UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for Oceans and Atmosphere
Washington, D.C. 20230

FEB - 8 2000

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act, an environmental review has been performed on the following action.

TITLE: Environmental Assessment for Amendment 58 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area

LOCATION: Federal Waters of the Bering Sea and Aleutian Islands

SUMMARY: Amendment 58 will reduce the annual trawl bycatch limits for chinook salmon and will revise the Chinook Salmon Savings Area (CHSSA) in the Bering Sea and Aleutian Islands management area (BSAI). Amendment 58 will: (1) reduce the chinook salmon bycatch limit from 48,000 salmon to 29,000 salmon over a 4-year period, (2) implement year-round accounting of chinook salmon bycatch in the pollock fishery beginning on January 1 of each year, (3) revise the boundaries of the CHSSA, and (4) set new CHSSA closure dates. The intended effect of this amendment is to reduce trawl bycatch of chinook salmon in the BSAI.

RESPONSIBLE OFFICIAL:
Steven Pennoyer
Regional Administrator
Alaska Region
National Marine Fisheries Service
P.O. Box 21668
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The environmental review process led us to conclude that this action will not have a significant impact on the environment. Therefore, an environmental impact statement was not prepared. A copy of the finding of no significant impact, including the environmental assessment, is enclosed for your information.

Also, please send one copy of your comment to me in Room 5805, PSP, U.S. Department of Commerce, Washington, D.C. 20230.

Sincerely,

Susan Fruchter

Susan B. Fruchter
Director of the Office of Policy
and Strategic Planning

Enclosure

ENVIRONMENTAL ASSESSMENT/REGULATORY IMPACT REVIEW/ INITIAL REGULATORY FLEXIBILITY ANALYSIS

for

An Amendment to Further Reduce Chinook Salmon Bycatch in Groundfish Trawl Fisheries of the Bering Sea and Aleutian Islands Area

Amendment 58 to the Fishery Management Plan for Bering Sea and Aleutian Islands Area

Date:	September 29, 1999
Lead Agency:	National Marine Fisheries Service Alaska Regional Office Juneau, Alaska and the Alaska Fisheries Science Center Seattle, Washington
Responsible Official:	Steven Pennoyer Regional Administrator Alaska Regional Office
For Further Information Contact:	Alaska Regional Office P.O. Box 21668 Juneau, Alaska 99802

Abstract: In September, 1997, the Yukon River Drainage Fisheries Association submitted a proposal to lower the chinook salmon PSC limit which triggers the closure of the Chinook Salmon Savings Area (CHSSA) in the Bering Sea. This proposal identified the current bycatch limit of 48,000 chinook salmon as inadequate and not effective in reducing chinook salmon bycatch. This is compounded by the fact that the a closure would only occur before April 15, after this date the CHSSA is open regardless of the chinook salmon bycatch for that year. This analysis examines a range of alternatives intended to: reduce the overall bycatch of chinook salmon; alter the area included in the CHSSA so that only areas of high bycatch will be included in closures; and determine seasonality and source of bycatch by fishing sector. Economic issues include forgone benefits by Alaskan coastal communities from intercepted salmon and increased CPUE for vessels after a limit is reached and a closure is implemented.

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Executive Summary

The Magnuson-Stevens Act amendments emphasized the importance of bycatch effects on achieving sustainable fisheries. National Standard 9 mandates that conservation and management measures shall, to the extent practicable: (1) further reduce bycatch; and (2) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. This Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA) addresses a proposal to further reduce the incidental bycatch of chinook salmon in the groundfish trawl fisheries of the Bering Sea and Aleutian Islands. The following alternatives were examined:

Alternative 1: No Action.

Trawling is prohibited in the Chinook Salmon Savings Areas through April 15 upon attainment of a bycatch limit of 48,000 chinook salmon in the BSAI.

Alternative 2:

Include salmon taken after April 15 towards the bycatch limit of 48,000 chinook salmon. The Chinook Salmon Savings Areas would close upon attainment of the bycatch limit, whenever this would occur. Hence these areas could close, or remained closed, during later pollock seasons.

Alternative 3:

Reduce the PSC limit to 36,000 chinook salmon in the BSAI. Trawling would be prohibited in the Chinook Salmon Savings Areas through April 15 upon attainment of a bycatch limit of 36,000 chinook salmon in the BSAI.

Option 1 (applicable to Alternatives 2 and 3): Seasonally allocate the PSC limit, such that there are separate triggers for the pollock seasons.

Option 2 (applicable to Alternatives 2 and 3): Begin accounting towards the PSC limit at the start of the fall pollock season (currently September 1, or the 'B' season), with the amount carried over to the next pollock 'A' season.

Alternative 4:

Annual closure of specific "hot spot" blocks. These specific blocks are the five contiguous blocks of the current Chinook Salmon Savings Area that in the vicinity of Unimak Island. These have been identified in the document as 200, 201, 202, 227, 228, and 254. Block 201 has been further subdivided in half east to west and labeled as 997 (the eastern half) and 998 (the western half).

Option 1: Consider a seasonal closure of the five blocks.

Option 2 (applicable to Alternative 4 and Option 1): The closure would only apply to the pollock fisheries although chinook salmon bycaught in all trawl fisheries would apply toward a cap if in effect.

Alternative 5: (Preferred)

Alternative 5 would combine elements of Alternatives 2, 3, and 4. Specifically, the chinook salmon bycatch cap would be reduced incrementally from 41,000 to 29,000 over three years beginning in the year 2000 (the phase-in schedule would be as follows: year 2000=41,000 chinook salmon; 2001= 37,000; 2002=33,000; 2003=29,000). Accounting for the cap would begin January 1 and continue year-round. Non-pollock fisheries would be exempt from the closure and those fisheries' chinook PSC bycatch would not be counted toward the PSC limit. This is a change from the status quo.

Currently, all chinook salmon bycaught are counted towards the PSC limit. The two Pribilof blocks would be deleted from the CHSSA closure area, and block 226 would be added. In the event the PSC limit is reached before April 15, the chinook savings areas would close immediately to pollock fishing. The closure would be removed after April 15, but would then be reinitiated on September 1.

The purpose of this action is to reduce the bycatch of chinook salmon in Bering Sea groundfish fisheries. Analysis showed that a PSC limit of 36,000 chinook salmon would be a sizeable reduction from recent catches (50,000 - 60,000 chinook, Table 2). The pollock fishery was found to harvest the largest and most variable amount of chinook salmon of the Bering Sea fisheries. The Pacific cod fishery made up the other portion with catches in the range of 5,000 - 7,000 chinook per year. The Council's intent, therefore, was a step-wise reduction in the annual catch of chinook salmon to 36,000. The Council assumed that the Pacific cod fishery would take 7,000 chinook a year, therefore the pollock bycatch would then be 29,000 chinook salmon.

Analysis of 1994-1997 observer data indicate that, regardless of season or year, the large majority of chinook salmon have been intercepted in the CHSSA. In the five years examined, the 48,000 PSC limit was reached three times, and the 36,000 PSC limit would have been reached in four of the five years. A 36,000 PSC limit would have reduced the total number of chinook taken from 7% to 28% (3,000 to 18,000 salmon depending on the year and given low bycatch outside the CHSSA). In 1998, approximately 60,000 chinook were intercepted and both PSC limits were exceeded.

An accounting year beginning September 1, as suggested by Option 2 of Alternative 3, would better agree with the biology of the salmon in the Bering Sea. This is because juvenile salmon (those primarily taken as bycatch) enter the Bering Sea to feed in the autumn and remain throughout the winter, later moving to other areas in the summer. If Option 2 had been in place, the 48,000 chinook PSC limit would have been reached in one of the five years (4 accounting years) examined. In the 1997-1998 accounting year, both the 36,000 PSC limit and the 48,000 PSC limits would have been reached 1/31/98 and 2/21/98, respectively. The potential cost of adopting Option 2 would be that chinook salmon taken in the 'B' season could impact the 'A' season by closing the CHSSA, an area that accounts for a relatively large portion of the 'A' season pollock catch, when the pollock are of greatest value valuable. Most of the pollock catch has been taken from the CHSSA during the 'A' season, but in the 'B' season, most of the pollock catch comes from outside the CHSSA.

The analysis also indicated that the current CHSSA could be modified slightly. There tends to be high bycatch in the vicinity of the Pribilof Islands, but bycatch within specific blocks is not consistent. It appears from recent data that the two block area near the Pribilof Islands has not had high bycatch rates of chinook salmon. Hence, these two blocks could be removed from the CHSSA. Alternatively, additional blocks, one which is made up mostly of land on Unimak Island, showed consistently high bycatch of chinook salmon. Consideration should be given to adding this block, or perhaps other blocks, to the CHSSA.

A simulated closure of the various "hotspot" blocks (Alternative 4) in different combinations caused variations in the bycatch patterns in the remaining open blocks. In the pollock fisheries, with the exception of 1995 when few chinook salmon were bycaught, the closure of any combination of blocks resulted in reductions in predicted chinook salmon bycatch, with greater reductions coincident with larger total area closures (more blocks included in the closure). Closures of the areas generally caused reductions in the bycatch of herring, slight increases in the bycatch of halibut, moderate increases in other (mostly chum) salmon bycatch, and large increases in crab bycatch. The closure of the blocks to all trawling further reduced the predicted levels of chinook salmon bycatch. However, because greater effort is directed into open areas, the closures to all trawling could potentially increase the percentage of crab bycatch of all species but could reduce halibut bycatch levels.

Under the status quo alternative, given a recent bycatch amount of 59,288 chinook salmon, a potential ex-vessel value of $445,000 could be foregone by users of the chinook salmon resource other than BSAI commercial fishermen. If one makes a number of simplifying assumptions (treated in detail in the RIR) an estimate can be made of the potential economic value attributable to chinook salmon bycatch reductions under the preferred alternative. For example, the preferred alternative could potentially reduce total chinook salmon bycatch in BSAI trawl fisheries by as much as 26,000 chinook salmon annually, with an estimated ex-vessel value of perhaps $196,275.

The costs associated with closures are due to potential foregone groundfish catch, reduced catch per unit effort (CPUE), and operational costs of moving out of closed areas. Fishermen try to fish in areas and ways in which they can maximize the returns on their capital; hence, forcing them to fish in non-optimal areas could result in lower CPUE and impose other costs. These costs could not be quantified in this analysis, but an analysis of CPUE in recent years predicted little change in the number of tows required to take the remaining catch outside of the closure areas. A simulation model was employed and the results indicated that if the proposed area closures were applied to all trawling, increased crab bycatch could occur, thus increasing bycatch costs.

There were several developments in 1998 which could have impacts on the analysis provided in this document. The proposed reductions through the American Fisheries Act in the size of the catcher/processor fleet, the reallocation of pollock total allowable catch (TAC) among the mothership, catcher-processor and shoreside sectors of the fleet, and authorization of operating cooperatives in each of the three major sectors will all change the patterns of effort for pollock target fisheries in the Bering Sea. The recent Biological Opinion (Section 7 consultation) on the fishing related impacts on Steller sea lions could also cause far-reaching changes in the distribution of pollock fishing effort. The consultation identified areas of critical habitat for Steller sea lions, and the NPFMC has recommended actions to reduce the fishing effort for pollock within this critical habitat, including closure of the Aleutian Islands management area to all pollock fishing. The NPFMC also recommended spreading effort out in time so that "pulse" fishing periods are reduced. The recommended periods are as follows (1) A1, beginning January 20; (2) A2, beginning February 20; (3) B, beginning August 1; and (4) C, beginning September 15.

The analysis in this document is dependent on historical data to define the most effective measures in reducing chinook salmon bycatch. However, the changes discussed above will redistribute effort both spatially and temporally and the impacts these changes might have on chinook salmon bycatch are difficult to predict. The central blocks in the CHSSA are all located within the Stellar sea lion critical habitat, and movement of effort out of this area could be expected to reduce chinook salmon bycatch. Similarly, fishing effort in August would be unlikely to encounter chinook salmon (although other salmon bycatch might be expected to be high). On the other hand, the beginning of the 'C' season on September 15 will likely increase the chances of chinook interceptions.

None of the alternatives are expected to have a significant impact on endangered, threatened, or candidate species, and none of the alternatives would affect takes of marine mammals. Actions taken to control chinook salmon bycatch in BSAI trawl fisheries will not alter the harvest of groundfish, but will reduce the incidental bycatch of chinook salmon. In sections 1.3.3 and 2.2 the origin of chinook salmon bycaught in BSAI trawl fisheries are discussed. Unfortunately, limited data are available to accurately describe the composition of this bycatch. However, information that has been analyzed such as coded wire returns, scales, and other methods, reveals that a very small fraction of the entire population of chinook salmon in the BSAI is composed of ESA listed salmon. NMFS presently is working under a biological opinion of no jeopardy regarding the take of certain ESA listed salmon (section 2.2). It is likely that a reduction in the overall take of chinook salmon in the BSAI would also reduce the probability that an ESA listed chinook salmon would be intercepted. Since the date of the last biological opinion on Pacific Northwest salmon, new salmon stocks have been added to the list of endangered or threatened species.

None of the alternatives is expected to result in a "significant regulatory action" as defined in E.O. 12866.

None of the alternatives is likely to significantly affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)(C) of the National Environmental Policy Act or its implementing regulations.

1.0 INTRODUCTION AND BACKGROUND

The groundfish fisheries in the Exclusive Economic Zone (EEZ) (3 to 200 miles offshore) off Alaska are managed under the Fishery Management Plan for the Groundfish Fisheries of the Gulf of Alaska and the Fishery Management Plan for the Groundfish Fisheries of the Bering Sea and Aleutian Islands Area. Both fishery management plans (FMP) were developed by the North Pacific Fishery Management Council (Council) under the Magnuson Fishery Conservation and Management Act (Magnuson Act). The Gulf of Alaska (GOA) FMP was approved by the Secretary of Commerce and become effective in 1978 and the Bering Sea and Aleutian Islands Area (BSAI) FMP become effective in 1982.

Actions taken to amend FMPs or implement other regulations governing the groundfish fisheries must meet the requirements of Federal laws and regulations. In addition to the Magnuson Act, the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (E.O.) 12866, and the Regulatory Flexibility Act (RFA).

NEPA, E.O. 12866 and the RFA require a description of the purpose and need for the proposed action as well as a description of alternative actions which may address the problem. This information is included in Section 1 of this document. Section 2 contains information on the biological and environmental impacts of the alternatives as required by NEPA. Impacts on endangered species and marine mammals are also addressed in this section. Section 3 contains a Regulatory Impact Review (RIR) which addresses the requirements of E.O. 12866, that economic impacts of the alternatives be considered. Section 4 contains the Initial Regulatory Flexibility Analysis (IRFA) required by the RFA which specifically addresses the impacts of the proposed action on small entities.

This Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA) addresses a proposal to further control the incidental bycatch of chinook salmon in the groundfish trawl fisheries of the Bering Sea and Aleutian Islands.

1.1 Purpose and Need

The Magnuson-Stevens Act amendments emphasized the importance of bycatch effects on achieving sustainable fisheries. National Standard 9 mandates that conservation and management measures shall, to the extent practicable: (1) minimize bycatch; and (2) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. In addition, Section 303 of the Act was amended to add bycatch reduction incentives as a discretionary provision of FMPs. This provision reads that any FMP may "include, consistent with the other provisions of this Act, conservation and management measures that provide harvest incentives for participants within each gear group to employ fishing practices that result in lower levels of bycatch or in lower levels of the mortality of bycatch."

Amendments to the Act also provide specific direction to the North Pacific Council regarding bycatch reduction (Section 313). Subpart (f) reads "In implementing section 303(a)(11) and this section, the North Pacific Council shall submit conservation and management measures to lower, on an annual basis for a period of not less than four years, the total amount of economic discards occurring in the fisheries under its jurisdiction". Additionally, section 313, subpart (g) provides for the Council to amend its FMPs to provide incentives to reduce bycatch and bycatch rates (Magnuson-Stevens Act). Incentives can include a system of fines (up to $25,000 per vessel per season), as well as allocations of regulatory discards to individual fishing vessels.

The specific language of the final rule on National Standard guidelines for bycatch, dated May 1, 1998 is provided below for reference:

Sec. 600.350 National Standard 9--Bycatch.

(a) Standard 9. Conservation and management measures shall, to the extent practicable:
  (1) Minimize bycatch; and
  (2) To the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

(b) General. This national standard requires Councils to consider the bycatch effects of existing and planned conservation and management measures. Bycatch can, in two ways, impede efforts to protect marine ecosystems and achieve sustainable fisheries and the full benefits they can provide to the Nation. First, bycatch can increase substantially the uncertainty concerning total fishing-related mortality, which makes it more difficult to assess the status of stocks, to set the appropriate OY and define overfishing levels, and to ensure that OYs are attained and overfishing levels are not exceeded. Second, bycatch may also preclude other more productive uses of fishery resources.

(c) Definition--Bycatch. The term ``bycatch'' means fish that are harvested in a fishery, but that are not sold or kept for personal use. Bycatch includes the discard of whole fish at sea or elsewhere, including economic discards and regulatory discards, and fishing mortality due to an encounter with fishing gear that does not result in Capture of fish (i.e., unobserved fishing mortality). Bycatch does not include any fish that legally are retained in a fishery and kept for personal, tribal, or cultural use, or that enter commerce through sale, barter, or trade. Bycatch does not include fish released alive under a recreational catch-and-release fishery management program. A catch-and-release fishery management program is one in which the retention of a particular species is prohibited. In such a program, those fish released alive would not be considered bycatch. Bycatch also does not include Atlantic highly migratory species harvested in a commercial fishery that are not regulatory discards and that are tagged and released alive under a scientific tag-and-release program established by the Secretary.

(d) Minimizing bycatch and bycatch mortality. The priority under this standard is first to avoid catching bycatch species where practicable. Fish that are bycatch and cannot be avoided must, to the extent practicable, be returned to the sea alive. Any proposed conservation and management measure that does not give priority to avoiding the Capture of bycatch species must be supported by appropriate analyses. In their evaluation, the Councils must consider the net benefits to the Nation, which include, but are not limited to: Negative impacts on affected stocks; incomes accruing to participants in directed fisheries in both the short and long term; incomes accruing to participants in fisheries that target the bycatch species; environmental consequences; non-market values of bycatch species, which include non-consumptive uses of bycatch species and existence values, as well as recreational values; and impacts on other marine organisms. To evaluate conservation and management measures relative to this and other national standards, as well as to evaluate total fishing mortality, Councils must--

  (1) Promote development of a database on bycatch and bycatch mortality in the fishery to the extent practicable. A review and, where necessary, improvement of data collection methods, data sources, and applications of data must be initiated for each fishery to determine the amount, type, disposition, and other characteristics of bycatch and bycatch mortality in each fishery for purposes of this standard and of section 303(a)(11) and (12) of the Magnuson-Stevens Act. Bycatch should be categorized to focus on management responses necessary to minimize bycatch and bycatch mortality to the extent practicable. When appropriate, management measures, such as at-sea monitoring programs, should be developed to meet these information needs.

  (2) For each management measure, assess the effects on the amount and type of bycatch and bycatch mortality in the fishery. Most conservation and management measures can affect the amounts of bycatch or bycatch mortality in a fishery, as well as the extent to which further reductions in bycatch are practicable. In analyzing measures, including the status quo, Councils should assess the impacts of minimizing bycatch and bycatch mortality, as well as consistency of the selected measure with other national standards and applicable laws. The benefits of minimizing bycatch to the extent practicable should be identified and an assessment of the impact of the selected measure on bycatch and bycatch mortality provided. Due to limitations on the information available, fishery managers may not be able to generate precise estimates of bycatch

and bycatch mortality or other effects for each alternative. In the absence of quantitative estimates of the impacts of each alternative, Councils may use qualitative measures.

Information on the amount and type of bycatch should be summarized in the SAFE reports.

(3) Select measures that, to the extent practicable, will minimize bycatch and bycatch mortality. (i) A determination of whether a conservation and management measure minimizes bycatch or bycatch mortality to the extent practicable, consistent with other national standards and maximization of net benefits to the Nation, should consider the following factors:

(A) Population effects for the bycatch species.

(B) Ecological effects due to changes in the bycatch of that species (effects on other species in the ecosystem).

(C) Changes in the bycatch of other species of fish and the resulting population and ecosystem effects.

(D) Effects on marine mammals and birds.

(E) Changes in fishing, processing, disposal, and marketing costs.

(F) Changes in fishing practices and behavior of fishermen.

(G) Changes in research, administration, and enforcement costs and management effectiveness.

(H) Changes in the economic, social, or cultural value of fishing activities and nonconsumptive uses of fishery resources.

(I) Changes in the distribution of benefits and costs.

(J) Social effects.

(ii) The Councils should adhere to the precautionary approach found in the Food and Agriculture Organization of the United Nations (FAO) Code of Conduct for Responsible Fisheries (Article 6.5), which is available from the Director, Publications Division, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy, when faced with uncertainty concerning any of the factors listed in this paragraph (d)(3).

(4) Monitor selected management measures. Effects of implemented measures should be evaluated routinely. Monitoring systems should be established prior to fishing under the selected management measures. Where applicable, plans should be developed and coordinated with industry and other concerned organizations to identify opportunities for cooperative data collection, coordination of data management for cost efficiency, and avoidance of duplicative effort.

(e) Other considerations. Other applicable laws, such as the MMPA, the ESA, and the Migratory Bird Treaty Act, require that Councils consider the impact of conservation and management measures on living marine resources other than fish; i.e., marine mammals and birds.

To comply with these provisions of the Act, the Council emphasized the need for additional bycatch management measures during the 1997 call for proposals. At the September meeting, the Council initiated development of several of the proposals received. One of the proposals approved for analysis was a proposal to lower the chinook salmon bycatch limits that triggers a closure of the Chinook Salmon Savings Areas (CHSSA) in the Bering Sea. This proposal, submitted by the Yukon River Drainage Fisheries Association, identified the current bycatch trigger of 48,000 chinook salmon as inadequate and not effectively reducing chinook salmon bycatch. Additionally, bycatch of chinook salmon after April 15 does not apply towards the PSC limit that triggers a closure.

1.2 Related NEPA Documents

This EA tiers off the Alaska Groundfish FSEIS (NMFS 1998a) which analyzed the effects of groundfish fisheries in the EEZ off Alaska and displayed fishery induced impacts on all aspects of the ecosystem. This EA also tiers off the Steller sea lion emergency rule EA (NMFS 1999), which analyzed (for the short-term) the impacts of implementing the reasonable and prudent alternatives to avoid the likelihood of the pollock fisheries off Alaska jeopardizing the continued existence of the western population of Steller sea lions, or adversely modifying its critical habitat. This EA also tiers of the 1999 Groundfish Total Allowable Catch Specifications EA (NMFS 1998b).

Fishery management measures being developed concurrently with this proposed action which affect the trawl pollock fisheries throughout some or all of these management areas include: 1) Amendment 57 to the FMP for the Groundfish Fishery of the Bering Sea and Aleutian Islands area to prohibit the use of nonpelagic trawl gear in directed pollock fisheries, 2) American Fisheries Act implementation, and, 3) Steller sea lion conservation measures. These actions are explained further below:

In June 1998, the Council adopted a fishery management plan amendment (Amendment 57) to the FMP for the Groundfish Fishery of the Bering Sea and Aleutian Islands that will prohibit the use of nonpelagic trawl gear in the BSAI pollock fishery. A draft Environmental EA/RIR/IRFA for this action was prepared and submitted for Secretarial review June 23, 1998. The proposed rule for Amendment 57 has been submitted for Secretarial review and final action on the proposed amendment may take place in the year 2000. In the meantime, the same results are being achieved in the directed pollock fisheries by Council action taken during the 1999 TAC specification process. None of the 1999 pollock TAC in the BSAI pollock fishery was allocated to vessels nonpelagic trawl gear. Prohibiting nonpelagic gear from directed pollock fisheries affects amounts of crab and halibut bycatch and rates of benthic substrate disturbance.

On October 21, 1998, the President signed into law the American Fisheries Act (AFA), which imposed major structural changes on the BSAI pollock fishery including: 1) The buyout of nine pollock factory trawlers, 2) major shifts in pollock allocations from the offshore to the inshore and CDQ sectors of the industry, 3) a prohibition on entry of new vessels and processors into the BSAI pollock fishery, 4) authorization of harvester cooperatives in the inshore, mothership, and offshore sectors, and 5) establishment of protections for other fisheries. The changes wrought by the AFA have the potential to interact greatly with the proposed RPA measures, in both positive and negative ways. Formation of fishery cooperatives under the AFA may reduce pressure on vessels participating in coops to race with each other to harvest available pollock quotas in Bering Sea management areas. However, the AFA-mandated shift in pollock allocations from the offshore sector to the less-mobile inshore sector could intensify fishing effort in nearshore areas critical to Steller sea lions, in the absence of mitigating measures. The Council is currently developing management measures to implement the provisions of the AFA, and an EA/RIR/IRFA for these potential regulations is being prepared.

The recent Biological Opinion (Section 7 consultation) on the fishing related impacts on Steller sea lions could also cause far-reaching changes in the distribution of pollock fishing effort. The consultation identified areas of critical habitat for Steller sea lions, and the NPFMC has recommended actions to reduce the fishing effort for pollock within this critical habitat. The NPFMC also recommended spreading effort out in time so that "pulse" fishing periods are reduced. The recommended periods are as follows (1) A1, beginning January 20; (2) A2, beginning February 20; (3) B, beginning August 1; and (4) C, beginning September 15. NMFS is currently considering Council recommended conservation measures and will develop proposed rulemaking accordingly, with final rulemaking required before the start of the 2000 pollock fishery.

Number of salmon taken as incidental bycatch in BSAI trawl fisheries, 1989-1998. Note that >95% of the "other" salmon is chum salmon.

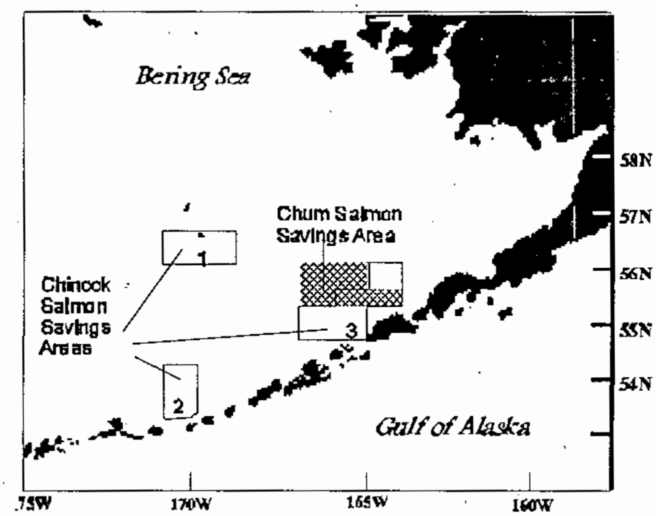
Year	Chinook Salmon	Other Salmon
1989	40,354	5,545
1990	13,990	16,661
1991	35,766	31,987
1992	37,372	38,919
1993	45,964	243,246
1994	43,636	94,508
1995	23,079	21,780
1996	63,179	77,926
1997	50,218	67,536
1998	59,336	70,703

1.3 Background

Salmon are taken incidentally as bycatch in trawl fisheries, particularly the midwater pollock fishery. A handful of chinook salmon are also taken as bycatch in the jig fishery for Pacific cod. Virtually all salmon bycatch is chinook salmon and chum salmon, with less than 5% of the salmon bycatch comprised of sockeye, pinks, or coho salmon. Previous analysis of bycatch data have indicated the bycatch is primarily juvenile salmon that are one or two years away from returning to the river of origin as adults. The origin of salmon taken as bycatch includes rivers in western Alaska, central and southeast Alaska, Asia, the Pacific Northwest, and British Columbia. The

Asia, the Pacific Northwest, and British Columbia. The number of salmon taken incidentally in recent BSAI groundfish fisheries is shown in the adjacent table.

Salmon are listed as a prohibited species in the groundfish fishery management plans, meaning that they cannot be kept, and must be returned to the sea as soon as possible with a minimum of injury. However, regulations implemented in 1994 prohibited the discard of salmon taken as bycatch in BSAI groundfish trawl fisheries until the number of salmon has been determined by a NMFS certified observer. The intent of these regulations was to provide additional information on the magnitude of salmon bycatch in these fisheries. Additional regulations were adopted to allow voluntary retention of salmon for donation to foodbanks. Salmon retained for this purpose are processed and distributed in a fashion that is easily monitored.



The Council has taken measures to control the bycatch of salmon in trawl fisheries. Several bycatch "hotspot" areas are closed to fishing if too many salmon are bycaught (see adjacent figure). The Chum Salmon Savings Area closes to all trawling from August 1 through August 31, and remains closed if a bycatch limit of 42,000 "other" salmon is taken within the Catcher Vessel Operational Area (CVOA). Trawling is prohibited in the Chinook Salmon Savings Areas through April 15 upon attainment of a bycatch limit of 48,000 chinook salmon in the Bering Sea and Aleutian Islands Area. The location of the 9 blocks included in this area is provided in **Figure 1**. Block number 3 of the chinook savings area is contained entirely within the CVOA.

1.4 Information Used for the Analysis

This analysis is based on observer data from 1994 through 1997, and on summary information provided by NMFS. A Geographic Information System (GIS) was used to look at when and where the salmon have been bycaught in those four years, and see if the old hot spots hold up, or if there are new hotspots which also might deserve attention. In order to look at the effects of extending the effective date for the current closure, we looked at cumulative salmon bycatch over time, estimated when a closure would be triggered, and contrasted the salmon bycatch and catch coming out of the closed area after a closure would have been triggered, based on 1994 -1997 data. The analysis summarizes the four years of historical data, but does not attempt to estimate the foregone catch. The bycatch implications of pushing effort into other areas was examined for specific hotspots and various bycatch species.

1.5 Origins of Chinook Salmon Caught Incidentally in BSAI Groundfish Fisheries

No stock identification work has been undertaken for chinook salmon since the studies discussed in Amendment 21b. Agencies are currently in the process of collecting genetic samples from streams around the Pacific Rim to use as baselines for future genetic work. There has been genetic identification of chum salmon taken by trawl fisheries in the Bering Sea. The previous studies for chinook salmon identification by scale pattern analysis as provided in Amendment 21b are duplicated below.

groundfish fisheries is Myers and Rogers (1988). Salmon scales collected by groundfish observers were analyzed to identify the origin of chinook salmon bycaught in the foreign and joint-venture trawl groundfish fisheries in the Bering Sea Exclusive Economic Zone (EEZ) during 1979, 1981 and 1982. The percent origin of chinook salmon from various regions and within the Western Alaska region over all three years was:

Western Alaska	60 %
Yukon	17 %
Kuskokwim	24 %
Bristol Bay	29 %
Central Alaska	17 %
Asia	14 %
S.E. Alaska/British Columbia	9 %

The percentages for the Yukon, Kuskokwim and Bristol Bay drainages are not intended to sum to the western Alaska total percentage. These percentages were derived through the same analysis used to determine the percent of chinook salmon of western Alaska origin, but with standards for each of these systems used separately. When the separate western Alaska systems were included in the analysis, the percentages of chinook salmon estimated to be of Central Alaska, Asia, and S.E. Alaska/British Columbia origin varied somewhat because the separate western Alaska systems did not sum to the western Alaska total percentage. The Central Alaska percentage includes fish from the Karluk, Chignik, Susitna, Kenai and Copper Rivers, and the percentage represented by any one of these systems alone would be difficult to determine.

Several studies have estimated the origin of chinook salmon captured in the Japanese mothership fisheries for salmon, both in the Bering Sea and in the North Pacific Ocean (Major, et al. 1975, 1977 a,b; Myers et al. 1984; Ito et al. 1985; Davis, 1990). Davis (1990) used scale pattern analysis to determine origins of chinook salmon near Japanese mothership and landbased driftnet salmon fisheries in 1985 and 1986. Based on scales collected in the vicinity of the mothership fisheries (north of the Aleutians and between 175°E and 175°W) the percent origin of immature (age-1.2) chinook salmon was:

	1985
Western Alaska	58 %
Central Alaska	3 %
Asia (Kamchatka)	39 %

Scale pattern information from 1986 was also analyzed, but the Kamchatka and Yukon standards were similar and did not allow an Asian/Western Alaskan origin stock separation (Davis, 1990).

A previous study of chinook salmon from the area of the Japanese mothership salmon fishery, 1975 to 1981 (Myers et al., 1987), indicated the following percentage origin of chinook salmon from the Bering Sea:

Western Alaska	70 %
Yukon	48 %*
Kuskokwim	21 %*
Bristol Bay	14 %*
Central Alaska	10 %
Asia	18 %
S.E. Alaska/British Columbia	2 %

* Not intended to sum to Western Alaska total percentage as explained above.

Davis (1990) cites additional scale pattern studies (Major et al. 1975, 1977a,b) which also indicated "that western Alaskan fish predominated in the Bering Sea and that the proportion of western Alaskan fish increased to the east."

Tagging data to determine region of chinook origin have been very limited but tend to corroborate results of scale pattern analyses (Myers and Rogers, 1988). Davis states "In summary, the meager information available from tagging experiments suggests that chinook in the Bering Sea may be predominantly of western Alaska origin and that chinook in the North Pacific Ocean may be a mixture of North American and Asian stocks" (Davis, 1990). North Pacific Ocean here refers to the area south of the Aleutian Island chain. Although scales from chinook salmon are currently being collected by observers, no scale pattern analysis is currently being conducted to determine the origin of chinook salmon bycaught in the groundfish fisheries. Observers are also collecting the heads of salmon with clipped adipose fins for potential recovery of coded wire tags.

Davis also cites ongoing studies on infection rates by myxosporean brain parasites of chinook salmon (Nagasawa and Urawa 1987; Urawa and Nagasawa 1988, 1989; Urawa et al. 1990). Of the two varieties of parasite under investigation, the parasite suggested to indicate an Asian origin has not been found in chinook salmon captured in the Bering Sea, indicating a prevalence of North American origin fish in the Bering Sea (Davis, 1990).

Myers and Rogers (1988) indicated that the predominant ages of chinook salmon intercepted in the Bering Sea groundfish fisheries based on 1979, 1981 and 1982 samples were ages 1.2 and 1.3 (years in fresh water, years in salt water, i.e. age 1.2 = four year old fish). Age 1.2 chinook accounted for 56% of the samples, and age 1.3 chinook accounted for 26% of the samples. Myers and Rogers speculated that the greatest effect of large incidental catches of ages 1.2 and 1.3 chinook salmon offshore on inshore harvests would likely occur 1 or 2 years later (or ages 1.3 and 1.4). Davis (1990) also found age 1.2 chinook salmon to comprise the major age group in research vessel catches (70% and 61% in 1985 and 1986, respectively).

In general, the majority of chinook salmon encountered in the Bering Sea, whether in directed Japanese mothership salmon fisheries or groundfish trawl fisheries, are of western Alaskan origin. There is a general tendency for the percentage of western Alaskan chinook to increase moving west to east toward the North American continent. However, western Alaskan chinook are the major component of chinooks caught throughout the Bering Sea. These results are indicated by scale pattern analyses, tagging, and parasite information.

In addition, although the chinook salmon encountered in the North Pacific Ocean (e.g. south of the Aleutian Islands) are primarily of Asian or central Alaska origin (depending on the study), "All studies agreed that western Alaska is an important secondary stock." (Davis, 1990). Chinook salmon of western Alaska origin utilize the entire Bering Sea, and to some extent the North Pacific Ocean as their range during the saltwater phase of their life.

The mean percentages of chinook salmon in the Bering Sea estimated to be of western Alaska origin in the various studies (expressed as a range with lowest and highest values if from multiple areas) are summarized as follows:

Study	Percent Western Alaska
Major et al. 1975.	58% - 93%
Myers et al. 1987.	65% - 76%
Myers and Rogers. 1988.	53% - 72%
Davis. 1990.	51% - 62%

1.6 Chinook Bycatch in Western Alaska Adult Equivalents

Chinook salmon bycaught in Bering Sea trawl fisheries are predominantly of western Alaskan origin and are primarily juveniles that are one to two years from returning to streams of origin (section 1.3.3 above). In order to arrive at a rough estimate of the effects that trawl bycatch might have on western Alaskan adults, available information from two western Alaskan river systems was employed. The Nushagak River chinook salmon run has been closely monitored by the Alaska Department of Fish and Game, and annual estimates of catch and **escapement** as well as age composition information were available for this river. Rough age composition of commercial and subsistence catch was available from Yukon River Area Management Reports as well.

The Nushagak River drainage covers an extensive portion of the Bristol Bay watershed, and is the largest producer of chinook salmon in Bristol Bay (Minard et al. 1992). Escapement into the Nushagak was approximated from aerial surveys from 1966-1985, and has been estimated using side scanning sonar since 1986. Age composition of escapements was from spawning ground samples in 1981-1985 and from sonar project samples 1987-1998. Commercial catch age samples have been taken since 1966 (Beverly Cross, ADF&G Anchorage, Personal Communication). Commercial, subsistence, and some recreational catch data for the Yukon River are available and there is information from monitored index streams which help gauge escapement levels, but stock size information for the entire river is lacking. Based on a Canadian tagging study and on some run composition information from ADF&G, Brannian (1990) was able to estimate the total Yukon River run for the years 1982-1986.

The following procedure and assumptions were followed in order to roughly express trawl bycaught chinook salmon in western Alaska adult equivalents.

The total annual numbers of chinook salmon intercepted in the Bering Sea from foreign, joint venture and domestic trawl fisheries during the period 1977-1998 were estimated from NMFS observer program reports. Based on the results of Myers and Rogers (1988), 57%, 63% and 60% of the chinook salmon bycaught in trawls during 1979, 1981 and 1982, respectively, were estimated to be of western Alaskan origin. The mean percentage of western Alaska origin chinook (60%) was assumed for all other years. These percentages were multiplied (as proportions) against the total bycatch in a year to estimate the number of chinook of western Alaskan origin in a given year.

