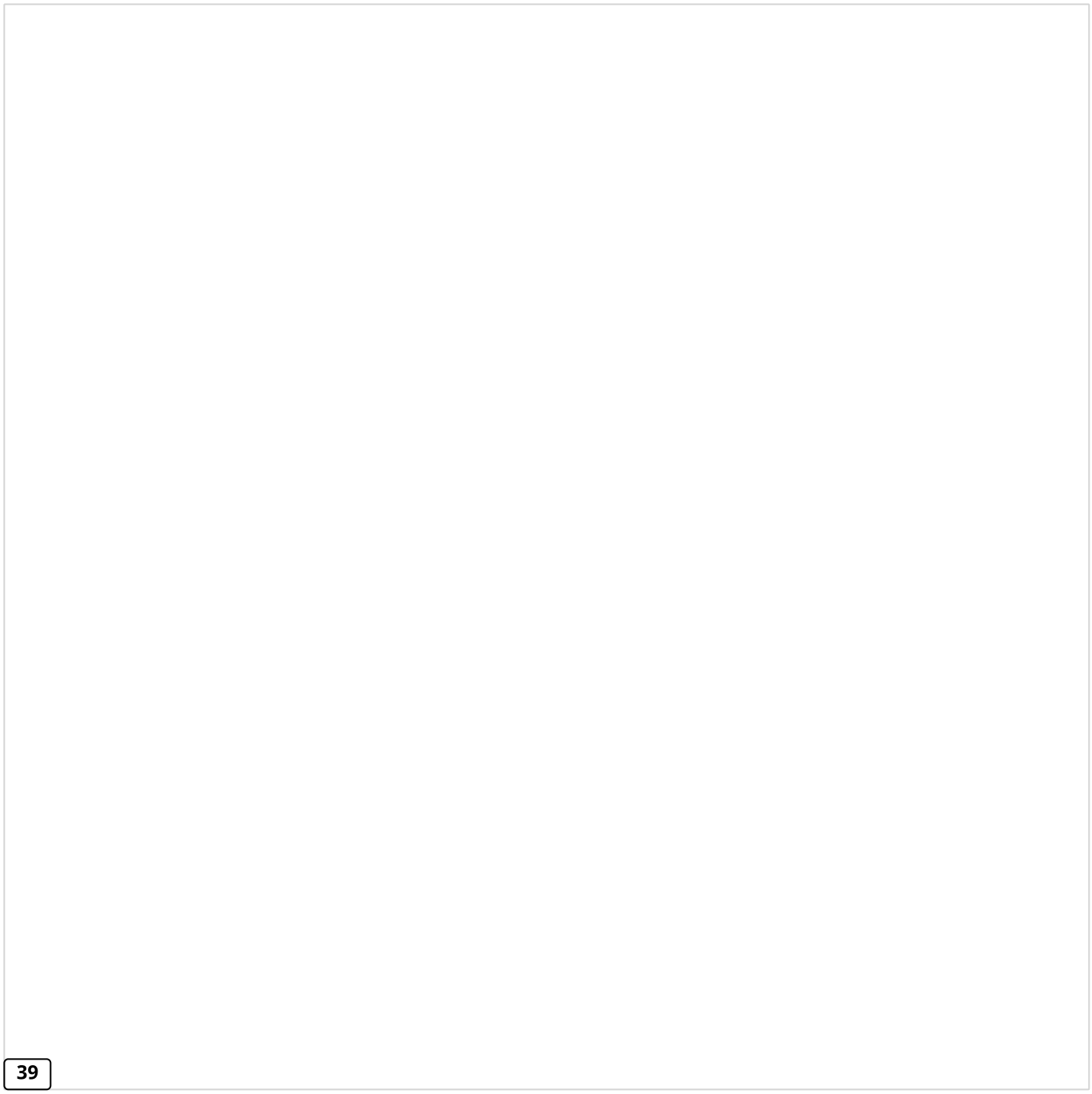

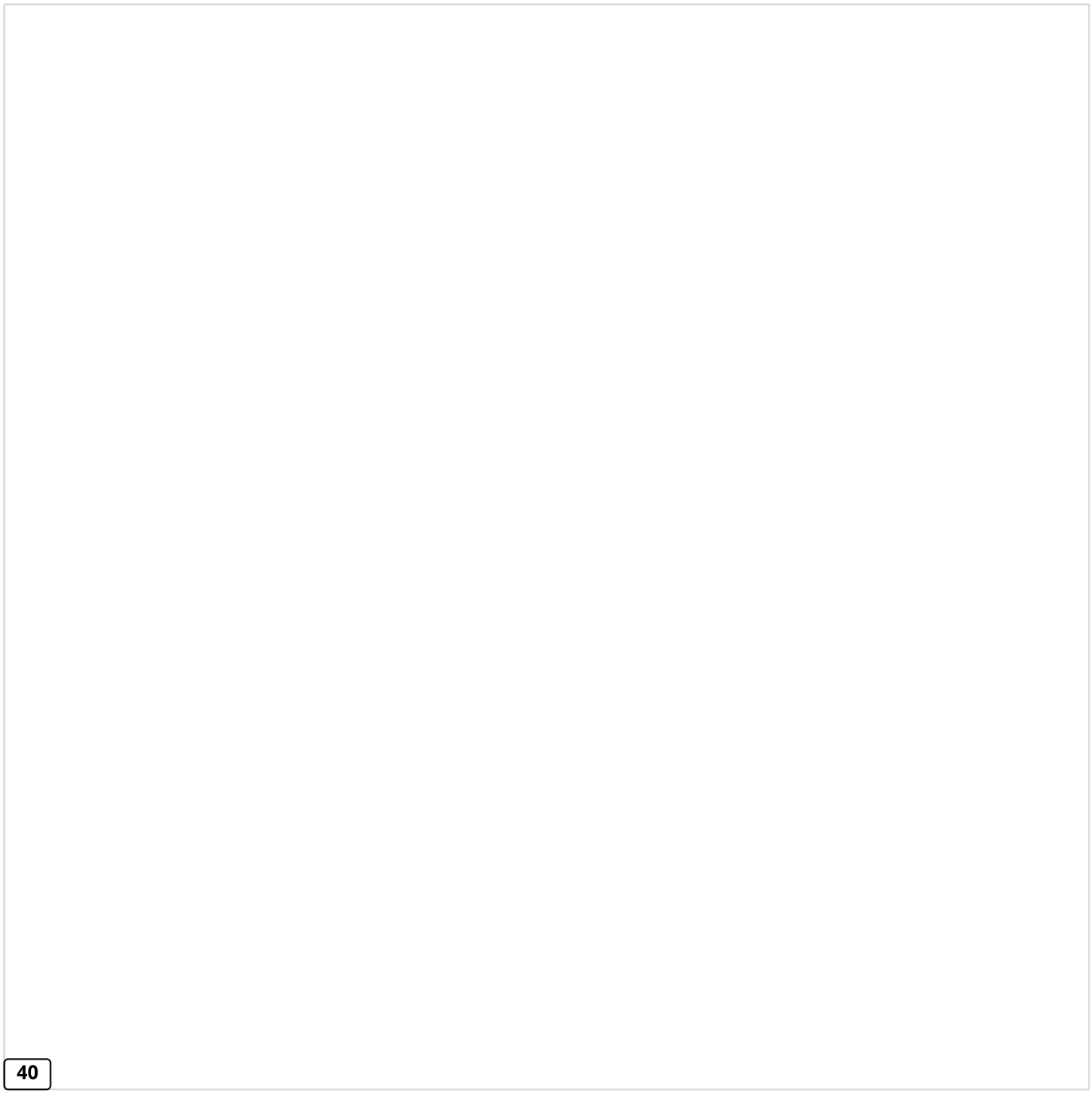

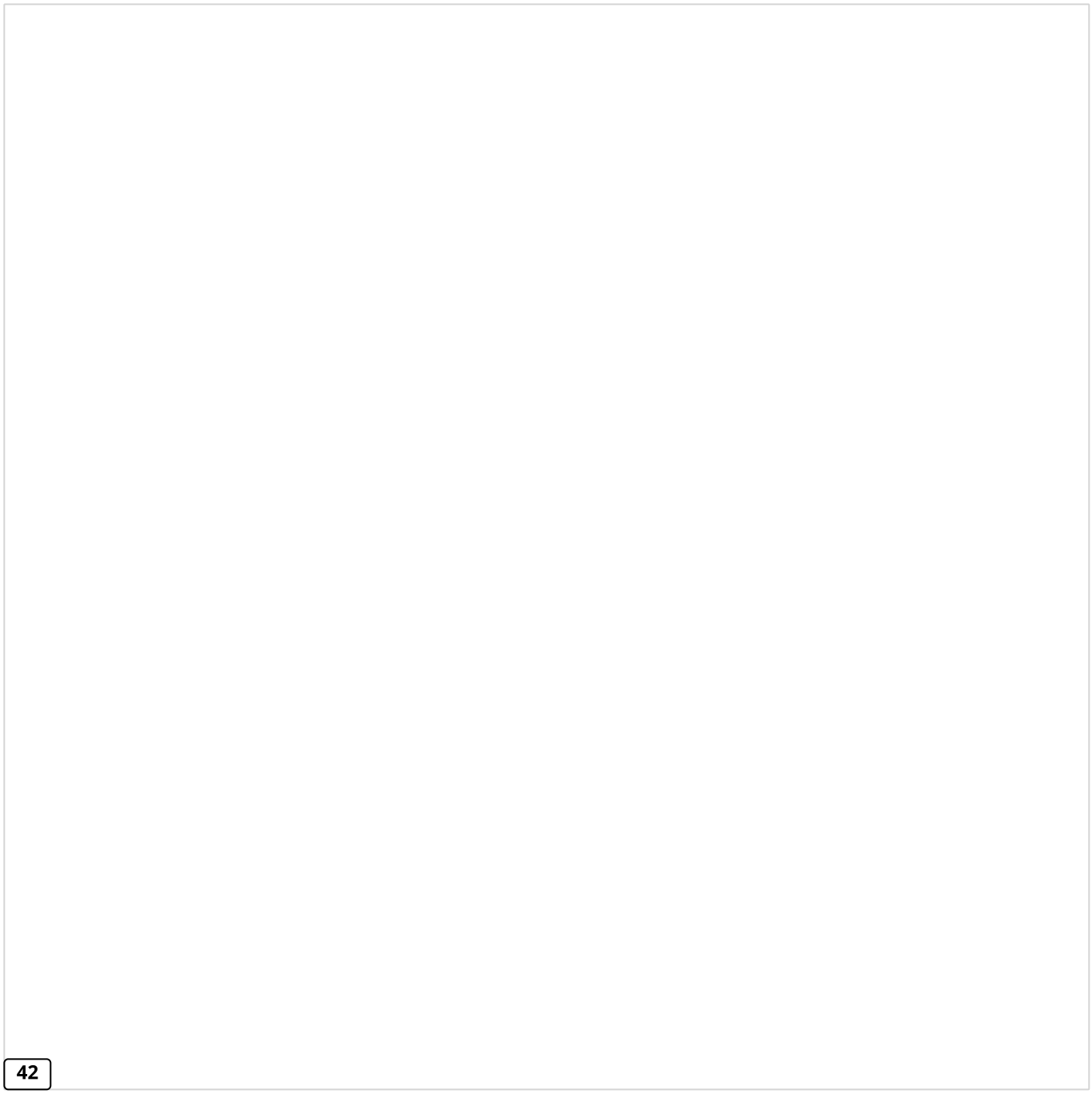

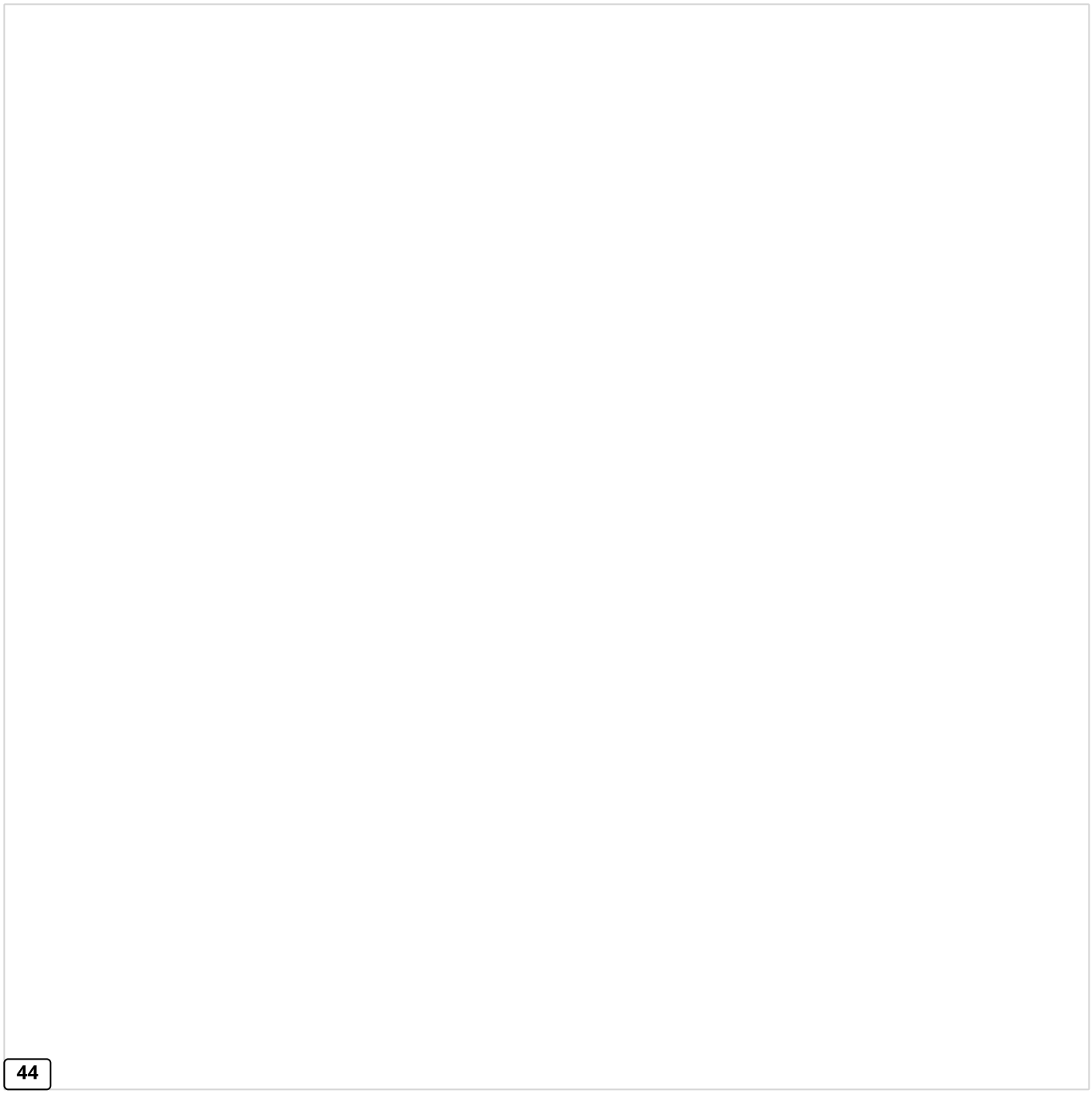

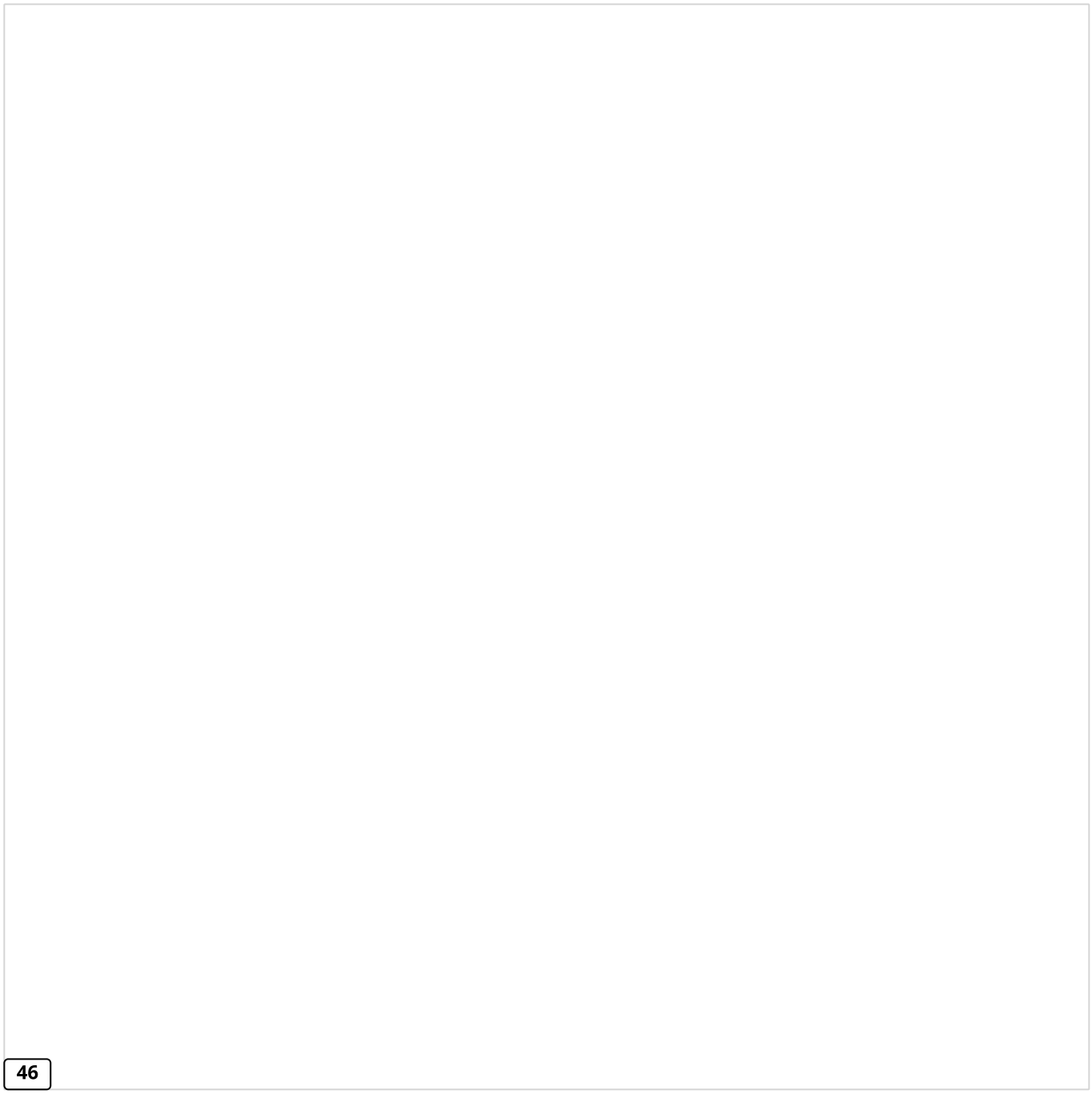