Myers and Rogers (1988) had estimated that 56% of the chinook included in their analysis were age 1.2 fish and that 26% of the chinook were age 1.3. Assuming that all chinook bycaught in trawl fisheries are either age 1.2 or 1.3 fish, the percentages were then adjusted to 68.3% and 31.7% age 1.2 and age 1.3 fish, respectively. The estimated numbers of western Alaska chinook were then multiplied by these proportions to estimate the numbers of age 1.2 and age 1.3 chinook from western Alaska.

Following the example of Myers and Rogers, the percentages of chinook salmon from the Yukon, Kuskokwim and Bristol Bay systems (< 100%) were adjusted to equal 100%. It was further assumed that all of the western Alaskan fish were from either the Yukon River or Bristol Bay systems since the most information was available from these two systems. The average percentage of Bristol Bay chinook (29%) was thus adjusted to 63.0% of all western Alaska fish, and the Yukon River (17%) was adjusted to 37% of all western Alaska fish. These percentages (as proportions) were multiplied against the total estimated number of western Alaskan chinook by age to estimate the total number of chinook contributing to the two systems as 1.2 and 1.3 year-old fish.

Based on the age composition of the bycaught chinook salmon (predominantly age 1.2 and age 1.3), and the western Alaska returns (predominantly age 1.3 and age 1.4), it was assumed that a portion of the chinook salmon bycaught in the trawl fisheries as age 1.3 fish would have returned in the same year if they had not been intercepted. The remainder of the age 1.3 chinook were assumed to return to the Nushagak and Yukon Rivers in the following year as age 1.4 fish. None of the age 1.2 bycaught chinook salmon were assumed to have returned to western Alaska during the year had they not been intercepted, a portion were assumed to return in the following year as age 1.3 fish, and the remainder were assumed to return 2 years later as age 1.4 fish.

Annual at-sea natural mortality rates were assumed to be similar to those used by the Joint Chinook Technical Committee in the Alaska-Canada treaty (PSC, 1988). The treaty assumes that the natural mortality rate over the year between ages 1.2 and 1.3 is 20%, and that the natural mortality rate over the year between ages 1.3 and 1.4 is 10%.

The age 1.3 portion of the intercepted chinook salmon were assumed to return in the same year or in the following year as age 1.4 fish. The estimated number of age 1.3 chinook salmon which were assumed to return in the following year as age 1.4 salmon was multiplied by the proportion of age 1.4 chinook salmon from each of the systems. Prior to multiplication, the age 1.3 salmon which were estimated to return the following year as age 1.4 salmon were discounted by the 10% natural mortality rate.

A similar procedure was followed to estimate the returns which would have been expected of salmon intercepted as age 1.2 fish. Fish returning the following year as age 1.3 fish were discounted by a natural mortality rate of 20%, and those which returned two years later as age 1.4 were further discounted by a natural mortality rate of 10%. Fish were allocated as ages 1.3 or 1.4 as above, by brood year contribution to returns as age 1.3 and 1.4 fish.

Preliminary information from ADF&G (Beverly Cross, ADF&G Anchorage, Personal Communication) was used to determine that the majority of chinook salmon return to the Nushagak River as age 1.3 (average 34.2% 1966-1998) and age 1.4 (average 43.5% 1966-1998) fish. The majority of chinook salmon return to the Yukon River as age 1.3 (average 23.1% 1980-1991) or age 1.4 (average 54.0% 1980-1991) fish. Assuming that all chinook return at age 1.3 or 1.4, the proportion of fish from the same brood year which returned as age 1.3 in a given year or as age 1.4 in the following year were determined by expanding the percentages to 100%.

As a rough estimate, approximately half of the bycaught chinook salmon in any given year would be expected to return to western Alaskan systems as adults had they not been intercepted (**Figure 2**). Since bycatch in a given year impacts multiple age groups, **Figure 3** provides the bycatch in a given year and the number of adult chinook salmon which would have returned in subsequent years had they not been bycaught. For instance the high bycatch in 1980 was composed of fish which would have contributed to the returns in 1980, 1981 and 1982. Bycatch has removed approximately 20,000 adult chinook salmon from western Alaska returns since 1993.

The impact of such bycatch on western Alaskan stocks is unknown. There are several variables which interact to influence the effect bycatch might have on stocks including chinook salmon run size, stock composition and catchability. Variations in run strength and/or year class strength could lead to disproportional bycatch of given runs. Tendencies for individual stocks to aggregate separately from other stocks would also lead to disproportional bycatch of stocks. Finally, the catchability of chinook salmon may vary by season or age of fish which might also lead to differential effects of bycatch.

The impact of bycatch on stocks other than western Alaskan is difficult to determine, however, we could expect similar overall impacts as those described above. Little information is available on what the composition of the other 50% of the catch might be, where these fish originate, and what would be the expected ratio of returned fish to native spawning grounds. Some of these fish would be likely to originate from Russia and the Pacific Northwest (Rogers 1992; Francis and Hare, 1994). In Alaska, sophisticated tagging studies have only been done for a few selected salmon species. No such data is available for other chinook salmon groups intercepted in Alaska.

1.7 Sampling of Chinook Salmon and Adequacy of Estimates

The Council has previously received a report on catch estimates and their precision in Bering Sea and Aleutian Islands pollock fisheries and in the Bering Sea yellowfin sole fishery. In summary, Analytical and statistical review of procedures for collection and analysis of commercial fishery data used for management and assessment of groundfish stocks in the U.S. Exclusive Economic Zone off Alaska, prepared for Dr. William Karp by Jon H. Volstad et al. of Verser, Inc. presented an evaluation of various methods for estimating catch from two fisheries in the Bering Sea. The analysis was well documented and the statistical estimators explained with useful results. The authors kept at the forefront several of the caveats and assumptions which have bearing on the results and cautioned applying the results to other fisheries but did recommend applying the methods to other fisheries in the future. The study provided statistical estimates based on a two stage sampling design with the first stage being the vessel level (number of vessels with observers) and the second stage being the haul level (number of hauls sampled per vessel). Useful graphs providing the changes in coefficients of variation (cv's) were provided under assumptions of various levels of vessel and haul sampling.

The results indicated that for the offshore pollock and yellowfin sole fleets (both with 100% observer coverage) more of the variance occurred at the vessel level than at the haul level so that the first level of sampling effort should be across vessels, or increasing observer coverage. The variability between hauls was greater for species encountered less often, so that for rarer species, increasing the number of hauls sampled for a vessel was also important.

The estimates of total groundfish catch from the two sampling-based estimators were closer to the more traditional estimates (e.g. based on the blend estimate) in data from the pollock fishery, and all estimates were within 5% of each other. In data from the yellowfin sole fishery, the two statistical estimates had very tight confidence intervals, and besides not being within the intervals, the traditional estimates were approximately 10% lower than the sampling-based estimates.

The total individual species catch was also estimated and, curiously, the best agreements between estimators were not only the estimate of catch from the targeted species (pollock in the pollock fishery and yellowfin sole in the yellowfin sole fishery), but also of the species for which numbers were estimated rather than weight - salmon and crab. The estimates of catch of these species from the various estimators were closer than the estimates for species such as Pacific cod and rock sole commonly encountered in the pollock and yellowfin sole fisheries. With few exceptions (up to 20%), the estimates did not vary by more than 10%. This is not to say that the coefficient of variation was not sometimes very large for the PSC estimates, as might be expected for rarer species.

An analysis of sampling requirements within each haul was beyond the scope of this study. This is unfortunate since it would be expected that samples within a haul would account for a large portion of the variability in catch and bycatch estimates. The absence of such an analysis led to assumptions which may have had unknown consequences on the current studies results. The analysis helps point out the need for an analysis of within haul variability and sampling protocols.

2.0 DESCRIPTION OF THE ALTERNATIVES

2.1 Alternative 1: No Action.

Trawling is prohibited in the Chinook Salmon Savings Areas through April 15 upon attainment of a bycatch limit of 48,000 chinook salmon in the BSAI.

2.2 Alternative 2:

Include salmon taken after April 15 towards the bycatch limit of 48,000 chinook salmon. The Chinook Salmon Savings Areas would close upon attainment of the bycatch limit, whenever this would occur. Hence these areas could close, or remained closed, during later pollock seasons.

2.3 Alternative 3:

Reduce the trigger level to 36,000 chinook salmon in the BSAI. Trawling would be prohibited in the Chinook Salmon Savings Areas through April 15 upon attainment of a bycatch limit of 36,000 chinook salmon in the BSAI.

Option 1 (applicable to Alternatives 2 and 3): Seasonally allocate the PSC limit, such that there are separate triggers for the pollock seasons.

Option 2 (applicable to Alternatives 2 and 3): Begin accounting towards the PSC limit at the start of the fall pollock season (currently September 1, or the 'B' season), with the amount carried over to the next pollock 'A' season.

2.4 Alternative 4:

Annual closure of specific "hot spot" blocks. These specific blocks are the five contiguous blocks of the current Chinook Salmon Savings Area that in the vicinity of Unimak Island. These have been identified in the document as 200, 201, 202, 227, 228, and 254. Block 201 has been further subdivided in half east to west and labeled as 997 (the eastern half) and 998 (the western half).

Option 1: Consider a seasonal closure of the five blocks.

Option 2 (applicable to Alternative 4 and Option 1): The closure would only apply to the pollock fisheries although chinook salmon bycaught in all fisheries would apply toward a PSC limit if in effect.

2.5 Alternative 5: (Preferred)

Alternative 5 would combine elements of Alternatives 2, 3, and 4. Specifically, the chinook salmon bycatch PSC limit would be reduced incrementally from 41,000 to 29,000 over three years beginning in the year 2000 (the phase-in schedule would be as follows: year 2000=41,000 chinook salmon; 2001= 37,000; 2002=33,000; 2003=29,000). Accounting for the PSC limit would begin January 1 and continue year-round. Non-pollock fisheries would be exempt from the closure and those fisheries' chinook PSC bycatch would not be counted toward the PSC limit. This is a change from the status quo, currently all chinook salmon bycaught are counted towards the PSC limit. The two Pribilof blocks would be deleted from the CHSSA closure area, and block 226 would be added. In the event the PSC limit is triggered before April 15, the chinook savings areas would close immediately to pollock fishing. The closure would be removed after April 15, but would be reinitiated September 1.

3.0 ANALYSIS OF THE ALTERNATIVES

3.1 Alternative 1: No Action.

Trawling is prohibited in the Chinook Salmon Savings Areas through April 15 upon attainment of a bycatch limit of 48,000 chinook salmon in the BSAI.

Chinook salmon bycatch in trawl fisheries reached a high in 1980 when foreign trawl vessels intercepted approximately 115,000 chinook salmon (**Figure 6**). Following governmental action to reduce bycatch in the trawl fisheries, the foreign fleet was constrained by and stayed within a bycatch reduction schedule which reduced the allowable level each year from 65,000 chinook salmon in 1981 to 16,500 chinook by 1986. Domestic trawl vessels began fishing in these same fisheries and areas in the mid-1980's and maintained chinook salmon bycatch below 40,000 fish through 1992. Since 1993, chinook salmon bycatch was below 40,000 fish in only 1995, and in 1996 and 1997 the bycatch was 63,179 and 50,218 chinook salmon, respectively. The bycatch in 1998 (through 12/19/98) was approximately 59,000 chinook salmon. A PSC limit at 48,000 chinook has been in place since 1995, however the PSC limit only applies to the first 3.5 months of the year, with no restrictions in the subsequent months. Salmon are rarely taken in fixed gear fisheries.

It is believed that most of the chinook taken as bycatch in the BSAI trawl fisheries are of western Alaska-origin. A discussion of the status of chinook stocks and commercial fisheries information for specific Western Alaskan river systems is provided in Appendix 1. In particular the poor returns to some of these systems in 1998 are discussed. In **Figure 7**, updated state-wide commercial and subsistence catch information since the analysis in Amendment 21b until 1997 is displayed. Note that not all of the information is available from the 1997 catch. The total statewide harvest of chinook salmon has been fairly constant in recent years, however, 1996 was the lowest statewide catch of chinook salmon since the late 1970's. While useful, catch numbers in themselves may not be indicative of the health of salmon stocks since, for instance, a strike by fishermen, or the lack of a market may be a cause for little or no catch in an area.

3.1.1 Chinook Salmon Bycatch in the Existing Chinook Salmon Savings Area

The Chinook Salmon Savings Area was adopted by the Council in 1995 and was effective beginning January 1, 1996 (see 50 CFR § 679.21(e)(7)(viii)). As explained in the introduction, a closure of this area would be triggered by the interception of 48,000 chinook salmon during the first 3.5 months of the year, and re-opened on April 16 if the closure had been in effect (the nine blocks included in the savings area are indicated in **Figure 1**). Although more than 48,000 chinook salmon were taken over the course of a year in 1996, 1997, and 1998, closure of the area has not been triggered because the PSC limit was not exceeded prior to April 15.

The total catch of chinook salmon by week and target fishery (B = bottom trawl for pollock; C = trawl for Pacific cod; and P = pelagic trawl for pollock) during the years 1994 - 1997 is provided in the left column of **Figure 12**, and the total catch of groundfish in these fisheries is provided in the right-hand column. Note that observer data is not yet available for 1998, and this year was not included in the analysis presented in this section. The purpose of **Figure 12** and of **Figures 13 and 14** is to compare the temporal patterns in bycatch and catch within the existing closure area with those outside the existing area. The patterns of chinook salmon bycatch were similar in 1994 and 1996, with the majority of chinook salmon taken during the first weeks of the fishing season. Most of this bycatch was taken by the pelagic pollock fishery, and bycatch of a lesser magnitude occurred during the second half of the year (although the amount of 'B' season chinook salmon bycatch was much higher in 1996 than in 1994). In 1995 with lower overall bycatch levels, the proportion of bycatch in the bottom trawl and Pacific cod fisheries was much higher in both fishing seasons. Though similar to 1994 and 1996 in the predominance of bycatch in the pelagic pollock fishery, the bycatch in 1997 differed from the previous years in the relatively low bycatch in the first half of the year, and the extremely high bycatch in the months of September and October. The temporal patterns in groundfish catch have been very similar across years and fisheries, with the exception that the pollock 'B' season began in mid-August in 1994 and 1995 and was changed to September 1 in 1996 and 1997. Again, this change in season to later in the year could help explain the higher chinook salmon bycatch seen in the second half of 1996 and 1997.

The temporal pattern of chinook bycatch and total groundfish catch from within the Chinook Salmon Savings Area is provided in **Figure 13**. The overall pattern in chinook salmon bycatch is very similar to that seen for the entire Bering Sea (**Figure 12**), with the greatest difference being that fewer salmon in all three target fisheries were taken within the area during the 1995 pollock 'B' season. This would indicate that with some exceptions, especially during the 'B' season, most of the chinook salmon are taken within the Chinook Salmon Savings Area. The patterns in total groundfish catch are similar over the first half of the year, indicating that much of the 'A' season catch is taken within the closure area as well. However, it is evident from the figure that much of the 'B' season catch is taken outside of the savings area.

The catch and bycatch taken outside of the Chinook Salmon Savings Area by week and across years are provided in **Figure 14**. As the figure indicates, very few chinook salmon were taken outside of the closure area during the 'A' season in any year, and few were taken outside of the closure area during the 'B' season in 1994 or 1996. During the low bycatch year of 1995, many of the salmon were taken outside of the closure area, and although the higher proportion of chinooks were taken within the closure area in 1997, a larger number were taken outside the closure area than had been previously seen. The graph indicates an increasing amount of groundfish catch has been taken outside of the closure area during the 'A' season over the period 1994 - 1997 and that a majority of the groundfish catch is taken outside of the closure area during the 'B' season in any year.

In summary, regardless of season or year, the majority of chinook salmon have been intercepted in the area defined by the blocks of the Chinook Salmon Savings Area. This coincided with a high proportion of the groundfish catch taken in the savings area during the 'A' season. During the 'B' season when fishing effort was more focused outside of the closure area, the majority of chinook salmon were taken within the savings area as well. The spatial patterns in bycatch in relation to the established Chinook Salmon Savings Area are discussed below.

3.2 Alternative 2:

Count salmon taken after April 15 against the PSC limit of 48,000 chinook salmon. The Chinook Salmon Savings Areas would close upon attainment of the bycatch limit, whenever this would occur. Hence these areas could close, or remained closed, during later pollock seasons.

3.2.1 Seasonal Bycatch of Chinook Salmon in the Bering Sea

The bycatch of chinook salmon is driven by the pollock fisheries which through 1998 were prosecuted in two distinct time periods: 1) the pollock 'A' season which is primarily a roe fishery and begins during the last week of January and lasts for approximately 4 - 6 weeks; and 2) the pollock 'B' season which during 1996-1998 began on September 1 and lasted approximately 5 - 8 weeks. The relatively short time period of these fisheries has made it difficult to determine what the impacts of the trawl fishery on chinook salmon bycatch during other times of the year would be. However, the analysis of the more continuous foreign and joint venture (JV) fishing operations in Amendment 21b indicated that chinook salmon bycatch was highest in the first four months and last three to four months of the year, with chinook salmon bycatch being very low to non-existent in May through August. As a general rule, the further into the winter months the higher the bycatch levels tended to be. There are currently Community Development Quota (CDQ) fisheries operating outside of the 'A' and 'B' seasons, and although some "other" (primarily chum) salmon bycatch was seen in these fisheries operating prior to the 'B' season, little chinook salmon bycatch has been seen outside of the primary fishing seasons based on observer data.

During 1998, several measures have been adopted which are expected to change the patterns in pollock fishing in the Bering Sea, and are expected to have unknown impacts on chinook salmon bycatch. The NPFMC instituted measures to prohibit bottom trawling for pollock in 1999, and the resultant increased pelagic trawling would be expected to increase chinook salmon bycatch since chinook are taken primarily in pelagic trawls. On December 3, 1999, NMFS issued a Biological Opinion (BO) which determined that there was a reasonable likelihood that the pollock fisheries off Alaska jeopardize the continued existence of the western population of Steller sea lions or adversely modify its critical habitat. The Council and NMFS promulgated emergency action to implement reasonable and prudent alternatives (RPAs) to the pollock fishery during the 1999 fishing year, and are presently promulgating permanent rulemaking for 2000 and beyond. As a result of the jeopardy finding, conservation measures have been implemented which transfer effort out of sea lion critical habitat areas (location similar to the Catcher Vessel Operational Area) and additional seasons have been created to distribute effort over time. The impacts on chinook salmon bycatch from these changes is unclear, although we could expect that bycatch may be reduced because the majority of the CHSSA is located within Steller sea lion critical habitat areas. Additionally, the 'B' season has been changed so that it begins August 1, a month of low chinook salmon bycatch. However, a new 'C' season is proposed that would begin on September 15, a month of high chinook salmon bycatch. There have also been recent changes in pollock allocations under the American Fisheries Act, which are expected to further change historical patterns in the pollock fishery.

The cumulative chinook salmon bycatches from all observed fisheries combined during the period 1993 through 1998 are provided in **Figure 9**. As the figure indicates, the pattern in bycatch levels over time differs annually and makes predictions in bycatch difficult. Two years were characterized by high bycatch during the 'A' season (1994 and 1996), and four years by high bycatch during the 'B' season (1993, 1996, 1997 and 1998). There was extremely low bycatch of chinooks seen in the 'B' season in 1994 and 1995, although 1994 had encountered a high number during the previous 'A' season. Bycatch in 1997 began with the lowest bycatch levels during the six 'A' seasons examined and ended with high bycatch levels in the 'B' season. The 1998 season began with levels similar to those seen in 1995 and 1997 during the 'A' season but ended with the highest catch in the 'B' season in any of the six years. In 1996, high chinook salmon bycatch characterized both pollock fishing seasons.

As discussed above, chinook salmon bycatch has been observed to increase during the autumn and into the winter months. The beginning of the pollock 'B' season changed between 1995 and 1996, from an August 15 opening to a September 1 opening. Chinook bycatch was very low in 1994 and 1995 during a fishing season beginning on August 15, and the bycatch of chinook salmon has been much higher during a fishing season beginning September 1 in 1996, 1997 and 1998.

An examination of cumulative bycatch of chinook salmon over the course of a year by target fishery revealed target fishery specific differences (**Figure 10**). The data provided in this figure is from observed vessels only (1994-1997), with target assigned by dominant species catch. Differences in the algorithm used in assigning targets in the past and that currently in use may cause differences by target fishery in groundfish catch and chinook salmon bycatch from previous reports. The cumulative bycatch of "other" chum salmon has been provided in this figure as well (dashed lines) for comparative purposes. Whereas 1995 generally had low chinook salmon bycatch levels, this year represented the highest bycatch levels in both the bottom trawl for pollock and the Pacific cod trawl fisheries. Among the possible causes for this were the bottom orientation of the gear used in pursuing these targets with chinook salmon perhaps being found at greater depths, or because of the more mixed-stock nature of the two targets in relation to the pelagic pollock target. The Pacific cod fishery is not regulated by the 'A' or 'B' season, and this fishery tends to have been mainly prosecuted prior to the pollock 'B' season in any year which is the reason for the low chinook bycatch in this fishery during the second half of any year.

The purpose of this analysis is to examine the impacts of imposing PSC limits of 36,000 or 48,000 chinook salmon on a seasonal or annual basis. **Figure 11** provides the proportion of chinook bycatch reported over the six years 1993 - 1998 during the first ('A' season) and second ('B' season) halves of the year. The two proposed bycatch PSC limits are indicated by lines in the figure. As discussed above, 1995, 1997 and 1998 had relatively low chinook salmon bycatch levels during the first half of the year, and 1994 and 1995 had relatively low bycatch levels during the second half of the year. The 36,000 chinook level was exceeded during the 'A' season in 1994 and 1996, and this level was exceeded by the end of the 'B' season in all years with the exception of 1995. The 48,000 chinook level was exceeded during the second half of the year in 1996, 1997, and 1998.

3.3 Alternative 3:

Reduce the trigger level from 48,000 to 36,000 chinook salmon in the BSAI. Trawling would be prohibited in the Chinook Salmon Savings Areas through April 15 upon attainment of a bycatch limit of 36,000 chinook salmon in the BSAI.

3.3.1 Annual Closure of the Chinook Salmon Savings Area Under Various PSC limits

Historical data (1994-1997) were examined to determine the time a closure would have been triggered given PSC limits of 36,000 or 48,000 chinook salmon. Weekly NMFS reports of total chinook salmon bycatch by week and target fishery were used in this analysis. Haul by haul observer data was used to determine the proportion of the catch and bycatch taken within the closure area. The data include catch and bycatch from all trawl targets in the Bering Sea. The results are summarized in **Table 1**. The paragraph headings below correspond to the sections in **Table 1**.

Dates closure would have been triggered:
The historical data indicate that the 48,000 PSC limit would have been reached on the week ending September 28 in 1996 and on the week ending October 18 in 1997. Given a PSC limit of 36,000, the closure would have been triggered during the 'A' season in 1994 and 1996 (April 9 and March 2, respectively), and during the 'B' season in 1997 (October 4). No closure would have been triggered in 1995.

Amount taken after the PSC limit had been reached – entire Bering Sea:
The PSC limit of 48,000 chinooks would have triggered a closure at the very end of the season in 1997, with 1 salmon and 34,560 mt (2% of the total year catch from all fisheries) taken after this date. Following the projected closure under a 48,000 chinook salmon PSC limit in 1996 (September 28), 14,721 chinook salmon (23% of the year catch) and 276,842 mt of groundfish (16% of the year catch) were taken from the Bering Sea in all fisheries after this date. The pollock fisheries accounted for 14,565 chinook salmon and 256,790 mt of groundfish during this period.

Three closures would have been triggered given a PSC limit of 36,000 chinook salmon. The high bycatch during the 'A' season in 1994 would have triggered a closure on April 9. Relatively few salmon were taken after this date in the Bering Sea (6,968 chinooks, or 16% of the total bycatch), however, 56% of the groundfish catch from all fisheries (1.018 million mt) was taken in the period after the PSC limit was reached in the entire Bering Sea. The pollock fisheries accounted for 4,586 chinook salmon and 724,067 mt of groundfish during the period following April 9. With no change in the seasonal closure of the Chinook Salmon Savings Area, the area would have been reopened on April 16. There were approximately 500 chinook salmon and 20,000 mt of groundfish taken during the one week the closure would have been in place (April 9 – April 15).

In 1996, the high 'A' season bycatch levels would have caused the 36,000 PSC limit to be reached on March 2, even earlier than in 1994. After this date, 26,521 chinook salmon (42% of the year total) were taken primarily in the pollock 'B' season, and 65% (1.106 million mt) of the total groundfish catch by all fisheries was taken from the entire Bering Sea after the 36,000 chinook PSC limit was reached. Between March 2 and the end of the year, 20,046 chinook salmon and 684,186 mt of groundfish were taken by the pollock fisheries operating in the Bering Sea. With no change in the seasonal closure of the Chinook Salmon Savings Area, the area would have been reopened on April 16. There were approximately 6,000 chinook salmon and 220,000 mt of groundfish taken during the six weeks the closure would have been in place (March 2 – April 15).

The low 'A' season bycatch of chinook salmon would nonetheless have allowed the 36,000 PSC limit to be reached because of the high 'B' season bycatch on October 4 in 1997. The catch of chinook salmon after the PSC limit had been reached was 11,603 (23% of the total bycatch), and the total groundfish catch taken in the Bering Sea after the closure was 119,042 mt (7% of the annual catch). Of this, 11,587 chinook salmon and 66,346 mt of groundfish were taken in the pollock fisheries.

Amount taken after the PSC limit had been reached within the current chinook salmon closure area:
Table 1 provides the amount of the total bycatch and catch taken from the Chinook Salmon Savings Area, following a closure due to the PSC limits. **Figures 15 and 16** provide graphics for this section of **Table 1** for chinook bycatch and groundfish catch, respectively. In each case, the total amount taken in the closure area after the date a PSC limit would have been reached is compared to the amount taken during the whole year from the entire Bering Sea. Comparisons are also made between the amount taken from the closure area to the total amount taken from the Bering Sea during the period after the PSC limit would have been reached.

Given a PSC limit of 36,000 chinook salmon, roughly 7% (3,129 chinook salmon) of the annual total chinook were taken within the closure area after the PSC limit was triggered in 1994 (approximately 85% or 2,600 fish were taken in the pollock fisheries). This is compared to 16% (6,968 fish) of the total chinook taken from the entire Bering Sea after the PSC limit was reached (45% of the chinook were taken in the closure area and 55% outside of the closure area following the PSC limit being reached). The groundfish catch within the closure area in 1994 following PSC limit attainment was 15% (280,786 mt) of the year total compared to 56% (1,018,815 mt) taken in the entire Bering Sea following PSC limit attainment (28% of the catch following a closure was taken within the closure area, and 72% was taken outside of the closure area). Approximately 95% of the 280,786 mt of groundfish catch was taken by the pollock fisheries within the closure area.

If the current seasonal closure had been in effect, the Chinook Salmon Savings Area would have been closed for one week between April 9, 1994 when the 36,000 PSC limit was triggered and April 15, 1994 when the area would have reopened. Nearly all of the chinook salmon were taken within the closure area during this week, and approximately one-third of the groundfish catch for the week came from the closed area.

In 1996 and 1997 a much higher proportion of the chinook salmon were taken within the closure area. In 1996, 28% (17,832 chinook salmon) of the 63,179 total chinook were taken in the closure area after the 36,000 chinook PSC limit would have been reached compared to 42% taken in the entire Bering Sea (67% were taken in the closure area and 33% outside after the closure after the PSC limit was triggered). Approximately 87% (15,500 fish) of the chinook salmon taken in the closure area after the PSC limit would have been reached were from the pollock fisheries. Of the total groundfish catch taken in 1996, 19% (324,212 mt) was taken in the closure area following attainment of the proposed 36,000 chinook PSC limit compared to 65% for the entire Bering Sea (29% in the closure area and 71% outside following the PSC limit). Approximately 88% of the groundfish catch from the closure area, after attainment of the proposed 36,000 chinook PSC limit, was attributable to the pollock fisheries.

Assuming a seasonal closure of the Chinook Salmon Savings Area in 1996 with a reopening on April 16, approximately 40% (2,300 fish) of the chinook salmon and 20% (40,000 mt) of the groundfish were taken in the closure area during the six week time period beginning March 2, 1996 when a closure would have been triggered.

Similarly in 1997, 16% of the total chinook (7,845 fish) were taken in the closure area following attainment of the proposed PSC limit, and 23% had been taken in the entire Bering Sea after that PSC limit was reached (68% were taken within the closure area and 32% outside after the proposed PSC limit was reached). The groundfish catch within the closure area in 1997 represented 3% (44,128 mt) of the total catch for the year following triggering of the proposed PSC limit, and 7% was taken in the entire Bering Sea following the PSC limit being reached (37% of the catch was taken in the closure area after a closure would have been triggered, and 63% was taken outside of the closure area). Essentially all of the salmon and groundfish catch taken from the closure area during the period following the closure date were from pollock fisheries.

The 48,000 PSC limit would have been only effectively attained in 1996, and 18% (11,655 fish) of the total chinook salmon taken following attainment of that PSC limit were taken within the closure area compared to 23% (14,721 fish) taken in the entire Bering Sea after the PSC limit was reached (79% of the chinook salmon taken after the PSC limit were within the closure area and 21% outside of the closure area). Roughly 7% (114,899 mt) of the groundfish taken after the 48,000 PSC limit was reached were taken within the closure area in 1996 compared to 16% from the entire Bering Sea (42% of the catch was taken within the closure area after the PSC limit was reached, and 58% was taken outside of the closure area).

In summary, in the four years examined, the 48,000 PSC limit was reached twice (1997 at the very end of the year), and the 36,000 PSC limit was reached in three of the four years. Assuming that attainment of the PSC limit would have closed the existing Chinook Salmon Savings Area, and that no additional chinook salmon would have been taken outside of the area, a 36,000 chinook PSC limit would have reduced the total number of chinook taken by between 7% and 28% in any given year. Assuming that none of the groundfish catch would be taken outside of the closed area, a closure triggered by a 36,000 chinook PSC limit would have reduced the total groundfish catch by between 3% and 19%. In the period following a 36,000 chinook PSC limit being attained, the bycatch taken outside of the closure area has been roughly one-third to one-half that taken inside the closure, and the catch taken outside of the closure area has been roughly two-thirds to three-quarters of that taken inside the closure area.

In reality, it is likely that a closure of the Chinook Salmon Savings Area would have caused effort to be focused outside of the closure area, so that the remaining groundfish catch could be taken. However, this does not mean that the remaining groundfish would not be taken without the additional costs of search time, competition within a smaller area, possible conflicts with other gear types, or increased or disproportional burden on certain segments of the fleet. Additional chinook salmon would be expected to be taken outside of the closure area, but in most years the rate of the take should be reduced compared to the take within the closure area.

3.3.2 <u>Option 1</u>: Seasonal Allocation of Chinook Salmon Bycatch PSC limits

As discussed above, the bycatch of chinook salmon in the Bering Sea is driven by the pollock fisheries since these are the fisheries with the highest volume, highest bycatch of salmon, and greatest spatial overlap with locations of high salmon bycatch. Whereas historically more seasonally diverse, the bycatch of salmon now largely coincides with the pollock 'A' and 'B' seasons. The application of a fixed PSC limit to an entire year (calendar year, or accounting year presented below) would likely cause a closure to most impact the fishery at the end of the year. Allocation of the PSC limit by fishing season would be necessary for equity between seasons.

The seasonality of chinook salmon bycatch and the implications of changes in the timing of the 'B' season were discussed above, and the analysis is expanded in this section. Since the pelagic fishery for pollock intercepts the majority of chinook salmon, this section will focus on that fishery. **Figures 17 - 20** provide the groundfish catch and chinook salmon bycatch in the pelagic pollock fishery by week, the cumulative catch and bycatch by week, and rates by week both inside and outside of the Chinook Salmon Savings Area. The approximate dates of September 1 and October 1 are included in the graphs for reference. In the upper two graphs in each figure, the groundfish values correspond to the left axis, and the chinook bycatch values correspond to the right axis.

In 1994, the pollock 'A' season began in the third week of January and was largely completed by the first week of March (**Figure 17**). The fishery was concentrated within the Chinook Salmon Savings Area blocks, and most of the chinook salmon were intercepted within the blocks. Chinook salmon bycatch rates were similar within and outside of the savings area. During the 'B' season, which began August 15 in 1994, the majority of the groundfish effort occurred outside of the Chinook Salmon Savings Area, and at the end of the year, the total catch inside and outside of the area was similar. There was a negligible amount of chinook salmon intercepted during the 'B' season in 1994. Approximately one-half to one-third of the groundfish catch was taken prior to September 1, and all of the 'B' season catch had been taken by October 1. Rates prior to October 1 were very low, and any hauls made under a pelagic pollock target after October 1 were extremely erratic and tended to be high.

In 1995, an even greater percentage of groundfish catch was taken within the Chinook Salmon Savings Area, during the 'A' season, but as discussed above there was little bycatch of either chinook salmon or "other" salmon in 1995 (**Figure 18**). Nearly all of the chinook salmon were intercepted within the savings area. The dominance of catch outside of the savings area during the 'B' season, the amounts of groundfish catch taken prior to September 1, and the completion of the 'B' season by October 1 are patterns similar to 1994. Bycatch of chinook salmon was also very low during the 'B' season. The bycatch rates during the two main pollock fishing seasons were much lower than in 1994 with the exception of hauls made toward the end of the 'A' season or after October 1 when the rates were variable and extremely high.

In 1996, more groundfish catch was taken outside of the Chinook Salmon Savings Area during the 'A' season than in either 1994 or 1995 and by the end of the season, more catch had been taken outside of the savings area than within (**Figure 19**). In spite of higher catch being taken outside of the closure area, the high bycatch of chinook salmon occurred within the savings area. Rates were particularly high within the savings area as well during the 'A' season. The 'B' season began on September 1, and approximately one-half to two-thirds of the catch had been taken prior to October 1. High bycatch of chinook salmon continued throughout the 'B' season in 1996, particularly within the savings area, and rates were especially high after October 1.

During the 'A' season in 1997, chinook bycatch rates were relatively low and few chinook salmon were intercepted (**Figure 20**). The majority of groundfish catch was taken within the Chinook Salmon Savings Area, and the majority of chinook salmon were taken within the area as well. The 'B' season began on September 1 in 1997, and the majority of the groundfish catch was taken outside of the savings area during this season. The 'B' season ended soon after October 1 with small effort continuing within the savings area into October. The numbers of chinook salmon taken inside and outside of the savings area were similar during the month of September, but high numbers of chinook were bycaught after October 1 within the savings area as is reflected by the high bycatch rates in the end of September and into October.

The variability in chinook salmon bycatch is evident in this and the previous discussion. In fact, the past four years have demonstrated all of the possible combinations in bycatch magnitudes by season. In 1994 bycatch was high in the 'A' season but low in the 'B' season, in 1995 there was little bycatch in either season, in 1996 bycatch was high in both seasons, and in 1997 there was little bycatch in the 'A' season but very high bycatch in the 'B' season. Therefore bycatch measures, such as PSC limits, which are not seasonally allocated could cause unnecessary restrictions. Such would be the case when there was high bycatch in an 'A' season causing a closure of the savings area during the 'B' season but when the 'B' season would have experienced low bycatch rates and numbers if fishing was allowed.

There are three possible options for allocating the bycatch PSC limit between the 'A' and 'B' seasons and no recommendations have been made in the present analysis. Recent changes in the possible make-up of the seasons increases the allocation options, and only the 'A' and 'B' season scenario is discussed here. An allocation between seasons could be split evenly, since the seasonal bycatch of salmon is somewhat unpredictable and each season would need available the maximum amount of chinook salmon possible to avert a possible closure. Bycatch does tend to be higher during the 'A' season, and the 'A' season fishery is more concentrated within the Chinook Salmon Savings Area, providing justification for an increased allocation to this season. However, the 'B' season has the greater portion of pollock allocation, meaning that more chinook salmon may be necessary for this fishery to attain its portion of the TAC without closure of the savings area. Also, both the A and B seasons are spit into segments, one of which may experience greater restrictions in fishing opportunities given a closure of the savings area. During the 'B' season, the near-shore fishery is largely prosecuted within the CVOA which contains five blocks of the 9 blocks comprising the CHSSA.

The change of the 'B' season to September 1 is a likely cause for the high chinook salmon bycatch seen during the 'B' season in both 1996 and 1997. Allocation of PSC limits by season might take this change into account since it appears to have increased the probability of chinook salmon encounters during the 'B' season. The implementation of a later 'C' season may also be likely to increase chinook salmon encounters as fishing is prosecuted into October, a month of high chinook salmon bycatch.

3.3.3 Option 2: Modification of the Accounting Year for Chinook Salmon Bycatch

The current accounting of catch and bycatch toward Total Allowable Catches (TAC) and Prohibited Species PSC limits (PSC) begins January 1. Establishment of an annual PSC limit for chinook salmon based on this beginning date means that the take of salmon in the first half of the year could lead to a closure protecting salmon in the second half of the year. It is likely that this would mean that impacts on one group of salmon (one or several brood years, or cohorts) would lead to protection measures on another group of salmon. This is because it is likely that juvenile salmon (those primarily taken as bycatch) entering the Bering Sea in the autumn to feed remain throughout the winter. This group then migrates to other locations during the summer months and many enter spawning grounds the following autumn. A new cohort then enters the Bering Sea in the autumn. In order to minimize the impacts on any one group of chinook salmon, a possible accounting mechanism could be to begin the accounting year at the approximate time a new group shows up in the Bering Sea, or around September 1.