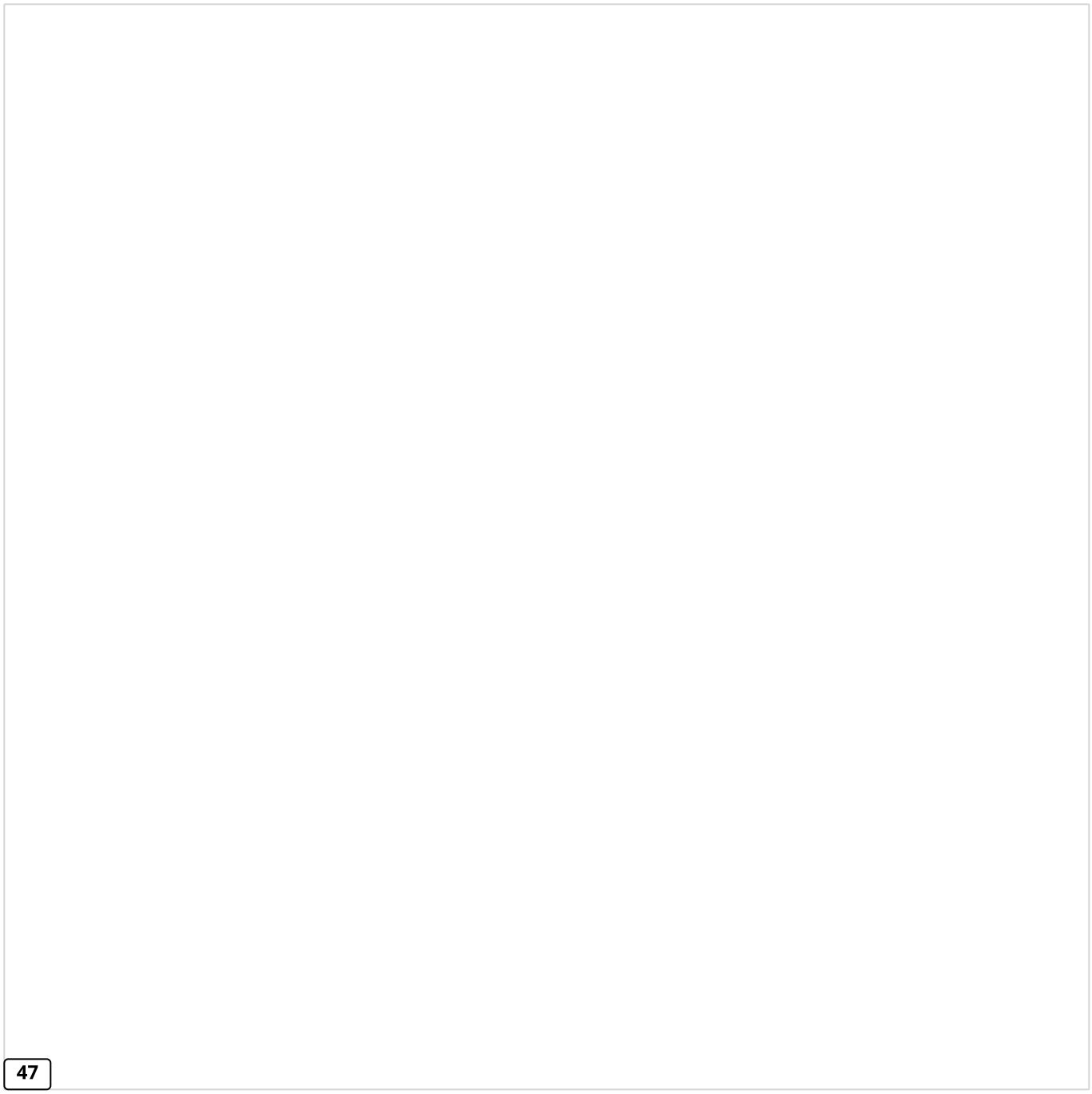

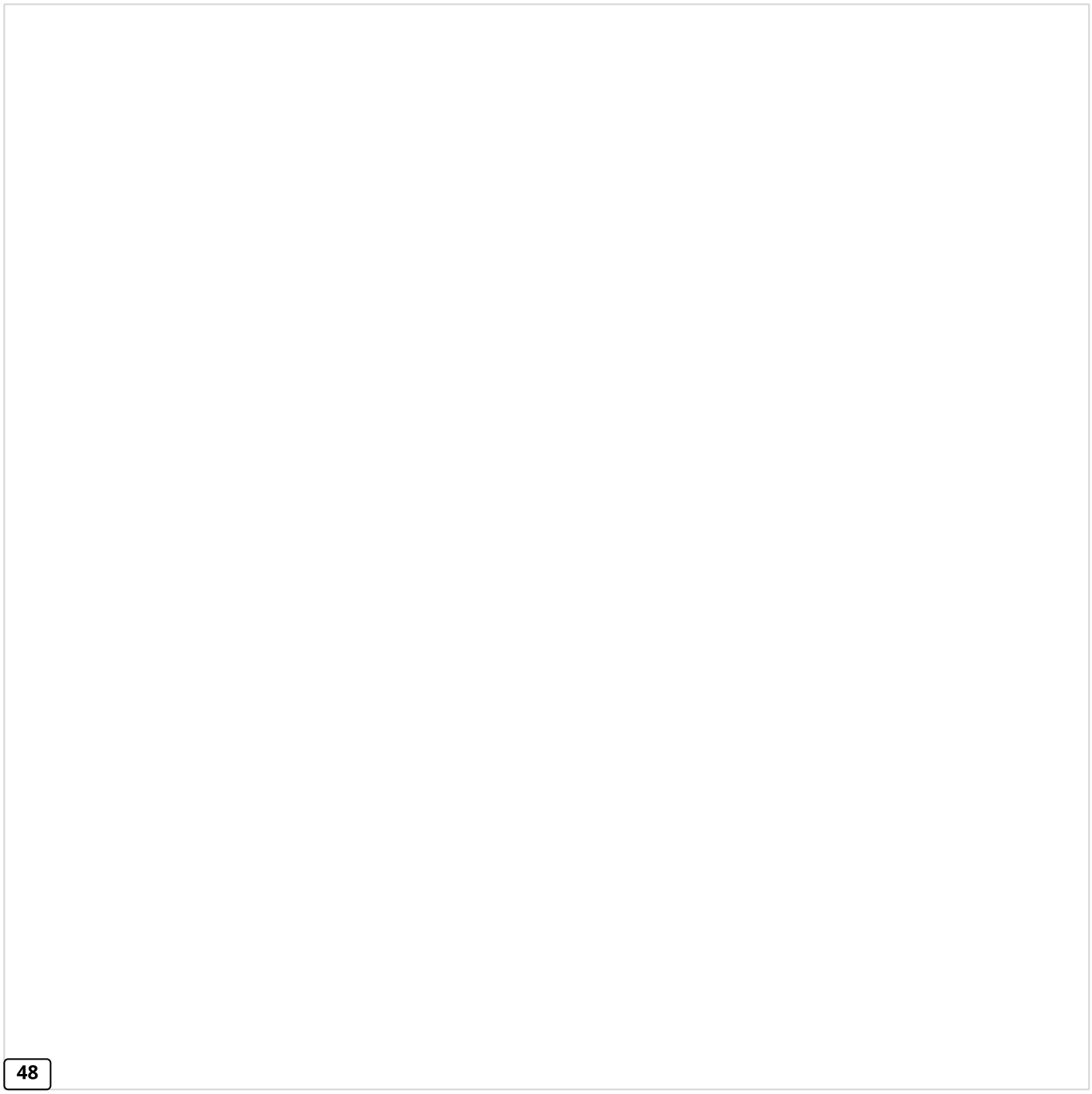

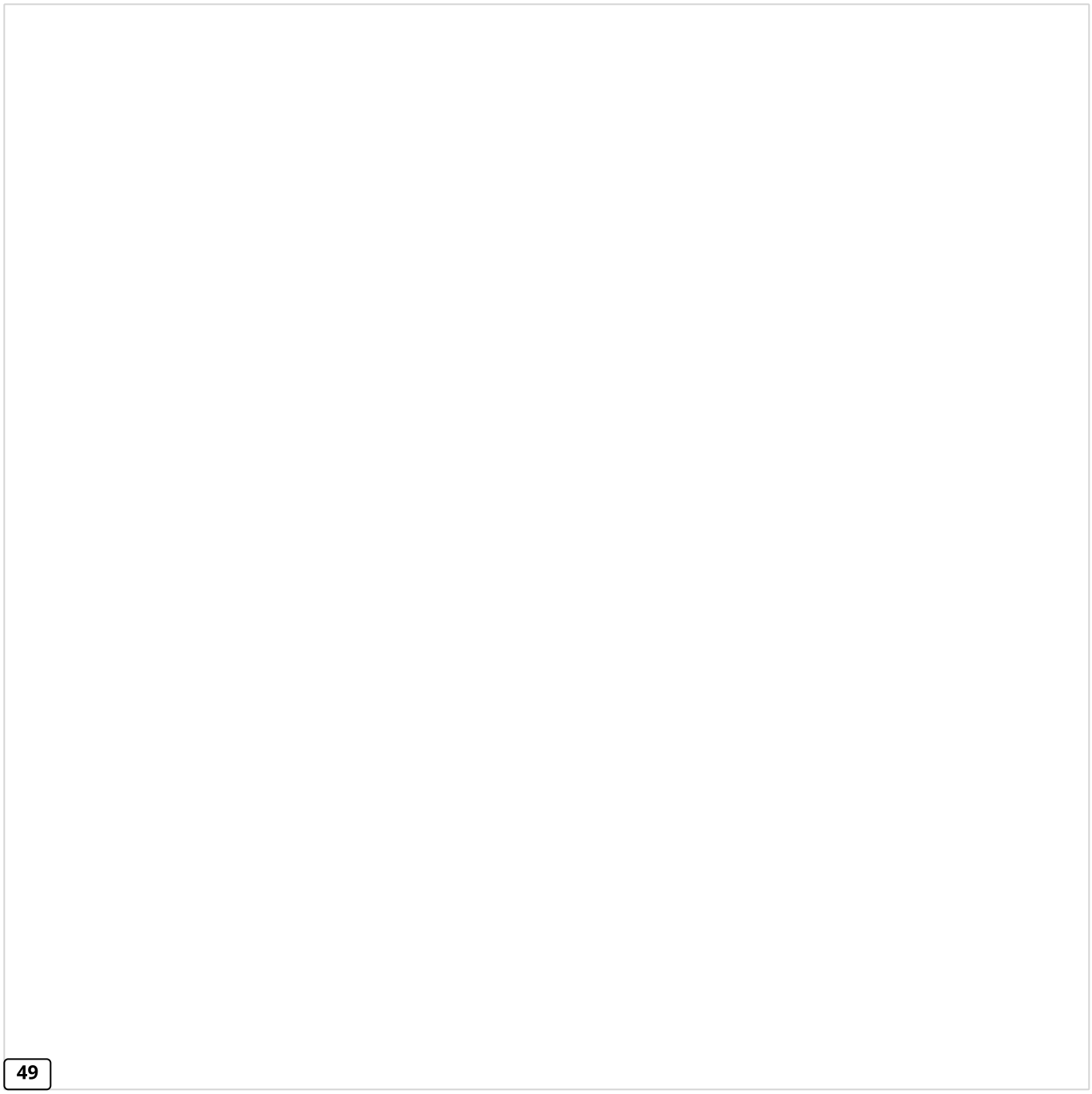

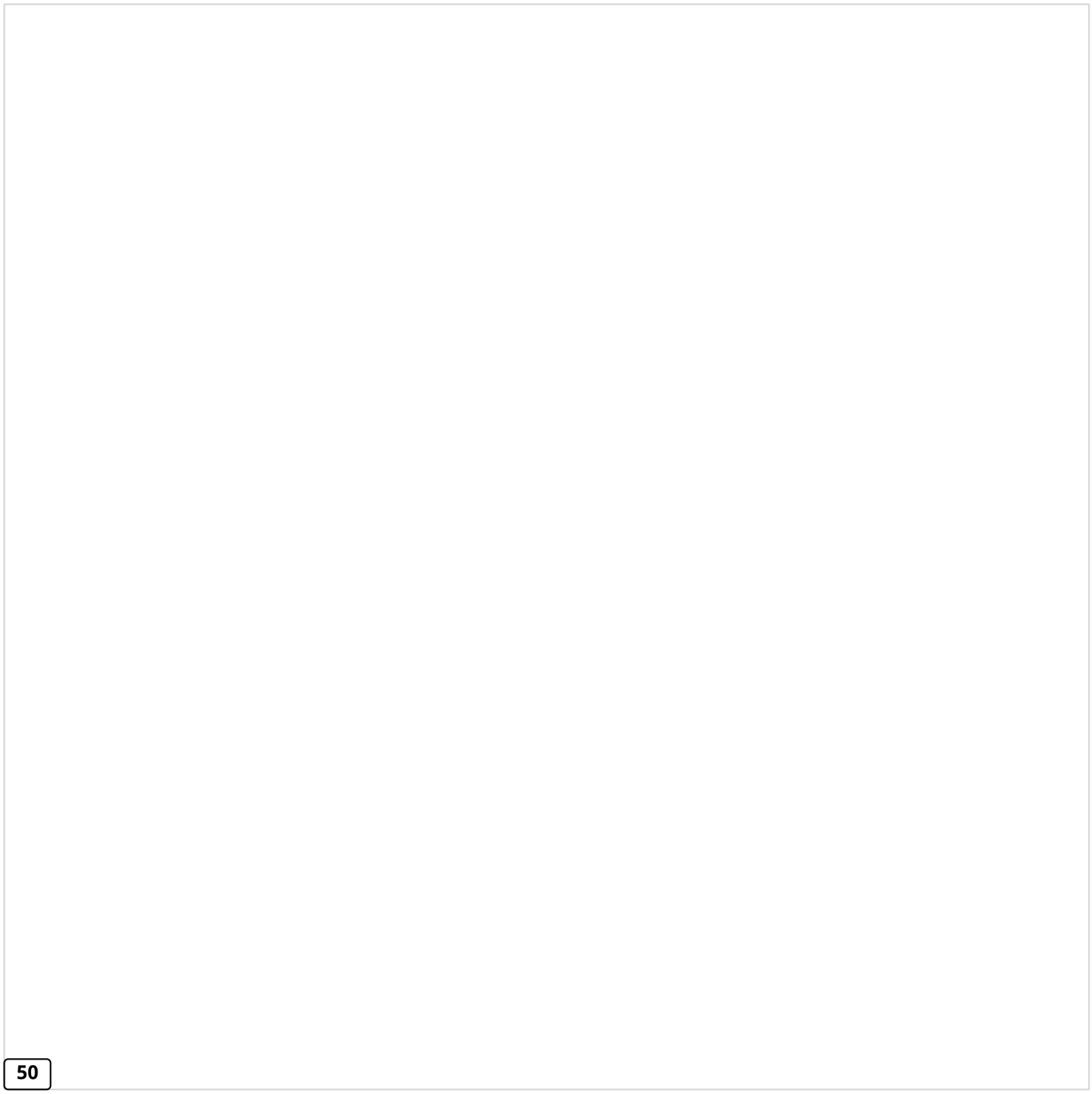