The cumulative bycatch of chinook salmon for 52 weeks beginning on September 1 (e.g. week 37) is provided in **Figure 21**. The high bycatch during the second half of 1993 and the first half of 1994 (accounting year 1993-1994) resulted in the cumulative total bycatch of approximately 57,000 chinook salmon. Similarly, a high bycatch of chinook salmon during the second half of 1997 and a moderate bycatch during the first half of 1998 (accounting year 1997-1998) resulted in a cumulative total of approximately 55,000 fish. The 1994-1995 and 1996-1997 accounting years were characterized by either a low second half of the year bycatch followed by a higher first half of the year bycatch or visa versa, resulting in a low overall bycatch levels for the accounting year. Although 1996 and 1997 were years of high bycatch, it appears that the impacts on the salmon resident in the Bering Sea during the 1996-1997 winter were relatively low.

Table 3 is similar to Table 1 in layout, with the accounting year beginning on September 1, rather than on January 1. Although summary 1993 data was available from NMFS, the 1993 observer data for the Bering Sea were not part of the four years included in the present analysis. The 48,000 chinook PSC limit was reached on February 21 in the 1997-1998 accounting season. It is evident from Figure 21 that the 48,000 PSC limit would have also been reached toward the end of March in 1993-1994, if the 1993 data were included in the present analysis. The 36,000 PSC limit was attained on the last week of the accounting year 1996-1997, on February 24 in the 1995-1996 season, and on January 31 in the 1997-1998 season. Approximately 3,518 chinook salmon (7% of the accounting year bycatch) were taken by all fisheries within the closure area after the PSC limit had been attained in the 1995-1996 season, and approximately 92,843 mt (6% of the accounting year catch from all fisheries) were taken within the closure area following attainment of the PSC limit. Observer data was not available for the 1998 data, so the proportion within the closure area could not be estimated.

In summary, an accounting year beginning September 1 would better agree with the biology of the salmon in the Bering Sea. In the four and one half years included in the analysis (four accounting years) the 48,000 PSC limit was reached in 1997-1998, and more than 48,000 chinook were taken in the 1993-1994 accounting year not included in the analysis. The impacts of a closure based on this accounting method would shift more from the 'B' season to the 'A' season pollock fishery, so that fish taken in the 'B' season would influence a closure which would be likely to take place during the 'A' season. The 'A' season also expends more effort, or depends more, on the area included within the Chinook Salmon Savings Area as discussed above.

3.4 Alternative 4:

Annual closure of specific "hot spot" blocks. These specific blocks are the five contiguous blocks of the current Chinook Salmon Savings Area that in the vicinity of Unimak Island. These have been identified in the document as 200, 201, 202, 227, 228, and 254. Block 201 has been further subdivided in half east to west and labeled as 997 (the eastern half) and 998 (the western half).

> Option 1: Consider a seasonal closure of the five blocks.
>
> Option 2 (applicable to Alternative 4 and Option 1): The closure would only apply to the pollock fisheries although chinook salmon bycaught in all federally managed groundfish fisheries would apply toward a PSC limit if in effect.

3.4.1 Analysis of "hot-spots" Areas

The initial draft of this amendment (dated April 1, 1998) included an examination of chinook salmon hotspots using NMFS observer data from 1994 – 1997. This analysis (included below) was to determine whether the hotspots identified in Amendment 21b that were based on foreign, JV and domestic hauls up to 1994 continued to be areas of high chinook salmon bycatch in more recent years. An addendum distributed at the April 1998 Council meeting included a more detailed examination of specific hotspots and included a simulated closure of selected hotspots. The addendum coded individual ½° latitude by 1° longitude blocks with identifying numbers and presented the results using these identifiers (**Figure 22**). Following presentation of this addendum, the Advisory Panel (AP) and the Council requested that the analysis be further expanded and included in the present amendment as Alternative 4. The AP and Council requested that the impacts of closing blocks 200, 227, 228, and 254 be examined and that block 201 be subdivided longitudinally. The two halves of block 201 are now identified as 997 and 998. The Council also requested that the impacts of closing only the pollock fisheries in these areas be presented and that the closures be looked at seasonally.

As had been found and presented in Amendment 21b, most chinook are bycaught during the winter months (September through April), and are consistently found in the vicinity of the horseshoe, in the two blocks north of Unimak Island, and within 15 miles of the 200 m depth contour. This was an alternative for closure proposed in Amendment 21b. Plots of all trawl hauls containing more than 25 chinook salmon during the years 1994-1997 are presented in **Figure 23**. This figure is identical to similar plots made from foreign, JV, and domestic data prior to 1994. The contour and Unimak block closure (Amendment 21b) was not viable because of the large impacts it would have on the trawl fleet. The Chum Salmon Savings Area consisted of 5 blocks to help control chum salmon bycatch. The existing 9 blocks of the CHSSA were also believed to be those blocks with the highest chinook salmon bycatch and were adopted for closure in 1995, upon attainment of a PSC limit.

3.4.2 Spatial Locations of Chinook Salmon Bycatch

In order to verify the consistency of various blocks over time within a year and across years, blocks were ranked by various bycatch-related standards. Observer data from trawl vessels in the Bering Sea during the period 1994 – 1997 were examined by week and target fishery for patterns in chinook salmon bycatch. Rather than examining points from individual hauls which can overlap (as displayed in Figure 23), the data was summarized by ½ degree latitude by 1 degree longitude squares. Because of the size of the data set (52 weeks, 4 years and 3 target fisheries), the data was further summarized into the following descriptive statistics. Blocks in each year and week were ranked according to total chinook salmon bycatch with 1 being the block with the highest bycatch for the week in a year. Blocks were further ranked by total chinook bycatch across all weeks within a year. The annual chinook bycatch rate (total chinook salmon bycatch divided by total groundfish catch) within each block was calculated as well. **Figures 24 – 27** provide the results for the pelagic trawl fishery for pollock, and **Figures 28 – 31** provide the results for the two trawl fisheries for pollock and the trawl fishery for Pacific cod combined.

Data were summarized by block for simplicity in implementation. As stated above, previous analysis of spatial patterns of chinook salmon bycatch in Amendment 21b found that chinook salmon bycatch is concentrated in the area of the "horseshoe" and along the 200 m depth contour which runs north and west from Unimak Island (see Figure 23). In Amendment 21b a high proportion of chinook salmon bycatch was found to occur within a 15 mile buffer extending to either side of the 200 m depth contour. This pattern was found to continue in the four years analyzed in this section. However, due to the difficulties in precisely defining a buffer on either side of the 200 m contour, and because of the size of the buffer area, this analysis focuses on ½ degree latitude by 1 degree longitude squares which the Council used in adopting the current Chinook Salmon Savings Area.

The number of weeks a block was ranked the highest (rank of 1) for chinook bycatch in the pelagic pollock fishery over the years 1994 – 1997 are provided in **Figure 24**. In each year the block within the Chinook Salmon Savings Area which touches the northwest corner of Unimak Island (coded as half-blocks number 997 and 998) was ranked highest for chinook salmon bycatch in the most weeks (12 weeks in 1994, 6 weeks in 1995, 14 weeks in 1996, and 9 weeks in 1997). The block north of the center of Unimak Island (coded as 228) was consistently the highest ranked block in more than one week in each year as well. There was little year-to-year consistency in the blocks outside of the "horseshoe" near Unimak Island, but the bycatch reported outside of the Chinook Salmon Savings Area in 1994 is apparent in the blocks ranked as highest for bycatch to the north and west of the Pribilof Islands.

The blocks which were ranked in the top three for bycatch in any week during 1994 – 1995 are provided in **Figure 25**. The block off of the northwest tip of Unimak Island (half-blocks 997 and 998) consistently was ranked among the top three for bycatch in more than 6 weeks a year, and the middle three blocks in the 5 contiguous blocks of the Chinook Salmon Savings Area in the vicinity of Unimak Island (half-blocks 997 and 998 and blocks 227 and 228) consistently were ranked within the top three for bycatch. A pattern outside of this area across years is difficult to determine.

The top ten and the top twenty blocks in overall rank for chinook salmon bycatch in a year are provided in **Figure 26**. Four of the five contiguous blocks in the Chinook Salmon Savings Area near Unimak Island were consistently in the top ten, and the remaining block was consistently in the top 20. One additional block in this area was consistently in the top ten as well, and this is the block which in addition to the water, covers the central portion of Unimak Island (coded as 202). Two blocks, one just north of the central block in the 5 contiguous closure blocks, and one two blocks to the south of this block were consistently in the top twenty ranking for bycatch.

Because bycatch can be a function of fishing effort, the number of chinook salmon per ton of groundfish in each block was examined as well. The dot density plot presented (**Figure 27**) has been scaled so that one dot is randomly drawn within a block for each rate of .004 chinook per mt groundfish. In other words, a square with a rate of .008 would have two dots, and a square with a rate of .04 would have 10 dots. With a few exceptions, rates were fairly evenly distributed along the shelf break in 1994. In 1995, which had relatively low chinook salmon bycatch, rates were relatively low along the shelf break, but were extremely high in the hauls which were made in the Bogoslof Is. area north of the Aleutian Islands. The years 1996 and 1997 both had relatively high bycatches of chinook salmon, and the highest rates were for the most part found in the vicinity of the "horseshoe" and Unimak Island – or the area corresponding to the CVOA (**Figure 1**).

The bycatch patterns from the two pollock and Pacific cod trawl fisheries combined are similar to those described above for pelagic pollock (**Figures 28 – 31**). The more bottom oriented trawl fisheries have added blocks with higher chinook bycatch to the shelf break to the north and west of the Pribilof Islands, and to the area to the east of the Pribilof Islands and to the north of the CVOA.

In summary, there has been consistently high bycatch within the five contiguous blocks of the Chinook Salmon Savings Area, with fairly high bycatch rates found in this area as well. An additional block which is made up mostly of land on Unimak Island (coded as 202) also consistently has high chinook salmon bycatch, as do a few blocks peripheral to these five blocks. The other two groups of two blocks each which make up the Chinook Salmon Savings Area sporadically have high chinook salmon bycatch, but can also have little bycatch. Chinook salmon are consistently taken in the vicinity of the Pribilof Islands and to the south and east of the islands, however, the specific locations from year to year do not often overlap. Similarly, the area along the shelf break to the north and east of the Pribilof Islands can have high bycatch, but there is no apparent inter-annual pattern in specific blocks.

3.4.3 Possible Impacts of Closure Areas

Any closures to protect chinook salmon will have impacts on the specific fisheries to which the closure applies by requiring movement to areas that remain open. Among the costs imposed are those due to increased travel time, prospecting or searching expenses, potentially reduced availability of target species, and increased interception of prohibited species, among other impacts. The movement of effort into adjacent or other areas can also have adverse impacts on other directed fisheries and could possibly lead to gear interactions such as when mobile gear passes through fixed-gear fisheries. The locations of the observed catcher/processor sector of the pot fishery for snow crab (C. *opilio*) are provided in **Figures 4 and 5** (provided by ADF&G staff). The fishery shifted from west and north of the Pribilof Islands, inward of the shelf break, in 1996 to east and south of the Pribilof Islands in 1997. The fishery occurs in February, and in 1997 appears to have overlapped with an area popular for pollock trawling at the same time of year. The snow crab fishery expanded to the south and east nearer Alaska Peninsula and Aleutian Island ports due to the expanded distribution of snow crab in 1997. In normal years the population is not found in quantity as far to the south.

The spillover effects, or the effects of moving the trawl fleet to an area which may experience higher bycatch of prohibited species are addressed below.

3.4.4 Effects of Closing Specific Blocks

The above analysis confirmed that blocks 200, 227, 228, 254, and 201 (split into 997 and 998) consistently had high chinook salmon bycatch and the Council requested that the impacts of closing them on an annual basis, or seasonally, be examined. An additional request was that the closure of the blocks only apply to the pollock fisheries, since these fisheries most impact chinook salmon. **Figure 32** provides an example of the permutations implied by the analysis which includes four years, three seasons, two fisheries, and seven block combinations. Each item in each level of the figure contains all of the elements in the lower levels. The data consisted of observer data collected from individual hauls during 1994-1997 with target assigned by dominant species catch. Only trawl hauls (bottom or pelagic) were included in the analysis.

A simulation was conducted which was similar in concept to that performed by the Bering Sea Bycatch Model (see Amendment 21b) in that catch by week was transferred from closed areas to all open areas in proportion to the amount of catch recorded from each open area during that week. The additional bycatch was then calculated according to the bycatch rate from each area in each week, with the additional catch applied to the bycatch rate. The areas used by the Bering Sea Bycatch Model were NMFS statistical areas, and those used in the present simulation were ½° latitude by 1° latitude or smaller blocks. The Bering Sea Bycatch Model was based on data which had been expanded from the observer data to represent the catch from all vessels fishing at all times in the entire Bering Sea. The current simulation used unexpanded observer data and differed from the Bering Sea Bycatch Model in that no prohibited species PSC limits triggered closures of directed fisheries. For instance, increased red king crab bycatch in Zone 1 would not precipitate the closure of Zone 1 with an additional reapportionment of effort in to remaining open areas from Zone 1. This is because with unexpanded catch estimates, it was not possible to ascertain when a PSC limit for a given prohibited species would have been reached. Similarly attainment of total allowable catch amounts could not be known. However, because closure of areas which generally have higher bycatch of a species were not triggered in the present simulation, many of the resulting increases (or decreases) in bycatch would tend to be over-estimates.

3.4.5 Directed Groundfish Catch and Bycatch Within Blocks

Target fisheries rely on access to the six blocks (200, 227, 228, 254, 997 and 998) to varying degrees. The percentage of total groundfish catch which was taken from all of these blocks by target fishery, gear, and year are presented in **Figure 33**. The data presented in this figure have been modified somewhat. Because target assignment is based on dominant catch, a pot catch for instance, may have one set that was predominantly pollock – a generally rare occurrence, and this would show up as pot pollock. Percentages representing very small target categories have been deleted from this graph. The figure shows that with the exception of fixed gear fisheries for Pacific cod, the six blocks are predominantly utilized by the trawl fisheries.

Pollock and Pacific cod are the primary target fisheries within the blocks. However, the other flatfish category has had between 30% and 45% of the total observed groundfish come from within the six blocks during the years 1994-1997, and rock sole has taken between 10% and 35% of its target catch from the blocks during this period. Between 47% and 70% of Pacific cod observed groundfish catch has been taken in the blocks and between 35% and 60% of bottom trawl for pollock target catch has come from the blocks. Although the percentage of catch taken from the blocks varies from year to year in most fisheries, it appears that the percentage of pelagic pollock taken from the blocks has declined from approximately 50% in 1994 and 1995 to approximately 40% in 1997.

Figures 34 - 41 provide the total groundfish catch, and bycatch of chinook and "other" salmon, halibut, herring, bairdi (Tanner) crab, opilio (snow) crab and red king crab for all trawl fisheries and trawl pollock fisheries only. The data in the figures are also categorized by year (1994-1997) and by the amount taken in each block by season. Because of expected changes in the pollock seasons, catch and bycatch are reported during the 'A' season (January-July), the 'B' season (August 1- September 15), the 'C' season (September 16 – November 1) and the remainder of the year. The total catch or bycatch taken within ("inside") all blocks and outside ("outside") of the blocks are included as well. It should be noted that blocks 997 and 998 are half the size of the other blocks.

The pollock fisheries make up a large portion of the total groundfish catch each year within the six blocks (bottom panel of **Figure 34**, labeled as "inside"), with a greater portion of other target catch being taken outside of the blocks. Approximately equal amounts of pollock are taken inside and outside of the six blocks. Within the six blocks, the block with the highest total groundfish catch was block 228, however, blocks 997 and 997 often had comparable amounts and are half the size of block 228. Overall, roughly half of the catch is taken during the 'A' season. It appears that in 1994 and 1995 more of the catch was taken during the 'B' season than during the 'C' season, but that approximately equal amounts have been taken during either season in 1996 and 1997.

Since chinook salmon are primarily intercepted in the trawl fisheries for pollock, the graph showing chinook salmon bycatch from all trawls is very similar to the chinook salmon bycatch from the pollock fisheries (**Figure 35**). The shift from chinook salmon bycatch primarily occurring during the 'A' season in 1994 and 1995 to an increasing bycatch during the 'B' and 'C' seasons is apparent in the figure. Bycatch was much higher during the 'C' season than during the 'B' season in 1996. More chinook salmon are taken within the six blocks than outside the blocks in every year (approximately twice the amount), and this is particularly true in 1996. As reported above, the blocks with consistently high bycatch are blocks 228, 997 and 998.

Similar to chinook salmon, virtually all of the "other" (primarily chum) salmon are taken by the pollock fisheries (**Figure 36**). In 1994 and 1997, approximately twice as many "other" salmon were taken outside of the six blocks than within them, and the amounts were more equal in 1995 and 1996. Almost all "other" salmon are intercepted during the 'B' season (August-September 15) with the exception of the high interception of "other" salmon within the blocks in the 1996 'C' season. Blocks 227 and 228 are part of the Chum Salmon Savings Area, and in 1996 and 1997 a large proportion of the "other"salmon taken in the six blocks were from these two blocks.

Halibut bycatch (expressed in kilograms) is fairly low in the pollock fisheries. However, although the pollock fisheries dominate the effort in the six blocks during the 'A' season, a large amount of halibut were taken by other fisheries within the blocks in every year (**Figure 37**) during this season. The amount of halibut taken within the blocks was equal to the amount taken outside in 1995, but represented approximately one third of the amount taken outside in other years. Very little halibut is taken in block 998, and the most is taken in blocks 228 and 997 (half the size of 228). Halibut is primarily taken during the 'A' season.

Herring bycatch (expressed in kilograms) was predominately during the 'B' season in 1995 and 1995, but a large amount was bycaught during the 'C' season in 1996 and 1997. A large portion was taken by the pollock fisheries (**Figure 38**). Approximately one third to one quarter of the herring is taken within the six blocks, and by far the individual block with the highest bycatch is block 998.

With the exception of bairdi crab (**Figure 39**), little (opilio, **Figure 40**) to no (red king crab, **Figure 41**) crab are taken within the six blocks. Within the blocks, bairdi crab are primarily intercepted by non-pollock fisheries in blocks 228 and 254.

3.4.6 Closure Simulation and "Spill-over" Effects

The effects on chinook salmon or other species bycatch by closing single or combined blocks was estimated by transferring effort from closed blocks to remaining open blocks. In the simulation, the catch from closed blocks in each week was transferred to open blocks according to the proportion of total groundfish catch recorded for that week in each block. Bycatch was calculated by multiplying the additional amount of groundfish transferred into an area by the bycatch rate in that block and week. The calculated bycatch rates were for all targets combined in each block and week. The bycatch in the pollock fisheries was calculated separately, and rates were based on pollock catch only.

The changes in effort which would be expected from the closures were calculated as well. The average catch per haul (catch per unit effort, or CPUE) for each week and block was calculated. The redistributed catch from closed blocks was apportioned to remaining open blocks as above and the number of hauls that would result from the increased catch was estimated for each block and week.

In the simulation, blocks were closed: 1) for the entire year, 2) for only the 'A' season (January-July), and 3) for only the 'B' season (August-December). The 'C' season was not considered as a separate closure option in this analysis. The following combinations of blocks were examined for closure: Half-block 997 alone; Half-block 998 alone; Block 997 and 998 together; Block 227 alone; Block 228 alone; Blocks 997, 998, and 200 together; Blocks 997, 998, 200, and 227 together; Blocks 997, 998, 200, 227 and 228 together; and blocks 997, 998, 200, 227, 228, and 254 together.

The results of the simulations in numbers (salmon or crab) or kilograms (herring and halibut) of bycatch are presented graphically in **Figures 42 - 55**, and as percentages in **Tables 4 and 5**. An appendix of maps has been provided (Appendix 2) showing the locations of the bycatch of the various species and the locations of directed catch. The maps can help identify the areas of high bycatch of various species and can be consulted in conjunction with the figures and tables in this section.

Figures 42 - 55 present the bycatch of various species as blocks are closed. In general, if a closure results in little change in the bycatch level, it indicates that the bycatch rates in some of the remaining open blocks are similar to that block. If the bycatch is reduced, it means that effort has been shifted into blocks with lower rates, and if the bycatch increases, the bycatch rates are higher in one or more of the open blocks. For instance, **Figure 42** provides the simulation results for the pollock fisheries alone in 1994 – 1997. When blocks 997, 227 and 228 are closed individually, there is little reduction in bycatch numbers of chinook salmon. However, when these blocks are closed in conjunction with each other or other blocks, there can be dramatic reductions in chinook salmon bycatch numbers. This indicates that the blocks have relatively high bycatch rates, and only the closure of all blocks with similar rates will result in significant bycatch reductions.

The results in **Figure 42** indicate that there was little change in chinook salmon bycatch when blocks were closed to pollock fishing during only the 'B' season, with the exception of 1997, a year in which high chinook bycatch levels occurred in the second half of the year. The closures in 1995, when chinook salmon bycatch was low, actually resulted in slight increases in chinook salmon. An annual closure of all blocks in 1995 to pollock fisheries only would have resulted in a predicted increase of 2.5% more chinook salmon (**Table 4**). In 1994, 1996, and 1997 an annual closure of all blocks for the entire year would have been expected to reduce chinook salmon bycatch numbers by 15.8%, 53.9% and 32.1% in each year, respectively. Closure of all blocks to pollock fishing during the 'A' season would have reduced chinook bycatch by 13.7% in 1994, by 33.4% in 1996 and by 3.6% in 1997. Closure of all blocks during the 'B' season would have reduced chinook bycatch by 2.1% in 1994, by 20.4% in 1996 and by 28.5% in 1997. Generally, increasing the number of closed blocks increased the savings in chinook salmon, however, the percent contribution in savings was not always similar across years. For instance, the closure of block 254 in addition to the other blocks contributed to the reduction of chinook salmon bycaught in 1995 and 1996, but resulted in increased bycatch in 1994 and 1997. Blocks reducing chinook salmon bycatch by the largest amounts were blocks 997, 998, and 228, and blocks 227 and 200 consistently added to reductions as well.

The result of closing the blocks to all trawling (upon attainment of a PSC limit) is similar to a closure of the blocks for the pollock fishery only. Marginal increased savings occur when additional fisheries are included in the simulated closures. The Pacific cod fishery is the only other fishery with significant chinook salmon bycatch (**Figure 43**). In most years, additional savings of up to approximately 10% were seen when the blocks were closed to all trawling (**Table 5**). Because of the relatively large proportion of chinook salmon taken in the Pacific cod fishery in 1995, substantial reductions in chinook bycatch occurred when block 228, or all blocks were closed to all trawling in 1995. However, this high rate of chinook salmon bycatch in the Pacific cod fishery has not been seen since 1995.

Virtually all "other" salmon are taken in the pollock fisheries, so **Figures 44** (pollock fisheries only) and **45** (all trawl fisheries) are nearly identical. Blocks 227 and 228 are included in the Chum Salmon Savings Area, and closures of these blocks resulted in reductions, or at least no increases in "other" salmon bycatch. Closure of several of the blocks lead to predicted increases in "other" salmon bycatch of by as much as 20%, depending on the block and the season. This indicates that most of the blocks have lower "other" salmon bycatch rates than blocks 227 and 228, as might be expected based on the analysis leading to the closure of the Chum Salmon Savings Area.

Relatively few halibut are taken by the pollock fisheries, however, with the exception of 1997, closure of the blocks generally resulted in increases in halibut bycatch (**Figure 46** and **Table 4**). Increases of between 5% and 12% were seen in 1994, 1995 and 1996 when all blocks were closed. On the other hand, closures of the blocks to all trawling generally resulted in predicted decreases in halibut bycatch in 1995 and 1997, slight increases in 1994 and larger increases in 1996 (**Figure 47** and **Table 5**). Halibut bycatch was predicted to decrease by about 5% when all blocks were closed to all trawling in 1995 and 1997. This would imply that the pollock fisheries catch more halibut elsewhere or encounter higher halibut bycatch rates in other blocks, and that all trawl fisheries combined experience relatively high halibut bycatch rates in the blocks with simulated closures during those years. **Figures 5 and 14 in Appendix 2** show the patterns in the bycatch of halibut in the pollock and all fisheries and indicate that the pollock fisheries encounter halibut in numbers along the shelf, whereas all fisheries combined mainly encounter halibut in the closure blocks.

The closures of various blocks were predicted to cause large reductions in herring bycatch in the pollock fisheries in 1994, small reductions in bycatch in 1997, and large increases in bycatch in 1995 and 1996 (**Figure 48**). Herring bycatch was predicted to be reduced by 14.4% in 1994, increase by 13.2% in 1995, by 24.7% in 1996 and by 0.3% in 1997 when all blocks were closed. The results are very similar when the blocks were closed to all trawling, with the exception of 1995 where no increase in bycatch was seen (**Figure 49**).

Because of low bycatch rates of crab in any of the blocks, closure of any or all of them resulted in predicted increases in the bycatch of bairdi, opilio and red king crab (**Figures 50 - 55** and **Tables 4 and 5**). Closure of all blocks to pollock fishing increased bairdi crab bycatch by between 4.1% and 25.5% (although the percentages decreased across years, probably with declines in bairdi crab stocks). Closure of all blocks to pollock fishing also increased opilio crab bycatch by between 8.4% and 32.5% and increased red king crab bycatch by between 4.7% and 61.4%. Closure of the Red King Crab Savings Area and vessel avoidance practices may be the reason for the drop in red king crab bycatch numbers outside of the blocks analyzed for closure.

Closure of the blocks to all trawling is predicted to increase bairdi crab bycatch by between 15.4% and 58.3%, increase opilio crab bycatch by between 27.2% and 50.0%, and increase red king crab bycatch by between 108.3% and 200.4% (**Table 5**). Note that although the closure of the Red King Crab Savings Area since 1995 has reduced overall red king crab bycatch numbers (**Figure 55**), the high bycatch rates in areas near the Red King Crab Savings Area would result in predicted bycatch increases.

The predicted changes in the number of hauls required to take the catch in areas outside of the closure areas are presented in **Figures 56 and 57**. An annual closure of all six blocks to pollock fisheries was predicted to increase the number of hauls necessary to take the foregone catch by 11% in 1994, 9% in 1995, 4% in 1996, and decrease the number of hauls by 3% in 1997. This indicates that in the last two years, relative catch per unit effort has become similar within and outside of the CHSSA blocks. When the six blocks are closed to all directed trawling, the number of hauls necessary to take the foregone catch increased by 9% in 1994, 13% in 1995, 2% in 1996, and decreased by 2% in 1997. The closure of individual blocks 997, 227 and 228 generally led to a reduction in the number of hauls required to take the foregone catch, while the closure of blocks 998, 200 and 254 generally resulted in a slight increase in the number of hauls.

In summary, closure of the various blocks in different combinations caused variations in the bycatch patterns in the remaining open blocks. In the pollock fisheries, with the exception of 1995 when few chinook salmon were bycaught, the closure of any combination of blocks resulted in reductions in predicted chinook salmon bycatch, with greater reductions coincident with larger total area closures (more blocks included in the closure). Closures of the areas generally caused reductions in the bycatch of herring, slight increases in the bycatch of halibut, moderate increases in "other" salmon bycatch, and large increases in crab bycatch. The blocks most similar to the area remaining open appear to be blocks 227 and 228, since closure of these blocks resulted in the smallest predicted changes in bycatch levels, with the exception of "other" salmon which these two blocks were chosen to help protect.

The closure of the blocks to all trawling further reduced the predicted levels of chinook salmon bycatch. However, because a greater amount of effort is directed into open areas, the closures to all trawling greatly increased the percentage of crab bycatch of all species but generally reduced halibut bycatch levels.

With PSC limits in place for hotspot areas, the areas analyzed above (one to six blocks) would remain open until the PSC limit had been reached, and then close for either the remainder of the year, or for the season chosen by the Council. To date, the Chinook Salmon Savings Area has not been closed by attainment of the 48,000 PSC limit. The selected blocks would be a subset of the current Chinook Salmon Savings Area, and the impacts and savings to chinook salmon would both be reduced from those presented in Alternatives 2 and 3. As is indicated by the simulated seasonal closure of blocks, the savings in salmon would be reduced compared to an annual closure. The attainment of a PSC limit prior to closure would ensure that 36,000 or 48,000 chinook salmon had already been taken, and while a triggered closure would reduce the additional amount taken, the savings would be less than those described with annual or seasonal closures above.

3.4.7 Chinook Salmon Bycatch by Target Fishery (Option 2)

Within Bering Sea trawl fisheries, chinook salmon are primarily encountered in the directed trawl fishery for pollock (**Table 2 and Figure 8**), in the last 3 years accounting for about 90% of the bycatch. The trawl fishery for Pacific cod is the only other directed fishery which takes a measurable number of chinook salmon, roughly 8-10%. The chinook salmon bycatch amounts have been fairly constant for the Pacific cod fisheries (5,000-8,000 per year) and more erratic for the pollock fishery (10,000 - 56,000) over the same time period (**Table 2**). By comparison, "other" salmon are taken almost exclusively by the pollock fisheries and there was a striking reduction in "other" salmon bycatch in 1995 as well as chinook salmon. As was the case in Amendment 21b, the focus of this analysis is on the pollock and Pacific cod trawl fisheries with an emphasis on the trawl fishery for pollock, since chinook bycatch has been very consistent in the Pacific cod trawl fishery and more erratic for the pollock fishery.

3.5 Alternative 5: (Preferred)

Alternative 5 would combine elements of Alternatives 2, 3, and 4. Specifically, the chinook salmon bycatch PSC limit would be reduced incrementally from 41,000 to 29,000 over three years beginning in the year 2000 (the phase-in schedule would be as follows: year 2000=41,000 chinook salmon; 2001=37,000; 2002=33,000; 2003=29,000). Accounting for the PSC limit would begin January 1 and continue year-round. Non-pollock fisheries would be exempt from the closure and those fisheries' chinook PSC bycatch would not be counted toward the PSC limit. This is a change from the status quo. Currently, all chinook salmon bycaught are counted towards the PSC limit. The two Pribilof blocks would be deleted from the CHSSA closure area, and block 226 would be added. In the event the PSC limit is triggered before April 15, the chinook savings areas would close immediately to pollock fishing. The closure would be removed after April 15, but would be reinitiated September 1.

Alternative 5 is a combination of Alternatives 2 through 4 with the addition of block 206 to the CHSSA and the deletion of the two blocks near the Pribilof Islands, and with the chinook PSC limit applying only to the pollock fishery. Block 226 was included because it has exhibited high bycatch rates of chinook salmon over the past few years (Figures 24 - 31).

The purpose of this action is to reduce the bycatch of chinook salmon in Bering Sea groundfish fisheries. Analysis showed that a bycatch limit of 36,000 chinook salmon would be a sizeable reduction from recent catches (50,000 - 60,000 chinook, Table 2). The pollock fishery was found to harvest the largest and most variable amount of chinook salmon of the Bering Sea fisheries. The Pacific cod fishery made up the other portion with catches in the range of 5,000 - 7,000 chinook per year. The Council's intent, therefore, was a step-wise reduction in the annual catch of chinook salmon to 36,000. The Council assumed that the Pacific cod fishery would take 7,000 chinook a year, therefore, by default, the effective pollock PSC limit would then be 29,000 chinook salmon. The Pacific cod fishery is not included in the PSC limit because the Council did not want that fishery to be subject to the closure of the CHSSA. This assumption holds true as long the Pacific cod fishery takes about the same amount of chinook salmon (or less) each year. If this sector's chinook catch increased, the Council would have to reconsider including it in the PSC limit, however, this is not expected.

3.6 Alternatives Considered and Rejected

Processing Sector Allocation of Chinook Salmon Bycatch PSC limits

The chinook salmon bycatch PSC limits can be explicitly allocated by target or processing sector. A detailed analysis of an allocation by processor mode or target is not possible because the processor mode is not consistently recorded in the observer data and because target assignment differs according to the assignment algorithm. **Table 2** summarizes chinook salmon bycatch information provided by NMFS on their web page for the years 1994 – 1998. The percentages of chinook salmon bycatch by processor in the pollock fishery, for example, may be useful in PSC limit allocation decisions. It should be noted that the number of chinook salmon intercepted in the bottom trawl for pollock target as provided in Table 2 differ greatly from the number of chinook salmon reported in the bottom trawl for pollock target based on observer data alone elsewhere in this document. This is because of the differences in algorithms used in assigning the bottom trawl and pelagic pollock targets. Recent proposed changes in pollock allocations across processing sectors would be expected to change the salmon bycatch percentages as provided in the table, and these changes should be noted when assigning chinook bycatch PSC limits according to processing sector.

3.7 Additional Considerations

There are several developments in 1998 which could have impacts on the analysis provided in this document. The proposed reductions through the American Fisheries Act in the size of the catcher/processor fleet, the reallocation of pollock total allowable catch (TAC) among the mothership, catcher/processor and shoreside sectors of the fleet, and the proposed co-op nature of portions of the fleet will all change the patterns of effort for pollock. The recent Biological Opinion (Section 7 consultation) on the fishing related impacts on Steller sea lions could also cause far-reaching changes in the distribution of pollock fishing effort. The consultation identified areas of critical habitat for Steller sea lions (Figure 1), and the NPFMC has recommended actions to reduce the fishing effort for pollock within this critical habitat. The NPFMC also recommended spreading effort out in time so that "pulse" fishing periods are reduced. The recommended periods are as follows (1) A1, beginning January 20; (2) A2, beginning February 20; (3) B, beginning August 1; and (4) C, beginning September 15 in the Bering Sea.

The analysis in this document is dependent on historical data to define the most effective measures in reducing chinook salmon bycatch. However, the changes discussed above will redistribute effort both spatially and temporally and the impacts these changes might have on chinook salmon bycatch are difficult to predict. The central blocks in the CHSSA are all located within the Stellar sea lion critical habitat, and movement of effort out of this area could be expected to reduce chinook salmon bycatch. Similarly, fishing effort in August would be unlikely to encounter chinook salmon (although "other" salmon bycatch might be expected to be higher), and would add to chinook salmon bycatch reductions. On the other hand, the beginning of the 'C' season on September 15 will likely increase the chances of chinook interceptions.

Although an analysis of all of the above changes was not possible, some information has been provided for background. As discussed in section 1.4.1, Figures 34 - 41 provide total observed catch and bycatch for several species within and outside six of the CHSSA blocks according to the newly proposed pollock seasons.

As additional information, **Tables 6 and 7** provide the total observed catch and bycatch of crab, salmon, halibut and herring in the pollock and all target fisheries as observed outside and within the Steller sea lion critical habitat-CVOA area (CH) by season. Within the pollock fisheries (**Table 6**), the total groundfish catch outside of CH increased in 1996 and 1997 (44.7% and 43.5%, respectively) as compared to 1994 and 1995 (36.8% and 32.5%, respectively). A maximum of 22.7% of the observed bycatch of chinook salmon in the pollock fisheries occurred outside of the CH (1995) and a low of 7% was taken outside of the CH in 1996. As reported above, the 'A' season bycatch of salmon within critical habitat (containing the CHSSA) was high during the period 1994-1996 (62% - 74%) but fell to 22% in 1997. In 1997, 40% of chinook salmon bycatch occurred during the 'C' season (Sept. 15 – Nov. 1).

In addition to examination of the spill-over effects (section 1.4.1) caused by individual block closures, the amount of groundfish catch that would be predicted to occur within critical habitat area following an annual closure is presented in **Table 8**. As each block or combination of blocks was closed (for the entire year), the amount of groundfish catch in the remainder of the critical habitat area was calculated, including the additional catch transferred from the closed blocks. The purpose of this analysis was to determine if there were any negative interactions between CHSSA closures and groundfish catch within Steller sea lion critical habitat. A negative impact would be if the catch within critical habitat increased due to a CHSSA closure.

The six blocks examined fall within the critical habitat boundary. The results in Table 8 are comparable to Tables 6 and 7 which tabulated the observed catch within critical habitat areas during various proposed fishing periods. The simulation results in Table 8 are based on the assumption that catch is transferred to all open blocks in proportion to the catch which was seen in the open blocks during that week. As the proportion of closed blocks (e.g. CHSSA blocks) increases within critical habitat, a greater portion of the catch is hypothesized to be taken outside of critical habitat. If all six blocks were closed to all trawl activity for the entire year, groundfish catch within critical habitat would be reduced to 48% – 57% of original levels. If all six blocks were closed to pollock fishing, catch of pollock would be reduced to 57% to 66% of original levels. We can therefore make the conclusion that catch within Steller sea lion critical habitat is likely to decrease (not increase) due to a closure of the CHSSA (whether that closure pertained to either the pollock fishery of the entire trawl fishery as a whole).

4.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES

The pollock trawl groundfish fisheries occur in the North Pacific Ocean and Bering Sea in the U.S. EEZ from 50° N to 65°N (Figures 2-9 and 2-11). These regulations affect groundfish fishing in statistical areas 509, 513, 514, 517, 518, 519, 521, 523, 541, 542, 543, 610, 620, 630, 640. Descriptions of the affected environment are given in the SEIS (NMFS 1998c). Substrate is described at section 3.1.1, water column at 3.1.3, temperature and nutrient regimes at 3.1.4, currents at 3.1.5, groundfish and their management at 3.3, marine mammals at 3.4, seabirds at 3.5, benthic infauna and epifauna at 3.6, prohibited species at 3.7, and the socioeconomic environment at 3.10. Additionally, the status of each target species category, biomass estimates, and acceptable biological catch specifications are presented both in summary and in detail in the annual GOA and BSAI stock assessment and fishery evaluation (SAFE) reports. The projections for fishing year 1999 are contained in the 1998 SAFE reports (NPFMC 1998a; 1998b.)

An environmental assessment (EA) as described by the National Environmental Policy Act (NEPA) of 1969 is used to determine whether the action considered will result in significant impact on the human environment. If the action is determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact (FONSI) will be the final environmental documents required by NEPA. If the analysis concludes that the proposal is a major Federal action significantly affecting the human environment, an environmental impact statement (EIS) must be prepared.

The environmental impacts generally associated with fishery management actions are effects resulting from (1) harvest of fish stocks which may result in changes in food availability to predators and scavengers, changes in the population structure of target fish stocks, and changes in the marine ecosystem community structure; (2) changes in the physical and biological structure of the marine environment as a result of fishing practices, e.g., effects of gear use and fish processing discards; and (3) entanglement/ entrapment of non-target organisms in active or inactive fishing gear.

An analysis of the effects of groundfish fishing on the ecosystem, social, and economic environment is contained in the FSEIS (NMFS 1998c). This analysis displays only those effects that are additional and attributable to promulgation of an FMP amendment to implement new chinook salmon PSC limitations.

4.1 Trophic interactions

The marine food-web of North Pacific marine fishes are complex (Livingston and Goiney 1983). Many species comprise the food web in the BSAI, including zooplankton and phytoplankton; a variety of molluscs, crustaceans, octopi and other invertebrates; and numerous species of demersal and pelagic fish. At the top of the food chain are humans, sharks, and over a dozen species of marine mammals. Environmental changes as well as human exploitation patterns can effect changes to trophic interactions. Fishing causes direct changes in the structure of fish communities by reducing the abundance of target or by-catch species, then these reductions may lead to responses in non-target species through changes in competitive interactions and predator prey relationships. Indirect effects of fishing on trophic interactions in marine ecosystems may also occur. Current debates on these topics include comparing relative roles of "top down" (predator) or "bottom up" (environmental and prey) control in ecosystems and the relative significance of "donor controlled" dynamics (in which victim populations influence enemy dynamics but enemies have no significant effect on victim populations) in the food webs (Jennings and Kaiser 1998.)

Fishery management measures in the proposed rule are intended to reduce stress in the North Pacific marine food-web for the primary benefit of chinook salmon. Similar effects, however, may accrue to the other ecosystem components as well. Below is an extensive explanation of predicted effects on chinook salmon followed by effects to marine mammal, seabird, forage fish species, and target fish species populations in the BSAI management area.

4.2 Impacts on Endangered or Threatened Species

The Endangered Species Act of 1973 as amended (16 U.S.C. 1531 *et seq*; ESA), provides for the conservation of endangered and threatened species of fish, wildlife, and plants. The program is administered jointly by the NMFS for most marine mammal species, marine and anadromous fish species, and marine plants species and by the USFWS for bird species, and terrestrial and freshwater wildlife and plant species.

The designation of an ESA listed species is based on the biological health of that species. The status determination is either threatened or endangered. Threatened species are those likely to become endangered in the foreseeable future [16 U.S.C. § 1532(20)]. Endangered species are those in danger of becoming extinct throughout all or a significant portion of their range [16 U.S.C. § 1532(20)]. Species can be listed as endangered without first being listed as threatened. The Secretary of Commerce, acting through NMFS, is authorized to list marine fish, plants, and mammals (except for walrus and sea otter) and anadromous fish species. The Secretary of the Interior, acting through the USFWS, is authorized to list walrus and sea otter, seabirds, terrestrial plants and wildlife, and freshwater fish and plant species.

In addition to listing species under the ESA, the critical habitat of a newly listed species must be designated concurrent with its listing to the "maximum extent prudent and determinable" [16 U.S.C. § 1533(b)(1)(A)]. The ESA defines critical habitat as those specific areas that are essential to the conservation of a listed species and that may be in need of special consideration. Federal agencies are prohibited from undertaking actions that destroy or adversely modify designated critical habitat. Some species, primarily the cetaceans, which were listed in 1969 under the Endangered Species Conservation Act and carried forward as endangered under the ESA, have not received critical habitat designations.

Federal agencies have an affirmative mandate to conserve listed species (Rohlf 1989). One assurance of this is Federal actions, activities or authorizations (hereafter referred to as Federal action) must be in compliance with the provisions of the ESA. Section 7 of the Act provides a mechanism for consultation by the Federal action agency with the appropriate expert agency (NMFS or USFWS). Informal consultations, resulting in letters of concurrence, are conducted for Federal actions that have no adverse affects on the listed species. Formal consultations, resulting in biological opinions, are conducted for Federal actions that may have an adverse affect on the listed species. Through the biological opinion, a determination is made as to whether the proposed action poses "jeopardy" or "no jeopardy" of extinction to the listed species. If the determination is that the action proposed (or ongoing) will cause jeopardy, reasonable and prudent alternatives may be suggested which, if implemented, would modify the action to no longer pose the jeopardy of extinction to the listed species. These reasonable and prudent alternatives must be incorporated into the Federal action if it is to proceed. A biological opinion with the conclusion of no jeopardy may contain a series of management measures intended to further reduce the negative impacts to the listed species. These management alternatives are advisory to the action agency [50 CFR. 402.24(j)]. If a likelihood exists of any taking occurring during promulgation of the action, an incidental take statement may be appended to a biological opinion to provide for the amount of take that is expected to occur from normal promulgation of the action. An incidental take statement is not the equivalent of a permit to take.

Fourteen species occurring in the GOA and/or BSAI groundfish management areas are currently listed as endangered or threatened under the ESA. The group includes seven great whales, one pinniped, three Pacific salmon, two seabirds, and one albatross.

Listed Species. The following species are currently listed as endangered or threatened under the ESA and occur in the GOA and/or BSAI groundfish management areas.

Common Name	Scientific Name	ESA Status
Northern Right Whale	*Balaena glacialis*	Endangered
Bowhead Whale [1]	*Balaena mysticetus*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Megaptera novaeangliae*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Snake River Sockeye Salmon	*Onchorynchus nerka*	Endangered
Short-tailed Albatross	*Phoebaotria albatrus*	Endangered
Steller Sea Lion	*Eumetopias jubatus*	Endangered and Threatened [2]
Snake River Fall Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Snake River Spring/Summer Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Puget Sound Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Lower Columbia River Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Upper Willamette River Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Upper Columbia River Spring Chinook Salmon	*Onchorynchus tshawytscha*	Endangered
Upper Columbia River Steelhead	*Onchorynchus mykiss*	Endangered
Snake River Basin Steelhead	*Onchorynchus mykiss*	Threatened
Lower Columbia River Steelhead	*Onchorynchus mykiss*	Threatened
Upper Willamette River Steelhead	*Onchorynchus mykiss*	Threatened
Middle Columbia River Steelhead	*Onchorynchus mykiss*	Threatened
Spectacled Eider	*Somateria fishcheri*	Threatened
Steller Eider	*Polysticta stelleri*	Threatened

[1] The bowhead whale is present in the Bering Sea area only.
[2] Steller sea lion are listed as endangered west of Cape Suckling and threatened east of Cape Suckling.

In summary, species listed under the ESA are present in the action area and, as detailed below, some may be negatively affected by groundfish fishing. NMFS is the expert agency for ESA listed marine mammals. The USFWS is the expert agency for ESA listed seabirds. The proposed action, promulgation of an FMP amendment to implement a reduction in the chinook salmon bycatch limit must be in compliance with the ESA.

Section 7 consultations have been done for all the above listed species, some individually and some as groups. See the FSEIS, section 3.8, for summaries of all previous section 7 consultations and Biological Opinions (NMFS 1998a). None of the alternatives considered for this rule are expected to have an impact on endangered, threatened, or candidate species other than chinook salmon. The purpose of this rule is to implement reductions in the take of chinook salmon in the BSAI. To the extent to which this purpose is achieved, this action will benefit rather than harm chinook salmon.

4.2.1 Endangered Cetaceans

NMFS concluded a formal section 7 consultation on the effects of the BSAI and GOA groundfish fisheries on endangered cetaceans within the BSAI and GOA on December 14, 1979, and April 19, 1991, respectively. These opinions concluded that the fisheries are unlikely to jeopardize the continued existence or recovery of endangered whales. Consideration of the bowhead whale as one of the listed species present within the area of the Bering Sea fishery was not recognized in the 1979 opinion, however, its range and status are not known to have changed. No new information exists that would cause NMFS to alter the conclusion of the 1979 or 1991 opinions. NMFS has no plan to reopen Section 7 consultations on the listed cetaceans during the 1998 Total Allowable Catch specification process. Of note, however, are observations of Northern Right Whales during

Bering Sea stock assessment cruises in the summer of 1997 (NMFS per. com). Prior to these sightings, and one observation of a group of two whales in 1996, confirmed sightings had not occurred.

4.2.2 Steller Sea Lion

The Steller sea lion range extends from California and associated waters to Alaska, including the Gulf of Alaska and Aleutian Islands, into the Bering Sea and North Pacific and into Russian waters and territory. In 1990, the species was listed as threatened under the Endangered Species Act (60 FR 51968). In 1997, NMFS reclassified Steller sea lions as two distinct populations (62 FR 24345). The population west of 144EW. longitude (a line near Cape Suckling, Alaska) was changed to endangered status; the remainder of the U.S. Steller sea lion population is still listed as threatened.

In 1993, NMFS designated critical habitat for the Steller sea lion (58 FR 45278). The designation was based on the Recovery Team's determination of habitat sites essential to reproduction, rest, refuge, and feeding. Listed critical habitats in Alaska include all rookeries, major haul-outs, and specific aquatic foraging habitats of the BSAI and GOA. No changes in critical habitat designation were made as result of the 1997 re-listing.

Beginning in 1990 when Steller sea lions were first listed under the ESA, NMFS determined that both groundfish fisheries may adversely affect Steller sea lions, and therefore conducted Section 7 consultations on the overall fisheries (NMFS 1991), and subsequent changes in the fisheries. These consultations and recommendations, and actions resulting from them, are listed in section 3.8.3 of the 1998 SEIS (NMFS 1998).

The first Biological Opinion (BiOp) was for the action authorizing the pollock and Atka mackerel fisheries for the years 1999 through 2002. It was issued December 3, 1998, by the Office of Protected Resources of NMFS. The scope of the consultation was the Atka mackerel fishery of the BSAI, and the pollock fisheries in the BSAI and the GOA. The BiOp concluded that the Atka mackerel fishery was not likely to jeopardize the continued existence of the western population of Steller sea lions or adversely modify its critical habitat. However, the BiOp also concluded that both of the pollock fisheries, as they had been proposed in 1998, were likely to cause jeopardy to Steller sea lions and adverse modification of designated Steller sea lion critical habitat. This determination was based primarily on the premise that the two pollock fisheries would compete with Steller sea lions by removing prey items from important foraging areas at crucial times of the year.

To avoid the likelihood of causing jeopardy and adverse modification, NMFS developed a framework of reasonable and prudent alternatives (RPAs) based on three objectives: (1) temporally disperse fishing effort, (2) spatially disperse fishing effort, and (3) provide full protection from fisheries competition in waters adjacent to rookeries and important haulouts. The RPAs contained guidelines for management measures which would achieve these principles. The Council initially provided recommendations for management measures at its December 1998 meeting. NMFS evaluated those recommendations and incorporated them into the RPAs on December 16, 1998. The RPAs were implemented by emergency interim rule for the first half of 1999, published on January 22, 1999 (64 FR 3437), amended on February 17, 1999 (64 FR 7814) and February 25, 1999 (64 FR 9375). The Council met again in February, April, and June 1999, to consider recommendations for extending the emergency rule for the second half of 1999, and at its June meeting, voted to extend the emergency rule (with modifications to the Bering Sea B and C seasons) until December 31, 1999 (July 21, 1999, 64 FR 39087; technical amendment August 10, 1999, 64 FR 43297).

The December 3, 1998, BiOp was challenged in the United States District Court for the Western District of Washington by Greenpeace, the American Oceans Campaign, and the Sierra Club. On July 9, 1999, (amended July 13, 1999), the Court upheld the no-jeopardy conclusion for the Atka mackerel fishery and the jeopardy conclusion for the pollock fisheries. However, the Court also found that "the Reasonable and Prudent Alternatives . . . were arbitrary and capricious . . . because they were not justified under the prevailing legal standards and because the record does not support a finding that they were reasonably likely to avoid jeopardy." On August 6, 1999, the Court remanded the BiOp back to NMFS for further analysis and explanation.

To comply with the Court's Order, NMFS conducted additional analyses and considered recommendations from the Council to develop Revised Final Reasonable and Prudent Alternatives (RFRPAs) (October 1999). NMFS intends to initiate rulemaking to implement these conservation measures for the year 2000 and beyond.

Given a closure of the CHSSA, the practical effect of this action would be positive for Steller sea lions as outlined in the RFRPAs. The reason for this is that the most significant closure area, the region with the highest salmon bycatch rates, is found within the Steller sea lion conservation area (formerly referred to as the combined critical habitat/catcher vessel operation area). The main objective of the RFRPAs is to reduce pollock harvests within the critical habitat areas, therefore any action that helps to accomplish this goal further supports the RFRPAs. Since the major part of the CHSSA is within the conservation area, and a closure would force pollock fishing to be reduced in this area, it is likely that this action is beneficial to Steller sea lions as outlined in the RFRPAs.

4.2.3 Pacific Salmon

No species of Pacific salmon originating from freshwater habitat in Alaska are listed under the ESA. These listed species originate in freshwater habitat in the headwaters of the Columbia (Snake) River. During ocean migration to the Pacific marine waters a small (undetermined) portion of the stock go into the Gulf of Alaska as far east as the Aleutian Islands. In that habitat they are mixed with hundreds to thousands of other stocks originating from the Columbia River, British Columbia, Alaska, and Asia. The listed fish are not visually distinguishable from the other, unlisted, stocks. Mortal take of them in the chinook salmon bycatch portion of the fisheries is assumed based on sketchy abundance, timing, and migration pattern information.

NMFS designated critical habitat in 1992 (57 FR 57051) for the for the Snake River sockeye, Snake River spring/summer chinook, and Snake River fall chinook salmon. The designations did not include any marine waters, therefore, does not include any of the habitat where the groundfish fisheries are promulgated.

NMFS has issued two biological opinions and no-jeopardy determinations for listed Pacific salmon in the Alaska groundfish fisheries (NMFS 1994, NMFS 1995). Conservation measures were recommended to reduce salmon bycatch and improve the level of information about the salmon bycatch. The no jeopardy determination was based on the assumption that if total salmon bycatch is controlled, the impacts to listed salmon are also controlled. The incidental take statement appended to the second biological opinion allowed for take of one Snake River fall chinook and zero take of either Snake River spring/summer chinook or Snake River sockeye, per year. As explained above, it is not technically possible to know if any have been taken. Compliance with the biological opinion is stated in terms of limiting salmon bycatch per year to under 55,000 and 40,000 for chinook salmon, and 200 and 100 sockeye salmon in the BSAI and GOA fisheries, respectively.

Since the date of the last biological opinion 8 new salmon or salmonid species originating in the Pacific Northwest have been listed under the ESA (see ESA listed species above).

4.2.4 Short-tailed Albatross

The entire world population in 1995 was estimated as 800 birds; 350 adults breed on two small islands near Japan. The population is growing but is still critically endangered because of its small size and restricted breeding range. Past observations indicate that older short-tailed albatrosses are present in Alaska primarily during the summer and fall months along the shelf break from the Alaska Peninsula to the Gulf of Alaska, although 1- and 2-year old juveniles may be present at other times of the year (FWS 1993). Consequently, these albatrosses generally would be exposed to fishery interactions most often during the summer and fall--during the latter part of the second and the whole of the third fishing quarters.

Short-tailed albatrosses reported caught in the longline fishery include two in 1995, one in October 1996, and none so far in 1997. Both 1995 birds were caught in the vicinity of Unimak Pass and were taken outside the observers' statistical samples.

Formal consultation on the effects of the groundfish fisheries on the short-tailed albatross under the jurisdiction of the FWS concluded that BSAI and GOA groundfish fisheries would adversely affect the short-tailed albatross and would result in the incidental take of up to two birds per year, but would not jeopardize the continued existence of that species (FWS 1989). Subsequent consultations for changes to the fishery that might affect the short-tailed albatross also concluded no jeopardy (FWS 1995, FWS 1997). The US Fish and Wildlife Service does not intend to renew consultation for the 1998 Total Allowable Catch specification process.

4.2.5 Spectacled Eider

These sea ducks feed on benthic mollusks and crustaceans taken in shallow marine waters or on pelagic crustaceans. The marine range for spectacled eider is not known, although Dau and Kitchinski (1977) review evidence that they winter near the pack ice in the northern Bering Sea. Spectacled eider are rarely seen in U.S. waters except in August through September when they molt in northeast Norton Sound and in migration near St. Lawrence Island. The lack of observations in U.S. waters suggests that, if not confined to sea ice polyneas, they likely winter near the Russian coast (FWS 1993). Although the species is noted as occurring in the GOA and BSAI management areas no evidence that they interact with these groundfish fisheries exists.

4.2.6 Conditions for Reinitiation of Consultation

For all ESA listed species, consultation must be reinitiated if: the amount or extent of taking specified in the Incidental Take Statement is exceeded, new information reveals effects of the action that may affect listed species in a way not previously considered, the action is subsequently modified in a manner that causes an effect to listed species that was not considered in the biological opinion, or a new species is listed or critical habitat is designated that may be affected by the action.

4.2.7 Impacts of the Alternatives on Endangered or Threatened Species

Further control of chinook salmon bycatch in BSAI trawl fisheries proposed under Alternatives 2 and 3 would not affect the prosecution of the groundfish fisheries of the BSAI in a way not previously considered in the above consultations. None of the alternatives would affect overall TAC amounts or takes of listed species. The option to reduce chinook salmon PSC limits may have a very minor positive impact on marine mammals utilizing salmon as prey, but it is extremely small relative to the total available forage of this species off Alaska. Therefore, none of the alternatives are expected to have a significant impact on endangered, threatened, or candidate species.

4.3 Impacts on Marine Mammals

Marine mammals not listed under the ESA that may be present in the BSAI include cetaceans, [minke whale (*Balaenoptera acutorostrata*), killer whale (*Orcinus orca*), Dall's porpoise *(Phocoenoides dalli*), harbor porpoise (*Phocoena phocoena*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), and the beaked whales (e.g., *Berardius bairdii* and *Mesoplodon spp.*)] as well as pinnipeds [northern fur seals (*Callorhinus ursinus*), and Pacific harbor seals (*Phoca vitulina*)] and the sea otter (*Enhydra lutris*).

None of the alternatives would affect takes of marine mammals. Actions taken to control salmon bycatch will not alter the harvest amount of groundfish. Therefore, none of the alternatives are expected to have a significant impact on marine mammals.

4.4 Coastal Zone Management Act

Implementation of the preferred alternative would be conducted in a manner consistent, to the maximum extent practicable, with the Alaska Coastal Management Program within the meaning of Section 30(c)(1) of the Coastal Zone Management Act of 1972 and its implementing regulations.

4.5 Impacts on Essential Fish Habitat (EFH)

The new mandate in the Magnuson-Stevens Act to identify, conserve, and enhance EFH grew out of the recognition that managing fisheries by dealing with individual species in isolation is not sufficient to maintain sustainable fisheries. It is also necessary to study the interactions of species and their habitat needs, and to manage the fisheries in such a way as to maintain a healthy ecosystem.

The Magnuson-Stevens Act requires that Federal agencies consult with the Secretary of Commerce with respect to any action "authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act" (Section 305(b)(2)). EFH is defined under the Act as the waters and substrate necessary to fish for spawning, breeding, feeding, growth, and growth to maturity. For species managed under the three FMPs pertaining to the Gulf of Alaska, EFH is described and identified in three amendments approved January 20, 1999. These are: Amendment 55 to the FMP for Groundfish of the Bering Sea and Aleutian Islands area, Amendment 5 to the FMP for Scallop Fisheries off Alaska, and Amendment 5 to the FMP for the Salmon Fisheries in the EEZ off the Coast of Alaska.

According to the habitat descriptions in these amendments, the CHSSA contains EFH for most of the species managed under these FMPs. A variety of species use the area for all of the purposes included in the Magnuson-Stevens Act definition–for breeding, feeding, and growth to maturity.

Commercial fishing has many effects on EFH for commercial and non-commercial species. It removes large amounts of biomass, thus changing the size and sex structure of the target species as well as changing species composition and therefore predator-prey ratios. Changes in the ecosystem due to cyclical changes in oceanic temperature can have strong effects on the ecosystem which may need to be counterbalanced by a cautionary approach to the fishery (NPFMC 1998). Different types of fishing gear impact EFH in various ways. A discussion of the impacts trawl gear is contained below.

Trawling

Although numerous studies on the effects of trawling have taken place in the eastern and western Atlantic, the North Sea, and around Australia and New Zealand–some of the conclusions of which could be applicable to the Bering Sea–until recently such studies had not taken place in the northern Pacific Ocean. Since 1996, however, the Alaska Fisheries Science Center (AFSC) has been conducting research to remedy this gap. Studies of trawl impacts are ongoing in the Gulf of Alaska, the eastern Bering Sea and the Aleutian Islands area. A summary of these research efforts can be found in the "Ecosystem Considerations for 1999" chapter of the 1999 SAFE (NPFMC 1999).

The study most pertinent to this EA was conducted by Freese et. al (1998). It was designed to find acute changes to habitat and the benthic community caused by trawling, and did not look at recovery of damaged organisms or delayed mortality of apparently undamaged organisms (such as study is contemplated).

The AFSC study examined past trawling activity by the domestic commercial fishing fleet and videotapes taken from a submersible in 1992 and 1994. The authors compared trawled areas to non-trawled areas. They found that in the trawled areas, even after a single pass, a significant number of boulders were displaced, and emergent epifauna were removed or damaged. They found significant damage to sponges and anthozoans in the trawled areas, and to one motile invertebrate, the brittlestar (*A ponderosa*). The density of sponges and anthozoans was lower in the trawled areas but the density of motile invertebrates was similar. As they expected, the authors noted an increase in the density of scavenging organisms in the trawl tracks.

The AFSC study is consistent with studies in other areas, as its authors point out in their introduction. In their review of 20 other studies, they found a common theme: mobile fishing gear reduces habitat complexity in three basic ways: (1) the trawl gear removes emergent epifauna; (2) it smooths sedimentary bedforms; and (3) it removes taxa that produce structure. Naturally, these effects vary according to the type of bottom, ocean currents, species mix, etc.

4.6 FINDING OF NO SIGNIFICANT IMPACT

This Environmental Assessment tiers off the SEIS (NMFS 1998c) and the 1999 Groundfish Total Allowable Catch Specification EA (NMFS 1999b).

For the reasons discussed above, implementation of the preferred Alternative to reduce chinook salmon bycatch in the BSAI would not significantly affect the quality of the human environment. Therefore, the preparation of an environmental impact statement is not required by section 102(2)(C) of NEPA or its implementing regulations.

Penelope D. Dalton   2/2/00

Assistant Administrator for Fisheries, NOAA   Date

5.0 REGULATORY IMPACT REVIEW: ECONOMIC AND SOCIOECONOMIC IMPACTS OF THE ALTERNATIVES

This section provides information about the economic and socioeconomic impacts of the alternatives including identification of the individuals or groups that may be affected by the action, the nature of these impacts, quantification of the economic impacts if possible, and discussion of the trade offs between benefits and costs, both qualitative and quantitative.

The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following statement from the order:

> In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environment, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

E. O. 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant." A "significant regulatory action" is one that is likely to:

> (1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;
>
> (2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
>
> (3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
>
> (4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

A regulatory program is "economically significant" if it is likely to result in the effects described above. The RIR is designed to provide information to determine whether the proposed regulation is likely to be "economically significant."

The primary economic and socioeconomic impacts of the alternatives under consideration in the proposed action include the effects of the chinook salmon bycatch management program on the BSAI trawl fisheries, including those employed in the harvesting, processing, and various marketing sectors, and the communities which support them, and as well as those people, businesses, and communities dependent on chinook salmon.

The origins of chinook salmon caught in BSAI trawl fisheries were described in Section 1.5 and 1.6. In summary, a large proportion of chinook salmon taken as bycatch in the BSAI is believed to originate from Western Alaska. If these salmon were not caught as bycatch in the BSAI trawl fisheries, some proportion of them would return to Western Alaska and would contribute to escapement and to subsistence, recreational, and commercial fisheries. All three fisheries contribute significantly to the economies and cultural life of Western Alaska communities.

Annual chinook salmon harvest levels are projected by ADF&G to remain stable for the next 3 years, between 600,000 and 700,000 chinook salmon, state wide.

Average 1998 ex-vessel price per pound for chinook salmon (as reported by ADF&G, 1999)

Region	Price per Pound	Pounds of Fish Total	Total Ex-vessel Value
Bristol Bay	$0.50	2,270,000	$1,140,000
AK Peninsula/Aleutian Is.	$0.47	170,000	$80,000
Kuskokwim	$0.27	630,000	$170,000
Yukon	$2.47	790,000	$1,920,000

5.0.1 *Estimating the Value of Chinook Savings*

For a number of reasons, it is very difficult to extrapolate from a projected reduction in bycatch of chinook salmon in the BSAI trawl fisheries, to a dollar benefit accruing to salmon fishermen, communities, or non-commercial (e.g., subsistence) users, who might subsequently capture these "saved" fish. First, there are very limited data on the true "source of origin" of many of the chinook bycaught in groundfish fisheries. While approximately half are assumed to originate in Western Alaska rivers, the source of the other half remains uncertain. Therefore, attributing the loss of any given fish, or portion of the bycatch, to a particular region or user group is problematic, at best. Second, all these salmon are immature when bycaught. That implies that, had they not been intercepted in the trawl fisheries, some would have succumbed to natural mortality and not recruited into a directed fishery, in any event. Counting their loss as a "costs" of bycatch would tend to *overstate* the potential savings of a bycatch reduction. On the other hand, some of these fish lost to trawl bycatch would likely have survived the additional year(s) at sea, avoided the nets and hooks of the target salmon fisheries, and escaped to spawn, and thus contribute to future runs of chinook salmon. The valuation of these fish, on the basis of the "average" bycatch loss, will tend to *understate* the potential savings of a given reduction in bycatch interceptions.

Acknowledging these complications and limitations, it may, nonetheless, be useful to provide a gross estimate of the potential economic value, attributable to changes in chinook salmon bycatch totals in the BSAI groundfish trawl fisheries. If one makes several simplifying assumptions, a crude estimate of gross ex vessel value can be derived. Assume that each chinook salmon (on average) weighs 15 pounds at the time it recruits into a terminal area target fishery. Assume further that the average price per pound (in real dollars), at ex vessel, is $0.50 (see table above).[1] In this case, each additional chinook salmon (avoided as bycatch, which survives to enter the target fishery) would be worth $7.50, at ex vessel. In 1998, approximately 59,336 chinook salmon were bycaught in all BSAI trawl fisheries. Under the limiting assumptions cited above, the potential ex vessel value of these fish was roughly $445,000.00. While a crude first approximation, this is likely a lower-bound estimate of their true potential value, since some would have been taken by subsistence uses, and some may have contributed to recreational harvests (both with potentially higher use values than that estimated for commercial ex vessel). All would have produced secondary economic impacts through the businesses (e.g., processors, guide services, fishing supply firms, etc.) and communities which support those who harvest chinook.

Finally, as noted, only about half of the chinook salmon bycaught in the BSAI are believed to originate from Western Alaska stocks (see section 1.5). This further complicates any estimate of the aggregate potential benefit which might accrue, from a reduction in bycatch, especially to the extent that some of these fish derive from non-U.S. sources. This is so because, under the guidelines for assessing economic impacts from proposed

Federal regulatory action, changes in "consumers' surpluses" or "producers' surpluses" attributable to a proposed action, which accrue to non-U.S. interests, are not counted in the net impact assessment. Therefore, chinook bycatch savings in the BSAI trawl fisheries, which result in increases in fishery recruitment and/or escapement to Asian (or even British Columbia) stocks, would not be regarded as "benefits" under this accounting formula. For the purposes of this RIR analysis, however, we will make the simplifying assumption that all chinook salmon are from Western Alaska stocks.

5.1 Alternative 1: Status Quo (No Action)

Retention of Alternative 1 would result in the continued counting of chinook bycatches from all target fisheries, beginning with each new calendar year, against the current 48,000 bycatch cap. When bycatches reach 48,000 chinook, this alternative would trigger chinook salmon area closures, but only until April 15. After April 15, these areas would re-open and would remain open regardless of subsequent chinook salmon bycatch amounts. The only reductions or limitations in chinook bycatch that may occur under this alternative would be those resulting from voluntary actions taken by fishermen, and thus, could not be assured.

Alternative 1 would result in adverse economic and socioeconomic impacts to Western Alaska if increases in chinook salmon bycatch, in the future, resulted in reduced returns to Western Alaska. Similar results would likely accrue to areas and users of non-Western Alaska chinook stocks, but very little is known about those stocks and, by extension, those user impacts. Historical catch amounts of chinook salmon are described in Section 1.3, which indicate that the 48,000 chinook PSC limit was significantly exceeded in each year since 1996. Every incitation is that, if the status quo option is retained, the bycatch limit will continue to be exceeded each year.

Given the Council's stated objectives for this action, there does not appear to be any attributable net benefit associated with retention of the Status Quo alternative. That is, while retention of the status quo might largely eliminate potential adjustment costs to BSAI groundfish trawlers, specifically associated with any of the alternatives addressed below, the adverse impacts attributable to a "No Action" decision would almost certainly exceed any such potential operating cost savings. Furthermore, retention of the status quo does not necessarily preclude the imposition of all operational adjustment costs to groundfish trawlers, since area closures will still occur when the existing 48,000 chinook bycatch limit is attained (albeit, over a more limited period of time).

5.2 Alternative 2:

Include salmon taken after April 15 towards the bycatch limit of 48,000 chinook salmon. The Chinook Salmon Savings Areas would close upon attainment of the bycatch limit whenever this would occur. Hence, these areas could close, or remained closed, during later pollock seasons.

The potential bycatch and operational effects on the BSAI groundfish fishery of Alternative 2 are described in section 3.2. The most obvious outcome of adopting this alternative (given previous year's catch analysis) is that the CHSSA would likely close only late each year, during the B or C pollock seasons, or possibly not at all in some years. Closures could be more likely, given recent, unrelated, Steller sea lion conservation measures and American Fisheries Act provisions, which have temporally redistributed the pollock fishing seasons, pushing fishing effort into later parts of the year (periods which have historically had high bycatch rates of chinook salmon).

However, the CHSSA is relied upon to a lesser degree, in the aggregate, by groundfish fishermen in the B and C seasons, primarily because catcher/processor vessels and motherships engaged in directed fishing for pollock are prohibited from fishing within this area during the B and C seasons (i.e., the CVOA which encompasses block 3 of the CHSSA (see figure 1) is off-limits to C/Ps and motherships in the pollock B and C seasons). Catcher vessels fishing for pollock and other vessels fishing for other groundfish species (e.g., P. cod) do rely upon the CVOA area in the Fall season. Under the AFA provisions the catcher vessel fleet is given 50% of the pollock TAC. However, provisions to be implemented in 2000 to protect Steller sea lions under ESA mandated processes will greatly limit the amount of pollock that can be removed from the CVOA during the B and C seasons. It is likely that this amount will be approximately 10-15% of the annual TAC. This change in fishing area is discussed in detail in the EA for the Steller sea lion conservation rule to be implemented before the start of the 2000 fishery. Under these changing conditions, it is truly unknown what affect a closure in the B or C season would have on the catcher/processor sector, but we can say that it will be much less than what would have occurred in previous years because the effort will be required to be dispersed outside the CVOA (and therefore outside of block 3 of the CHSSA) which in effect would simulate a partial closure of the CHSSA without the PSC limit ever being reached. We can postulate therefore, that the effects of these other regulatory changes are likely to alter chinook salmon bycatch patterns, and in this particular case are likely to reduce chinook salmon bycatch within block 3 of the CHSSA during the B and C seasons. It is also likely that the catcher vessel sector will form cooperatives in the 2000 fishing season. This will assist the industry in absorbing these new restrictions by allowing slower fishing, higher yields, and better products due to the elimination of the "race for fish" which did not allow for the maximization of quality and therefore profits. These co-op vessels would then have a greater ability to choose where they fished when they wanted to fish, and would allow them the flexibility to stop fishing (or change areas) when encountering high chinook salmon bycatch.

It is difficult to predict how many salmon would actually be saved under this alternative. For example, there is no assurance that a substantial number of chinook salmon will not be bycaught elsewhere, in areas outside the CHSSA, after a closure. The number of chinook salmon saved by closing the CHSSA after reaching a 48,000 PSC limit could be as many as, perhaps, 10,000 or as few as 2,000, given recent annual bycatch amounts. The gross ex vessel value of this potential salmon bycatch savings may, on the basis of the simplifying assumptions cited above, be between $15,000 and $75,000, annually (see section 5.0.1).

The BSAI trawl fishing sector would not be expected to forego significant directed groundfish catch as a result of adoption of this alternative. Nonetheless, these operations would be expected to incur increased costs, in the form of reduced CPUE, greater transit time and expense, as well as, cost associated with operating in unfamiliar (or, at the very least, 'second-best') fishing grounds. In the latter case, additional costs may result from increased 'prospecting' time, or gear losses/damage attributable to operating in unaccustomed locations and conditions.

For some segments of the industry, it might be the case that their continued participation in the fishery, during the period following the closure, would be jeopardized. For example, if the closure forced a relocation to areas too distant, or into periods of extreme sea and weather conditions, smaller operators and/or those dependent upon onshore processors, might be significantly disadvantage. In such a circumstance, the share of the total groundfish harvest normally taken by this segment of the industry might be forfeited to larger, more mobile operations, if the smaller, less mobile vessels cannot operate effectively outside of the CHSSA. Since the total groundfish TAC would still be expected to be harvested, these impacts would be largely distributional in nature.

It is extremely difficult to predict these costs given the variability of fishermen's behavior. However, one might reasonably assume that costs imposed by this alternative could be at least of the magnitude of the aforementioned "potential gains" in saved chinook salmon. On this basis, it would appear that Alternative 2 does not clearly benefit either the commercial groundfish fishery or those groups who directly harvest chinook salmon.

5.3 Alternative 3:

Reduce the PSC limit from 48,000 to 36,000 chinook salmon in the BSAI. Trawling would be prohibited in the Chinook Salmon Savings Areas through April 15 upon attainment of a bycatch limit of 36,000 chinook salmon in the BSAI.

To place this alternative in context, under the current PSC limit of 48,000 chinook salmon, a closure would have been triggered at the very end of the season in 1997 (with only 1 chinook salmon and 34,560 mt, or approximately 2% of the total year catch from all BSAI groundfish fisheries, taken after the predicted closure). A 48,000 chinook salmon PSC limit would have been reached on September 28, 1996, with 14,721 chinook salmon (23% of the year catch) and 276,842 mt of groundfish (16% of that year's groundfish catch) taken after this date in BSAI fisheries.
Had Alternative 3 been in place during these periods, with its required reduction in the PSC limit from 48,000 to 36,000 chinook salmon, a closure would have been triggered during the 'A' season in 1994 and 1996 (April 9 and March 2, respectively), and during the 'B' season in 1997 (October 4). No closure would have been triggered in 1995, under this rule.

In 1994, after the projected closure date, 26,521 chinook salmon (42% of the year total, taken primarily in the pollock 'B' season), and 65% (1.106 million mt) of the total groundfish catch was taken from the BSAI. The majority of these 26,521 chinook salmon may have been avoided by the groundfish trawl fishery, once a closure had been implemented and fishing activity was moved out of areas with traditional concentrations of chinook. While this is the expectation, it is by no means certain that this would have been the outcome. As bycacth data suggest, the timing and location of bycacth interception is extremely variable. Assuming a bycatch savings of the entire 26,521 chinook could be realized under this alternative, the estimated potential ex vessel value of these fish would have been about $198,900, when recruited into terminal fisheries in the following year (see section 5.0.1).

However, the CHSSA would have been reopened on April 16. Therefore, it is likely that not all of these fish would have been avoided during the balance of the groundfish fishing year. In 1996, after March 2 (the time of the closure had this alternative been in place), 20,046 chinook salmon and 684,186 mt of groundfish were taken by the pollock fisheries operating in the Bering Sea. There were approximately 6,000 chinook salmon and 220,000 mt of groundfish taken during the six weeks between March 2 and April 15 (the interval over which the closure would have been in place). If the actual 'realized' bycatch savings attributable to this action were nearer this total, the estimated value of these 6,000 chinook salmon might be approximately $45,000 (given all the caveats cited above).

Following a closure under the proposed Alternative 3, groundfish fishing effort would have been forced outside the CHSSA. Given that fishermen voluntarily chose to fish inside the CHSSA, during this time period under the status quo, one would expect that a closure would have imposed a range of operating costs and adjustments, similar to those discussed under Alternative 2, immediately above.

Had Alternative 3 been in place, these impacts may, in fact, have been somewhat greater in magnitude, than under Alternative 2, because of the substantially earlier occurrence of the closure. Indeed, for the pollock fishery, the A season produces the highest unit value catch and is the period of greatest fishing intensity within this area of the Bering Sea. Therefore, a closure during the A season would have had a proportionally greater adverse economic impact than a similar closure later in the fishing year. Simultaneously, the A season (which typically takes place during the January- late March or early April period) often coincides with the most extreme sea, ice, and weather conditions confronted by the fishery. (Note: the pollock fishery is closed from October 31 through January 19.) Thus, a closure of these "relatively" nearer shore fishing areas could have had an even greater disproportionate impact on smaller, less mobile, and/or inshore processor-linked operations.