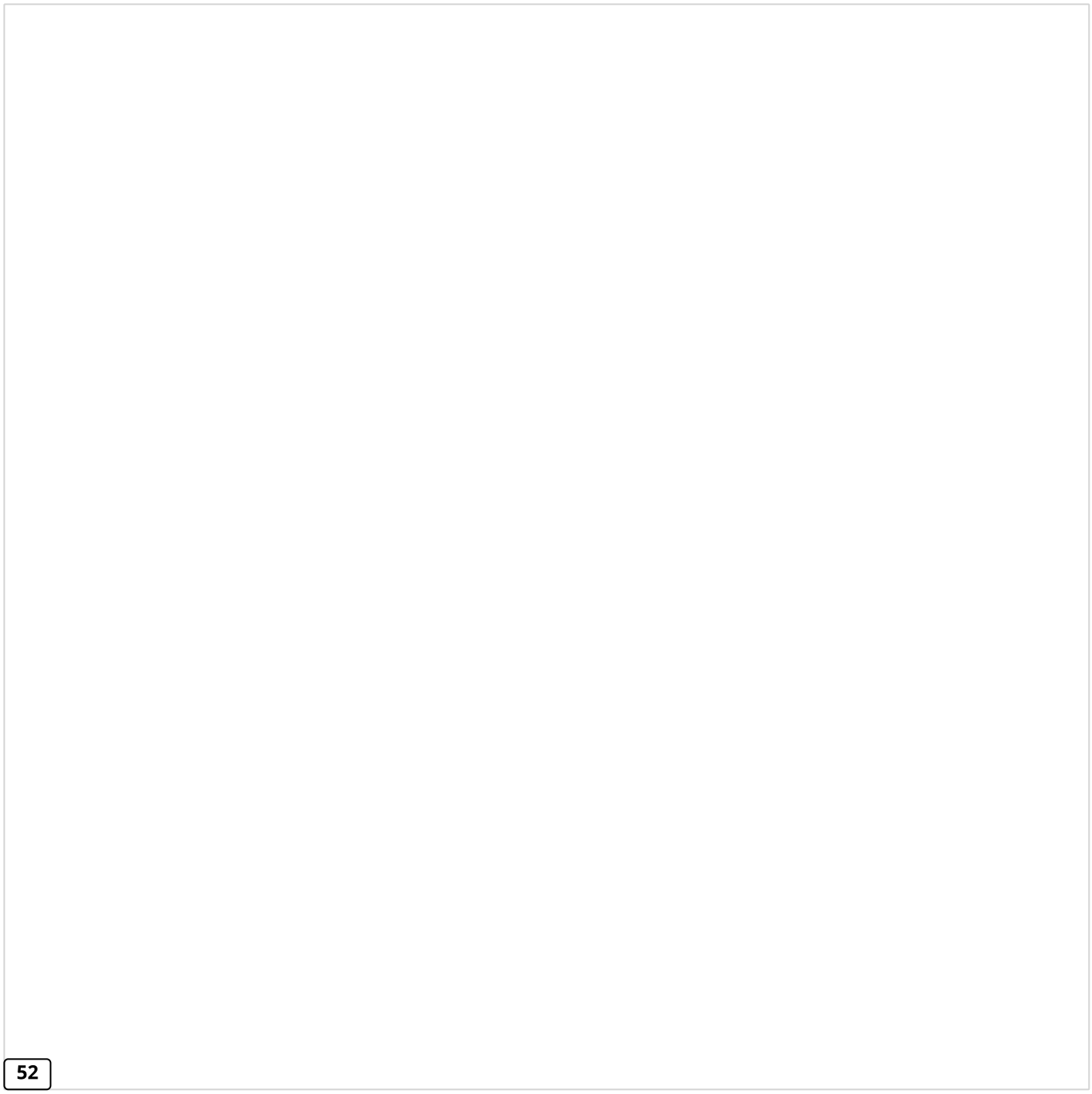

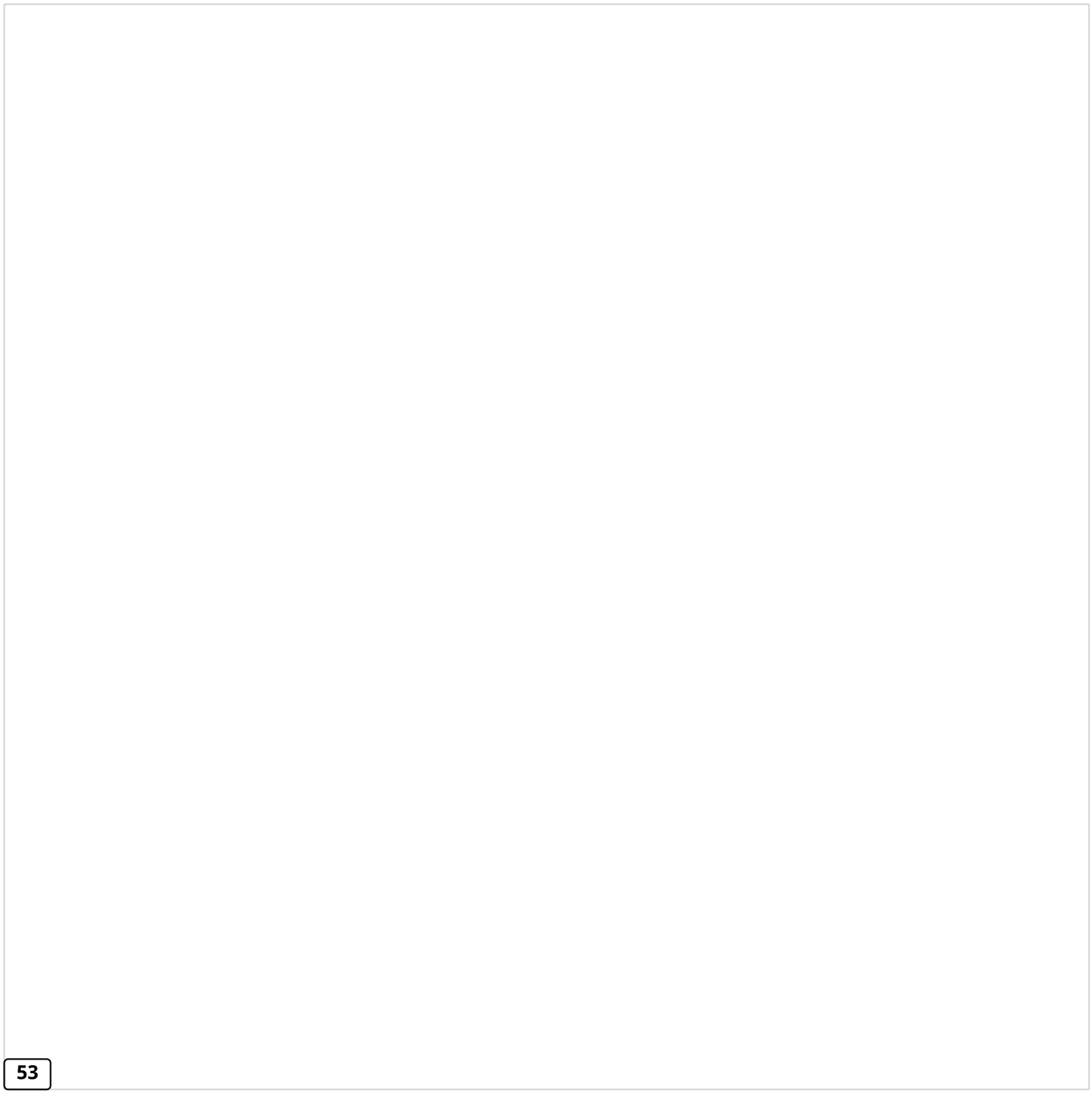

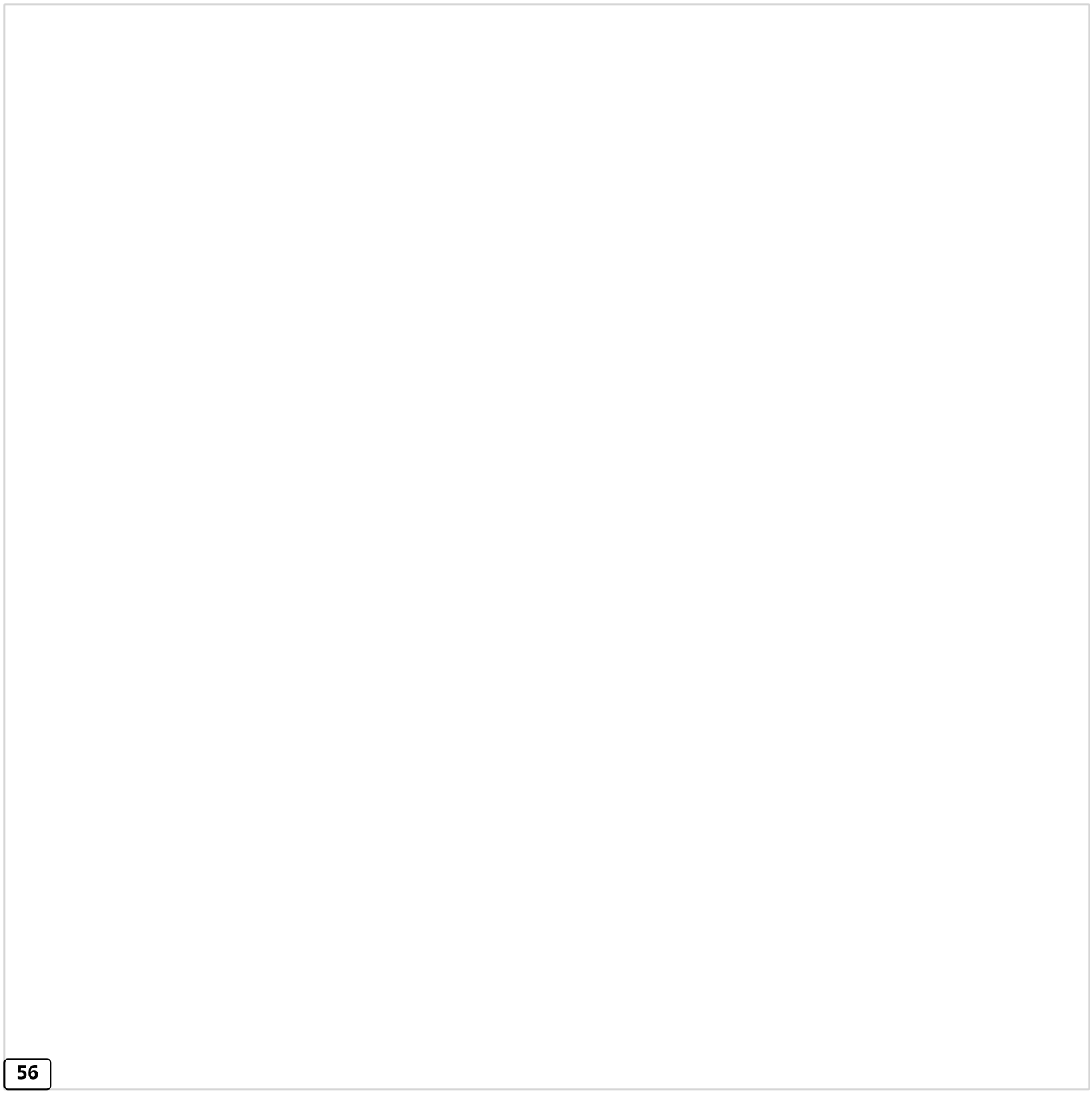

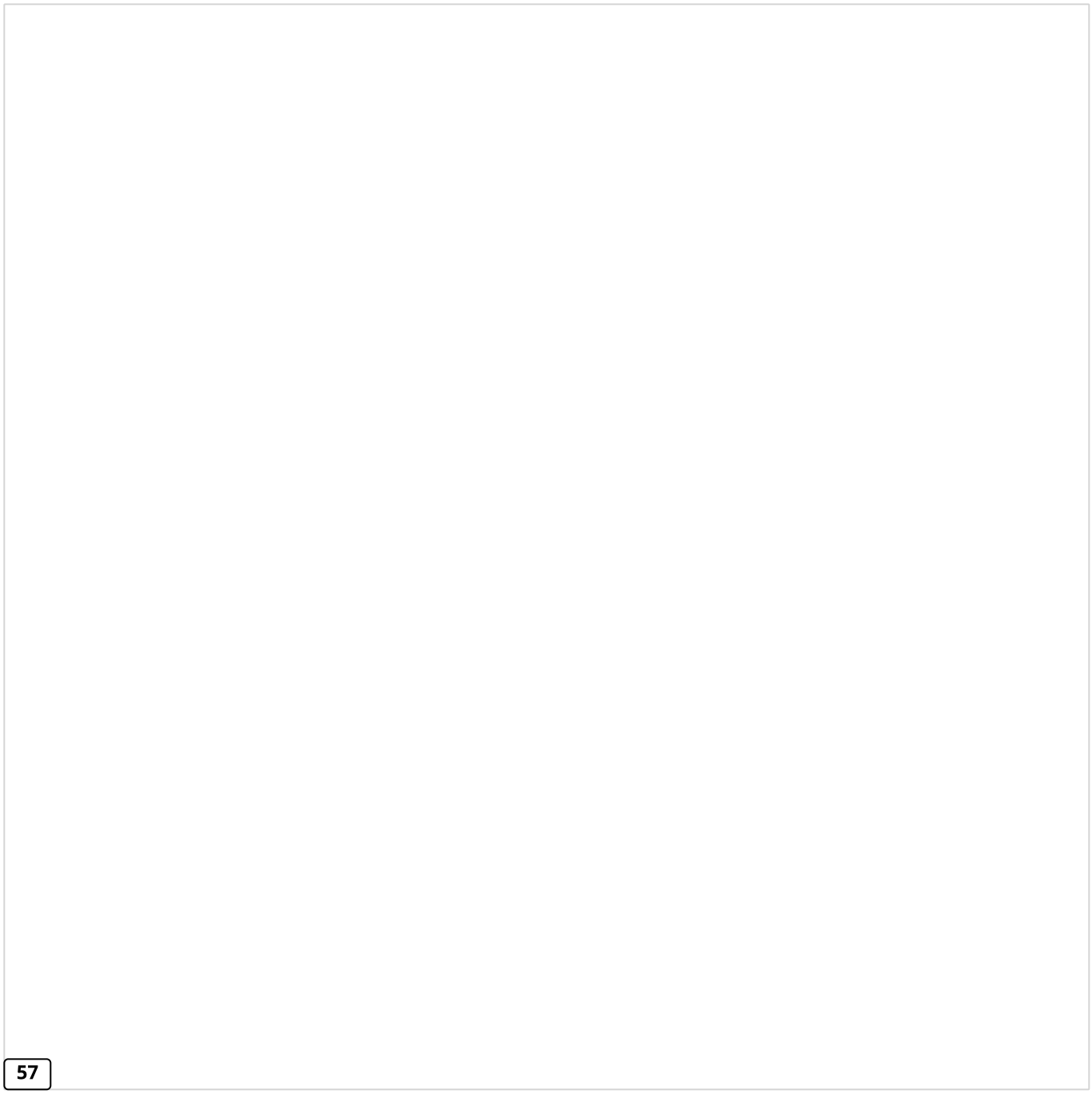

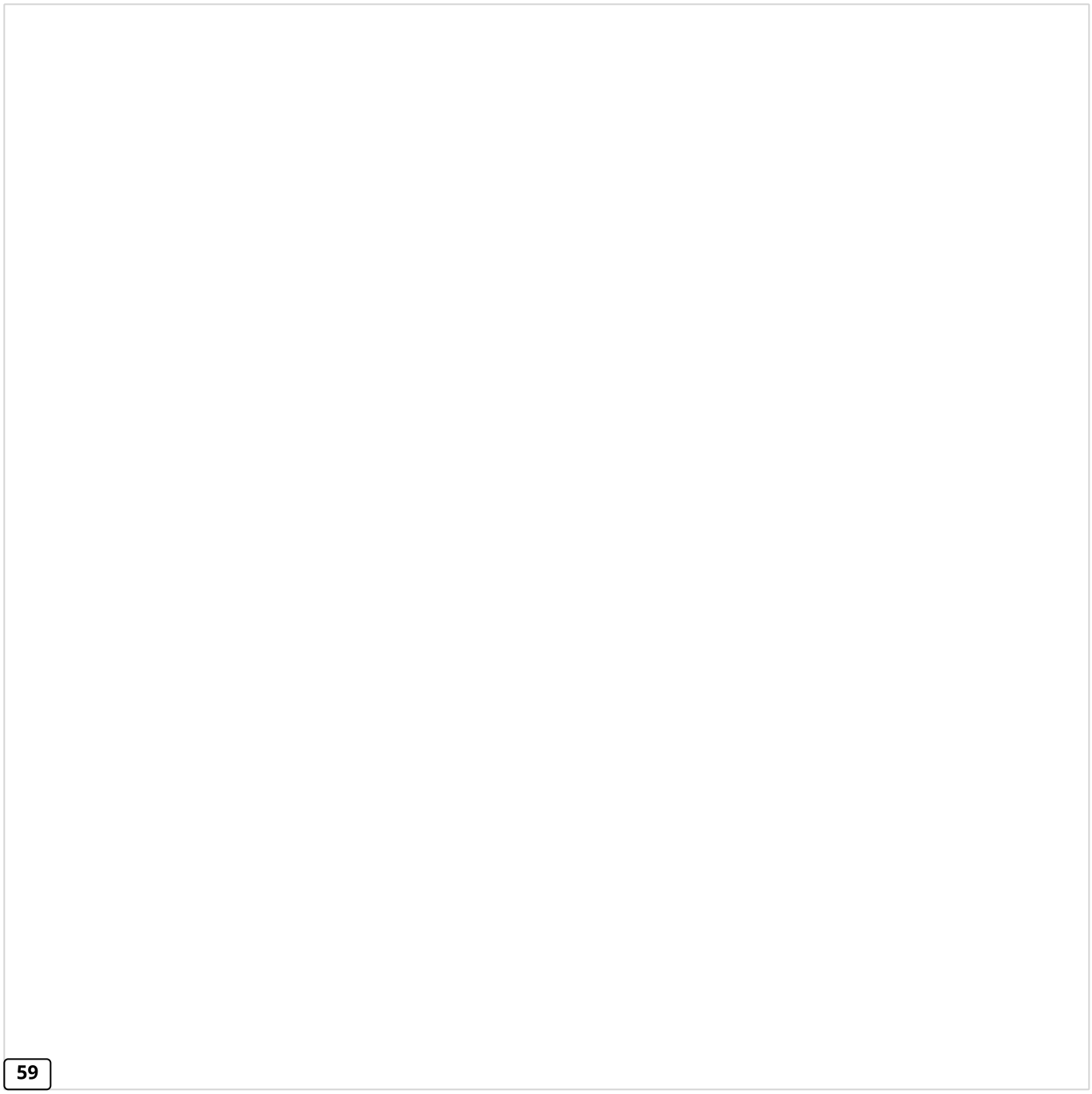

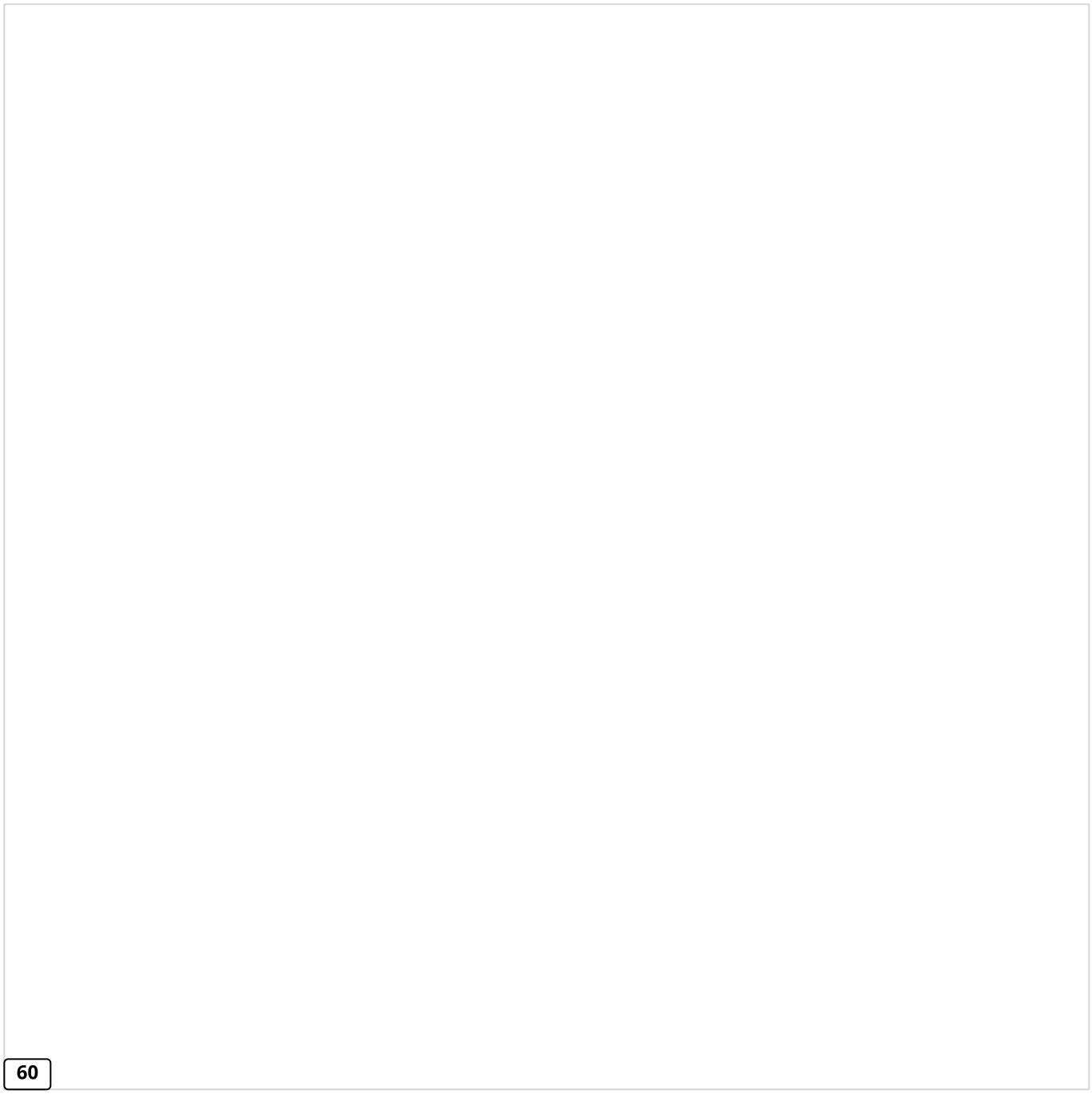

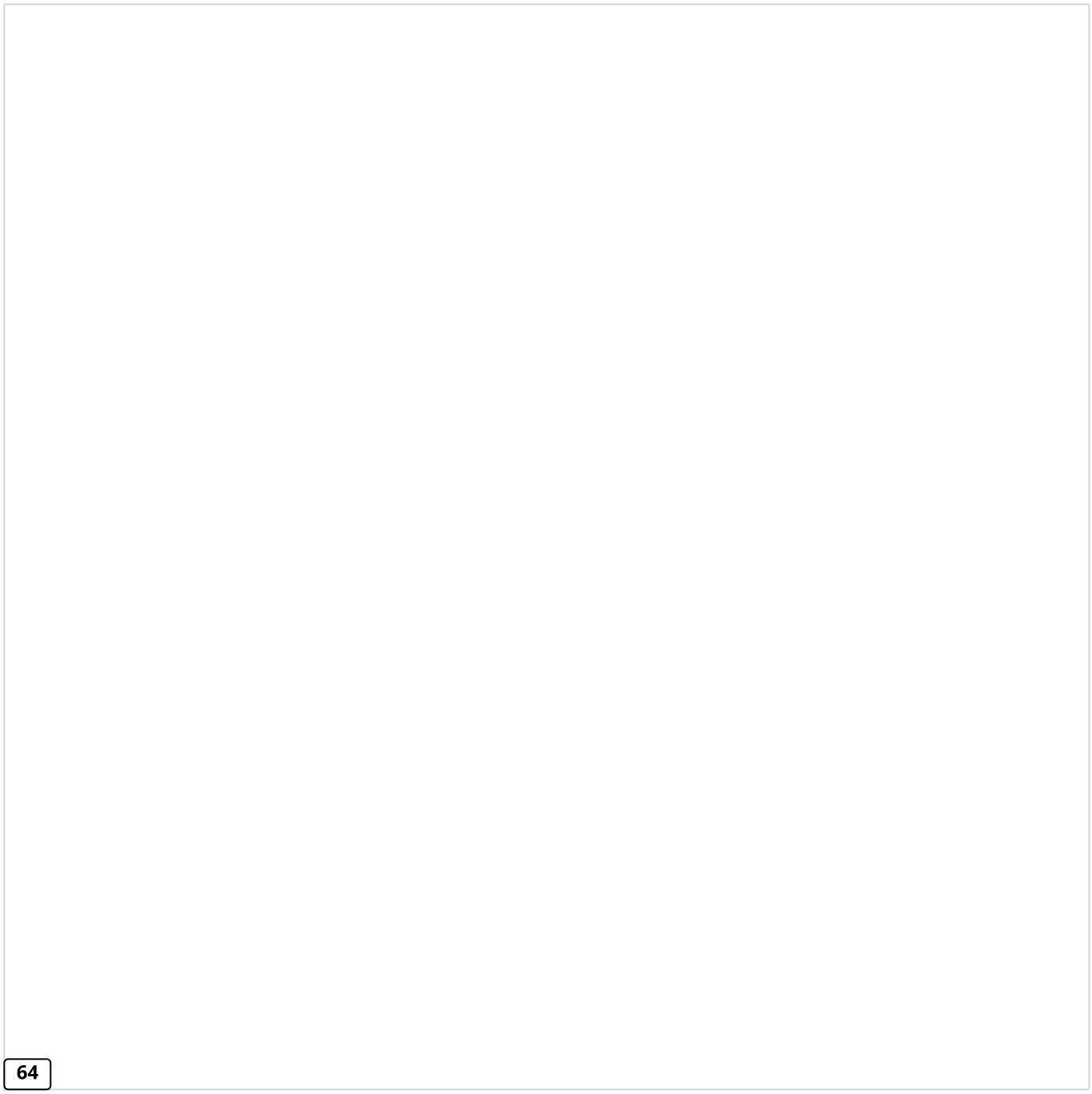

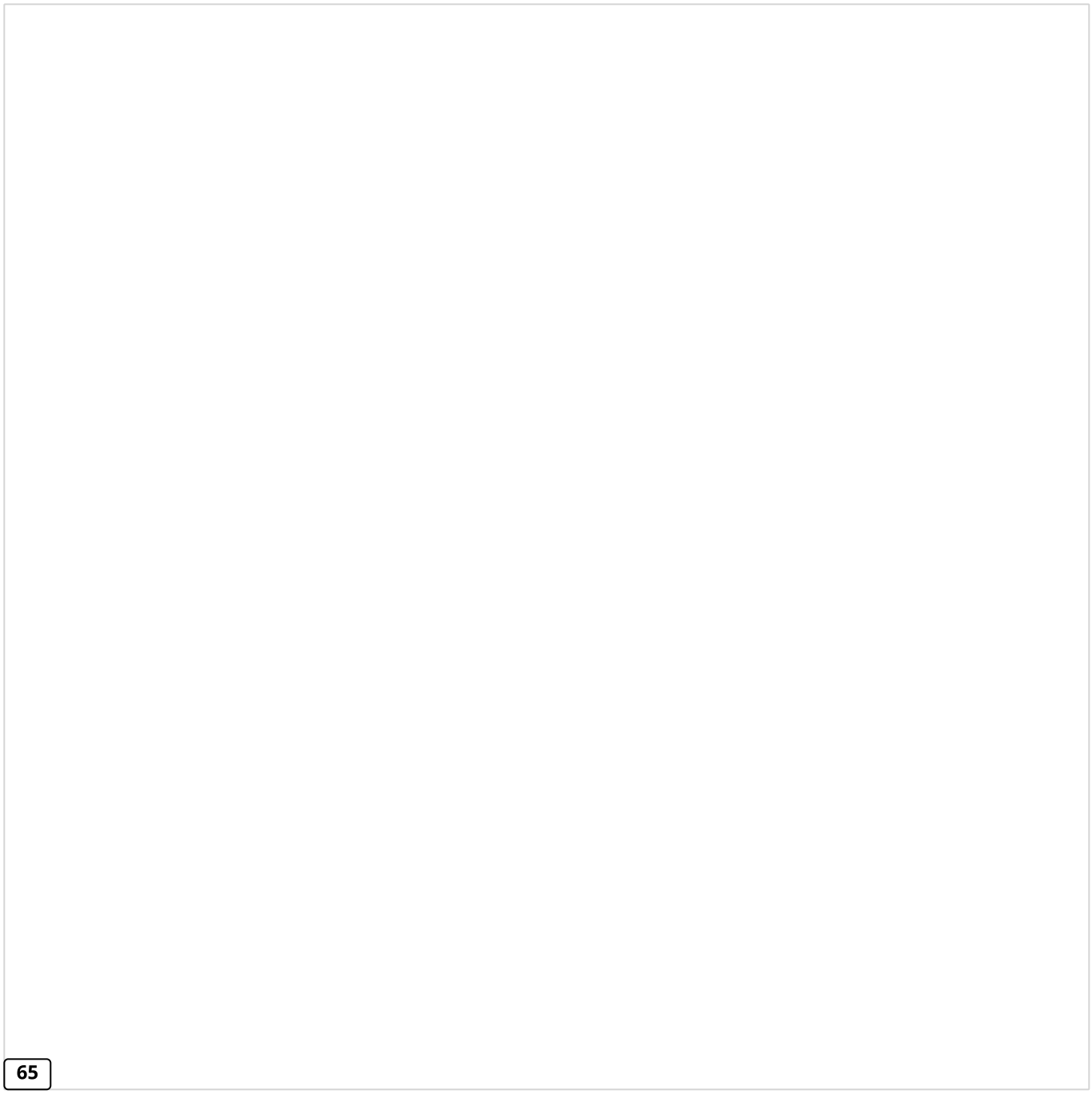

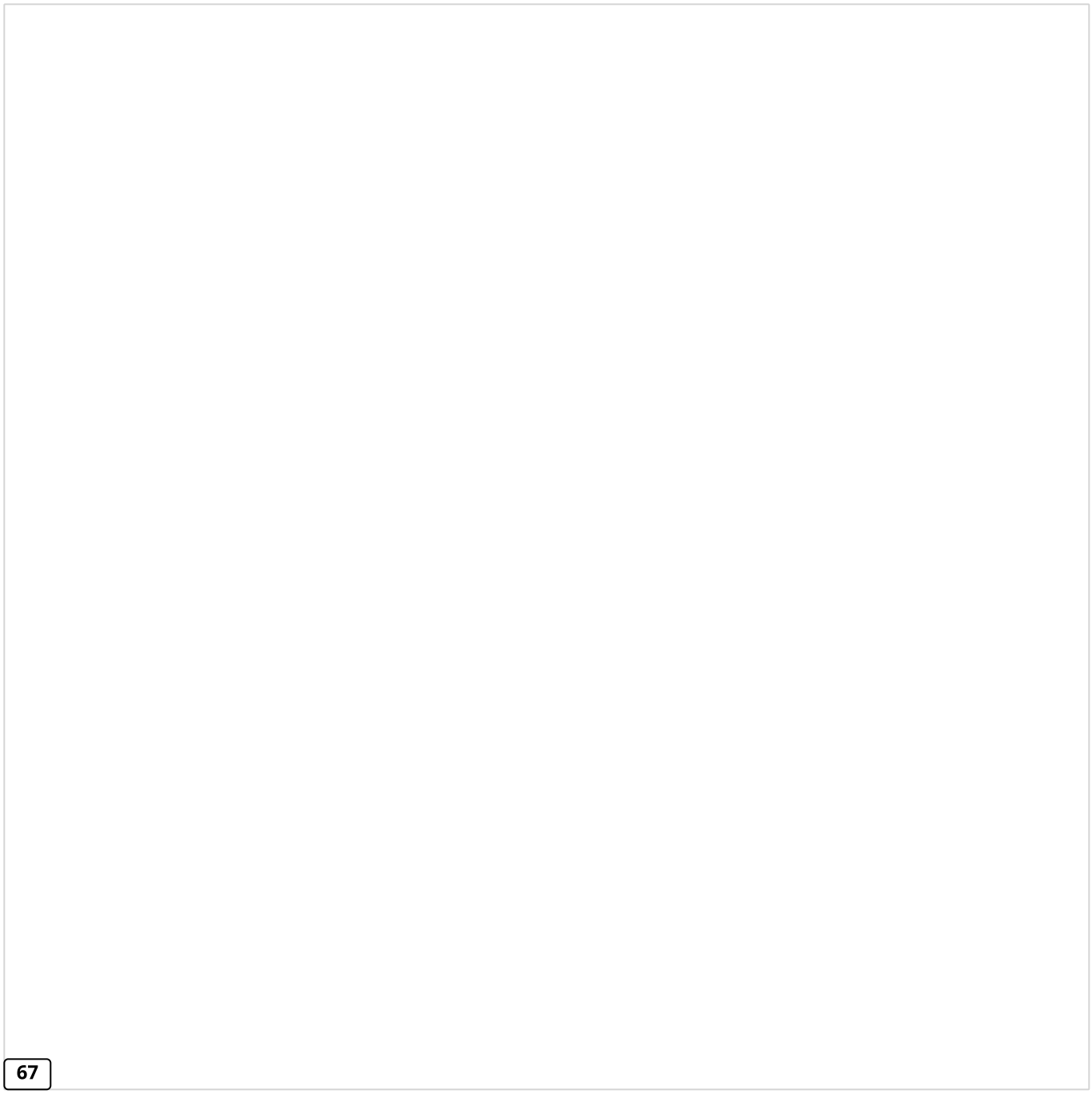

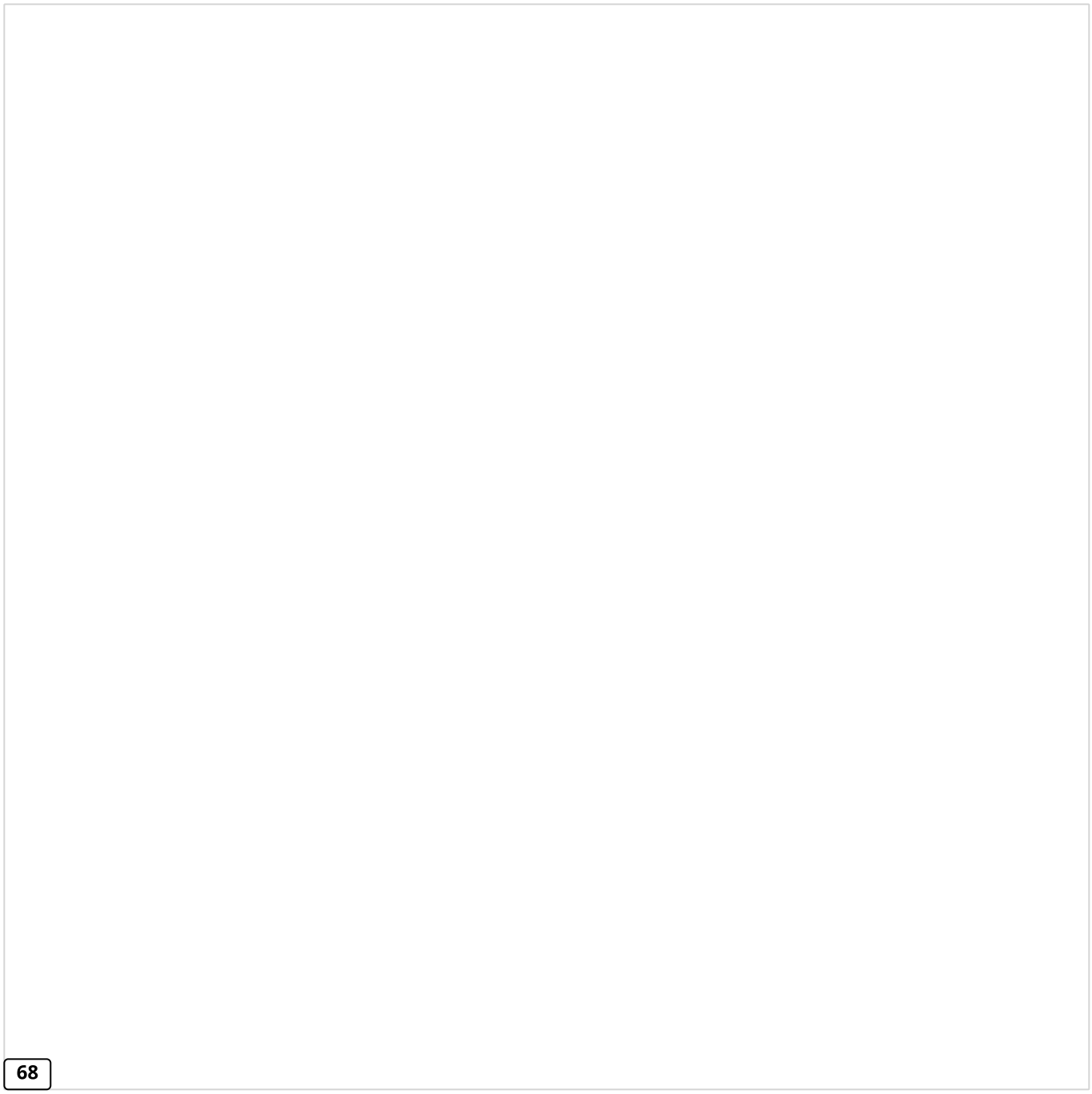