Based upon historical catch and bycatch data for the BSAI groundfish fisheries, it appears that between 30,000 and40,000 chinook salmon would likely be bycaught before April 15, in a typical fishing year. On this basis, one could predict that it would be a relatively rare event to attain a PSC limit of 36,000 (as proposed under this alternative) early enough in the year (i.e., before April 15) to significantly reduce bycatch of chinook salmon.

As in the above example, this PSC limit was reached on April 9 and March 2 in two recent years. Had the "proposed" cap been in place in 1996 an estimated 20,046 chinook salmon would have been caught after the closure and of those, only 6,000 were caught before April 15 (about 30% of the post- April 15 catch). One could hypothesize that the 6,000 chinook salmon (with an approximate $45,000 ex vessel value) would have been available for users of the chinook resource (other than BSAI groundfish fisheries) in subsequent years. However, after April 15 (re-opening of the CHSSA), the BSAI fisheries would have been expected to intercepted a further 14,000 chinook salmon, amounting to a value of $105,000, even with the proposed cap and closure.

The actual effects of choosing this alternative would likely be very limited given historical bycatch patterns and the proposed limit and dates those limits would apply to a closure. This alternative is very similar to the status quo as a reduction in the PSC limit, with the status quo closure dates, would not effectively change current fishing patterns, although, it could have some unanticipated "distributional" effects on the trawl industry, itself.

5.4 Alternative 4

The purpose for Alternative 4 was to look at the effects of closing individual blocks that are already within block 3 (as referenced in figure 1) of the CHSSA. On its own this alternative would not be practicable as it is better described as a sub-option of Alternative 5 because its intended purpose was to analyze the possibility of using different areas for block 3 of the CHSSA. This area has shown the greatest amount of chinook salmon bycatch and is an area of intense fishing activity especially by the catcher vessel fleet. Analysis (see section 3.4) showed that these six blocks were necessary for closures to be effective, as they all exhibit similar bycatch rates. Closing any one cell would merely push fishing into a near-bye block with similar rates, resulting in similar total bycatch of chinook salmon. Therefore, for purposes of this RIR, this alternatives is described in detail under Alternative 5.

5.5 Alternatives 5

Under Alternative 5, the chinook salmon PSC limit would be reduced incrementally to 29,000 salmon. However, this limit would only apply to the BSAI pollock fishery (i.e., other groundfish fisheries would be exempt from the limit, closures, and chinook bycatch accounting toward the limit).

The Council's assumption is that the Pacific cod fishery will intercept no more than 7,000 chinook salmon annually. Their historic pattern has been about 3,000 to 7,000 chinook salmon. The overall goal for the proposed action was a reduction of total chinook salmon bycatch to 36,000 (e.g., 29,000 in the pollock fishery and 7,000 in the Pacific cod fishery). These two fisheries account for about 99% of the annual catch of chinook salmon (Table 2). Closure of the CHSSA, due to the attainment of the limit, would be effective from January 1 through April 15, and again from September 1 through December 31. These time periods were chosen for this alternative because this is the period when the bycatch rates of chinook salmon are highest. The summer has historically been a time of very low chinook salmon bycatch.

The pollock fishery has historically accounted for 15,341 to 55,170 (1995 and 1998, respectively) chinook salmon bycaught annually in the BSAI. Given a PSC limit of 29,000 chinook salmon, set exclusively for the pollock fishery, the number of salmon possibly avoided (in the pollock fishery) if the closures were 100% effective, could be anything from 0 and 26,170 (with a potential ex vessel value of $0 to $196,275; using the valuation method in section 5.0.1). The value of these chinook to recreational and subsistence users would likely be in excess of this amount, but cannot be estimated at this time.

Because the proposed PSC reduction and closures, under Alternative 5, would only apply to the pollock fishery, no other fisheries would incur direct costs associated with adoption this alternative. There may be indirect impacts which cannot, as yet, be predicted, although they should not be substantial (or, presumably, they would have emerged in the course of this assessment). However, there may be foregone catch of pollock due to closures of the CHSSA in the B and C seasons. As noted above, this is unlikely given the reduced dependence upon this area in these seasons (CVOA closure to catcher/processors and distribution of stock outside the CVOA in B and C seasons). Closures would only limit the area that these vessels could fish, it would not close the fishery. Therefore, it is unlikely pollock TAC would remain unharvested.

The most likely outcome is that pollock vessels would suffer reduced CPUE. As noted above, it is extremely difficult to predict the economic burden on these vessels due to a decrease in CPUE. However, given a possible savings of $196,275 worth of chinook salmon, we would expect that this would either outweigh or greatly reduce the overall economic burden to the Nation, of closing the CHSSA in the B and C seasons (if a limit were reached). Once again, there may be unanticipated "distributional" impacts, within the pollock fishing and processing sectors, attributable to adoption of this alternative. The nature of these distributional impacts was treated above, although the actual magnitude of such potential effects is an empirical question.

5.6 Administrative, Enforcement and Information Costs

Under any of the alternatives, other than Status Quo, additional Coast Guard aircraft and cutter resources will be needed to enforce the proposed alternatives. Alternative 4, option 2 would have the highest impact, as it would require a Coast Guard boarding to confirm the targeted fishery, and thus a cutter presence in the area would be required. Either cutters or aircraft could enforce all other alternatives. The Coast Guard would most likely redirect resources from existing domestic fishery enforcement activities, on as "as available" basis. Thus, there would be no attributable additional direct enforcement cost associated with adoption of any of the alternatives.

6.0 INITIAL REGULATORY FLEXIBILITY ANALYSIS (IRFA)

The Regulatory Flexibility Act requires preparation of an IRFA unless the agency certifies that the proposed rule is not expected to have a significant economic impact on a substantial number of small entities. The central focus of the IRFA should be on the economic impacts of a regulation on small entities and on the alternatives that might minimize the impacts and still accomplish the statutory objectives. To ensure a broad consideration of impacts and alternatives, NMFS has prepared an IRFA pursuant to 5 USC 603, without first making the threshold determination of whether or not this proposed action would have a significant economic impact on small entities.

6.1 Requirement to Prepare an IRFA

The level of detail and sophistication of the analysis should reflect the significance of the impact on small entities. Under 5 U.S.C., Section 603(b) of the RFA, each IRFA is required to address:

- A description of the reasons why action by the agency is being considered;
- A succinct statement of the objectives of, and the legal basis for, the proposed rule;
- A description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply (including a profile of the industry divided into industry segments, if appropriate);
- A description of the projected reporting, record keeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record;
- An identification, to the extent practicable, of all relevant Federal rules that may duplicate, overlap or conflict with the proposed rule;
- A description of any significant alternatives to the proposed rule that accomplish the stated objectives of the Magnuson-Stevens Act and any other applicable statutes and that would minimize any significant economic impact of the proposed rule on small entities. Consistent with the stated objectives of applicable statutes, the analysis shall discuss significant alternatives, such as:

    1. The establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities;
    2. The clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;
    3. The use of performance rather than design standards;
    4. An exemption from coverage of the rule, or any part thereof, for such small entities.

6.2 What is a "small entity"?

The RFA recognizes and defines three kinds of small entities: (1) small businesses, (2) small non-profit organizations, and (3) and small government jurisdictions.

6.2.1 Small businesses

Section 601(3) of the RFA defines a "small business" as having the same meaning as "small business concern" which is defined under Section 3 of the Small Business Act. "Small business" or "small business concern" includes any firm that is independently owned and operated and not dominate in its field of operation. The SBA has further defined a "small business concern" as one "organized for profit, with a place of business located in the United States, and which operates primarily within the United States or which makes a significant contribution to the U.S. economy through payment of taxes or use of American products, materials or labor...A small business concern may be in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that where the form is a joint venture there can be no more than 49% participation by foreign business entities in the joint venture."

The SBA has established size criteria for all major industry sectors in the US including fish harvesting and fish processing businesses. A business involved in fish harvesting is a small business if it is independently owned and operated and not dominant in its field of operation (including its affiliates) and if it has combined annual receipts not in excess of $ 3 million for all its affiliated operations worldwide. A seafood processor is a small business if it is independently owned and operated, not dominant in its field of operation, and employs 500 or less persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide. A business involved in both the harvesting and processing of seafood products is a small business if it meets the $3 million criterion for fish harvesting operations. Finally a wholesale business servicing the fishing industry is a small businesses if it employs 100 or less persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide.

The SBA has established "principles of affiliation" to determine whether a business concern is "independently owned and operated." In general, business concerns are affiliates of each other when one concern controls or has the power to control the other, or a third party controls or has the power to control both. The SBA considers factors such as ownership, management, previous relationships with or ties to another concern, and contractual relationships, in determining whether affiliation exists. Individuals or firms that have identical or substantially identical business or economic interests, such as family members, persons with common investments, or firms that are economically dependent through contractual or other relationships, are treated as one party with such interests aggregated when measuring the size of the concern in question. The SBA counts the receipts or employees of the concern whose size is at issue and those of all its domestic and foreign affiliates, regardless of whether the affiliates are organized for profit, in determining the concern's size. However, business concerns owned and controlled by Indian Tribes, Alaska Regional or Village Corporations organized pursuant to the Alaska Native Claims Settlement Act (43 U.S.C. 1601), Native Hawaiian Organizations, or Community Development Corporations authorized by 42 U.S.C. 9805 are not considered affiliates of such entities, or with other concerns owned by these entities solely because of their common ownership.

Affiliation may be based on stock ownership when (1) A person is an affiliate of a concern if the person owns or controls, or has the power to control 50% or more of its voting stock, or a block of stock which affords control because it is large compared to other outstanding blocks of stock, or (2) If two or more persons each owns, controls or has the power to control less than 50% of the voting stock of a concern, with minority holdings that are equal or approximately equal in size, but the aggregate of these minority holdings is large as compared with any other stock holding, each such person is presumed to be an affiliate of the concern.

Affiliation may be based on common management or joint venture arrangements. Affiliation arises where one or more officers, directors or general partners controls the board of directors and/or the management of another concern. Parties to a joint venture also may be affiliates. A contractor and subcontractor are treated as joint venturers if the ostensible subcontractor will perform primary and vital requirements of a contract or if the prime contractor is unusually reliant upon the ostensible subcontractor. All requirements of the contract are considered in reviewing such relationship, including contract management, technical responsibilities, and the percentage of subcontracted work.

6.2.2 Small organizations

The RFA defines "small organizations" as any not-for-profit enterprise that is independently owned and operated and is not dominant in its field.

6.2.3 Small governmental jurisdictions

The RFA defines small governmental jurisdictions as governments of cities, counties, towns, townships, villages, school districts, or special districts with populations of less than 50,000.

6.3 Reason for considering the proposed action

The purpose and intent of the chinook salmon management action, under consideration herein, were treated at length in Section 3.0 of the Regulatory Impact Review. A detailed description of the problem that underlies the proposed action, and the actions objectives, is contained in Section 1.0 of this combined EA/RIR/IRFA document.

6.4 Number and description of affected small entities

The following series of subsections enumerate, to the extent practicable, the number and nature of the "small entities" which comprise the commercial sectors, not-for-profit organizations, and governmental jurisdictions and communities which depend directly or indirectly upon the groundfish (and especially pollock) fisheries of the Bering Sea. Taken as a whole, these "entities" define the "directly regulated" (and therefore, potentially impacted) universe for purposes of the IRFA.

6.4.1 Small entities in the BSAI pollock fishery affected under the preferred alternative (Alternative 5)

While available data on ownership and affiliation patterns in the 1999 BSAI pollock fishery are not sufficiently detailed to discern whether each individual business concern meets the definition of "small entity," data available from the sector profiles prepared for the Inshore/Offshore-3 FMP Amendment and the NMFS Economic SAFE document do allow some general conclusions to be drawn concerning the number of small entities present in recent years in each component of the industry. These general conclusions are displayed in the table below.

While these data reflect the 1996-1997 fishing years, they are believed to be a reasonable description of the several operational sectors, with respect to RFA size criteria. AFA provisions, adopted January 1, 1999, reduced the *total* number of "entities" which are authorized to participate in the BSAI management area pollock fisheries in the future, below those reflected in the table below. However, none of the remaining vessels or processing operations, authorized to participate in these fisheries under AFA, would be expected to have been reclassified <u>from</u> the "large" to the "small" RFA categories. That is, if an operation was classified as "large" (for IRFA purposes) prior to AFA, it is highly unlikely that it would now meet the RFA "small entities" criteria. The reverse is not necessarily the case, however.

Estimated numbers and types of entities participating in the BSAI pollock fishery.

Industry component or type of entity	*Small*	*Large*	*Total*
Inshore sector			
Inshore processors	0	8	8
Catcher boats < 125' LOA	37	15	52
Catcher boats ≥ 125' LOA	2	15	17
Offshore sector			
"True" motherships	0	3	3
Catcher/processors	0	22	22
Catcher boats < 125' LOA	21	5	26
Catcher boats ≥ 125' LOA	2	0	2
Vessels delivering to both sectors			
Catcher boats < 125' LOA	1	13	14
Catcher boats ≥ 125' LOA	0	8	8
CDQ groups (not-for-profit)	6	0	6
Government jurisdictions	60	1	61

Source: 1996-97 NMFS Blend and ADF&G Fish ticket data

6.4.1.1 Inshore pollock processors

Four of the 8 inshore processors operating in the BSAI pollock fishery are either wholly owned subsidiaries or close affiliates of Japanese multi-national corporations. Due to their affiliation with large foreign entities with more than 500 employees worldwide, none of these processors is a small entity. Of the remaining 4 inshore processors, 3 are owned by U.S. companies that employ more than 500 persons in all their affiliated operations, and therefore cannot be considered small entities. The remaining inshore processor has been identified as closely affiliated with its 5 delivering catcher boats and the gross annual receipts of the affiliated entities, taken together (the processor and its 5 affiliated catcher boats), exceed the $3 million criterion for fish harvesting operations.. Therefore, none of the inshore processors in the BSAI pollock fishery appear to meet the RFA criteria for small entities.

6.4.1.2 Pollock catcher boats

There were 119 catcher boats active in the BSAI pollock target fisheries, altogether: Sixty-nine operated in the inshore sector exclusively, 28 operate in the offshore sector exclusively, and 22 operated in both sectors. (This latter pattern of dual-sector activity is limited under AFA. Specifically, catcher vessels delivering to C/Ps are precluded, under AFA, from delivering pollock to any other processing sector, in the future).

Of the 91 catcher boats that operated exclusively or partly in the inshore sector, the available ownership data identify 26 vessels owned, in whole or in part, by inshore processors. These 26 vessels may be considered to be affiliated with their respective inshore processor owners and cannot therefore be considered small entities, because none of the inshore processors in the BSAI pollock fishery, themselves, are small entities for RFA purposes. An additional 5 catcher boats have been identified as closely affiliated with an inshore floating processor. These 5 catcher boats, taken together with their affiliated processor, exceed the $3 million criterion for fish harvesting operations and are therefore not believed to be small entities. Furthermore, an additional 20 catcher boats have ownership affiliations with other catcher boats or catcher/processors. The gross annual receipts of each of these groups of affiliated catcher boats is believed to exceed the $3 million criterion for small entities, when all their fisheries earnings are taken as a whole.

The remaining 40 catcher boats operating exclusively or partly in the inshore sector are believed to qualify as "small entities." As earlier suggested, the number of catcher vessels which will be permitted to participate in future inshore pollock target fisheries in the Bering Sea management area is smaller than the totals identified above owing to provisions of the AFA. In the initial 1999 A1 and A2 pollock fisheries in the Bering Sea, it is estimated that approximately 53 catcher vessels participated in the harvest of the inshore pollock allocation. In subsequent 1999 Bering Sea pollock openings, additional catcher vessels may choose to enter the fishery, since as many as 106 appear to be "eligible" under AFA criteria.

Twenty eight catcher boats operated in the offshore sector exclusively, while 22 operated in both sectors, for a total of 50 offshore catcher boats. (As noted, this multi-sector operational pattern is precluded in the future for the seven boats affiliated with the C/P fleet, by provisions of the AFA.) Of the combined at-sea catcher boat sector, 13 have ownership affiliations with large inshore or offshore processors and, therefore, do not meet the $3 million criterion for small entities. An additional 13 catcher boats have ownership affiliations with other vessels or operations that, taken together with their affiliated entities, are believed to exceed the $3 million gross receipts criterion for small entities. The remaining 24 catcher boats operating exclusively or partly in the offshore sector are believed to qualify as "small entities." The number of catcher vessels which will be permitted to participate in future Bering Sea pollock target fisheries is restricted to a slightly smaller total by provisions of the AFA.

The provisions of the AFA which permit establishment of operational cooperatives in all three processing sectors (i.e., catcher/processor, mothership, and inshore) beginning in 2000 could result in there being no small entities (as defined under RFA) participating in the harvesting and processing of the pollock TAC. This may be so, because fishing sector cooperatives, by definition, coordinate and prosecute the fishery as an integrated organization, sharing information, risk, and (presumably) profits among the "affiliated" members of the co-op. Under such circumstances, it is improbable that any of the co-ops would meet the RFA "small entities" criteria, and through "affiliate" status, neither would the individual cooperative members.

6.4.1.3 "True" motherships

Three "true" motherships operate in the offshore sector. All three "true" motherships have ownership or business affiliations with large Japanese-owned processing companies, and are further affiliated with some of their delivering catcher boats. Taken together with their affiliated entities, none of the "true" motherships meet the criteria for small entities.

6.4.1.4 Pollock catcher processors

For an offshore catcher processor to qualify as a small entity, it must be independently owned and operated, have no more than 49% foreign ownership, and have gross annual receipts of less than $3 million. None of the offshore catcher processors operating in the BSAI pollock fishery appear to meet the criteria for small entities, i.e., none qualify as "small entities." The number of catcher processors authorized to participate in future Bering Sea pollock target fisheries has been reduced to 20, under provisions of the AFA.

6.4.1.5 Small not-for-profit organizations

The Community Development Quota (CDQ) program was implemented in December 1992, as part of the original BSAI Inshore/Offshore FMP amendment. The CDQ program has made it possible for both individuals from western Alaska villages and the CDQ groups (which were formed to facilitate administration of the program) to participate directly in the commercial fisheries occurring in the adjacent Bering Sea and Aleutian Islands management areas. The six CDQ groups participating in the BSAI pollock fishery, comprised of 56 western Alaska Native villages, are the only small not-for-profit organizations that have been identified as potentially directly affected by the Steller sea lion RPA alternatives under consideration by this action.

6.4.1.6 Small governmental jurisdictions

Fifty-six CDQ communities and four Alaska non-CDQ communities (Unalaska/Dutch Harbor, Sand Point, King Cove, and Kodiak) are identified as small governmental jurisdictions with direct involvement in and dependence on the BSAI pollock fishery. The remaining government jurisdiction with direct involvement in the BSAI pollock fishery, Seattle, Washington, does not qualify as a small governmental jurisdiction.

6.5 Adverse economic impacts on small entities

After reviewing the alternatives and suboptions analyzed in "environmental assessment" and "regulatory impact review" sections of this document, several conclusions may be drawn concerning the potential differential impacts of this suite of RPA actions on "small entities" in the Bering Sea and Aleutian Islands management areas. These are summarized in the following sections.

6.5.1 Impacts on catcher boats

The only small businesses that participate directly in the BSAI pollock fishery are independent catcher boats. All other business entities (catcher/processors, motherships, shoreside processors, and processor affiliated catcher boats) participating in the BSAI pollock fishery are categorized as "large" entities, on the basis of the RFA criteria.

Historically, independent catcher boats have participated in both the inshore and offshore sectors of the BSAI pollock fishery, and would be expected to do so under provisions of the AFA. However, it is anticipated that most, if not all, of the catcher vessels will form cooperative agreements in the 2000 pollock fishery (under AFA). Therefore, we would then consider these vessel co-ops, assuming they meet the appropriate qualifications, as large entities. At this time, there is no way of knowing how many vessels will co-op or what earnings these cooperatives are likely to generate. It is certainly likely that most will co-op, and that most co-ops would be considered as large entities. Under this scenario, any impact of this action on small entities would be very small, although we are unable to quantify what that impact may be without knowledge of the co-op structure which has not been determined at this time.

On the basis of the pre-AFA fisheries data (which represent the "best available" quantifiable statistics, at present) of the 50 independent catcher boats estimated to be "small entities" in the BSAI, 46 are under 125' and 4 are 125' or larger. The estimated number of catcher boats that participated in the 1996 pollock fishery by sector, vessel size, and "small" or "large" entity status are displayed in the table below

Estimated number of catcher boats that participated in the BSAI pollock fishery by sector, vessel size, and "small" or "large" entity status.

Catcher boat size and sector	*Small entities*		*Large entities*	
	< 125'	*≥ 125'*	*< 125'*	*≥ 125'*
Inshore sector	37	2	15	15
Offshore sector	21	2	5	0
Both sectors	1	0	13	8
Total	59	4	33	23

Source: NMFS Blend and ADF&G Fish Ticket data, 1996-97.

Under AFA, only seven catcher boats are authorized to participate in the C/P "over-the-side" pollock harvest and only 21 are authorized to support true motherships. A "fixed" (but as yet not completely defined) number are authorized to deliver to inshore processors in the BSAI management area (preliminary estimates place this number at ninety-two).

Comparing the preliminary 1999 participation data with the table above suggests that, for the A1 and A2 BS openings, a total of 26 catcher vessels supported the C/P and true mothership sectors, the majority of these would be expected to be "small entities," for IRFA purposes.

Any adverse economic effects of the preferred alternative are likely to be limited for this sector. Because this sector can fish within the CVOA during the B and C seasons, a closure of the CHSSA would affect them, in ways which were enumerated in the RIR discussion of the preferred alternative. However, there still would be significant area within the CVOA that would remain open to this sector following a closure of the CHSSA. While there may be some, as yet unmeasurable, impacts from the proposed action, none are expected to significantly adversely impact a substantial number of small entities, as those terms are defined for RFA purposes. Unfortunately, while that is the expectation, given the information currently available, it is not possible to quantitatively certify this outcome.

6.5.2 Impacts on processors

All of the C/Ps, motherships, and inshore processors in the BSAI management area qualify as "large" entities, under RFA criteria.

Provisions of the proposed chinook salmon action could result in adverse impacts, in the form of changes in operating periods or duration of openings, changes in product mix and quality, availability of raw material and/or quality of fish delivered, and market or price effects. There is no reason to conclude, however, that these impacts would accrue disproportionally to the small processors.

6.5.3 Impacts on small organizations

The only entities directly associated with the pollock target fisheries which meet the strict RFA standards for inclusion as "small organizations" are the Community Development Quota (CDQ) groups. The Alaska CDQ program was designed to provide an avenue of entry into the BSAI management area pollock harvesting and processing sectors for groups of communities adjacent to, but with no prior history of participation in, these economically important fisheries. Established in 1991, the program established six "not-for-profit" CDQ groups. These include: (1) the Aleutian Pribilof Island Community Development Association [comprised of six communities]; (2) the Bristol Bay Economic Development Corporation [comprised of 13 communities]; (3) the Norton Sound Economic Development Corporation [comprised of 15 communities]; (4) the Yukon Delta

Fisheries Development Association [representing 4 communities]; (5) the Central Bering Sea Fisherman's Association [representing a single community]; and (6) the Coastal Villages Region Fund [comprised of 17 communities].

Based upon the EA and RIR analyses, reported above, there would be expected to be no measurable adverse economic effects from the proposed management action accruing to small entities, as that term is defined under RFA. However, empirical data are insufficient to support a rigorous quantitative examination of this issue and, therefore, the agency is not able to "certify" this outcome.

6.5.4 Impacts on small governmental jurisdictions

The chinook salmon proposed bycatch limitations are not expected to result in substantial reductions in total pollock catch from a given management area, as a result of spatial, temporal, or exclusionary dispersion of the target fishery. However, some change in pollock target harvest patterns seems probable, especially if the PSC limit is attained and the CHSSA closes during the pollock fishing season. The size and scope of likely impacts on the principal pollock-dependent communities, adjacent to the eastern Bering Sea and Aleutian Islands management areas, will vary directly with the magnitude of these changes and may be appropriately attributable to the proposed chinook salmon regulatory alternatives. Our ability to measure, or even qualitatively characterize, these effects are extremely limited. As the chinook bycatch data suggest, inter-seasonal and inter-annual interception patterns are highly variable. While expectations are that any attributable adverse impact to this category of small entities would be minor, a "factual basis", upon which to certify this finding, cannot be offered.

6.6 Reporting and record keeping requirements

The proposed chinook salmon action contains no new or revised record keeping or reporting requirements. Therefore, there are no attributable costs or burdens to cite.

6.7 Other relevant Federal regulations

There are no other pending Federal regulations, which can be identified, which would have undesirable interactions with the proposed action.

6.8 Alternatives which minimize impacts on small entities

The Council's preferred alternative specifically targets the pollock fishery which is composed primarily of large entities and which historically has been responsible for the vast majority of chinook salmon bycatch in the BSAI. All other fisheries in the BSAI, many of which have a higher number and percentage of small entity participation, are exempt from the chinook salmon PSC limit and any trawling prohibitions that might result from attainment of a PSC limit, under the preferred alternative. Chinook salmon bycaught in non-pollock fisheries, also would not be counted toward the cap under the preferred alternative, which reduces the potential for behavior of non-pollock fisheries to adversely impact (small) pollock operations. NMFS is not aware of any other alternatives which would minimize impacts on small entities, while achieving the objectives of this action.

7.0 REFERENCES

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10.0 LIST OF TABLES

Table 1. Comparison of historic total chinook salmon bycatch and dates with bycatch caps set at 48,000 fish on an annual basis, and 36,000 on an annual basis. Accounting beginning on January 1 and continuing to December 31.

Total trawl groundfish catch and chinook salmon bycatch as reported by NMFS.

YEAR	Chinook salmon bycatch (in numbers of fish)
1994	43,693
1995	23,080
1996	63,179
1997	50,218

YEAR	Total trawl groundfish catch (in metric tons)
1994	1,829,470
1995	1,779,575
1996	1,698,575
1997	1,852,167

Caps of 36,000 and 48,000 chinook in place for entire year.

Dates closure would have been triggered.

YEAR	36,000 chinook cap	48,000 chinook cap
1994	4/8/94	na
1995	na	na
1996	3/2/96	9/28/96
1997	10/4/97	10/18/97

Amount taken after the cap had been reached - entire Bering Sea.

YEAR	Chinook salmon 36,000 chinook cap		48,000 chinook cap	
1994	6,968	16%	-	0%
1995	-	0%	-	0%
1996	26,521	42%	14,721	23%
1997	11,603	23%	1	0%

YEAR	Total groundfish catch 36,000 chinook cap		48,000 chinook cap	
1994	1,018,815	56%	-	0%
1995	-	0%	-	0%
1996	1,106,048	65%	276,842	16%
1997	119,042	7%	34,560	2%

Percent = amount after cap / total catch

Amount taken after the cap had been reached within the current chinook salmon closure area.

YEAR	Chinook salmon 36,000 chinook cap		48,000 chinook cap	
1994	3,129	7%	-	0%
1995	-	0%	-	0%
1996	17,832	28%	11,655	18%
1997	7,845	16%	-	0%

YEAR	Total groundfish catch 36,000 chinook cap		48,000 chinook cap	
1994	280,788	15%	-	0%
1995	-	0%	-	0%
1996	324,212	19%	114,899	7%
1997	44,128	3%	-	0%

Percent = amount in closure after cap / total catch

After trigger was reached - the percentage of chinook taken within the chinook closure area.

YEAR	Chinook salmon 36,000 chinook cap	48,000 chinook cap
1994	45%	na
1995	na	na
1996	67%	79%
1997	68%	0%

YEAR	Total groundfish catch 36,000 chinook cap	48,000 chinook cap
1994	28%	na
1995	na	na
1996	29%	42%
1997	37%	0%

Percent = amount in closure after cap / total amount after cap

Table 2. Estimated catch of chinook salmon as reported by NMFS by target fishery and processing mode for the years 1994 – 1998. Percentages of the year total are provided.

Total number of chinook salmon by target and mode

1998	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel			414	414
Bottom Pollock	189	398	416	1,003
Pacific cod	903	923	1,368	3,194
Flatfish			0	0
Rockfish			0	0
Flathead sole			398	398
Pelagic pollock	29,797	13,239	11,131	54,167
Rocksole			5	5
Sablefish	0		0	0
Greenland turbot			0	0
Arrowtooth flounder			1	1
Yellowfin sole	1	0	105	106
Total	30,889	14,559	13,840	59,288

1997	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel			184	184
Bottom Pollock	172	470	411	1,054
Pacific cod	2,036	1,837	1,417	5,290
Flatfish			0	0
Rockfish			71	71
Flathead sole			0	0
0			0	0
Pelagic pollock	27,222	6,970	9,239	43,430
Rocksole		0	84	84
Greenland turbot			0	0
Arrowtooth flounder			0	0
Yellowfin sole	0	0	43	43
Total	29,430	8,277	11,509	50,216

1996	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel			481	481
Bottom Pollock	507	1,509	3,169	5,185
Pacific cod	1,953	2,777	1,317	6,047
Flatfish			1	1
Rockfish			439	439
Flathead sole			0	0
Pelagic pollock	24,726	10,294	15,417	50,438
Rocksole		0	501	501
Sablefish			0	0
Greenland turbot			0	0
Arrowtooth flounder			0	0
Yellowfin sole	0	23	9	32
Total	27,186	14,603	21,334	63,124

1995	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel			10	10
Bottom Pollock	152	137	4,414	4,703
Pacific cod	2,142	1,510	3,355	7,006
Flatfish		0	0	0
Rockfish			168	168
Flathead sole			128	128
Pelagic pollock	3,253	1,475	5,910	10,638
Rocksole		265	161	426
Sablefish			0	0
Greenland turbot	0	0	0	0
Arrowtooth flounder			0	0
Yellowfin sole	0	0	0	0
Total	5,547	3,387	14,147	23,080

1994	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel			2,140	2,140
Bottom Pollock	18	216	1,831	2,065
Pacific cod	3,852	170	3,157	7,179
Flatfish			669	669
Rockfish			118	118
Pelagic pollock	9,786	2,178	19,107	31,071
Rocksole		0	341	341
Sablefish	0		0	0
Greenland turbot	4		54	58
Yellowfin sole	40	0	13	53
Total	13,700	2,584	27,430	43,694

Percent of annual total

	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel	0.00%	0.00%	0.70%	0.70%
Bottom Pollock	0.32%	0.67%	0.70%	1.69%
Pacific cod	1.52%	1.56%	2.31%	5.39%
Flatfish	0.00%	0.00%	0.00%	0.00%
Rockfish	0.00%	0.00%	0.00%	0.00%
Flathead sole	0.00%	0.00%	0.67%	0.67%
Pelagic pollock	50.28%	22.33%	18.78%	91.38%
Rocksole	0.00%	0.00%	0.01%	0.01%
Sablefish	0.00%	0.00%	0.00%	0.00%
Greenland turbot	0.00%	0.00%	0.00%	0.00%
Arrowtooth flounder	0.00%	0.00%	0.00%	0.00%
Yellowfin sole	0.00%	0.00%	0.18%	0.18%
Total	52.10%	24.56%	23.34%	100.00%

	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel	0.00%	0.00%	0.37%	0.37%
Bottom Pollock	0.34%	0.94%	0.82%	2.10%
Pacific cod	4.06%	3.66%	2.82%	10.53%
Flatfish	0.00%	0.00%	0.00%	0.00%
Rockfish	0.00%	0.00%	0.14%	0.14%
Flathead sole	0.00%	0.00%	0.00%	0.00%
0	0.00%	0.00%	0.00%	0.00%
Pelagic pollock	54.21%	13.88%	18.52%	86.61%
Rocksole	0.00%	0.00%	0.17%	0.17%
Greenland turbot	0.00%	0.00%	0.00%	0.00%
Arrowtooth flounder	0.00%	0.00%	0.00%	0.00%
Yellowfin sole	0.00%	0.00%	0.09%	0.09%
Total	58.61%	16.47%	22.92%	100.00%

	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel	0.00%	0.00%	0.76%	0.76%
Bottom Pollock	0.80%	2.39%	5.02%	8.21%
Pacific cod	3.09%	4.40%	2.09%	9.58%
Flatfish	0.00%	0.00%	0.00%	0.00%
Rockfish	0.00%	0.00%	0.70%	0.70%
Flathead sole	0.00%	0.00%	0.00%	0.00%
Pelagic pollock	39.17%	16.31%	24.42%	79.90%
Rocksole	0.00%	0.00%	0.79%	0.79%
Sablefish	0.00%	0.00%	0.00%	0.00%
Greenland turbot	0.00%	0.00%	0.00%	0.00%
Arrowtooth flounder	0.00%	0.00%	0.00%	0.00%
Yellowfin sole	0.00%	0.04%	0.01%	0.05%
Total	43.07%	23.13%	33.80%	100.00%

	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel	0.00%	0.00%	0.04%	0.04%
Bottom Pollock	0.66%	0.60%	19.12%	20.38%
Pacific cod	9.28%	6.54%	14.54%	30.35%
Flatfish	0.00%	0.00%	0.00%	0.00%
Rockfish	0.00%	0.00%	0.73%	0.73%
Flathead sole	0.00%	0.00%	0.55%	0.55%
Pelagic pollock	14.10%	6.39%	25.61%	46.09%
Rocksole	0.00%	1.15%	0.70%	1.84%
Sablefish	0.00%	0.00%	0.00%	0.00%
Greenland turbot	0.00%	0.00%	0.00%	0.00%
Arrowtooth flounder	0.00%	0.00%	0.00%	0.00%
Yellowfin sole	0.00%	0.00%	0.00%	0.00%
Total	24.03%	14.67%	61.29%	100.00%

	Shoreside	Mothership	Catcher/Processor	Total
Atka Mackerel	0.00%	0.00%	4.90%	4.90%
Bottom Pollock	0.04%	0.49%	4.18%	4.73%
Pacific cod	8.82%	0.39%	7.23%	16.43%
Flatfish	0.00%	0.00%	1.53%	1.53%
Rockfish	0.00%	0.00%	0.27%	0.27%
Pelagic pollock	22.40%	4.98%	43.73%	71.11%
Rocksole	0.00%	0.00%	0.78%	0.78%
Sablefish	0.00%	0.00%	0.00%	0.00%
Greenland turbot	0.01%	0.00%	0.12%	0.13%
Yellowfin sole	0.09%	0.00%	0.03%	0.12%
Total	31.35%	5.87%	62.78%	100.00%

Table 3. Comparison of historic total chinook salmon bycatch and dates with bycatch caps set at 48,000 fish on an annual basis, and 36,000 on an annual basis. Accounting beginning on September 1 and continuing to August 31 the next year.

Total trawl catch and chinook bycatch if accounting season was September 1 - August 31.
(beginning first full week after Sept. 1 as reported by NMFS)

YEAR	Chinook salmon bycatch (in numbers of fish)
1994 - 1995	23,135
1995 - 1996	46,948
1996 - 1997	36,095
1997 - 1998	53,744

YEAR	Total trawl groundfish catch (in metric tons)
1994 - 1995	1,746,092
1995 - 1996	1,430,322
1996 - 1997	1,702,857
1997 - 1998	1,448,264

Caps of 36,000 and 48,000 chinook in place for entire offset year.

Dates closure would have been triggered.

YEAR	36,000 chinook cap	48,000 chinook cap
1994 - 1995	na	na
1995 - 1996	2/24/96	na
1996 - 1997	8/30/97	na
1997 - 1998	1/31/98	2/21/98

Amount taken after the cap had been reached - entire Bering Sea.

YEAR	Chinook salmon 36,000 chinook cap		48,000 chinook cap	
1994 - 1995	-	0%	-	0%
1995 - 1996	8,158	17%	-	0%
1996 - 1997	-	0%	-	0%
1997 - 1998	14,813	28%	4,329	8%

YEAR	Total groundfish catch 36,000 chinook cap		48,000 chinook cap	
1994 - 1995	-	0%	-	0%
1995 - 1996	512,485	36%	-	0%
1996 - 1997	-	0%	-	0%
1997 - 1998	704,053	49%	328,780	23%

Amount taken after the cap had been reached within the current chinook salmon closure area.

YEAR	Chinook salmon 36,000 chinook cap		48,000 chinook cap	
1994 - 1995	-	0%	-	0%
1995 - 1996	3,516	7%	-	0%
1996 - 1997	-	0%	-	0%
1997 - 1998	not available			

YEAR	Total groundfish catch 36,000 chinook cap		48,000 chinook cap	
1994 - 1995	-	0%	-	0%
1995 - 1996	92,843	6%	-	0%
1996 - 1997	-	0%	-	0%
1997 - 1998	not available			

Table 4. Percentage changes in bycatch amounts from status quo due to simulated closure of specific cells. NMFS observer data 1994-97. Percentage is bycatch from pollock plus non-impacted fishery amounts / Total from all trawl fisheries.