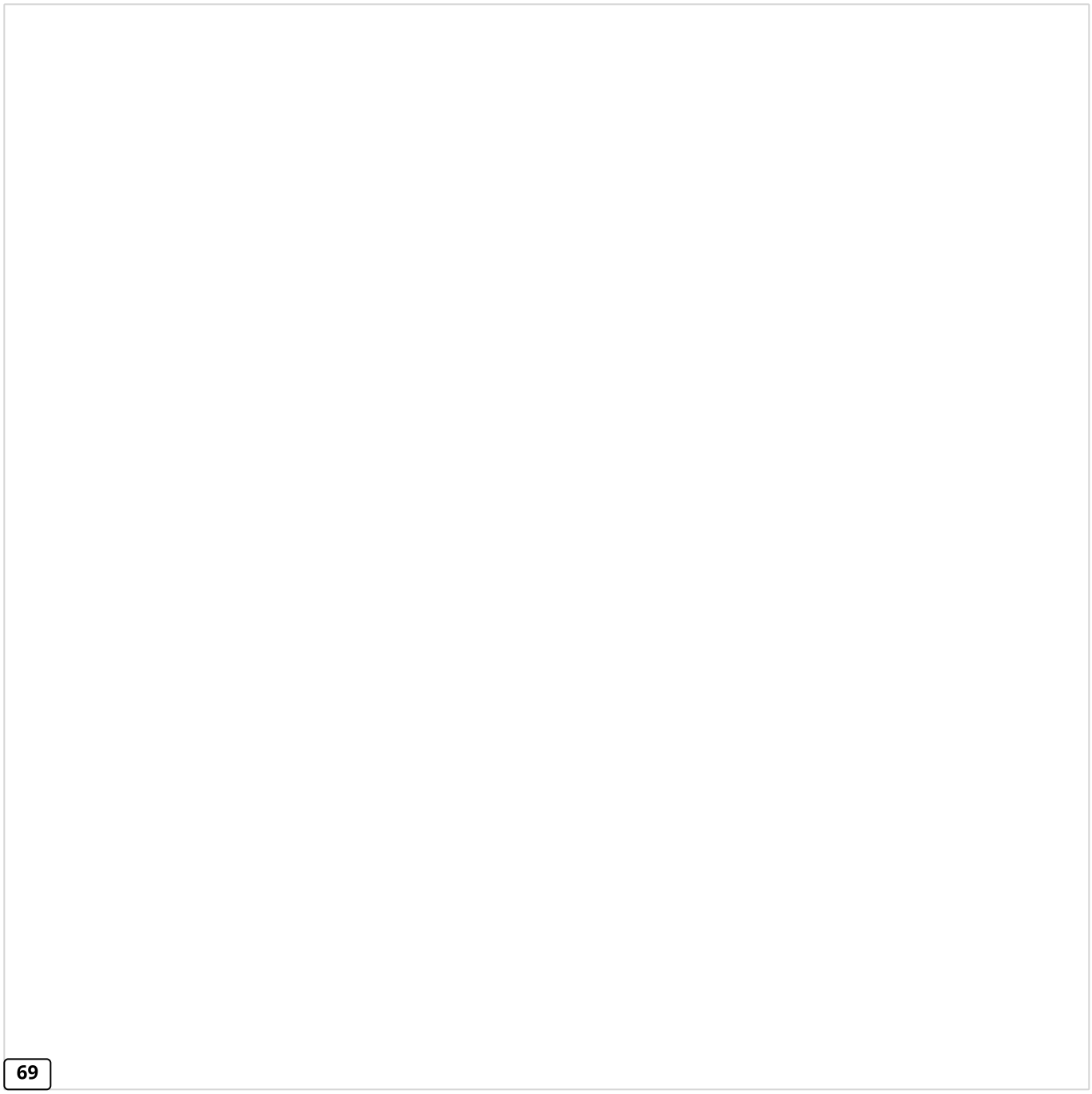

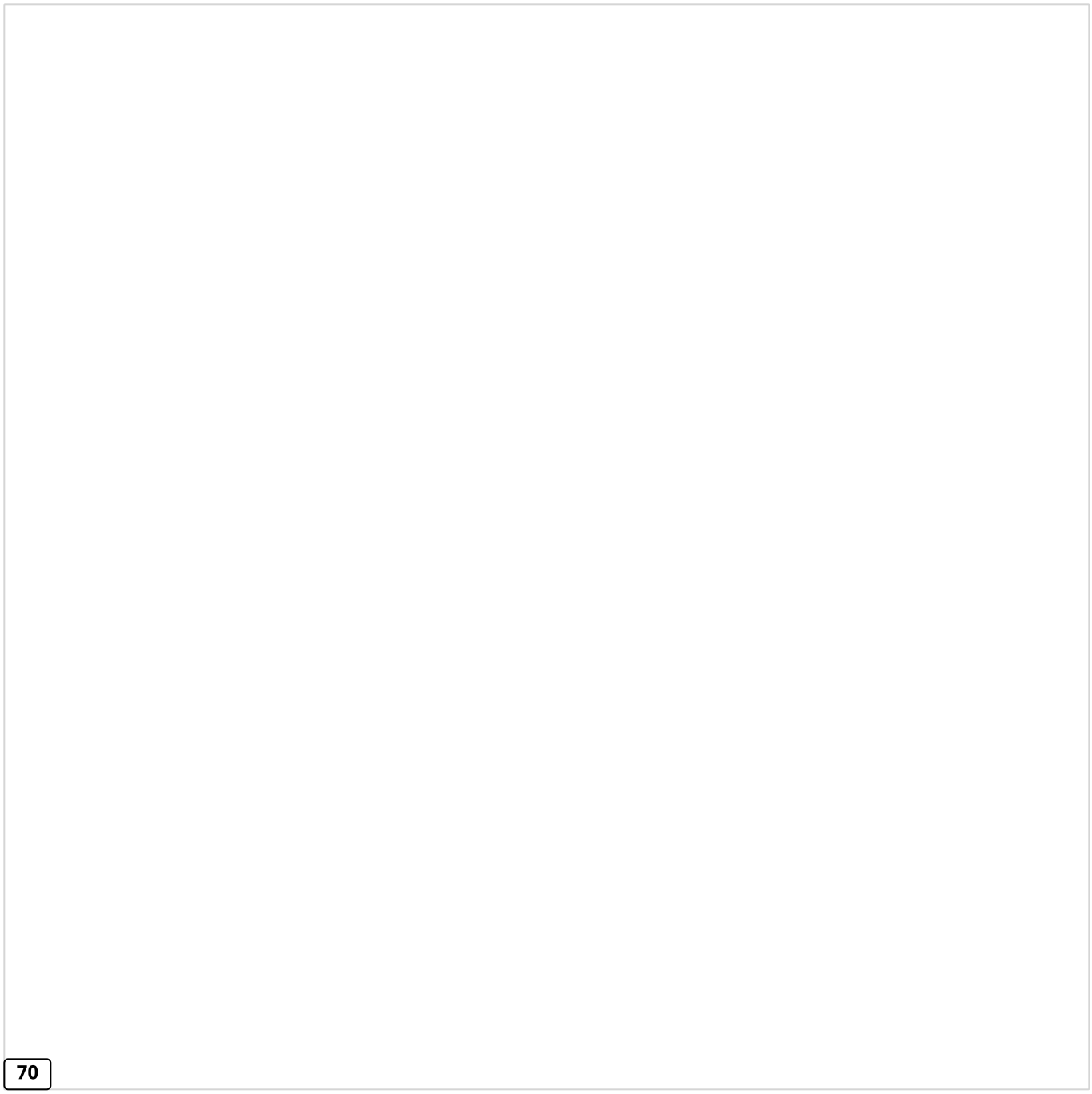

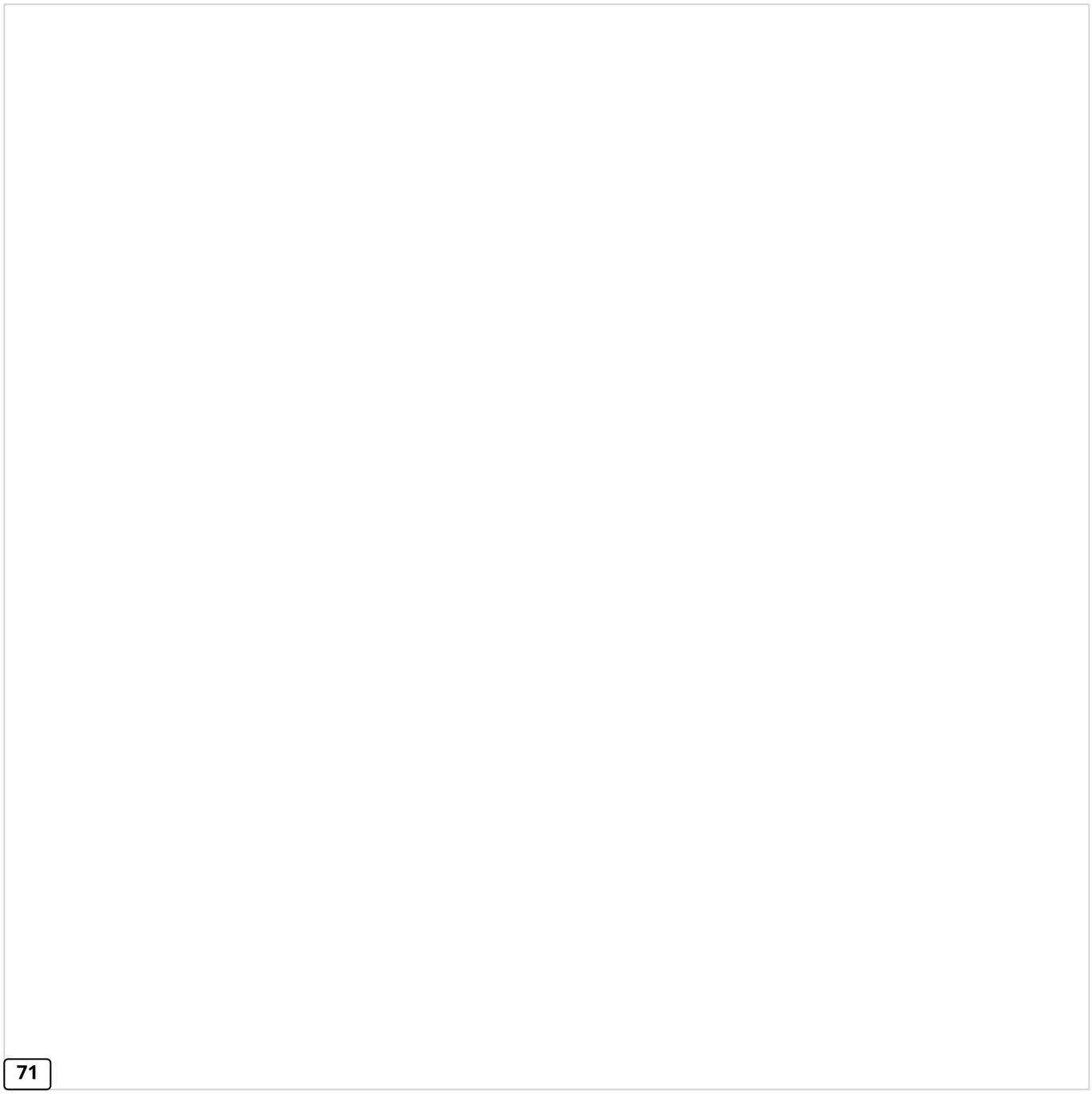

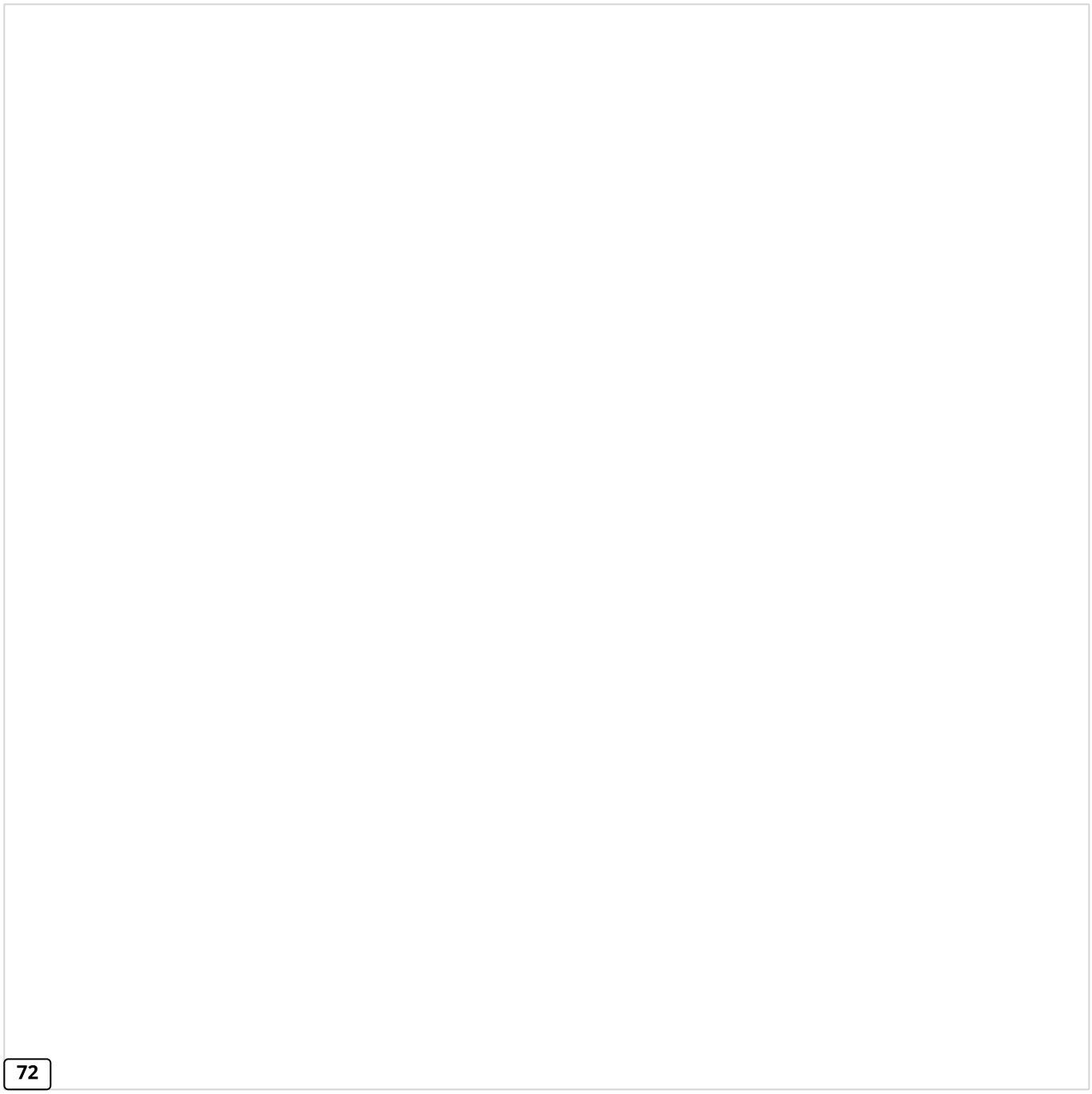

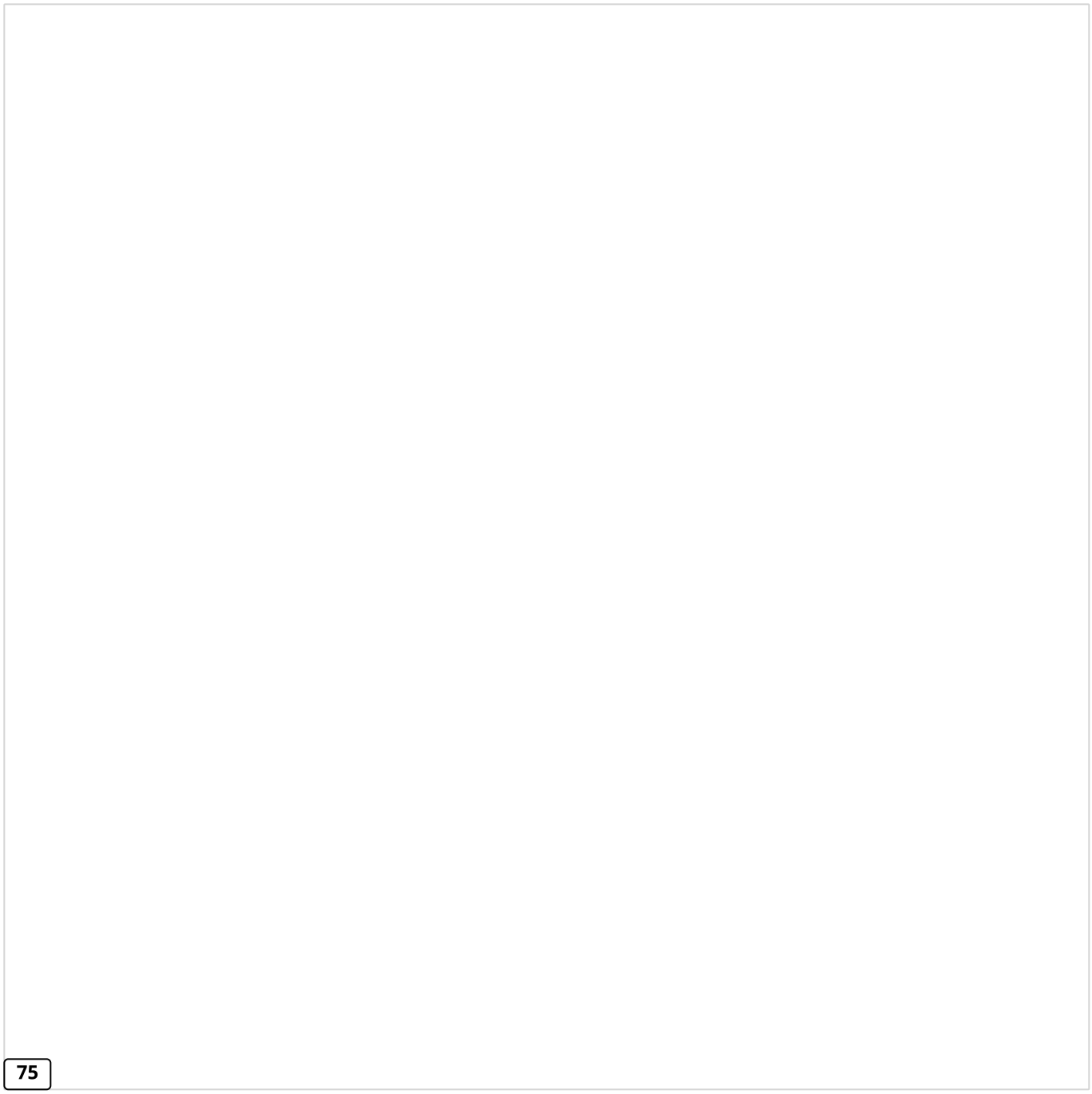

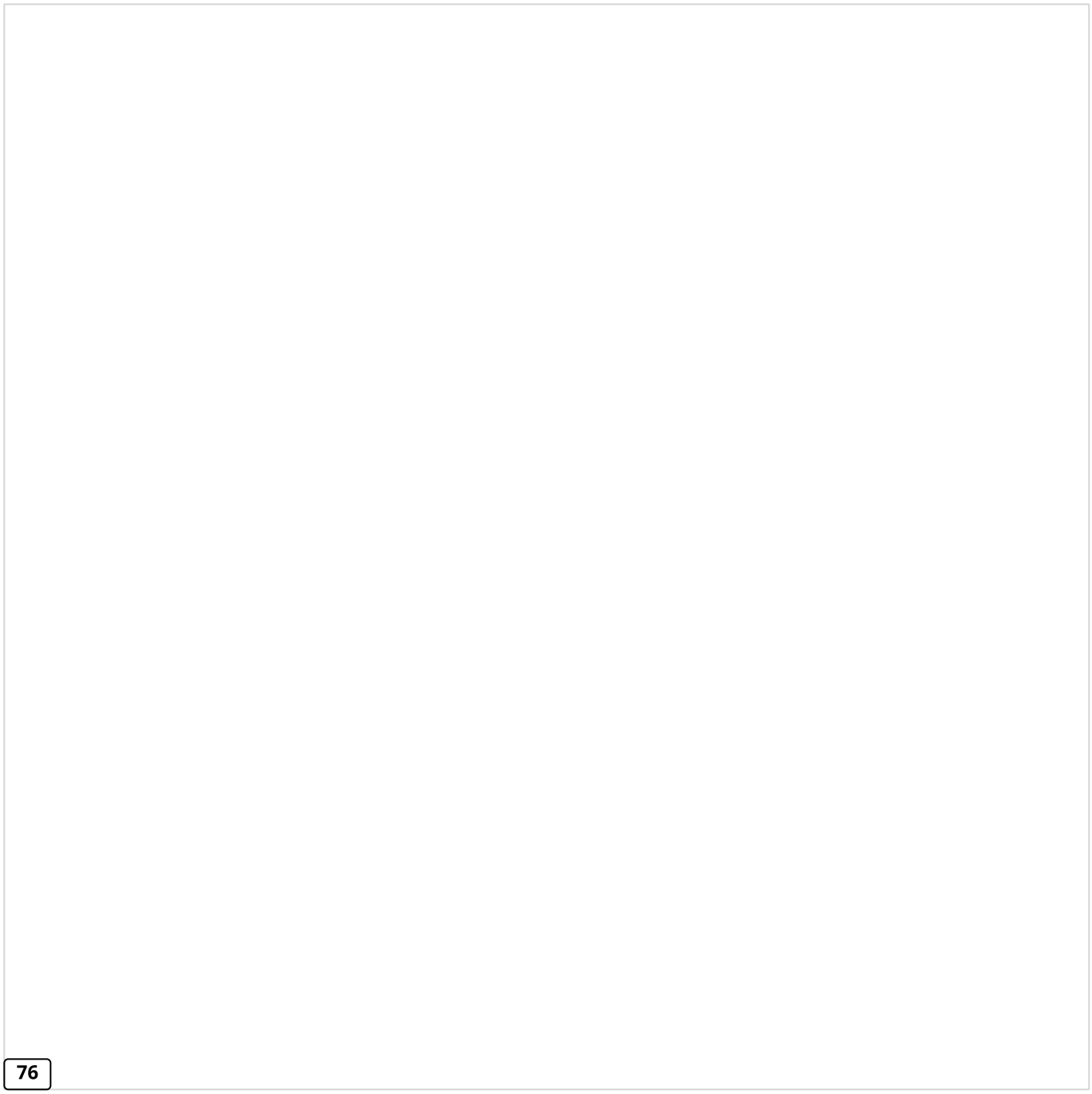

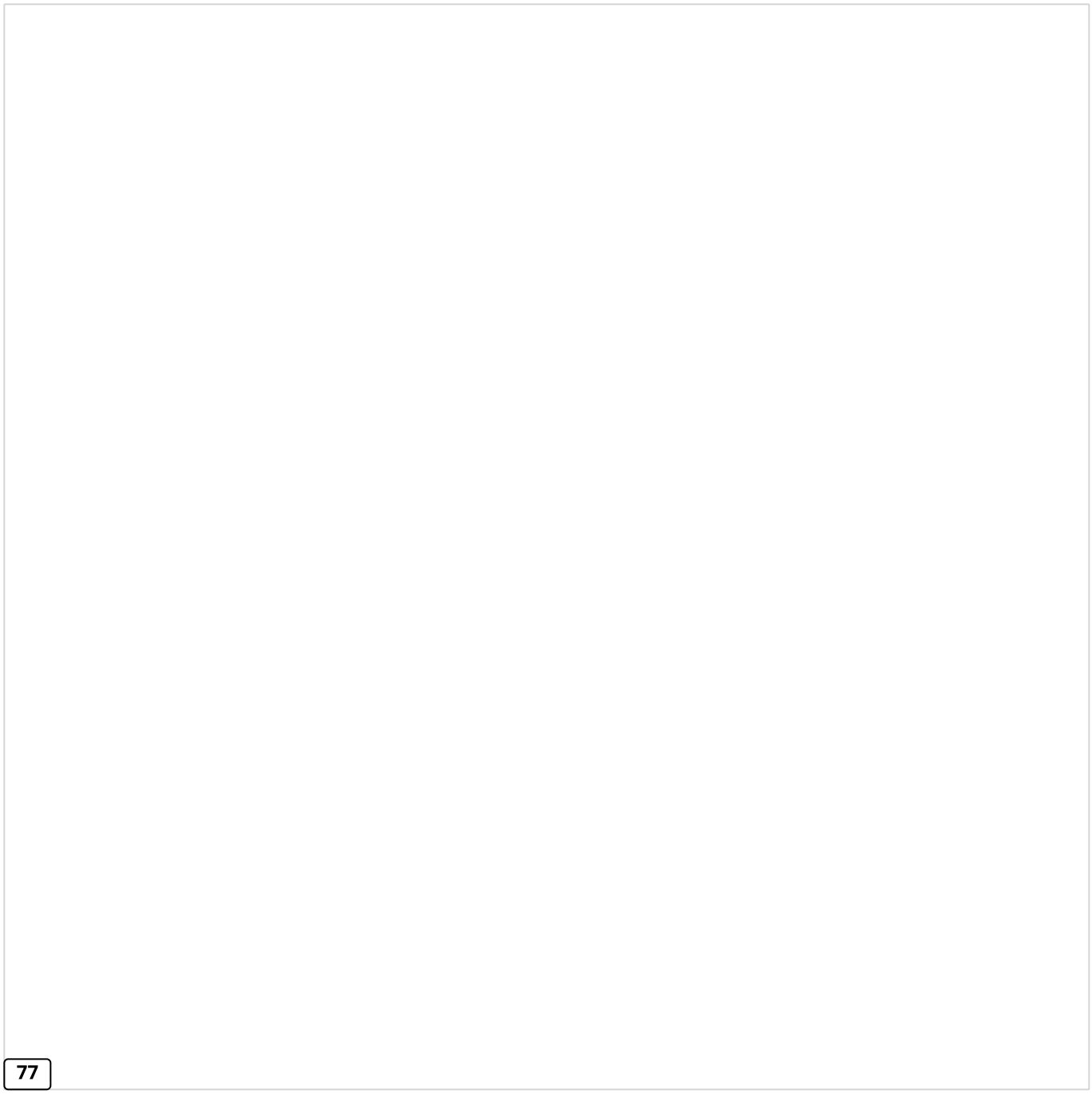

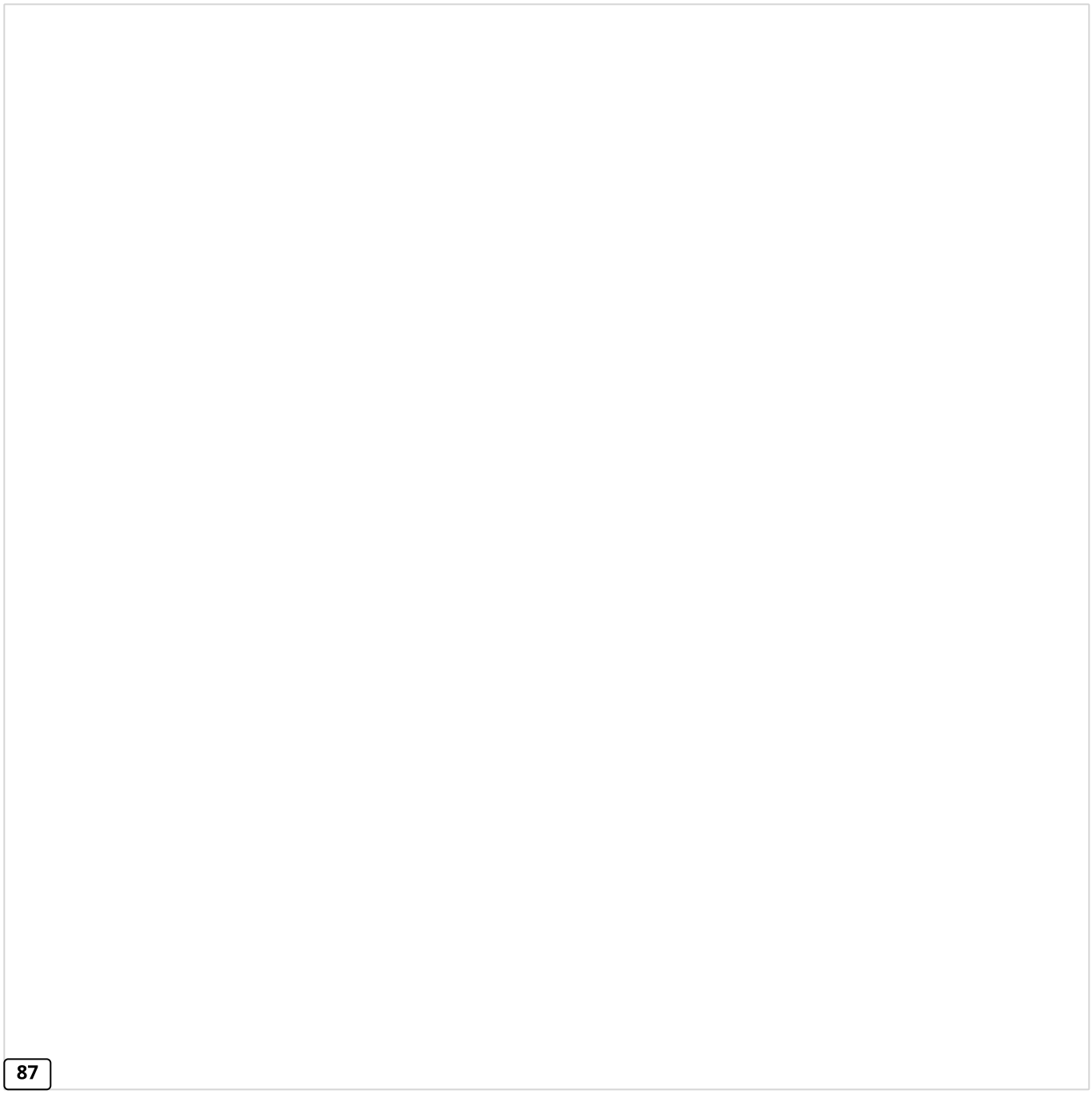

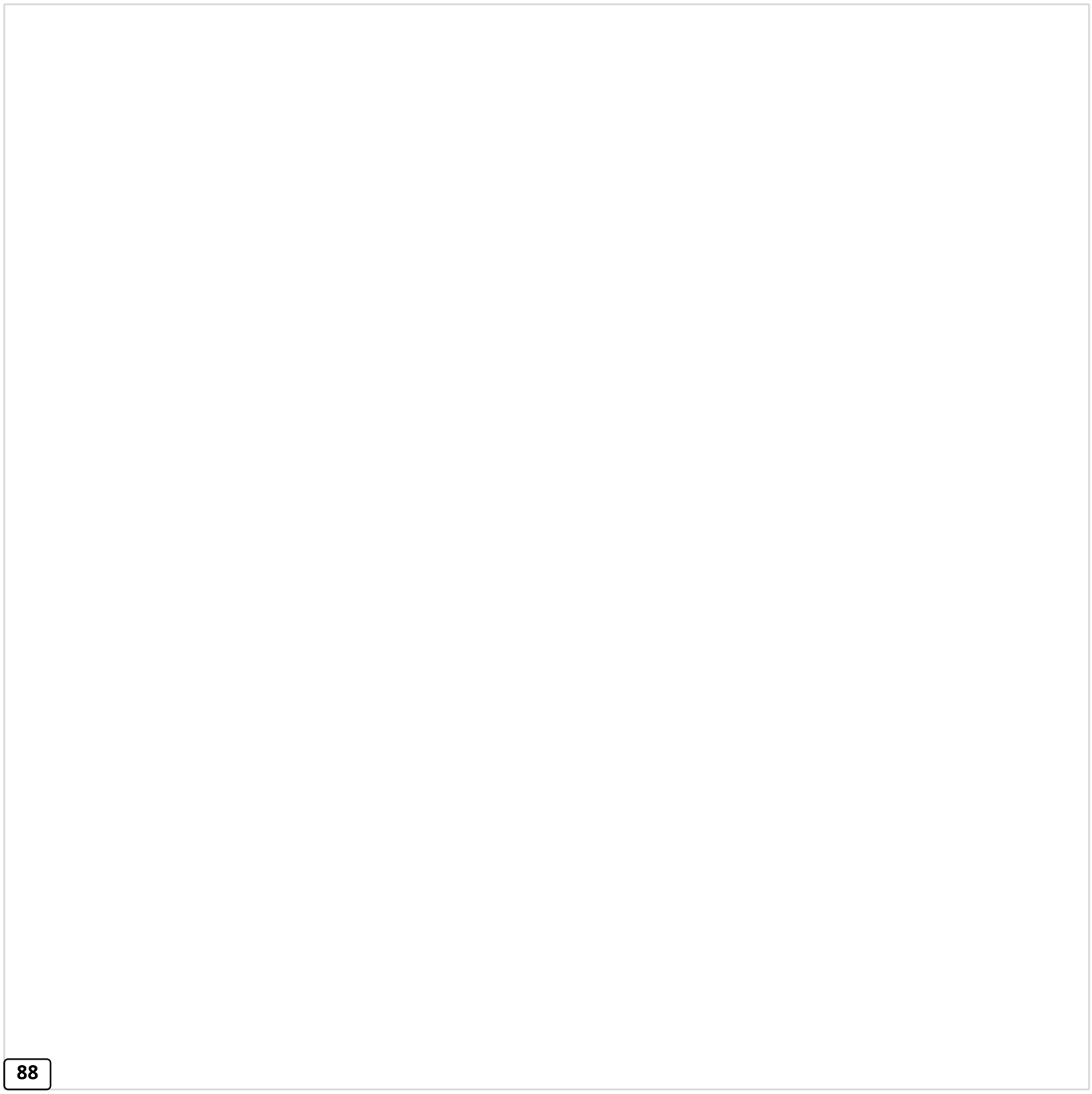