Chinook salmon bycatch

	1994 Closure Period			1995 Closure Period			1996 Closure Period			1997 Closure Period		
Closure Area	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season
Half block 997	-1.2%	-0.5%	-0.7%	7.2%	7.4%	-0.2%	-2.4%	-0.7%	-1.7%	-7.2%	-3.5%	-3.7%
Half block 998	-9.7%	-9.5%	-0.2%	-0.8%	0.1%	-0.9%	-14.9%	-10.8%	-4.1%	-6.4%	-0.2%	-6.3%
Blocks 997+998	-11.9%	-10.5%	-1.4%	6.6%	7.8%	-1.3%	-21.2%	-14.7%	-6.8%	-14.3%	-3.7%	-10.6%
Block 227	-2.0%	-2.0%	0.0%	1.8%	2.0%	-0.4%	-2.9%	-0.7%	-2.2%	-2.7%	-0.4%	-2.3%
Block 228	-3.0%	-3.0%	0.0%	-0.4%	-0.1%	-0.3%	-4.8%	-1.0%	-3.8%	-4.9%	0.1%	-4.0%
Blocks 997+998+200	-11.9%	-10.5%	-2.0%	5.9%	7.9%	-1.9%	-24.1%	-15.8%	-8.3%	-16.9%	-3.9%	-12.0%
Blocks 997+998+200+227	-15.4%	-13.3%	-2.1%	10.2%	12.8%	-2.5%	-28.9%	-17.1%	-11.8%	-20.9%	-4.6%	-16.3%
Blocks 997+998+200+227+228	-21.3%	-19.2%	-2.1%	4.3%	6.9%	-2.6%	-40.9%	-20.0%	-20.3%	-33.6%	-5.8%	-27.8%
All Blocks 997+998+200+227+228+254	-15.8%	-13.7%	-2.1%	2.5%	5.3%	-2.9%	-53.9%	-33.4%	-20.4%	-32.1%	-3.6%	-28.5%

Chum salmon bycatch

	1994 Closure Period			1995 Closure Period			1996 Closure Period			1997 Closure Period		
Closure Area	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season
Half block 997	1.3%	0.3%	1.0%	-1.5%	0.0%	-1.5%	1.5%	0.2%	1.3%	4.9%	0.2%	4.8%
Half block 998	14.2%	7.5%	6.7%	2.9%	-0.1%	3.0%	12.1%	0.0%	12.1%	8.2%	0.0%	8.2%
Blocks 997+998	18.9%	11.9%	6.3%	1.2%	-0.1%	1.3%	13.8%	-1.3%	14.8%	18.8%	0.3%	18.3%
Block 227	-4.0%	-0.6%	-3.5%	-4.4%	0.1%	-4.6%	-7.6%	0.0%	-7.6%	-1.8%	0.0%	-1.8%
Block 228	0.3%	-0.1%	0.4%	-1.9%	0.6%	-2.0%	-9.9%	0.0%	-9.9%	-3.9%	0.5%	-4.4%
Blocks 997+998+200	18.9%	11.8%	3.5%	0.1%	-0.1%	0.3%	14.7%	-1.3%	16.0%	15.2%	0.1%	15.1%
Blocks 997+998+200+227	8.3%	10.1%	-1.8%	-6.2%	0.0%	-6.2%	4.8%	-1.3%	6.1%	13.5%	0.1%	13.4%
Blocks 997+998+200+227+228	6.8%	10.0%	-1.2%	-7.9%	1.3%	-8.2%	-10.4%	-1.2%	-9.2%	8.4%	0.6%	8.9%
All Blocks 997+998+200+227+228+254	6.1%	8.8%	-1.6%	-19.9%	2.0%	-21.9%	-8.1%	-1.2%	-6.9%	11.2%	1.2%	10.0%

Halibut bycatch

	1994 Closure Period			1995 Closure Period			1996 Closure Period			1997 Closure Period		
Closure Area	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season
Half block 997	0.9%	-0.2%	1.0%	0.0%	-0.1%	0.1%	2.3%	2.0%	0.3%	-0.5%	-0.5%	0.0%
Half block 998	3.0%	0.5%	2.5%	1.4%	0.3%	1.1%	1.2%	0.5%	0.7%	0.1%	0.0%	0.1%
Blocks 997+998	7.8%	0.7%	7.1%	1.8%	0.3%	1.2%	4.9%	3.3%	1.6%	-0.2%	-0.4%	0.2%
Block 227	0.9%	0.8%	0.1%	0.5%	0.4%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
Block 228	1.4%	1.4%	0.1%	2.7%	2.7%	0.0%	-0.7%	-0.5%	-0.2%	-1.1%	-1.2%	0.1%
Blocks 997+998+200	7.8%	0.7%	7.4%	1.7%	0.3%	1.4%	5.0%	3.4%	1.6%	-0.2%	-0.4%	0.3%
Blocks 997+998+200+227	9.3%	1.8%	7.7%	2.6%	1.1%	1.3%	5.2%	3.8%	1.8%	-0.1%	-0.4%	0.3%
Blocks 997+998+200+227+228	11.9%	4.2%	7.8%	11.0%	9.4%	1.5%	5.5%	4.3%	1.2%	-1.3%	-1.8%	0.5%
All Blocks 997+998+200+227+228+254	11.8%	4.1%	7.8%	6.8%	5.1%	1.9%	4.9%	3.7%	1.2%	-1.5%	-1.9%	0.5%

Herring bycatch

	1994 Closure Period			1995 Closure Period			1996 Closure Period			1997 Closure Period		
Closure Area	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season
Half block 997	-6.9%	-1.7%	-5.2%	1.5%	0.1%	1.4%	3.5%	0.1%	3.4%	0.8%	0.8%	0.1%
Half block 998	-7.3%	-1.0%	-6.2%	5.0%	11.2%	-6.1%	2.2%	0.0%	2.2%	-2.5%	-1.5%	-1.1%
Blocks 997+998	-18.1%	-4.8%	-13.3%	6.7%	11.3%	-4.6%	6.0%	-0.4%	6.3%	-1.5%	-2.0%	0.8%
Block 227	-0.5%	0.0%	-0.5%	1.1%	0.0%	1.1%	3.0%	0.0%	3.0%	-2.8%	0.0%	-2.8%
Block 228	0.2%	0.1%	0.2%	0.7%	0.0%	0.7%	5.9%	0.5%	5.4%	-1.1%	0.0%	-1.1%
Blocks 997+998+200	-18.1%	-4.9%	-10.1%	9.5%	11.3%	-1.8%	7.3%	-0.4%	7.7%	-0.8%	-2.0%	1.3%
Blocks 997+998+200+227	-16.1%	-4.8%	-11.3%	10.8%	11.3%	-0.5%	12.3%	-0.4%	12.7%	-4.0%	-2.0%	-2.0%
Blocks 997+998+200+227+228	-15.9%	-4.7%	-11.1%	11.9%	11.3%	0.7%	23.1%	0.4%	22.8%	-2.1%	-2.0%	-0.1%
All Blocks 997+998+200+227+228+254	-14.4%	-4.7%	-9.7%	13.2%	11.3%	1.9%	24.7%	0.5%	24.2%	0.3%	-2.0%	2.3%

Bairdi crab bycatch

	1994 Closure Period			1995 Closure Period			1996 Closure Period			1997 Closure Period		
Closure Area	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season
Half block 997	2.9%	1.2%	1.8%	1.6%	1.1%	0.5%	2.9%	2.1%	0.8%	1.1%	0.7%	0.4%
Half block 998	6.1%	1.2%	4.8%	5.4%	2.3%	3.1%	2.3%	0.8%	1.5%	1.4%	0.2%	1.2%
Blocks 997+998	12.6%	5.0%	7.8%	7.9%	3.8%	4.1%	7.9%	5.1%	2.9%	3.8%	1.4%	2.4%
Block 227	1.6%	0.5%	1.1%	0.4%	0.3%	0.0%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%
Block 228	2.9%	2.8%	0.1%	3.1%	3.0%	0.1%	-0.2%	-0.6%	0.4%	-1.2%	-1.3%	0.1%
Blocks 997+998+200	12.8%	5.0%	8.3%	8.1%	3.9%	4.3%	6.1%	5.1%	3.0%	4.2%	1.4%	2.8%
Blocks 997+998+200+227	16.0%	5.8%	10.4%	8.7%	4.3%	4.4%	6.8%	5.6%	3.2%	4.4%	1.5%	2.9%
Blocks 997+998+200+227+228	21.1%	10.4%	10.7%	14.8%	10.2%	4.6%	10.1%	6.0%	4.1%	3.8%	0.3%	3.6%
All Blocks 997+998+200+227+228+254	25.5%	14.8%	10.7%	20.1%	15.4%	4.7%	9.8%	5.2%	4.3%	4.1%	1.1%	3.0%

Opilio crab bycatch

	1994 Closure Period			1995 Closure Period			1996 Closure Period			1997 Closure Period		
Closure Area	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season
Half block 997	3.9%	2.0%	1.5%	1.1%	0.4%	0.7%	5.7%	4.3%	1.4%	1.3%	0.3%	1.2%
Half block 998	8.2%	1.9%	6.3%	8.7%	3.7%	5.0%	3.3%	0.8%	2.6%	3.1%	0.1%	3.0%
Blocks 997+998	26.4%	11.8%	14.7%	12.8%	5.1%	7.7%	14.0%	8.7%	5.3%	6.7%	0.7%	6.0%
Block 227	2.0%	0.1%	1.9%	0.1%	0.0%	0.1%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%
Block 228	0.5%	0.4%	0.1%	0.3%	0.2%	0.1%	0.8%	0.2%	0.8%	0.1%	-0.2%	0.3%
Blocks 997+998+200	26.4%	11.8%	15.5%	13.2%	5.1%	8.1%	14.2%	8.7%	8.8%	7.8%	0.8%	6.8%
Blocks 997+998+200+227	31.0%	11.8%	19.2%	13.4%	5.1%	8.3%	15.8%	10.0%	5.7%	7.7%	0.8%	6.8%
Blocks 997+998+200+227+228	31.8%	12.3%	19.5%	14.0%	5.4%	8.8%	17.6%	10.8%	6.8%	8.2%	0.7%	7.5%
All Blocks 997+998+200+227+228+254	32.5%	12.8%	19.8%	14.1%	6.3%	6.7%	17.7%	10.8%	7.1%	8.4%	0.8%	7.5%

Red king crab bycatch

	1994 Closure Period			1995 Closure Period			1996 Closure Period			1997 Closure Period		
Closure Area	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season	Annual	A Season	B Season
Half block 997	1.2%	1.2%	0.0%	2.1%	1.7%	0.4%	5.2%	2.8%	2.6%	2.4%	2.3%	0.0%
Half block 998	2.1%	2.1%	0.0%	1.4%	0.3%	1.1%	4.8%	0.2%	4.5%	0.1%	0.0%	0.1%
Blocks 997+998	3.6%	3.8%	0.0%	3.8%	2.1%	1.7%	11.8%	3.2%	8.6%	2.9%	2.9%	0.2%
Block 227	2.0%	2.0%	0.0%	0.4%	0.4%	0.0%	1.8%	1.1%	0.6%	0.1%	0.1%	0.0%
Block 228	9.3%	9.3%	0.0%	8.8%	8.8%	0.0%	8.0%	7.2%	0.8%	0.1%	0.0%	0.0%
Blocks 997+998+200	3.6%	3.8%	0.0%	3.8%	2.1%	1.9%	12.7%	3.2%	9.8%	2.6%	2.3%	0.2%
Blocks 997+998+200+227	6.0%	6.0%	0.0%	4.4%	2.6%	1.8%	16.0%	5.2%	10.8%	3.1%	2.9%	0.2%
Blocks 997+998+200+227+228	20.8%	20.8%	0.0%	19.9%	18.0%	1.9%	59.8%	47.3%	12.5%	4.2%	4.0%	0.2%
All Blocks 997+998+200+227+228+254	37.0%	37.0%	0.0%	34.4%	32.5%	1.9%	61.4%	49.1%	12.3%	4.7%	4.5%	0.2%

Table 5. Percentage changes in bycatch amounts from status quo due to simulated closure of specific cells. NMFS observer data 1994-97. Percentage is simulated bycatch from all closed fisheries / Total from all trawl fisheries.

Chinook salmon bycatch

Closure Area	1994 Closure Period Annual	1994 A Season	1994 B Season	1995 Closure Period Annual	1995 A Season	1995 B Season	1996 Closure Period Annual	1996 A Season	1996 B Season	1997 Closure Period Annual	1997 A Season	1997 B Season
Half block 997	-1.9%	-1.0%	-0.9%	4.3%	4.2%	0.1%	-4.4%	-2.8%	-1.7%	-9.8%	-5.6%	-4.2%
Half block 998	-11.0%	-10.4%	-0.5%	-1.0%	0.2%	-1.1%	-15.9%	-11.6%	-4.2%	-9.0%	-0.3%	-8.7%
Blocks 997+998	-13.9%	-12.1%	-1.8%	3.9%	4.6%	-0.7%	-24.5%	-17.8%	-6.7%	-20.0%	-5.9%	-14.0%
Block 227	-3.1%	-3.1%	0.0%	1.3%	1.7%	-0.4%	-3.3%	-1.0%	-2.3%	-3.2%	-0.5%	-2.7%
Block 228	-5.6%	-5.6%	0.0%	-19.8%	-19.5%	-0.3%	-8.9%	-4.9%	-4.0%	-7.2%	-0.8%	-8.3%
Blocks 997+998+200	-14.5%	-12.1%	-2.4%	3.2%	4.8%	-1.6%	-27.3%	-18.8%	-8.4%	-22.8%	-6.2%	-16.4%
Blocks 997+998+200+227	-18.5%	-16.1%	-2.3%	6.2%	8.1%	-1.9%	-32.9%	-20.9%	-12.0%	-27.4%	-7.1%	-20.3%
Blocks 997+998+200+227+228	-27.9%	-25.4%	-2.5%	-15.5%	-13.5%	-2.0%	-59.5%	-39.5%	-20.0%	-42.8%	-10.5%	-32.3%
All Blocks 997+998+200+227+228+254	-25.0%	-22.5%	-2.5%	-19.2%	-17.0%	-2.2%	-63.3%	-43.2%	-20.1%	-41.7%	-8.5%	-33.2%

Chum salmon bycatch

Closure Area	1994 Closure Period Annual	1994 A Season	1994 B Season	1995 Closure Period Annual	1995 A Season	1995 B Season	1996 Closure Period Annual	1996 A Season	1996 B Season	1997 Closure Period Annual	1997 A Season	1997 B Season
Half block 997	0.6%	0.1%	0.6%	-1.3%	0.0%	-1.6%	-0.4%	-1.2%	0.8%	3.6%	0.3%	3.3%
Half block 998	12.6%	7.3%	5.3%	2.8%	-0.1%	2.9%	10.8%	0.1%	10.7%	5.6%	0.0%	5.6%
Blocks 997+998	17.5%	11.3%	6.2%	1.4%	0.0%	1.6%	11.2%	-1.3%	12.5%	10.7%	0.4%	10.3%
Block 227	-4.4%	-0.6%	-3.8%	-4.5%	0.1%	-4.8%	-7.9%	-0.1%	-7.8%	-2.0%	0.0%	-2.0%
Block 228	0.3%	-0.1%	0.4%	-2.6%	-0.5%	-2.2%	-10.3%	0.0%	-10.3%	-4.7%	0.8%	-5.5%
Blocks 997+998+200	12.5%	11.3%	1.2%	0.1%	0.0%	0.2%	12.1%	-1.3%	13.4%	7.9%	0.2%	7.8%
Blocks 997+998+200+227	5.5%	9.8%	-4.3%	-6.1%	0.1%	-6.2%	1.8%	-1.5%	3.3%	3.7%	0.2%	5.5%
Blocks 997+998+200+227+228	5.0%	9.6%	-3.8%	-8.1%	0.3%	-8.4%	-13.7%	-1.5%	-12.2%	0.0%	1.3%	-1.3%
All Blocks 997+998+200+227+228+254	5.2%	9.4%	-4.2%	-20.9%	1.1%	-22.0%	-11.8%	-1.5%	-10.3%	1.2%	2.1%	-0.9%

Halibut bycatch

Closure Area	1994 Closure Period Annual	1994 A Season	1994 B Season	1995 Closure Period Annual	1995 A Season	1995 B Season	1996 Closure Period Annual	1996 A Season	1996 B Season	1997 Closure Period Annual	1997 A Season	1997 B Season
Half block 997	-5.3%	-6.4%	1.1%	-18.2%	-18.4%	0.2%	-2.0%	-2.0%	-0.1%	-4.0%	-4.7%	0.7%
Half block 998	3.3%	0.5%	2.8%	4.8%	1.4%	3.4%	5.6%	2.9%	2.7%	2.3%	0.1%	2.2%
Blocks 997+998	-0.7%	-5.2%	4.5%	-11.0%	-15.0%	4.0%	5.0%	2.7%	2.9%	-1.0%	-4.5%	3.5%
Block 227	2.0%	1.8%	0.1%	1.3%	1.3%	0.1%	0.8%	0.3%	0.5%	0.6%	0.3%	0.1%
Block 228	1.5%	1.4%	0.1%	8.7%	8.6%	0.1%	-3.4%	-6.1%	2.7%	-2.4%	-2.8%	0.0%
Blocks 997+998+200	-1.5%	-6.2%	4.8%	-13.6%	-17.8%	4.3%	5.8%	2.7%	3.1%	-0.7%	-4.5%	3.8%
Blocks 997+998+200+227	0.5%	-4.5%	5.1%	-12.0%	-16.4%	4.4%	7.3%	3.7%	3.6%	0.2%	-3.8%	4.1%
Blocks 997+998+200+227+228	-0.3%	-6.4%	5.2%	2.5%	-2.1%	4.6%	13.9%	4.8%	9.3%	-1.3%	-6.8%	5.5%
All Blocks 997+998+200+227+228+254	2.0%	-3.2%	5.2%	-4.2%	-8.8%	4.6%	8.7%	-1.4%	10.1%	-5.4%	-11.1%	5.7%

Herring bycatch

Closure Area	1994 Closure Period Annual	1994 A Season	1994 B Season	1995 Closure Period Annual	1995 A Season	1995 B Season	1996 Closure Period Annual	1996 A Season	1996 B Season	1997 Closure Period Annual	1997 A Season	1997 B Season
Half block 997	-7.7%	-1.2%	-6.6%	1.3%	0.1%	1.2%	4.6%	0.2%	4.6%	1.0%	1.3%	-0.3%
Half block 998	-9.1%	-3.6%	-5.8%	-7.4%	-0.3%	-7.1%	-6.4%	0.1%	-6.6%	-3.8%	-1.5%	-2.2%
Blocks 997+998	-20.7%	-6.4%	-14.3%	-6.1%	-0.2%	-5.9%	-1.5%	0.1%	-1.7%	-3.4%	-1.1%	-2.3%
Block 227	-0.4%	0.1%	-0.5%	0.8%	0.0%	0.9%	3.2%	0.0%	3.1%	-2.9%	0.0%	-2.9%
Block 228	0.2%	0.1%	0.2%	0.8%	0.0%	0.8%	6.5%	0.8%	5.9%	-1.4%	0.6%	-2.0%
Blocks 997+998+200	-17.3%	-6.4%	-11.6%	-3.6%	-0.2%	-3.4%	-0.1%	0.1%	-0.2%	-2.8%	-1.1%	-1.7%
Blocks 997+998+200+227	-18.9%	-6.4%	-12.5%	-2.6%	-0.2%	-2.3%	5.1%	0.2%	4.9%	-6.1%	-1.0%	-6.1%
Blocks 997+998+200+227+228	-18.6%	-6.3%	-12.3%	-1.7%	-0.2%	-1.3%	15.7%	0.6%	14.8%	-6.4%	0.0%	-6.3%
All Blocks 997+998+200+227+228+254	-17.3%	-6.3%	-11.0%	-0.6%	-0.2%	-0.4%	17.1%	0.8%	16.3%	-6.2%	0.0%	-6.2%

Bairdi crab bycatch

Closure Area	1994 Closure Period Annual	1994 A Season	1994 B Season	1995 Closure Period Annual	1995 A Season	1995 B Season	1996 Closure Period Annual	1996 A Season	1996 B Season	1997 Closure Period Annual	1997 A Season	1997 B Season
Half block 997	7.5%	4.6%	2.9%	11.7%	10.6%	1.1%	10.6%	7.0%	3.6%	8.0%	7.1%	1.7%
Half block 998	12.7%	3.7%	8.6%	12.7%	2.4%	10.3%	10.5%	3.9%	6.6%	5.0%	0.4%	4.6%
Blocks 997+998	25.1%	12.2%	12.9%	25.6%	13.3%	12.3%	25.3%	13.3%	12.0%	15.2%	7.8%	7.4%
Block 227	4.6%	2.9%	1.7%	1.7%	1.4%	0.3%	1.2%	0.4%	0.8%	1.2%	0.9%	0.3%
Block 228	9.6%	8.5%	0.1%	8.2%	8.2%	0.0%	4.4%	2.0%	2.4%	-6.8%	-7.7%	0.9%
Blocks 997+998+200	27.0%	12.2%	14.7%	28.6%	13.4%	15.2%	25.8%	13.6%	12.4%	16.0%	8.0%	8.0%
Blocks 997+998+200+227	33.1%	15.5%	17.6%	29.2%	15.6%	13.6%	28.4%	14.6%	13.8%	17.8%	8.2%	8.9%
Blocks 997+998+200+227+228	48.1%	30.1%	17.9%	48.1%	33.2%	14.9%	44.2%	25.8%	18.4%	14.2%	3.8%	10.5%
All Blocks 997+998+200+227+228+254	58.3%	40.0%	18.3%	49.3%	33.8%	15.5%	34.6%	15.1%	18.4%	15.4%	4.7%	10.7%

Opilio crab bycatch

Closure Area	1994 Closure Period Annual	1994 A Season	1994 B Season	1995 Closure Period Annual	1995 A Season	1995 B Season	1996 Closure Period Annual	1996 A Season	1996 B Season	1997 Closure Period Annual	1997 A Season	1997 B Season
Half block 997	7.8%	3.4%	4.3%	5.3%	2.9%	2.4%	14.5%	8.9%	5.7%	7.4%	3.9%	3.6%
Half block 998	17.3%	3.1%	14.1%	23.6%	5.8%	17.7%	13.5%	3.8%	9.7%	11.4%	0.8%	10.8%
Blocks 997+998	32.6%	11.8%	20.7%	30.6%	9.2%	21.4%	33.0%	15.0%	18.1%	22.2%	4.9%	17.3%
Block 227	3.0%	0.2%	2.8%	0.5%	0.1%	0.5%	1.1%	0.3%	0.8%	0.9%	0.3%	0.6%
Block 228	2.3%	2.1%	0.2%	0.9%	0.2%	0.7%	6.9%	4.6%	2.4%	0.1%	-1.9%	2.0%
Blocks 997+998+200	34.9%	11.8%	23.1%	32.6%	9.3%	23.3%	34.3%	15.6%	18.7%	23.8%	5.1%	18.7%
Blocks 997+998+200+227	40.0%	12.0%	28.0%	33.6%	9.4%	24.1%	36.5%	16.5%	20.0%	25.2%	6.4%	19.8%
Blocks 997+998+200+227+228	43.1%	14.6%	28.6%	35.4%	9.9%	25.5%	48.7%	24.5%	24.3%	28.4%	4.3%	24.1%
All Blocks 997+998+200+227+228+254	44.7%	15.6%	29.0%	35.9%	9.8%	26.2%	50.0%	24.6%	25.3%	27.2%	2.6%	24.6%

Red king crab bycatch

Closure Area	1994 Closure Period Annual	1994 A Season	1994 B Season	1995 Closure Period Annual	1995 A Season	1995 B Season	1996 Closure Period Annual	1996 A Season	1996 B Season	1997 Closure Period Annual	1997 A Season	1997 B Season
Half block 997	5.1%	5.1%	0.1%	23.8%	23.1%	0.7%	12.7%	9.6%	3.0%	75.3%	75.0%	0.3%
Half block 998	5.2%	5.0%	0.2%	3.0%	0.7%	2.9%	7.4%	1.8%	6.6%	1.2%	0.2%	1.0%
Blocks 997+998	11.0%	10.7%	0.3%	27.4%	24.1%	3.3%	22.0%	12.2%	9.8%	70.7%	78.2%	1.5%
Block 227	11.8%	11.8%	0.0%	12.3%	12.3%	0.0%	5.3%	4.3%	0.9%	3.2%	3.1%	0.1%
Block 228	38.4%	38.4%	0.0%	34.3%	34.3%	0.0%	24.6%	23.5%	1.1%	10.2%	10.1%	0.1%
Blocks 997+998+200	11.0%	10.7%	0.3%	27.2%	23.6%	3.5%	23.2%	12.2%	11.0%	78.9%	75.3%	1.6%
Blocks 997+998+200+227	24.2%	23.9%	0.3%	46.0%	42.5%	3.5%	31.9%	19.4%	12.5%	89.5%	87.7%	1.8%
Blocks 997+998+200+227+228	82.9%	82.6%	0.3%	137.0%	133.5%	3.5%	105.7%	91.3%	14.3%	128.8%	126.6%	2.1%
All Blocks 997+998+200+227+228+254	128.8%	128.5%	0.3%	200.4%	196.8%	3.6%	108.3%	93.8%	14.6%	132.2%	130.1%	2.1%

Table 6. Observed groundfish catch and bycatch of various species within Steller sea lion critical habitat/CVOA in the pollock trawl fisheries, 1994 – 1997. Values within critical habitat by season are also provided.

	Numbers of salmon and crab, weight of other				Percent of total by year			
Total Groundfish Catch	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	352,546	301,872	379,544	338,591	36.80%	32.51%	44.71%	43.47%
Inside CH, A season	392,789	392,231	241,525	283,913	41.00%	42.24%	28.45%	36.45%
Inside CH, Aug 1 - Sep 15	182,503	172,844	72,134	86,083	19.05%	18.61%	8.50%	11.05%
Inside CH, Sep 15 - Nov 1	25,464	58,561	151,408	70,381	2.66%	6.31%	17.84%	9.04%
Inside CH, Nov - Dec	4,792	3,082	4,252	0	0.50%	0.33%	0.50%	0.00%
Total	958,094	928,590	848,863	778,987				
Chinook	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	3,516	2,227	2,585	6,981	18.49%	22.67%	7.02%	22.34%
Inside CH, A season	14,108	6,194	22,729	7,021	74.19%	63.04%	61.69%	22.47%
Inside CH, Aug 1 - Sep 15	778	603	484	4,856	4.09%	6.14%	1.31%	15.54%
Inside CH, Sep 15 - Nov 1	243	801	10,798	12,388	1.28%	8.15%	29.31%	39.65%
Inside CH, Nov - Dec	372	0	248	0	1.96%	0.00%	0.67%	0.00%
Total	19,017	9,825	36,844	31,246				
Chum	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	18,168	3,198	26,301	23,085	31.74%	32.09%	49.40%	51.63%
Inside CH, A season	1,576	136	778	868	2.75%	1.36%	1.46%	1.94%
Inside CH, Aug 1 - Sep 15	37,239	5,000	1,651	10,436	65.07%	50.17%	3.10%	23.34%
Inside CH, Sep 15 - Nov 1	236	1,633	24,496	10,326	0.41%	16.38%	46.01%	23.09%
Inside CH, Nov - Dec	11	0	14	0	0.02%	0.00%	0.03%	0.00%
Total	57,228	9,967	53,240	44,715				
Halibut	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	457,441	167,275	189,939	100,292	58.11%	36.31%	44.48%	30.89%
Inside CH, A season	319,502	266,916	175,719	193,767	40.59%	57.94%	41.15%	59.67%
Inside CH, Aug 1 - Sep 15	8,787	10,009	6,590	14,345	1.12%	2.17%	1.54%	4.42%
Inside CH, Sep 15 - Nov 1	1,427	16,018	54,298	16,306	0.18%	3.48%	12.71%	5.02%
Inside CH, Nov - Dec	22	468	516	0	0.00%	0.10%	0.12%	0.00%
Total	787,180	460,686	427,063	324,711				
Herring	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	378,873	198,584	539,569	238,631	31.82%	30.44%	60.44%	31.41%
Inside CH, A season	77,346	24,575	9,088	22,837	6.50%	3.77%	1.02%	3.01%
Inside CH, Aug 1 - Sep 15	668,235	382,887	193,404	323,906	56.12%	58.69%	21.66%	42.63%
Inside CH, Sep 15 - Nov 1	66,299	46,338	150,714	174,419	5.57%	7.10%	16.88%	22.96%
Inside CH, Nov - Dec	3	0	1	0	0.00%	0.00%	0.00%	0.00%
Total	1,190,756	652,385	892,776	759,794				
Bairdi crab	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	374,458	116,264	80,886	50,745	90.09%	59.56%	71.43%	49.62%
Inside CH, A season	41,160	78,675	31,494	51,512	9.90%	40.30%	27.81%	50.37%
Inside CH, Aug 1 - Sep 15	44	21	48	4	0.01%	0.01%	0.04%	0.00%
Inside CH, Sep 15 - Nov 1	1	252	811	16	0.00%	0.13%	0.72%	0.02%
Inside CH, Nov - Dec	0	0	0	0	0.00%	0.00%	0.00%	0.00%
Total	415,681	195,212	113,239	102,277				
Opilio crab	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	1,739,879	421,065	236,614	284,888	99.86%	98.65%	95.93%	81.01%
Inside CH, A season	2,513	5,767	6,585	66,707	0.14%	1.35%	2.67%	18.97%
Inside CH, Aug 1 - Sep 15	5	8	130	5	0.00%	0.00%	0.05%	0.00%
Inside CH, Sep 15 - Nov 1	0	3	3,313	64	0.00%	0.00%	1.34%	0.02%
Inside CH, Nov - Dec	0	0	0	0	0.00%	0.00%	0.00%	0.00%
Total	1,742,397	426,843	246,642	351,664				
Red king crab	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	23,406	2,317	3,941	166	84.98%	71.56%	99.87%	19.37%
Inside CH, A season	4,137	920	4	691	15.02%	28.41%	0.10%	80.63%
Inside CH, Aug 1 - Sep 15	0	1	0	0	0.00%	0.03%	0.00%	0.00%
Inside CH, Sep 15 - Nov 1	0	0	1	0	0.00%	0.00%	0.03%	0.00%
Inside CH, Nov - Dec	0	0	0	0	0.00%	0.00%	0.00%	0.00%
Total	27,543	3,238	3,946	857				

Table 7. Observed groundfish catch and bycatch of various species within Steller sea lion critical habitat/CVOA in all trawl fisheries, 1994 – 1997. Values within critical habitat by season are also provided. Percentages are the percent of total within a year.

	Numbers of salmon and crab, weight of other				Percent of total by year			
Total Groundfish Catch	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	541,426	452,674	558,843	549,467	44.75%	39.54%	51.59%	52.27%
Inside CH, A season	455,354	456,987	293,733	344,715	37.64%	39.92%	27.11%	32.79%
Inside CH, Aug 1 - Sep 15	182,839	173,123	72,410	86,404	15.11%	15.12%	6.68%	8.22%
Inside CH, Sep 15 - Nov 1	25,489	58,970	153,950	70,637	2.11%	5.15%	14.21%	6.72%
Inside CH, Nov - Dec	4,792	3,062	4,360	0	0.40%	0.27%	0.40%	0.00%
Total	1,209,900	1,144,846	1,083,296	1,051,223				
Chinook	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	5,460	3,494	4,476	8,161	23.01%	25.39%	10.94%	24.13%
Inside CH, A season	16,872	8,860	24,816	8,348	71.11%	64.39%	60.64%	24.68%
Inside CH, Aug 1 - Sep 15	778	605	484	4,865	3.28%	4.40%	1.16%	14.38%
Inside CH, Sep 15 - Nov 1	243	801	10,900	12,446	1.02%	5.82%	26.63%	36.80%
Inside CH, Nov - Dec	372	0	248	0	1.57%	0.00%	0.61%	0.00%
Total	23,725	13,760	40,926	33,820				
Chum	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	18,244	4,398	26,394	23,372	31.80%	38.60%	49.31%	51.87%
Inside CH, A season	1,644	309	887	870	2.87%	2.71%	1.62%	1.93%
Inside CH, Aug 1 - Sep 15	37,242	5,054	1,651	10,454	64.91%	44.36%	3.08%	23.20%
Inside CH, Sep 15 - Nov 1	236	1,633	24,602	10,359	0.41%	14.33%	45.96%	22.99%
Inside CH, Nov - Dec	11	0	14	0	0.02%	0.00%	0.03%	0.00%
Total	57,377	11,394	53,528	45,055				
Halibut	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	1,429,320	1,013,645	1,355,340	1,390,287	42.17%	33.67%	46.45%	52.98%
Inside CH, A season	1,949,880	1,957,502	1,368,619	1,202,520	57.53%	65.03%	46.90%	45.82%
Inside CH, Aug 1 - Sep 15	8,813	10,021	7,418	15,188	0.26%	0.33%	0.25%	0.58%
Inside CH, Sep 15 - Nov 1	1,427	28,523	181,601	16,340	0.04%	0.95%	6.22%	0.62%
Inside CH, Nov - Dec	22	468	4,994	0	0.00%	0.02%	0.17%	0.00%
Total	3,389,461	3,010,159	2,917,973	2,624,335				
Herring	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	432,239	225,194	755,220	342,207	30.77%	33.15%	60.92%	36.98%
Inside CH, A season	113,217	24,601	9,466	23,099	8.06%	3.62%	0.76%	2.50%
Inside CH, Aug 1 - Sep 15	771,526	383,104	323,986	329,225	54.93%	56.40%	26.14%	35.58%
Inside CH, Sep 15 - Nov 1	87,551	46,338	150,930	230,679	6.23%	6.82%	12.18%	24.93%
Inside CH, Nov - Dec	3	0	1	0	0.00%	0.00%	0.00%	0.00%
Total	1,404,535	679,237	1,239,602	925,209				
Bairdi crab	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	1,234,511	803,392	726,038	711,646	86.80%	69.48%	77.33%	69.18%
Inside CH, A season	187,616	352,184	209,337	315,471	13.19%	30.46%	22.30%	30.67%
Inside CH, Aug 1 - Sep 15	44	21	118	1,476	0.00%	0.00%	0.01%	0.14%
Inside CH, Sep 15 - Nov 1	1	723	3,321	16	0.00%	0.06%	0.35%	0.00%
Inside CH, Nov - Dec	0	0	81	0	0.00%	0.00%	0.01%	0.00%
Total	1,422,172	1,156,320	938,895	1,028,609				
Opilio crab	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	7,018,602	2,821,546	1,910,904	2,280,440	99.84%	98.39%	98.06%	84.91%
Inside CH, A season	11,065	46,168	30,059	399,677	0.16%	1.61%	1.54%	14.88%
Inside CH, Aug 1 - Sep 15	5	8	311	5,385	0.00%	0.00%	0.02%	0.20%
Inside CH, Sep 15 - Nov 1	0	3	7,333	195	0.00%	0.00%	0.38%	0.01%
Inside CH, Nov - Dec	0	0	32	0	0.00%	0.00%	0.00%	0.00%
Total	7,029,672	2,867,725	1,948,639	2,685,697				
Red king crab	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Outside critical habitat (CH)	104,840	17,931	11,353	22,384	89.65%	84.82%	98.36%	84.58%
Inside CH, A season	12,098	3,209	188	4,081	10.35%	15.18%	1.63%	15.42%
Inside CH, Aug 1 - Sep 15	0	1	0	0	0.00%	0.00%	0.00%	0.00%
Inside CH, Sep 15 - Nov 1	0	0	1	0	0.00%	0.00%	0.01%	0.00%
Inside CH, Nov - Dec	0	0	0	0	0.00%	0.00%	0.00%	0.00%
Total	116,938	21,141	11,542	26,465				

Table 8. Predicted groundfish catch within Steller sea lion critical habitat/CVOA in all trawl fisheries (top panel) and the pollock trawl fisheries (bottom panel). 1994 – 1997 upon closure of cells as indicated. % = Total/annual total.