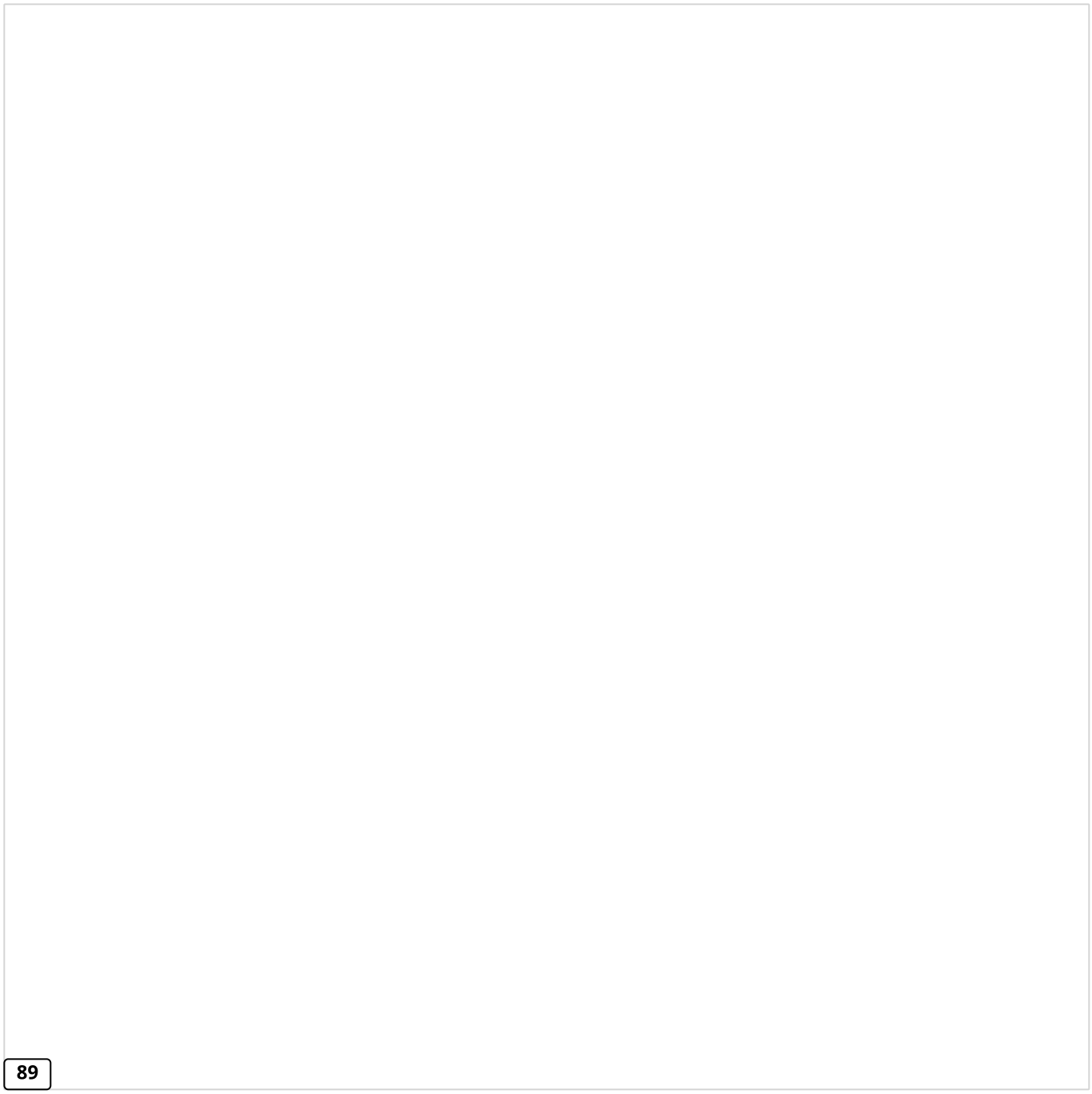

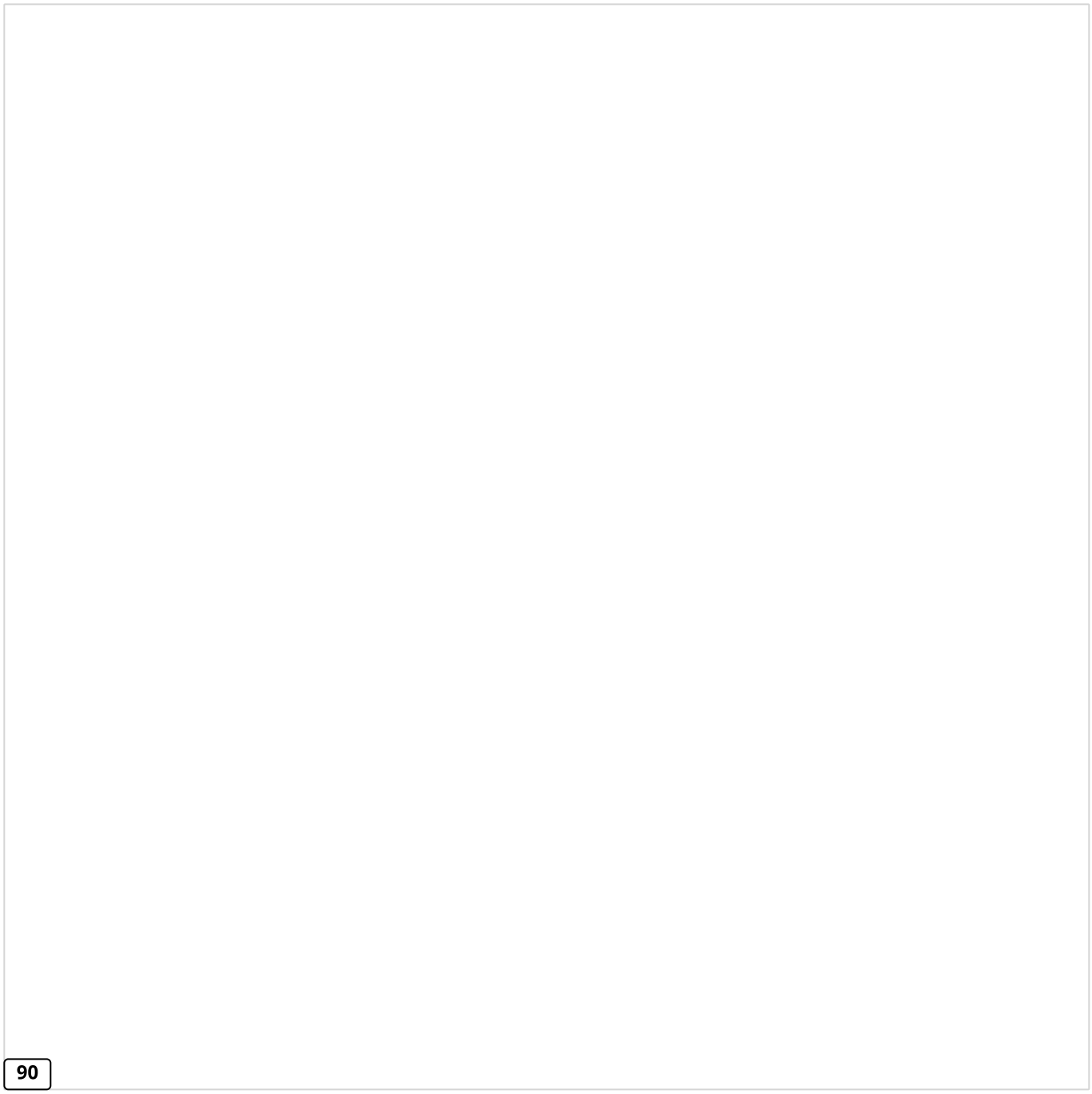

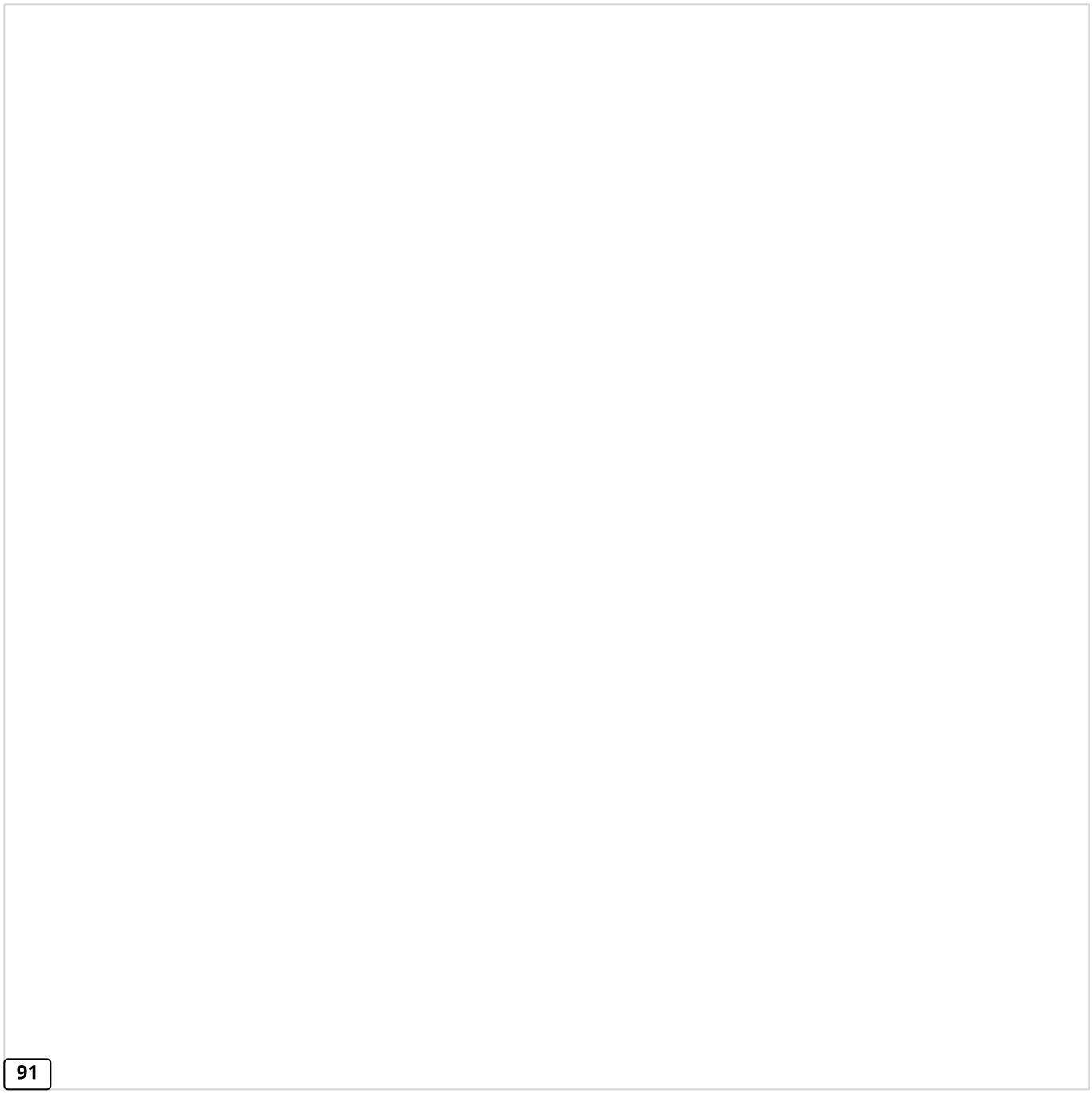

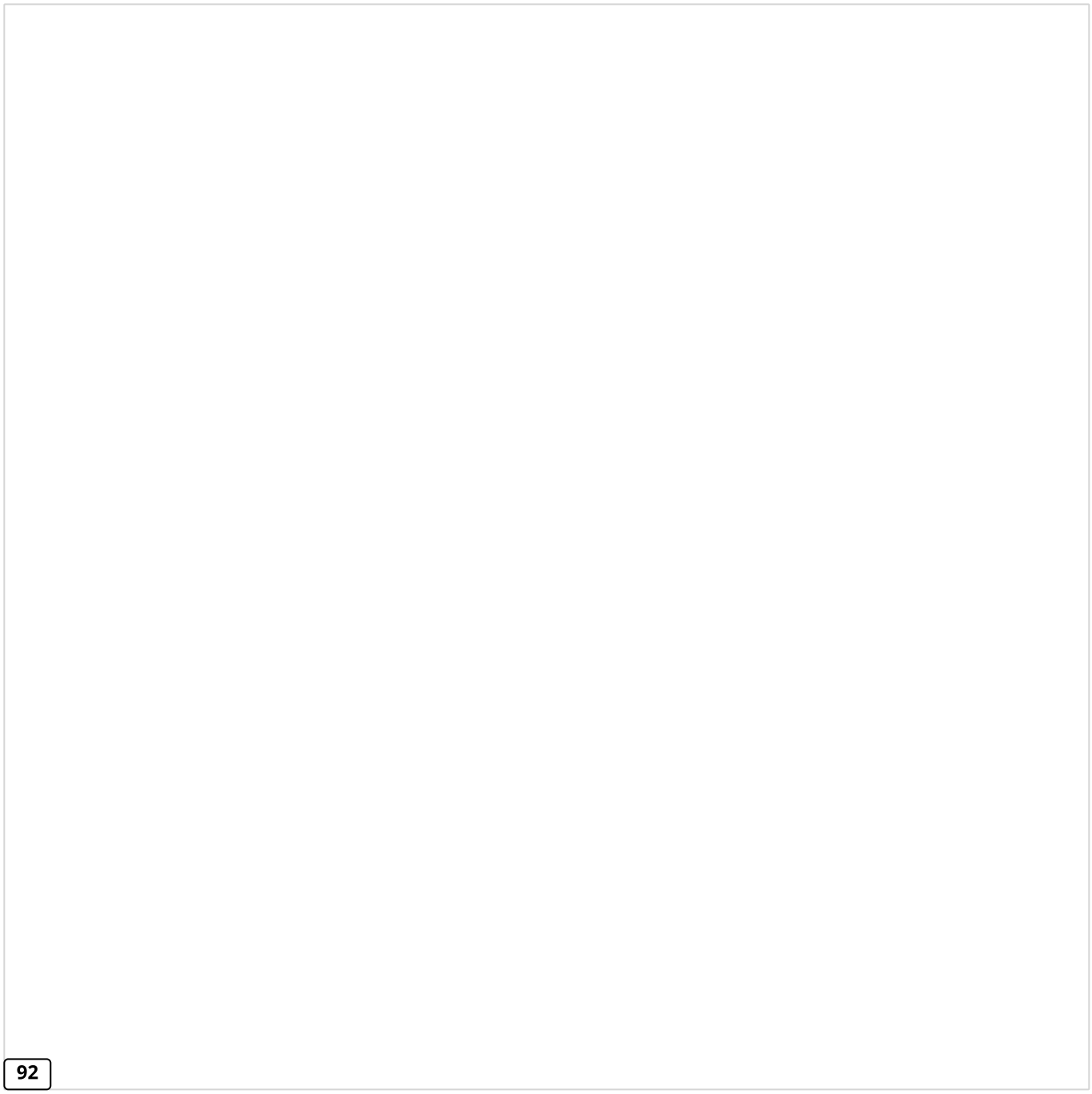

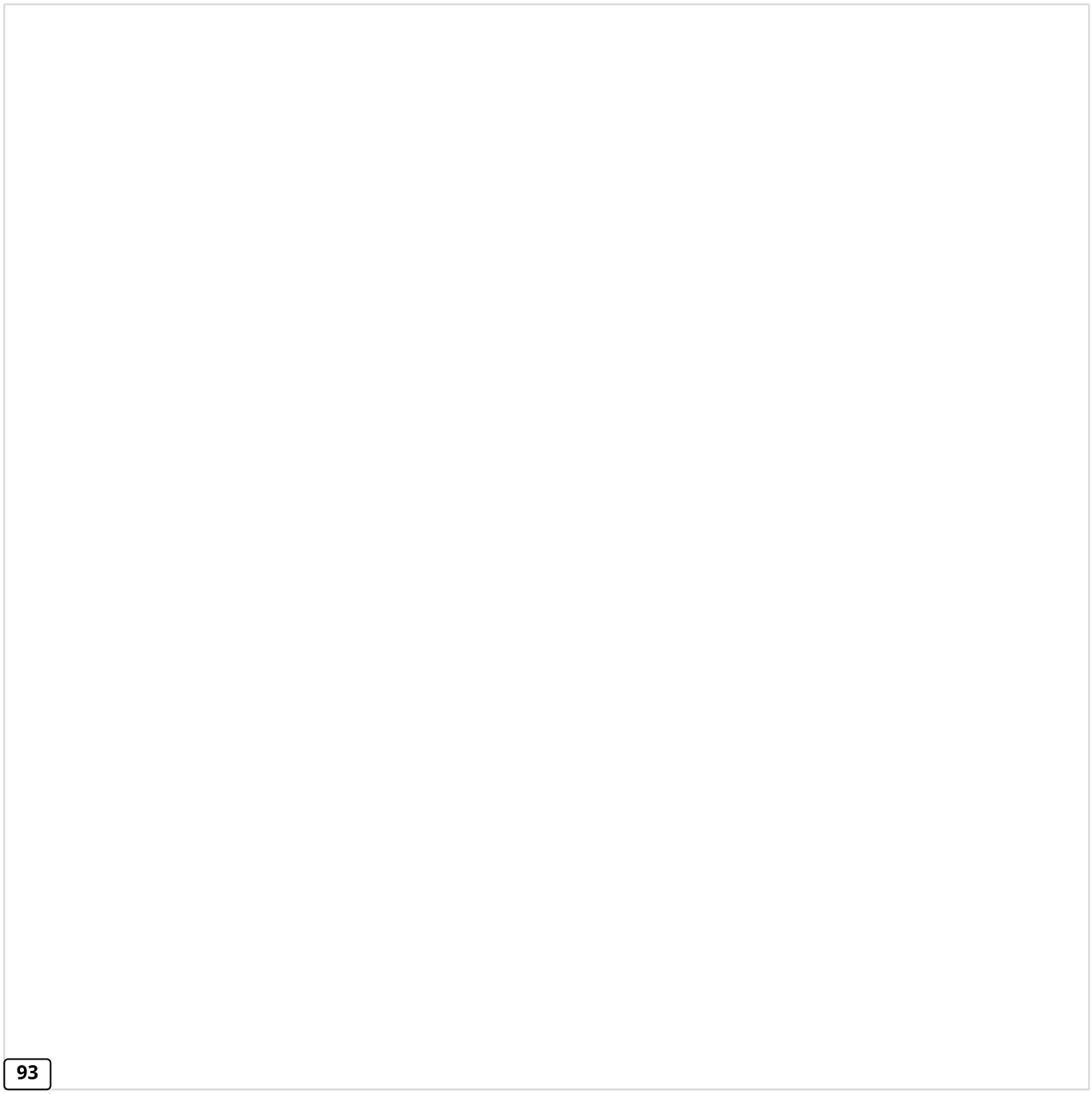

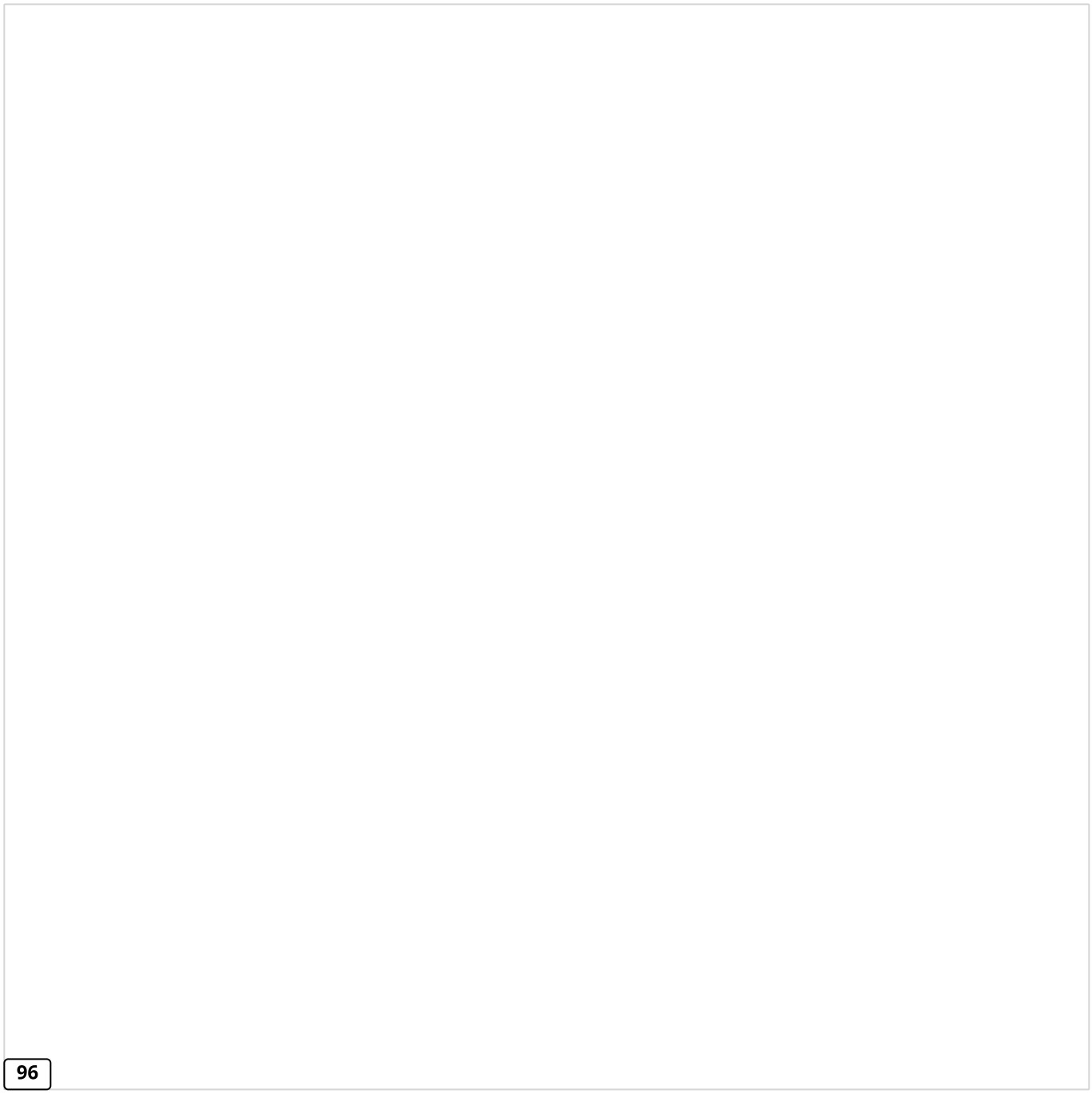

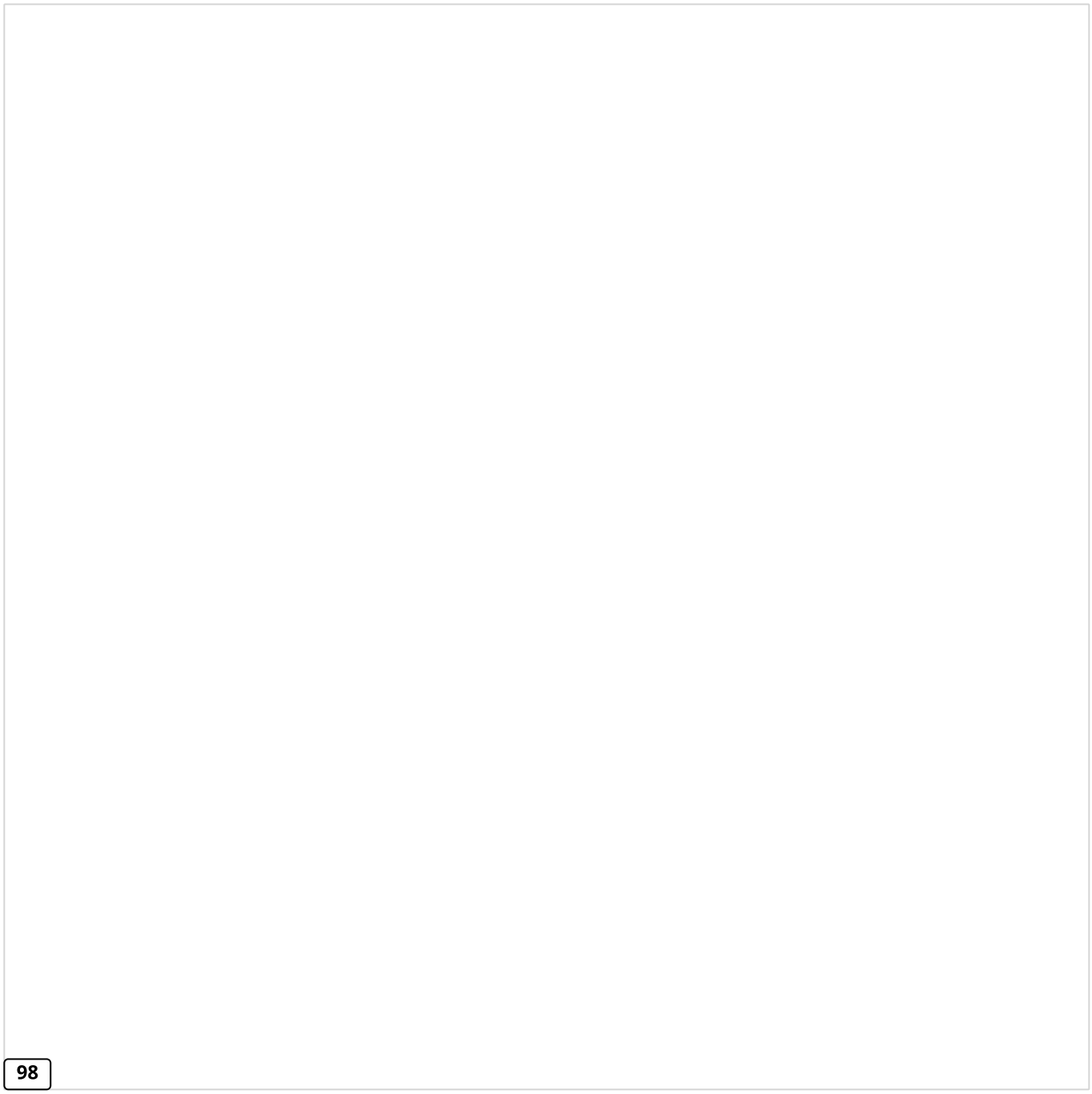

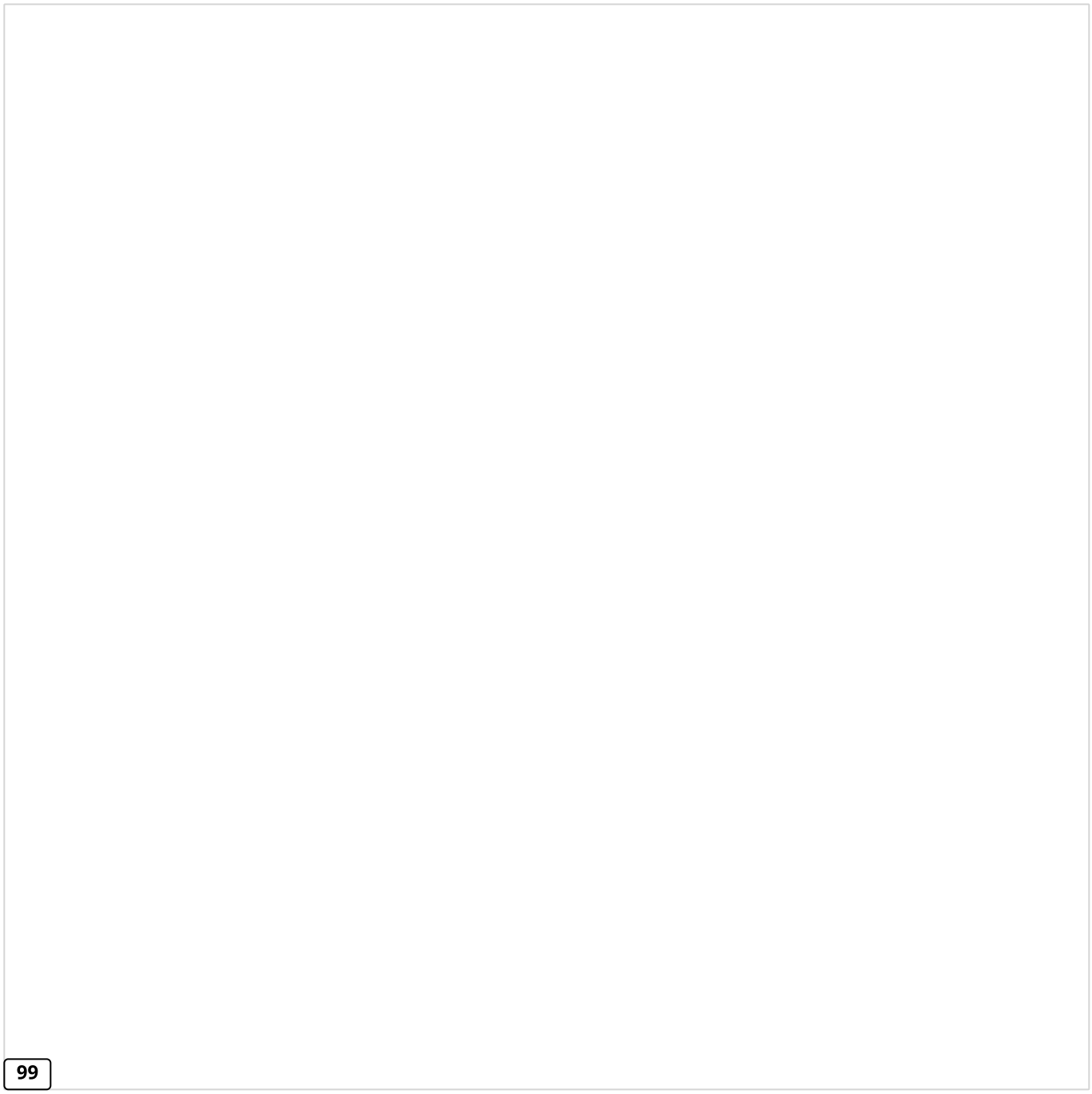

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