Catch in critical habitat after annual closures - All trawl fisheries

		Cell Closures								
1994	No closure	997	998	997&998	227	228	997&998&200	997&998&200&227	997&998&200&227&228	997&998&200&227&228&254
Total	658,474	629,393	585,183	525,705	654,973	622,058	508,697	481,534	426,875	377,962
A season (January - July)	455,354	443,062	443,974	425,322	445,002	409,600	425,094	413,426	350,029	308,373
B season (August - December)	213,120	186,331	141,209	100,384	209,970	212,459	83,603	78,108	76,845	71,585
August 1 - September 15	182,839	157,447	121,202	83,242	179,759	182,178	70,463	65,116	63,854	58,597
September 16 - November 1	25,489	24,664	18,301	17,142	25,420	25,489	13,140	12,992	12,992	12,992
November - December	4,792	4,221	1,706	0	4,792	4,792	0	0	0	0
Percent of Annual - No closure		94.15%	87.54%	78.64%	97.98%	93.06%	76.10%	73.53%	63.86%	56.54%
1995										
Total	692,172	648,094	616,312	561,825	682,009	644,927	548,472	530,149	440,197	395,172
A season (January - July)	456,997	425,998	452,050	420,361	450,696	415,980	420,086	410,575	334,107	294,741
B season (August - December)	235,175	222,096	164,282	141,465	231,313	228,947	128,386	119,574	106,089	100,431
August 1 - September 15	173,123	162,138	127,049	110,915	170,381	168,361	98,303	93,582	84,967	80,388
September 16 - November 1	58,970	56,876	34,130	29,424	57,850	57,504	28,957	25,992	21,122	20,044
November - December	3,082	3,082	3,082	1,126	3,082	3,082	1,128	0	0	0
Percent of Annual - No closure		93.63%	89.04%	81.17%	98.53%	93.17%	79.24%	76.59%	63.60%	57.09%
1996										
Total	524,452	474,778	468,907	405,884	513,475	472,445	400,416	381,736	278,347	251,591
A season (January - July)	293,733	263,709	281,558	246,207	291,799	263,805	245,407	241,726	182,852	161,772
B season (August - December)	230,719	211,068	187,349	159,677	221,676	208,640	155,009	140,010	95,495	89,819
August 1 - September 15	72,410	64,403	55,348	43,707	70,821	69,271	41,688	39,163	33,749	30,674
September 16 - November 1	153,950	142,309	127,642	111,616	146,696	135,574	108,968	96,701	61,458	58,857
November - December	4,360	4,354	4,359	4,354	4,158	3,796	4,354	4,146	288	288
Percent of Annual - No closure		90.53%	89.41%	77.39%	97.91%	90.08%	76.35%	72.79%	53.07%	47.97%
1997										
Total	501,756	457,606	453,114	399,776	494,504	441,068	395,073	383,800	285,603	244,041
A season (January - July)	344,715	316,259	343,505	314,599	341,812	292,880	313,931	309,465	228,596	188,726
B season (August - December)	157,041	140,747	109,609	85,177	152,692	148,178	81,142	74,334	57,006	55,315
August 1 - September 15	86,404	72,917	54,242	33,705	85,130	82,838	31,724	29,586	23,553	23,544
September 16 - November 1	70,637	67,830	55,367	51,472	67,563	65,340	49,418	44,768	33,454	31,771
November - December	0	0	0	0	0	0	0	0	0	0
Percent of Annual - No closure		91.08%	90.31%	79.68%	98.55%	87.90%	78.74%	76.49%	56.92%	48.64%

Catch in critical habitat after annual closures - Pollock fisheries only

		Cell Closures								
1994	No closure	997	998	997&998	227	228	997&998&200	997&998&200&227	997&998&200&227&228	997&998&200&227&228&254
Total	605,547	576,684	531,080	478,785	597,832	585,796	462,178	451,375	423,704	392,051
A season (January - July)	392,789	389,149	386,297	375,480	387,799	373,664	375,468	369,850	343,437	317,148
B season (August - December)	212,759	167,535	144,782	103,305	210,033	212,132	86,710	81,525	80,266	74,903
August 1 - September 15	182,503	158,121	122,743	85,085	179,833	181,876	72,258	67,216	65,957	60,594
September 16 - November 1	25,464	24,858	19,368	18,220	25,409	25,464	14,452	14,309	14,309	14,309
November - December	4,792	4,558	2,671	0	4,792	4,792	0	0	0	0
Percent of Annual - No closure		95.23%	87.70%	79.07%	98.73%	96.74%	76.32%	74.54%	69.97%	64.74%
1995										
Total	626,718	608,033	560,900	530,554	620,493	590,247	517,784	505,611	445,240	411,216
A season (January - July)	392,231	384,961	389,483	381,543	389,630	361,672	381,543	378,075	331,116	302,698
B season (August - December)	234,487	223,073	171,418	149,011	230,863	228,575	136,241	127,536	114,124	108,518
August 1 - September 15	172,844	162,671	129,044	113,099	170,231	168,313	100,785	95,083	87,516	83,000
September 16 - November 1	58,561	57,319	39,292	34,786	57,550	57,179	34,330	31,453	26,607	25,518
November - December	3,082	3,082	3,082	1,126	3,082	3,082	1,128	0	0	0
Percent of Annual - No closure		97.02%	89.50%	84.66%	99.01%	94.18%	82.62%	80.68%	71.04%	65.61%
1996										
Total	469,319	436,033	422,042	374,551	460,417	439,778	369,276	353,515	290,510	270,861
A season (January - July)	241,525	225,714	234,078	213,029	241,019	232,193	212,449	211,187	191,986	177,811
B season (August - December)	227,795	210,318	187,964	161,522	219,399	207,585	156,827	142,328	98,525	93,050
August 1 - September 15	72,134	65,448	57,018	45,774	70,639	69,173	43,694	41,200	35,831	32,773
September 16 - November 1	151,408	140,618	126,694	111,495	144,507	134,159	108,881	96,875	62,694	60,276
November - December	4,252	4,252	4,252	4,252	4,252	4,252	4,252	4,252	0	0
Percent of Annual - No closure		92.91%	89.93%	79.81%	98.10%	93.71%	78.69%	75.32%	61.90%	57.71%
1997										
Total	440,376	416,142	400,511	367,014	434,861	398,936	363,341	355,082	282,783	248,893
A season (January - July)	283,913	273,275	283,576	272,575	282,076	248,602	272,176	269,630	209,560	176,918
B season (August - December)	156,463	142,867	116,935	94,439	152,785	150,333	91,165	85,451	73,223	71,975
August 1 - September 15	86,083	74,674	58,804	39,074	84,861	82,734	37,693	35,480	29,331	29,321
September 16 - November 1	70,381	68,192	58,131	55,365	67,923	67,600	53,473	49,971	43,892	42,654
November - December	0	0	0	0	0	0	0	0	0	0
Percent of Annual - No closure		94.50%	90.95%	83.34%	98.75%	90.14%	82.51%	80.63%	64.21%	56.52%

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Figure 15. Historic chinook bycatch prior to a proposed closure, after a closure inside the Chinook Salmon Savings Area , and after a closure outside of the Chinook Salmon Savings Area. PSC limit amounts of 36,000 chinook and 48,000 chinook left and right. Total percentages in bottom panel.

Figure 16. Historic groundfish catch prior to a proposed closure, after a closure inside the Chinook Salmon Savings Area , and after a closure outside of the Chinook Salmon Savings Area. PSC limit categories of 36,000 chinook and 48,000 chinook left and right. Total percentages in bottom panel.

Figure 17. Pelagic pollock fishery catch and chinook bycatch within and outside of the Chinook Salmon Savings Area by week in 1994 (top panel); cumulative catch and bycatch (middle panel); and rates (bottom panel, number salmon per metric ton of groundfish). Vertical reference lines correspond to September 1 and October 1 dates.

Figure 18. Pelagic pollock fishery catch and chinook bycatch within and outside of the Chinook Salmon Savings Area by week in 1995 (top panel); cumulative catch and bycatch (middle panel); and rates (bottom panel, number salmon per metric ton of groundfish). Vertical reference lines correspond to September 1 and October 1 dates.

Figure 19. Pelagic pollock fishery catch and chinook bycatch within and outside of the Chinook Salmon Savings Area by week in 1996 (top panel); cumulative catch and bycatch (middle panel); and rates (bottom panel, number salmon per metric ton of groundfish). Vertical reference lines correspond to September 1 and October 1 dates.

Figure 20. Pelagic pollock fishery catch and chinook bycatch within and outside of the Chinook Salmon Savings Area by week in 1997 (top panel); cumulative catch and bycatch (middle panel); and rates (bottom panel, number salmon per metric ton of groundfish). Vertical reference lines correspond to September 1 and October 1 dates.

Figure 21. Cumulative trawl bycatch of chinook salmon in the Bering Sea by week and target fishery. Accounting period beginning September 1 and ending August 31 with week 37 corresponding to September 1.

Figure 22. Block reference codes used to identify individual 1/2° latitude by 1° longitude blocks in the Bering Sea. Note that block 201 in sequence had been halved and recoded as 997 and 998.

Figure 23. Locations of observed hauls with more than 25 chinook salmon in a haul, 1994-1997. Chinook Salmon Savings Area 9 blocks are very bold and the CVOA is outlined.

Figure 24. Blocks with trawl fishing by the pelagic pollock fishery in each year 1994 – 1997. Number of weeks a block was ranked number 1 (highest) for bycatch of chinook salmon as indicated by scale on each map.

Figure 25. Blocks with trawl fishing by the pelagic pollock fishery in each year 1994 – 1997. Number of weeks a block was ranked 1, 2, or 3 (three highest) for bycatch of chinook salmon as indicated by scale on each map.

Figure 26. Blocks with trawl fishing by the pelagic pollock fishery in each year 1994 – 1997. Overall rank for chinook salmon bycatch over all weeks as indicated by scale on each map. Top 10 squares and top 20 squares in each year are indicated.

Figure 27. Blocks with trawl fishing by the pelagic pollock fishery in each year 1994 – 1997. Dot density map of chinook salmon bycatch rates with additional dots drawn at random in each square for every unit of .004 chinook salmon per metric ton of groundfish catch.

Figure 28. Blocks with trawl fishing by the pelagic pollock, bottom pollock and Pacific cod fisheries in each year 1994 – 1997. Number of weeks a block was ranked number 1 (highest) for bycatch of chinook salmon as indicated by scale on each map.

Figure 29. Blocks with trawl fishing by the pelagic pollock, bottom pollock and Pacific cod fisheries in each year 1994 – 1997. Number of weeks a block was ranked 1, 2, or 3 (three highest) for bycatch of chinook salmon as indicated by scale on each map.

Figure 30. Blocks with trawl fishing by the pelagic pollock, bottom pollock and Pacific cod fisheries in each year 1994 – 1997. Overall rank for chinook salmon bycatch over all weeks as indicated by scale on each map. Top 10 squares and top 20 squares in each year are indicated.

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Figure 35. Observed chinook salmon bycatch in coded 1/2° latitude by 1° longitude blocks (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six blocks is indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

Figure 36. Observed chum salmon bycatch in coded 1/2° latitude by 1° longitude blocks (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six blocks is indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

Figure 37. Observed halibut bycatch in coded 1/2° latitude by 1° longitude blocks (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six blocks is as indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

Figure 38. Observed herring bycatch in coded 1/2° latitude by 1° longitude blocks (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six blocks is as indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

Figure 39. Observed bairdi crab bycatch in coded 1/2° latitude by 1° longitude blocks (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six blocks is as indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

Figure 40. Observed opilio crab bycatch in coded 1/2° latitude by 1° longitude blocks (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six blocks is as indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

Figure 41. Observed red king crab bycatch in coded 1/2° latitude by 1° longitude blocks (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six blocks is indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

Figure 42. Expected chinook salmon bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

Figure 43. Expected chinook salmon bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

Figure 44. Expected chum salmon bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

Figure 45. Expected chum salmon bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

Figure 46. Expected halibut bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

Figure 47. Expected halibut bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

Figure 48. Expected herring bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

Figure 49. Expected herring bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

Figure 50. Expected bairdi crab bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

Figure 51. Expected bairdi crab bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

Figure 52. Expected opilio crab bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

Figure 53. Expected opilio crab bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

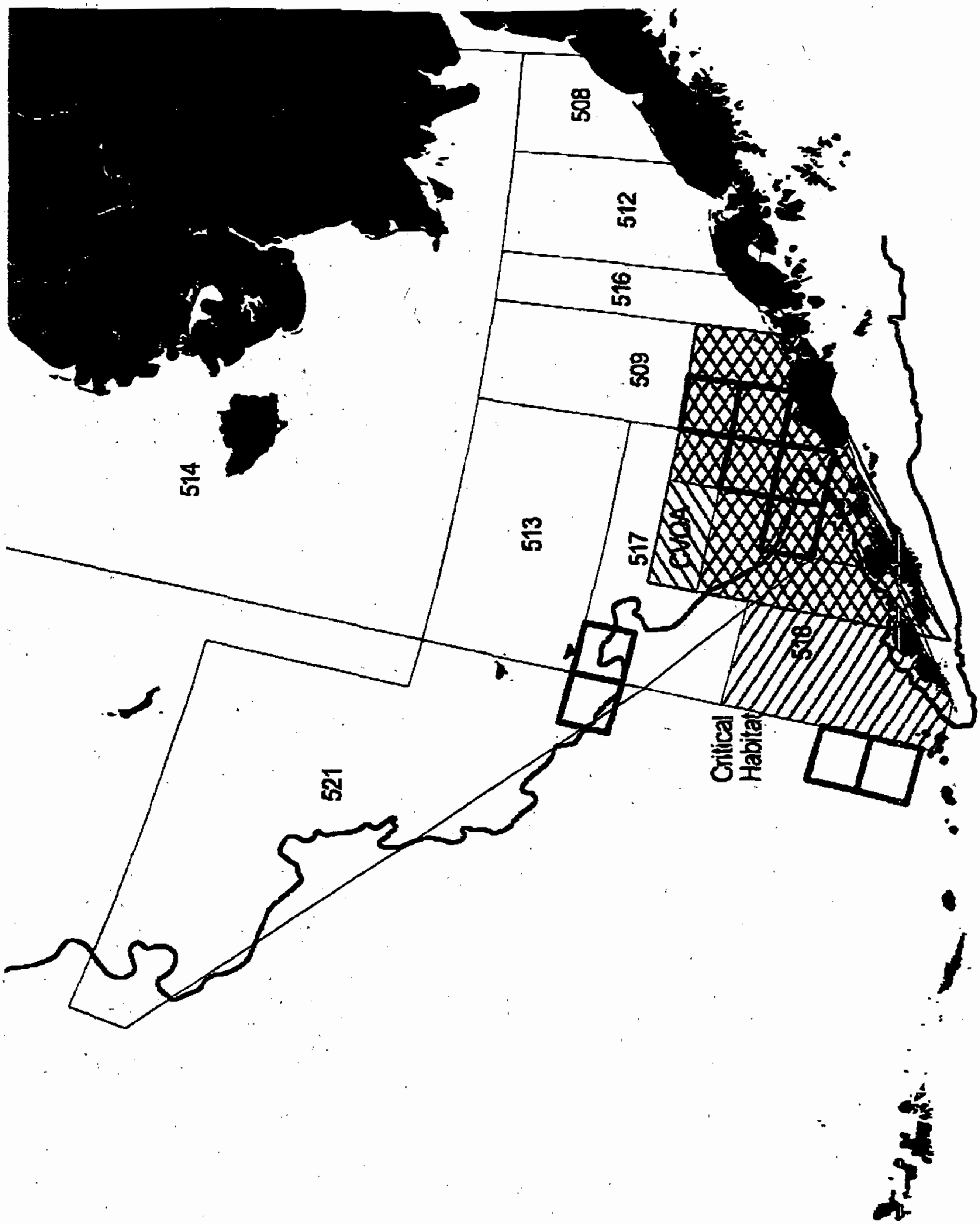
Figure 54. Expected red king crab bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

Figure 55. Expected red king crab bycatch from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

Figure 56. Expected number of hauls from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

Figure 57. Expected number of hauls from simulation of block closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

Figure 1. Bering Sea with NMFS statistical areas, Chinook Salmon Savings Area (nine squares in bold), and the Catcher Vessel Operational Area (CVOA, shaded).



NMFS statistical areas, CVOA (slant NE/SW), Sea lion Critical Habitat/CVOA (slant NW/SE) and current chinook salmon savings areas (bold line).

Figure 2. Bycatch of chinook salmon in the Bering Sea and number of adult chinook salmon of western Alaskan origin estimated to have survived if not intercepted.

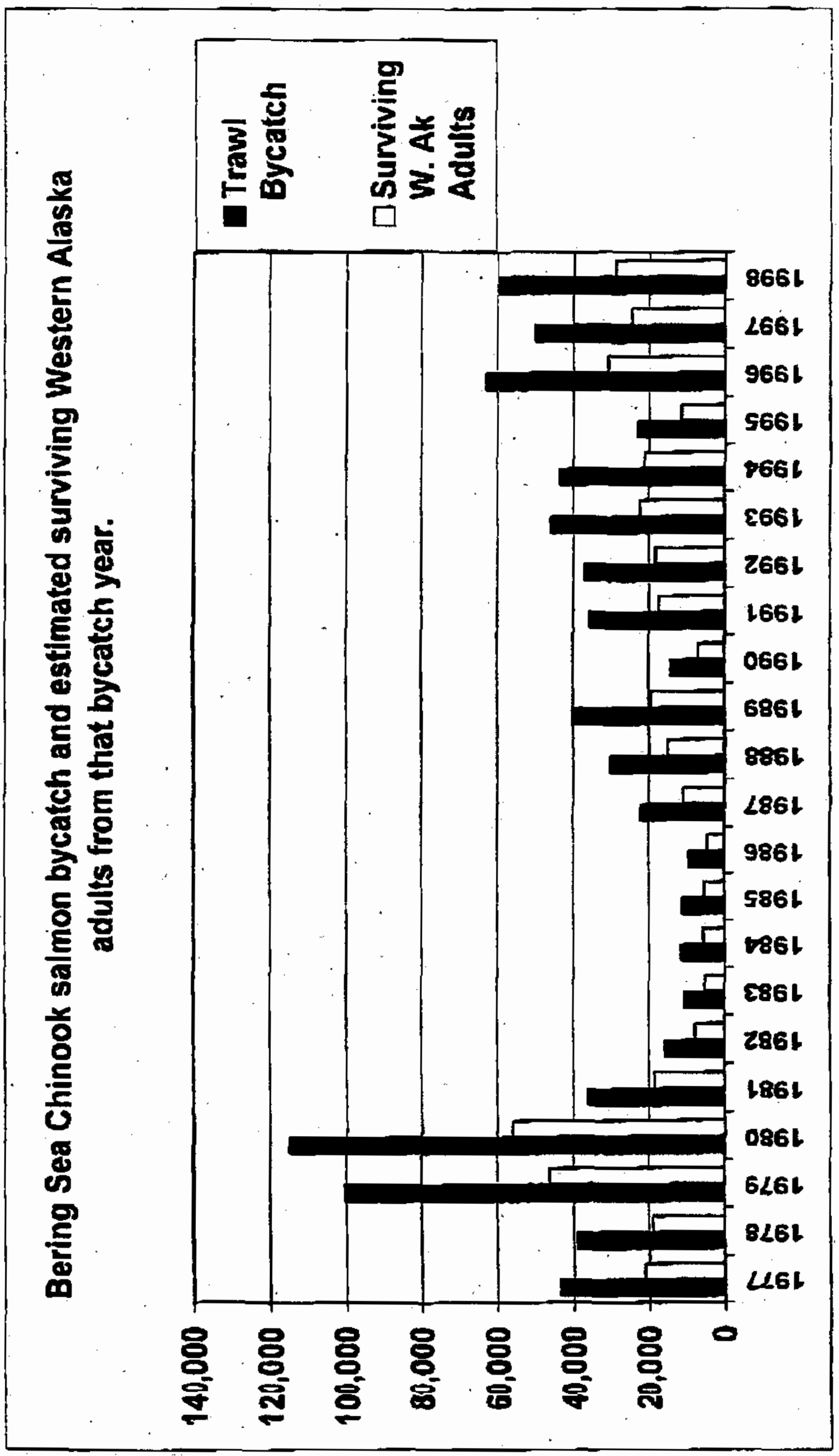


Figure 3. Bycatch of chinook salmon in the Bering Sea and the number of adult chinook salmon of western Alaskan origin apportioned to the year the adults would have returned to systems if not intercepted.

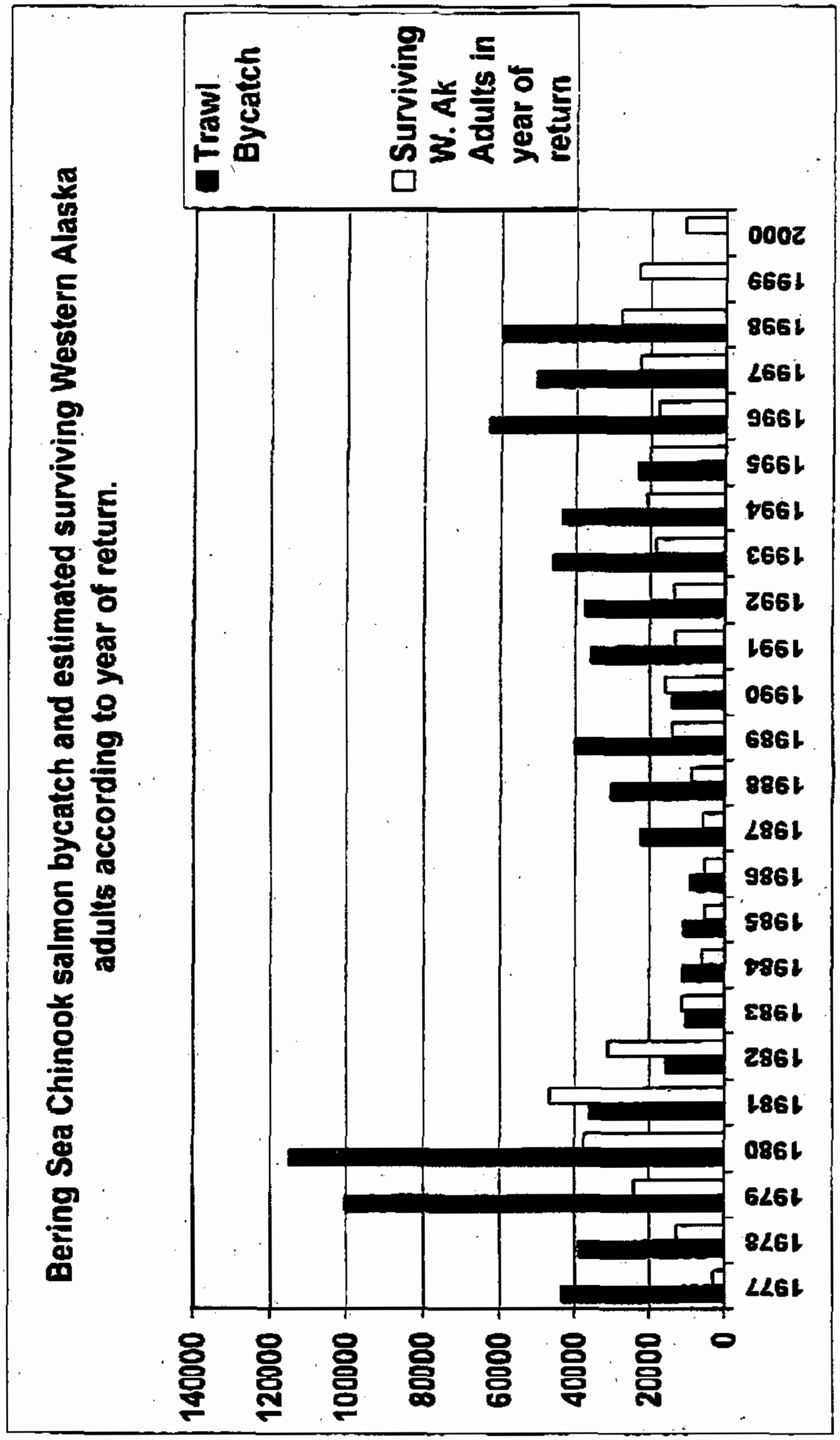
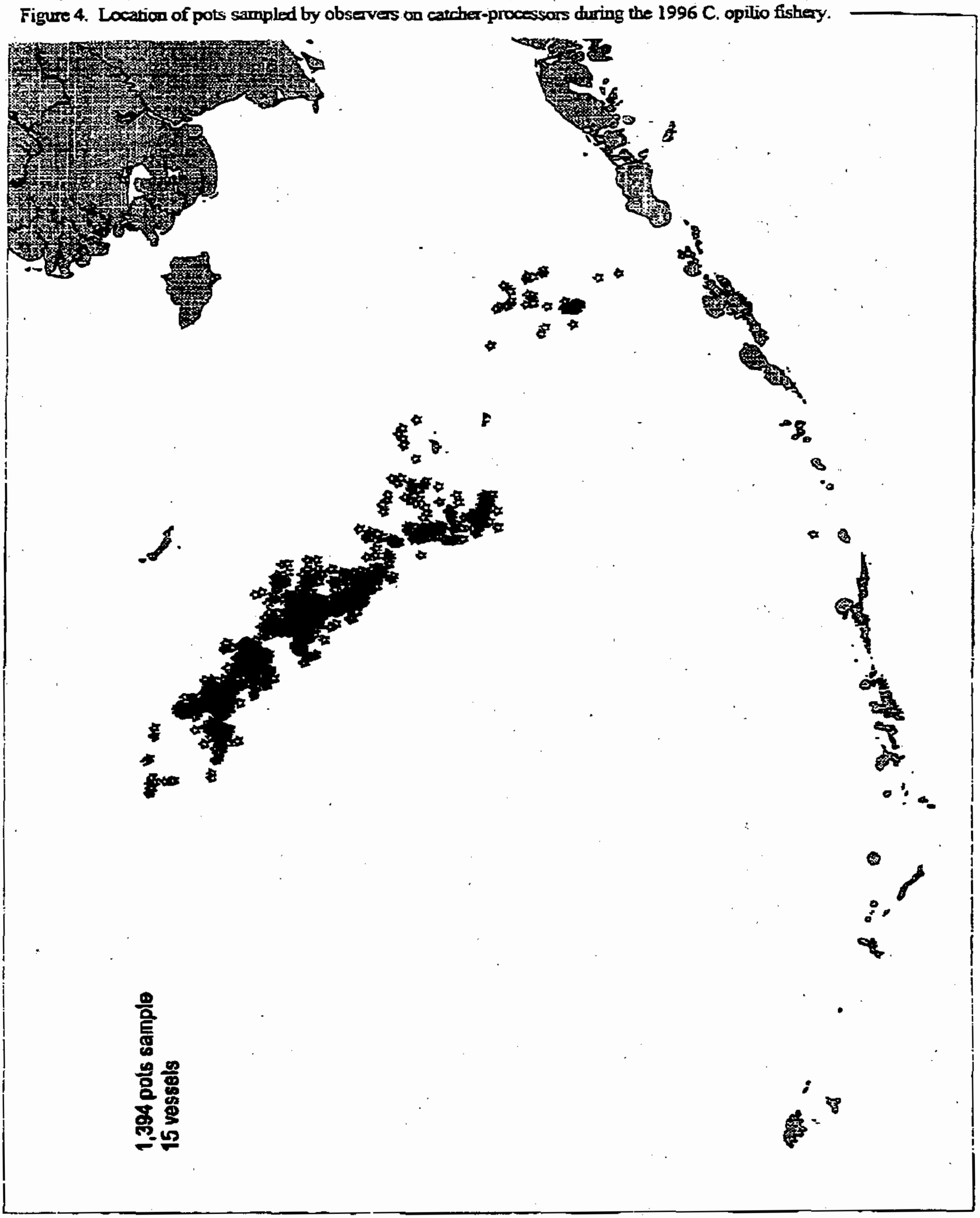
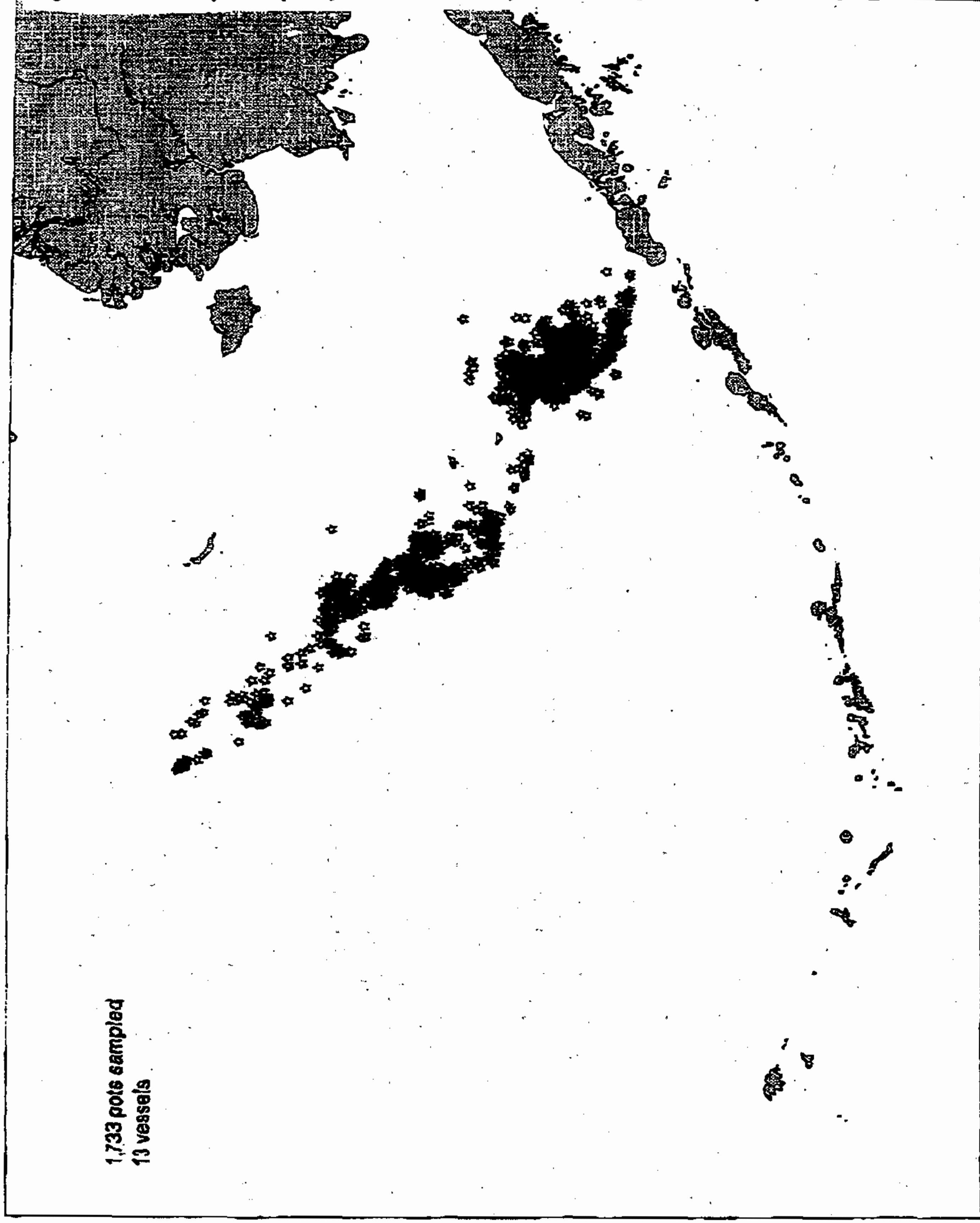


Figure 4. Location of pots sampled by observers on catcher-processors during the 1996 C. opilio fishery.



Location of pots sampled by observers on catcher-processors during the 1996 C. opilio fishery.

Figure 5. Location of pots sampled by observers on catcher-processors during the 1997 C. opilio fishery



Location of pots sampled by observers on catcher-processors during the 1997 C. opilio fishery.

Figure 6. Foreign, joint venture, and domestic chinook salmon bycatch in the Bering Sea, 1980 – 1998 (to 8/29/98), as reported by the National Marine Fisheries Service.

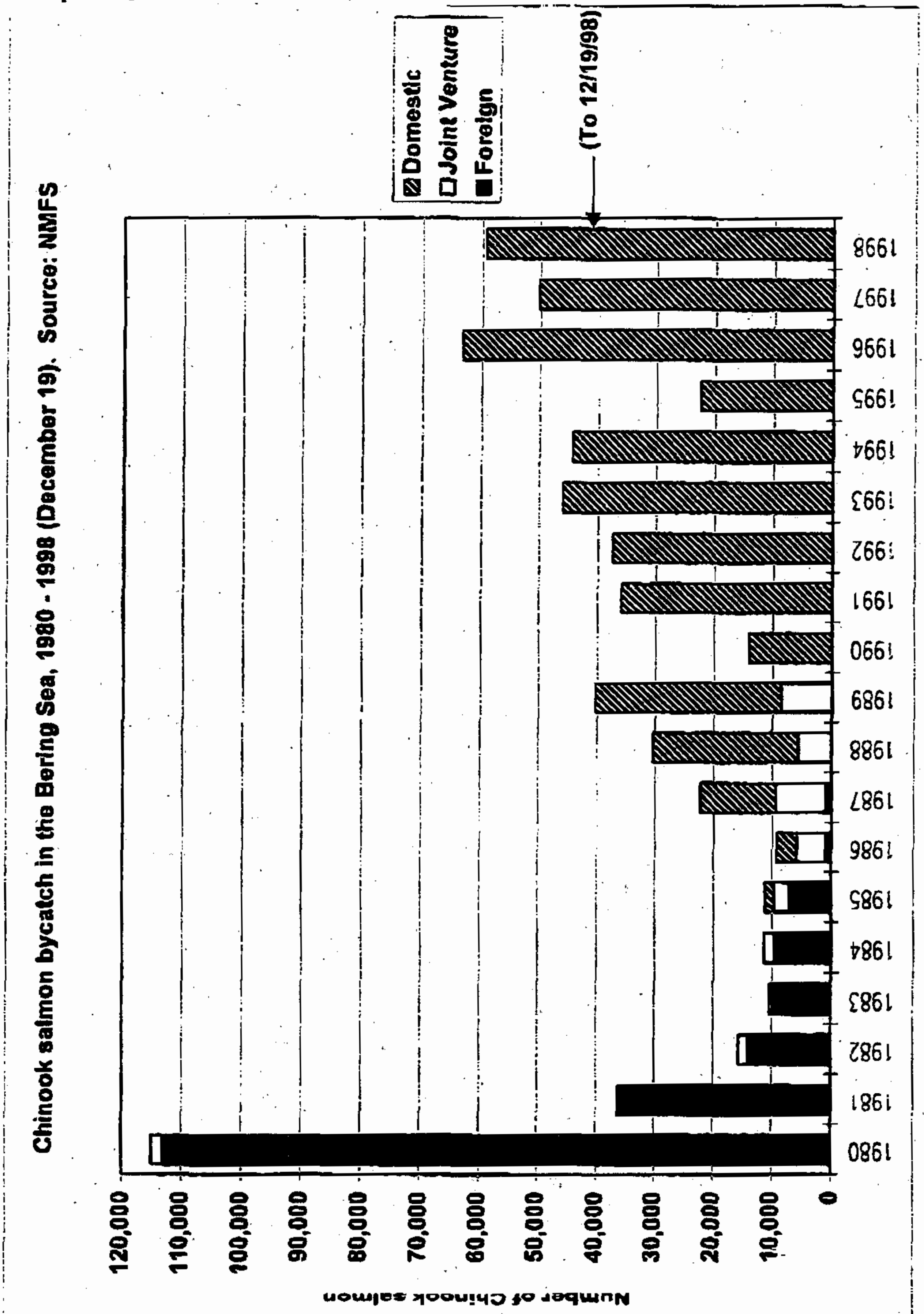


Figure 7. Commercial harvest of chinook salmon by ADF&G management area, 1973 – 1997. Subsistence catch in the Yukon River area to 1996, and the Kuskokwim area to 1992 are included. Note that the commercial data from 1997 are incomplete.

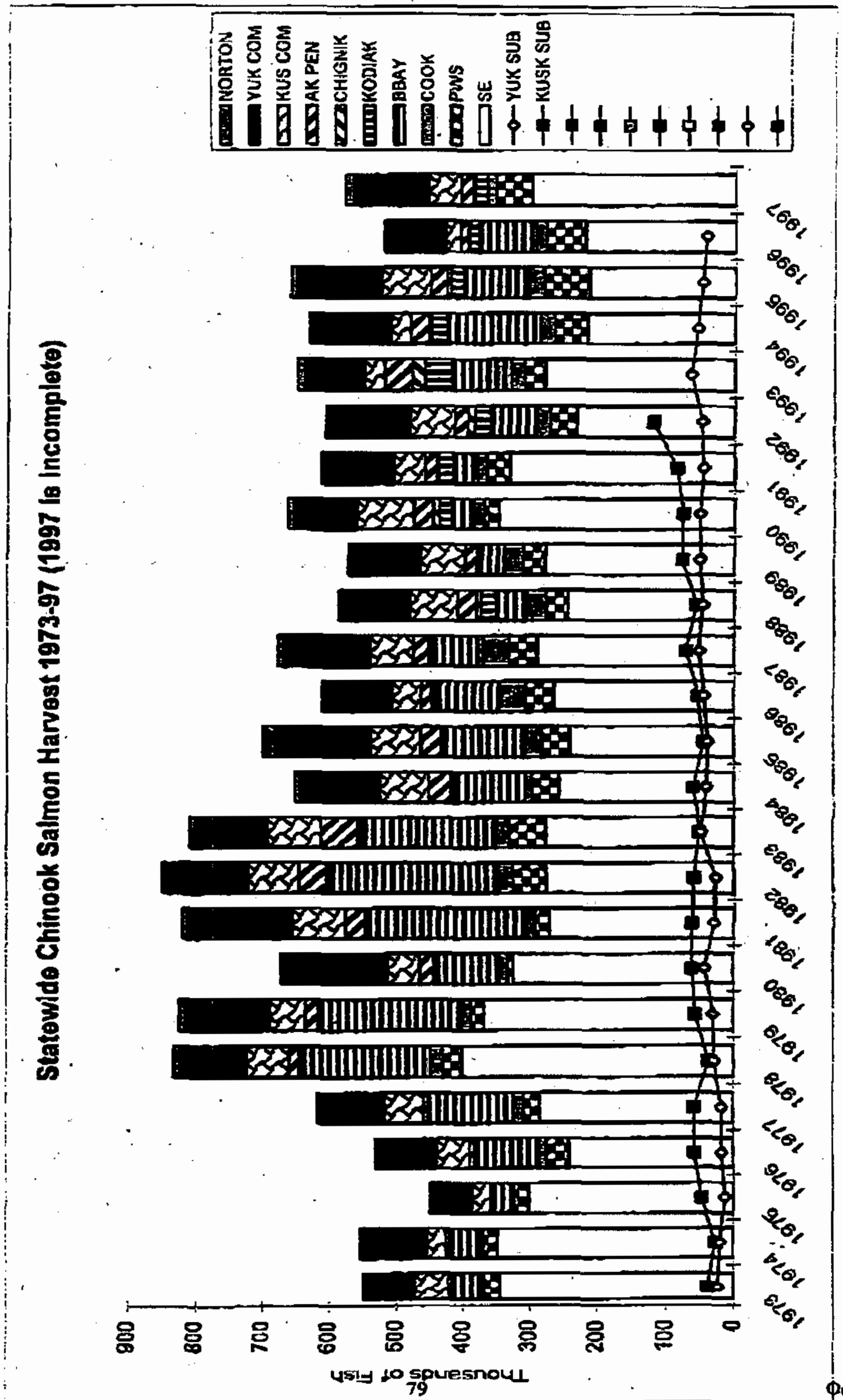


Figure 8. Catch of chinook and chum salmon and of total groundfish by target fishery as reported by observers, 1994 – 1997. Salmon are reported in numbers of fish, and groundfish in metric tons.

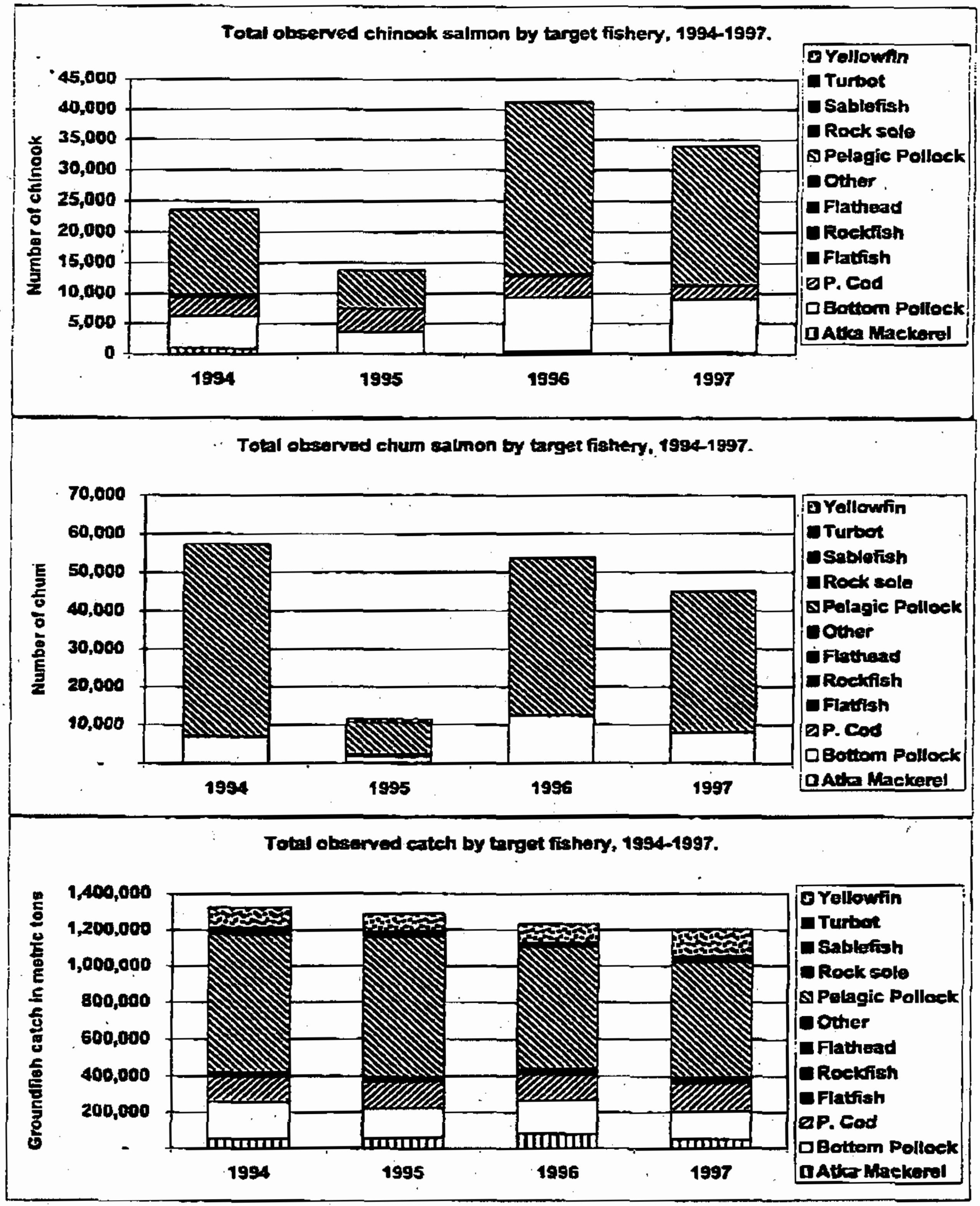


Figure 9. Cumulative trawl bycatch of chinook salmon in the Bering Sea by week, 1993 – Aug. 1998, as reported by NMFS.

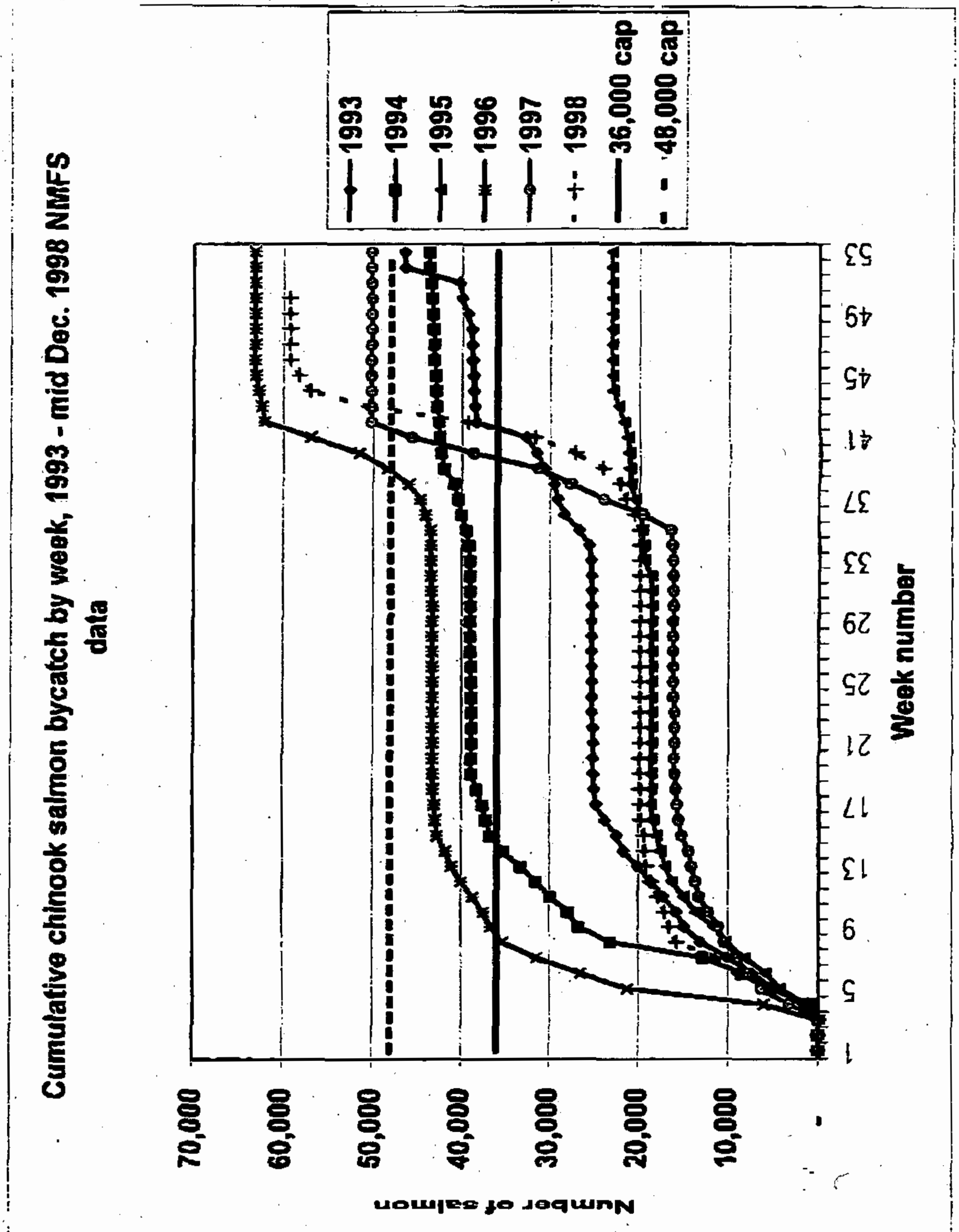


Figure 10. Cumulative trawl bycatch of chinook salmon in the Bering Sea by week and target fishery, 1993 – 1997, as reported by NMFS. Top panel = bottom trawl for pollock, Middle panel = Pacific cod, Bottom panel = pelagic pollock target.

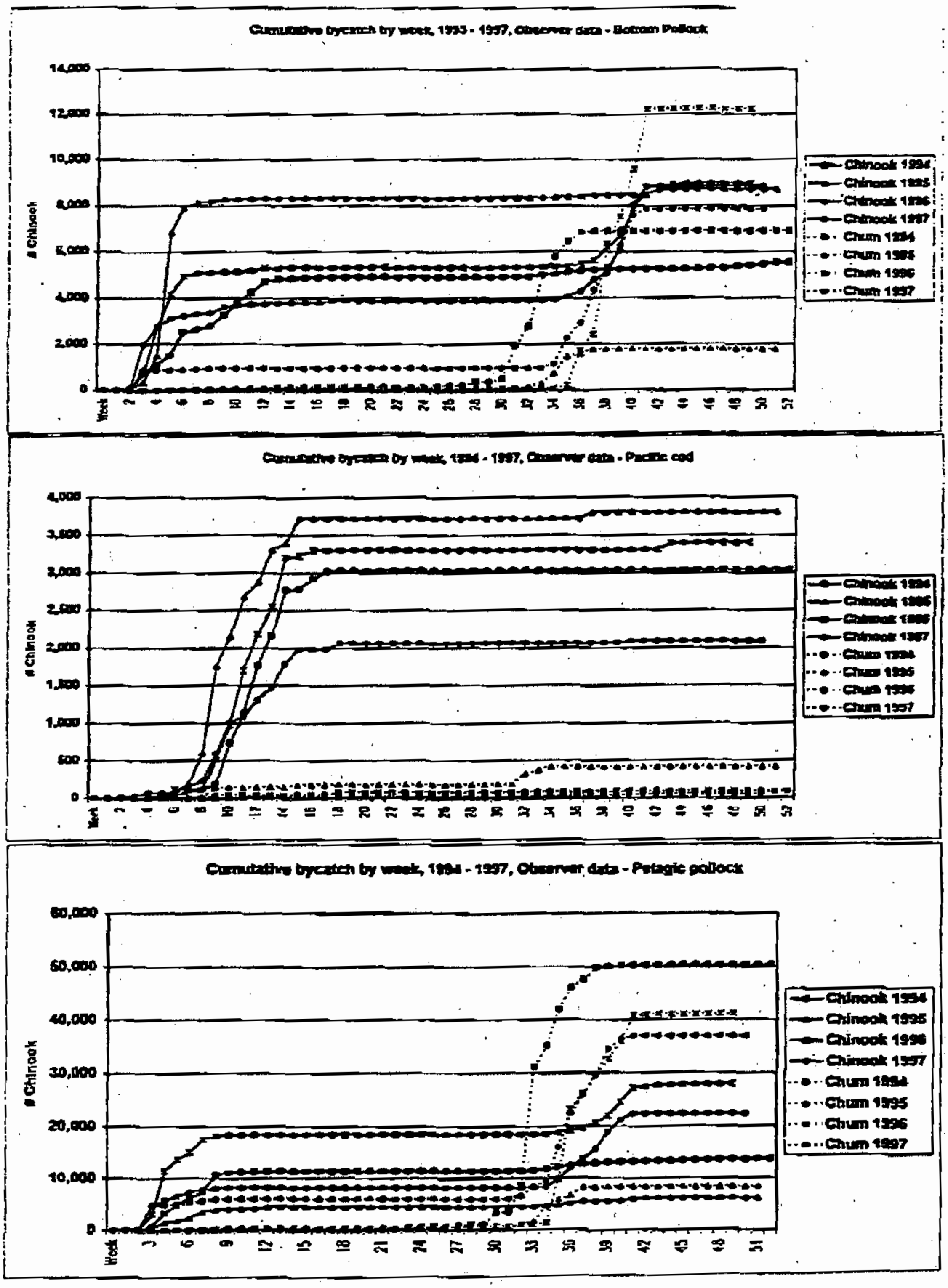


Figure 11. Total chinook salmon bycatch by six month period (Jan. – Jun. and Jul. – Dec.) over the years 1993 – first half of 1998.

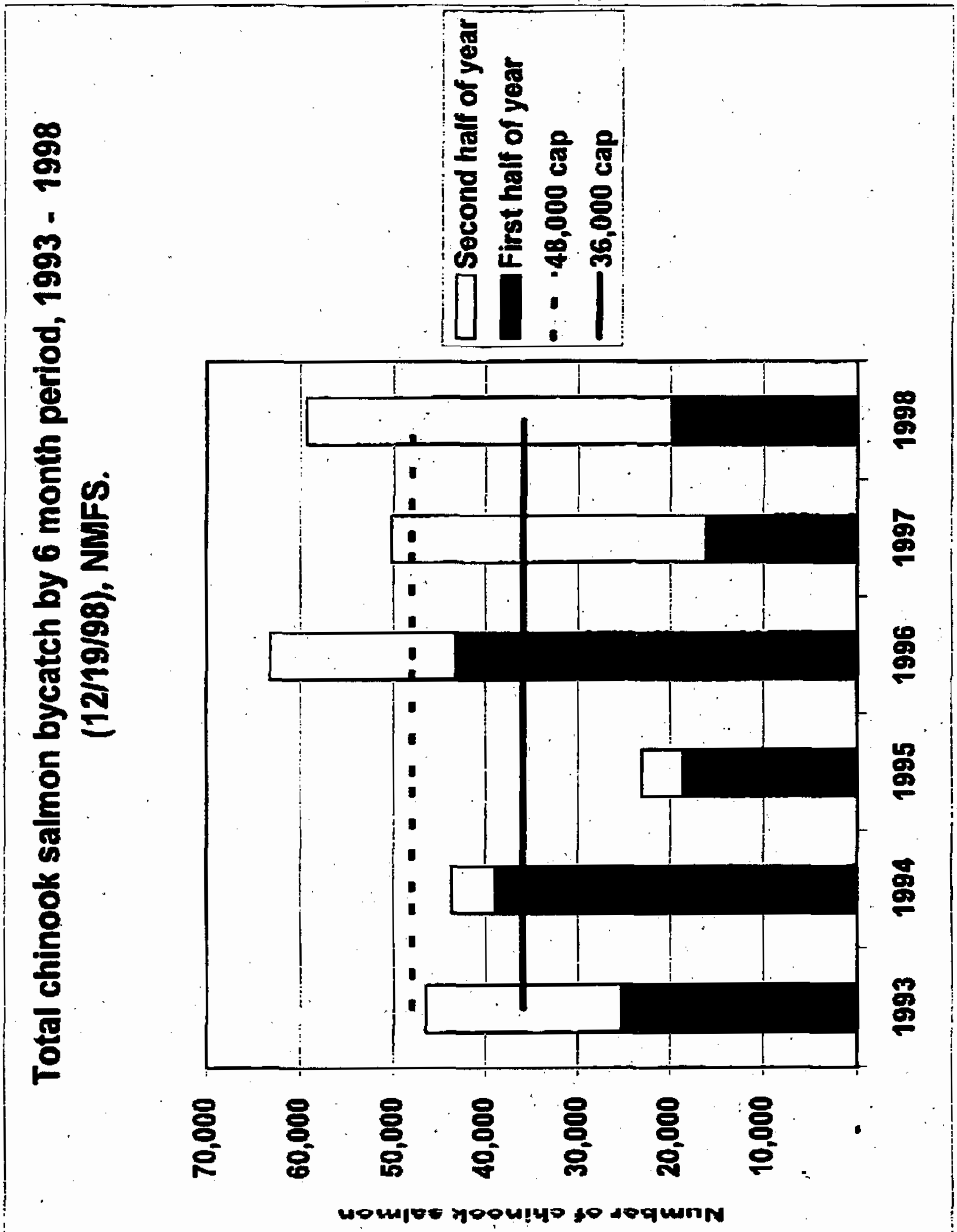


Figure 12. Chinook salmon bycatch in the Bering Sea by week, target (B,C,P) and year (1994 – 1997) (Left panels), and total groundfish catch in the Bering Sea by week, target and year (Right panels). Target fisheries are B = bottom trawl for pollock, C = Pacific cod trawl, and P = pelagic trawl for pollock.

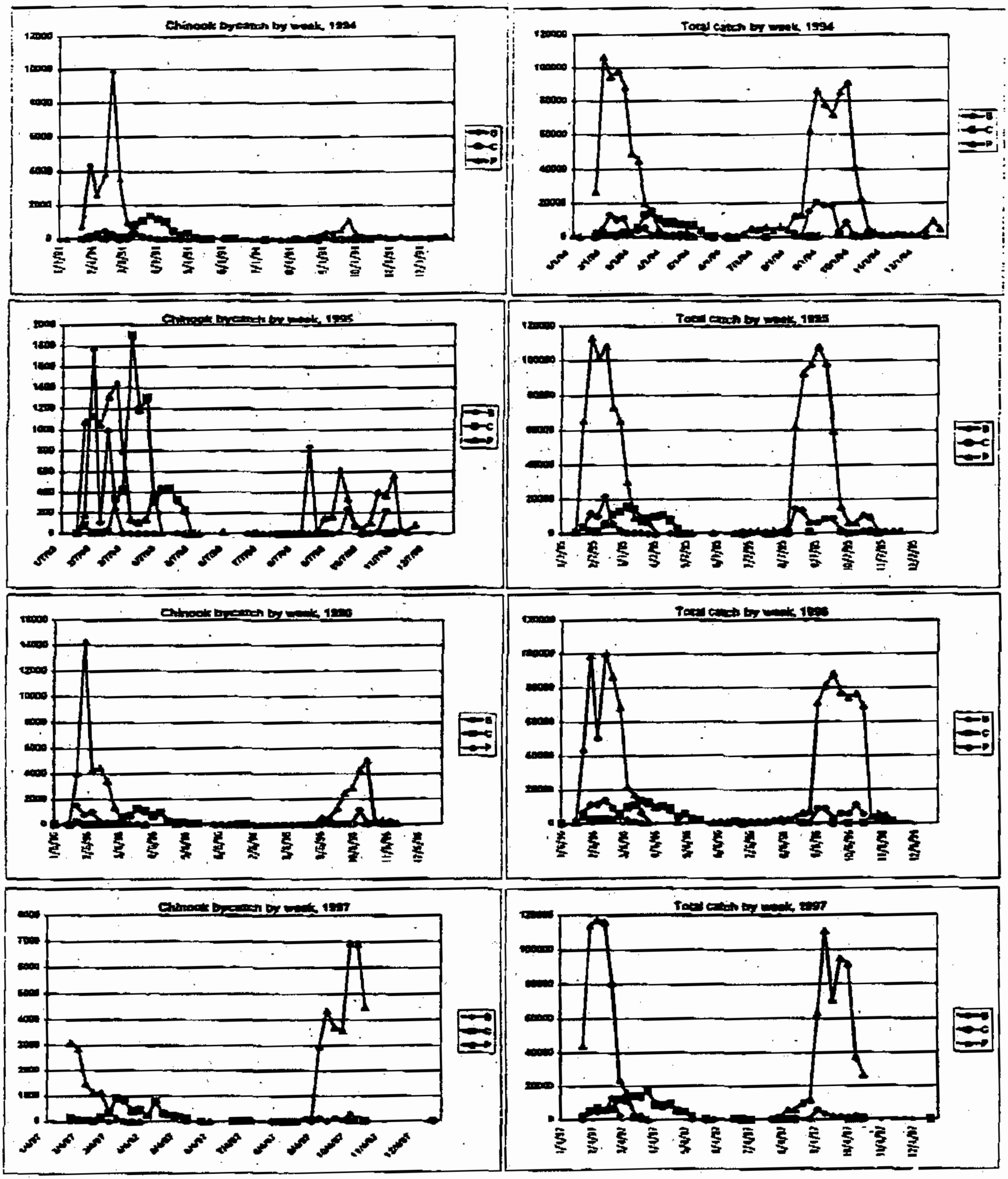
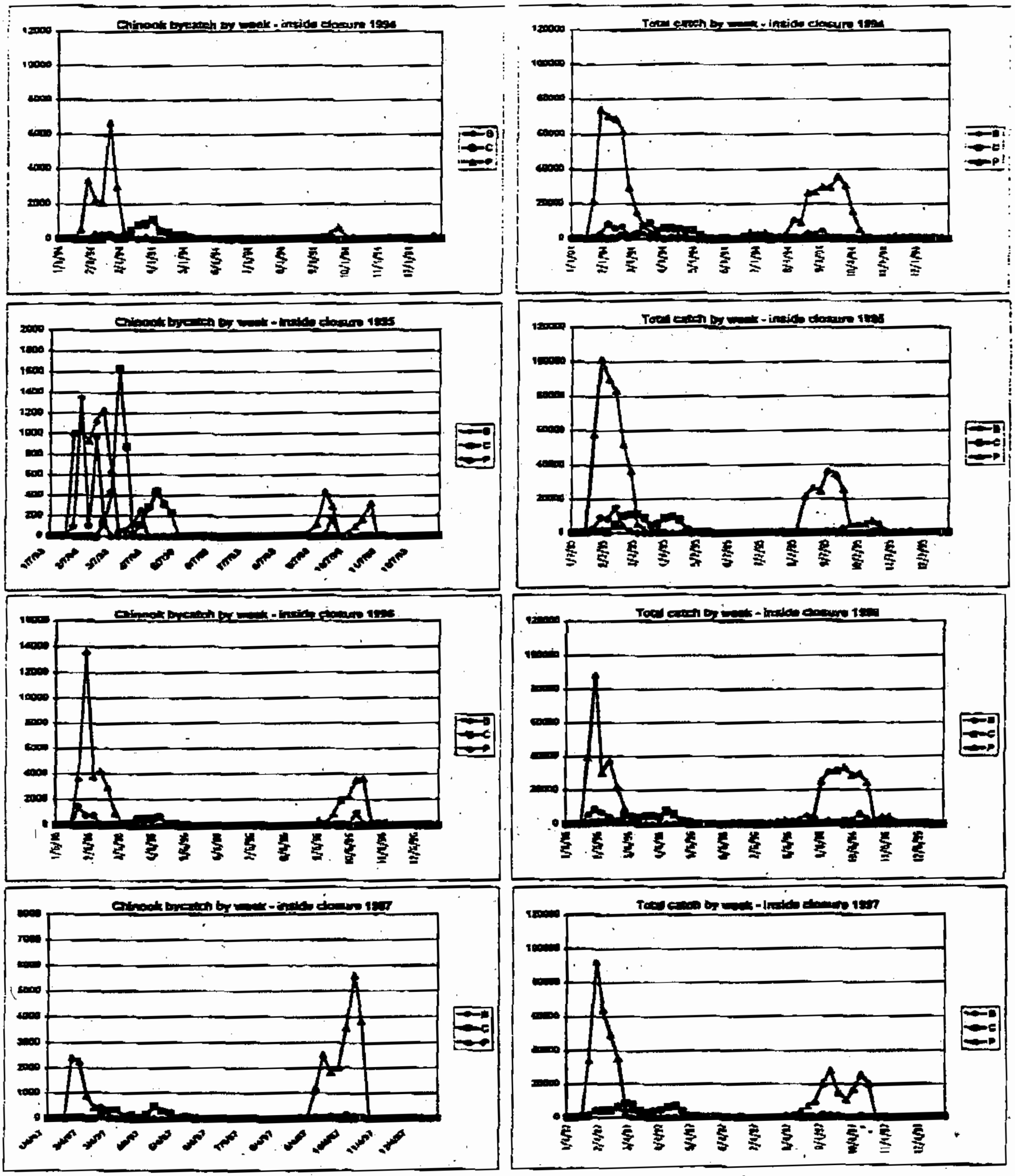


Figure 13. Chinook salmon bycatch in the Chinook Salmon Savings Area by week, target (B,C,P) and year (1994 – 1997) (Left panels), and total groundfish catch in the Chinook Salmon Savings Area by week, target and year (Right panels). Target fisheries are B = bottom trawl for pollock, C = Pacific cod trawl, and P = pelagic trawl for pollock.



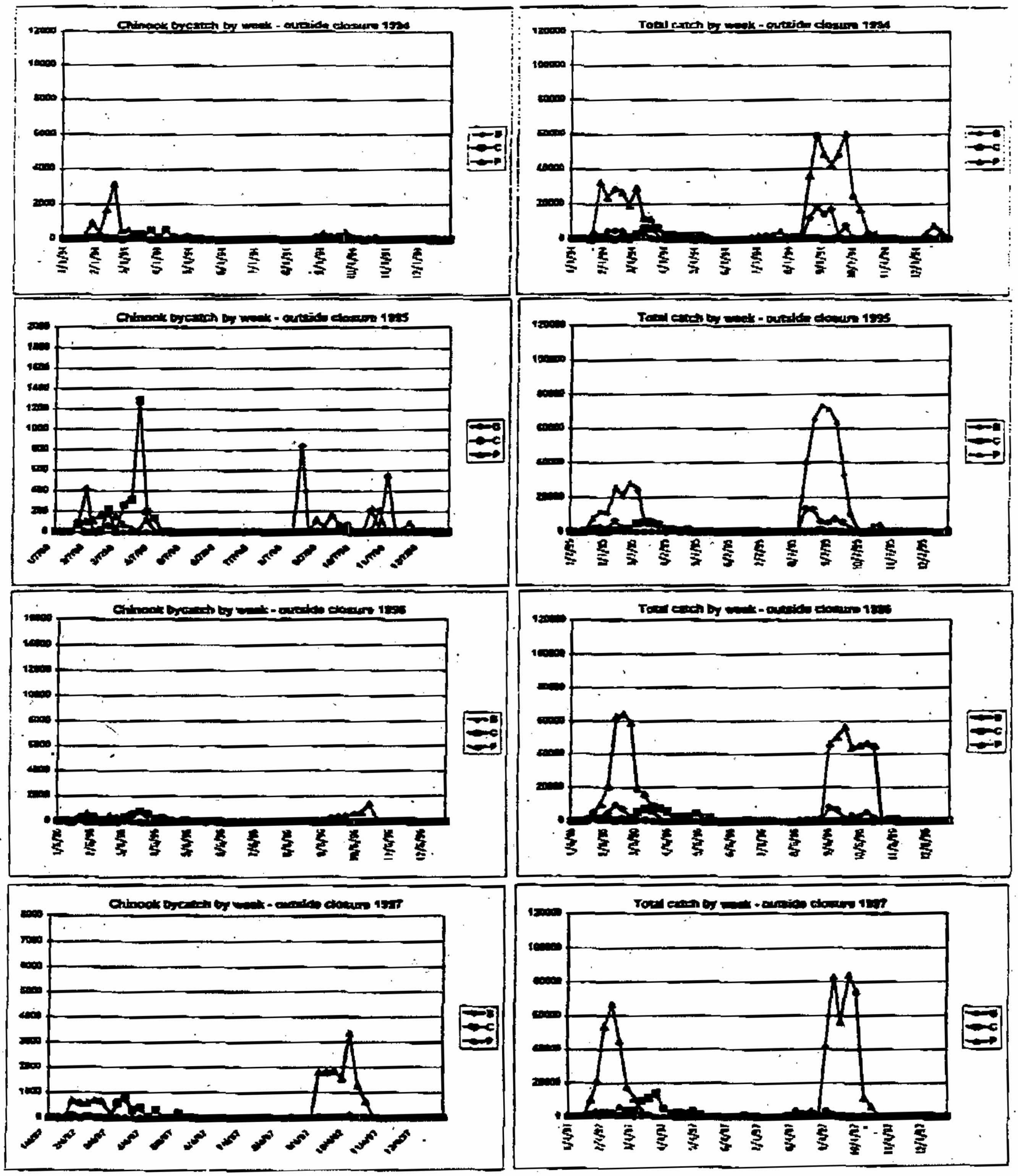
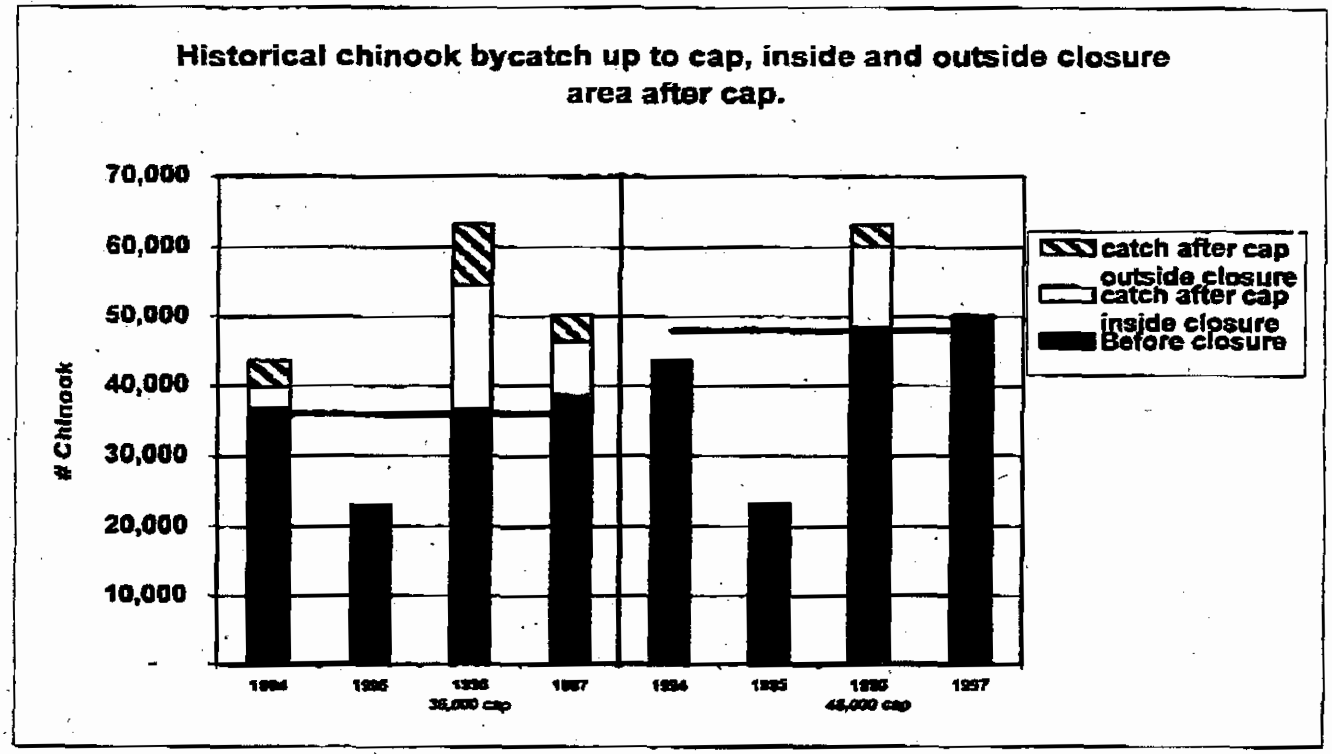


Figure 14. Chinook salmon bycatch outside the Chinook Salmon Savings Area by week, target (B,C,P) and year (1994 – 1997) (Left panels), and total groundfish catch outside the Chinook Salmon Savings Area by week, target and year (Right panels). Target fisheries are B = bottom trawl for pollock, C = Pacific cod trawl, and P = pelagic trawl for pollock.

Figure 15. Historic chinook bycatch prior to a proposed closure, after a closure inside the Chinook Salmon Savings Area, and after a closure outside of the Chinook Salmon Savings Area. Cap amounts of 36,000 chinook and 48,000 chinook left and right. Total percentages in bottom panel.



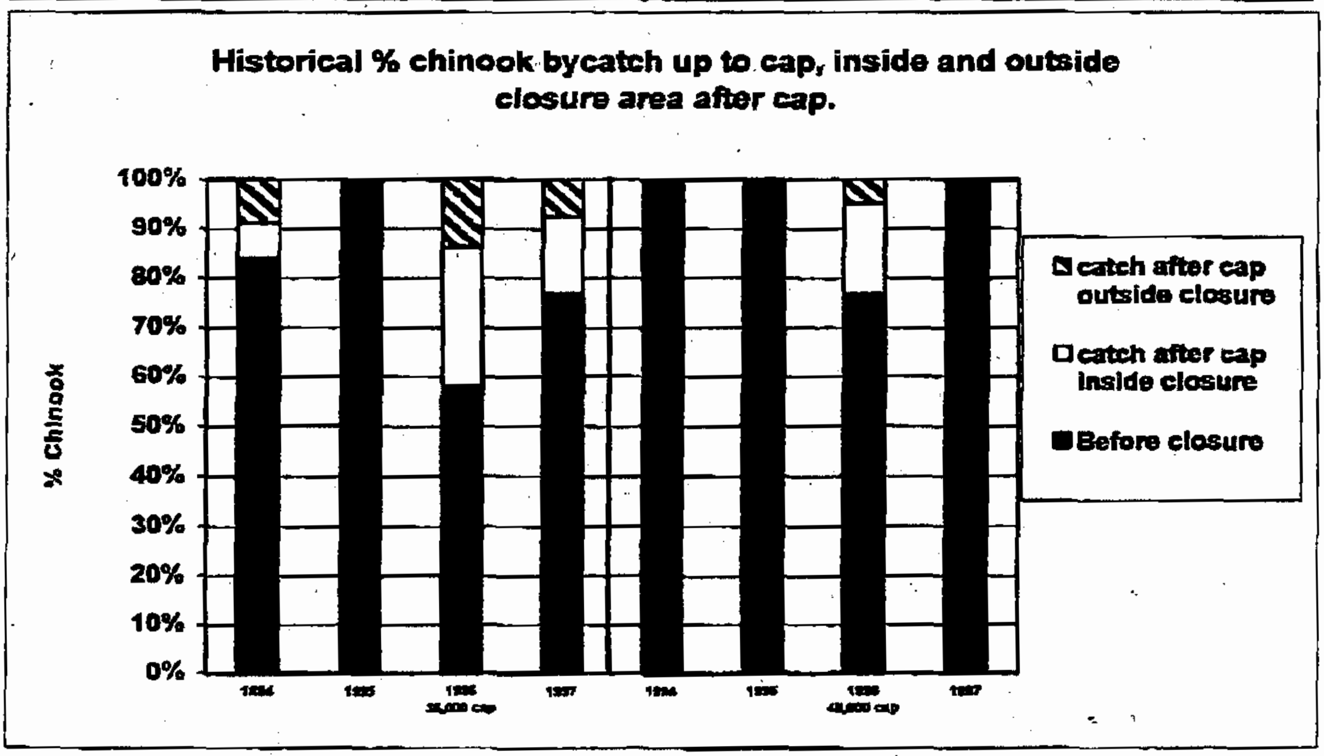
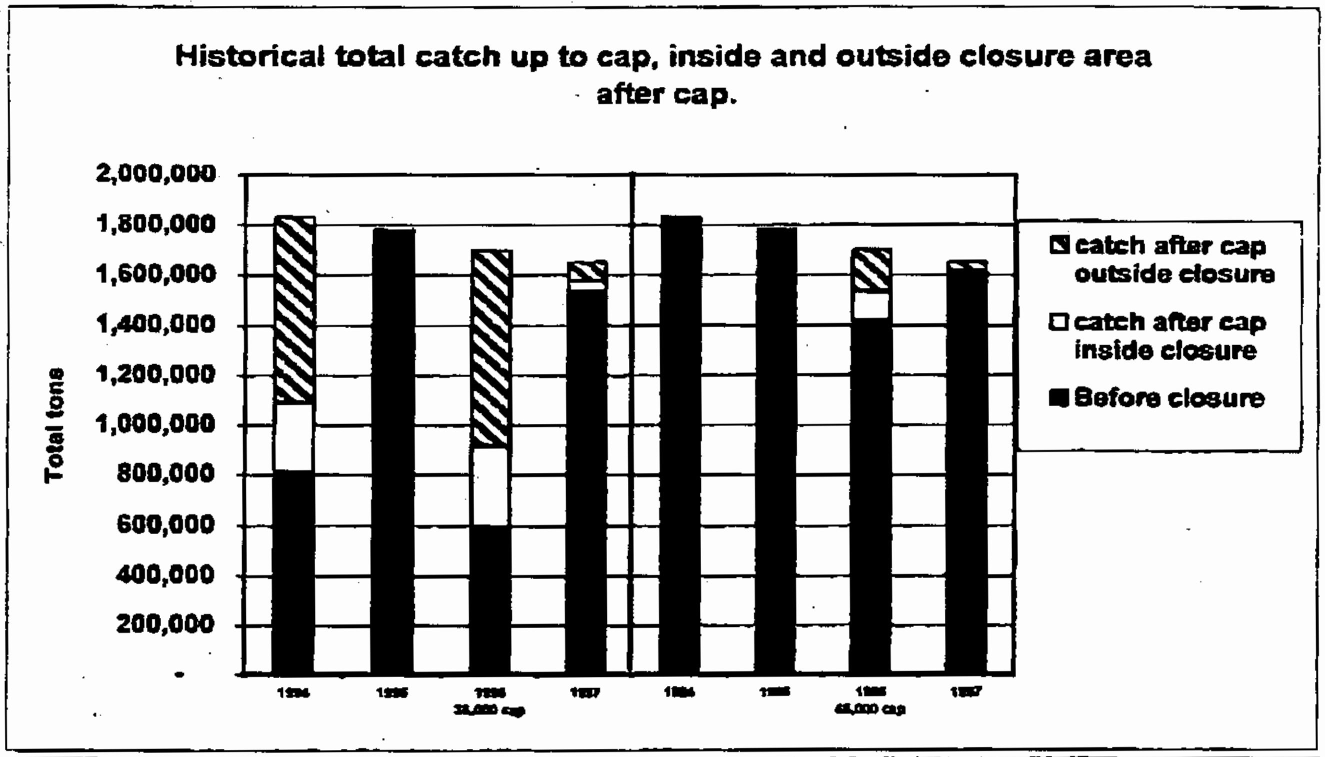


Figure 16. Historic groundfish catch prior to a proposed closure, after a closure inside the Chinook Salmon Savings Area , and after a closure outside of the Chinook Salmon Savings Area. Cap categories of 36,000 chinook and 48,000 chinook left and right. Total percentages in bottom panel.



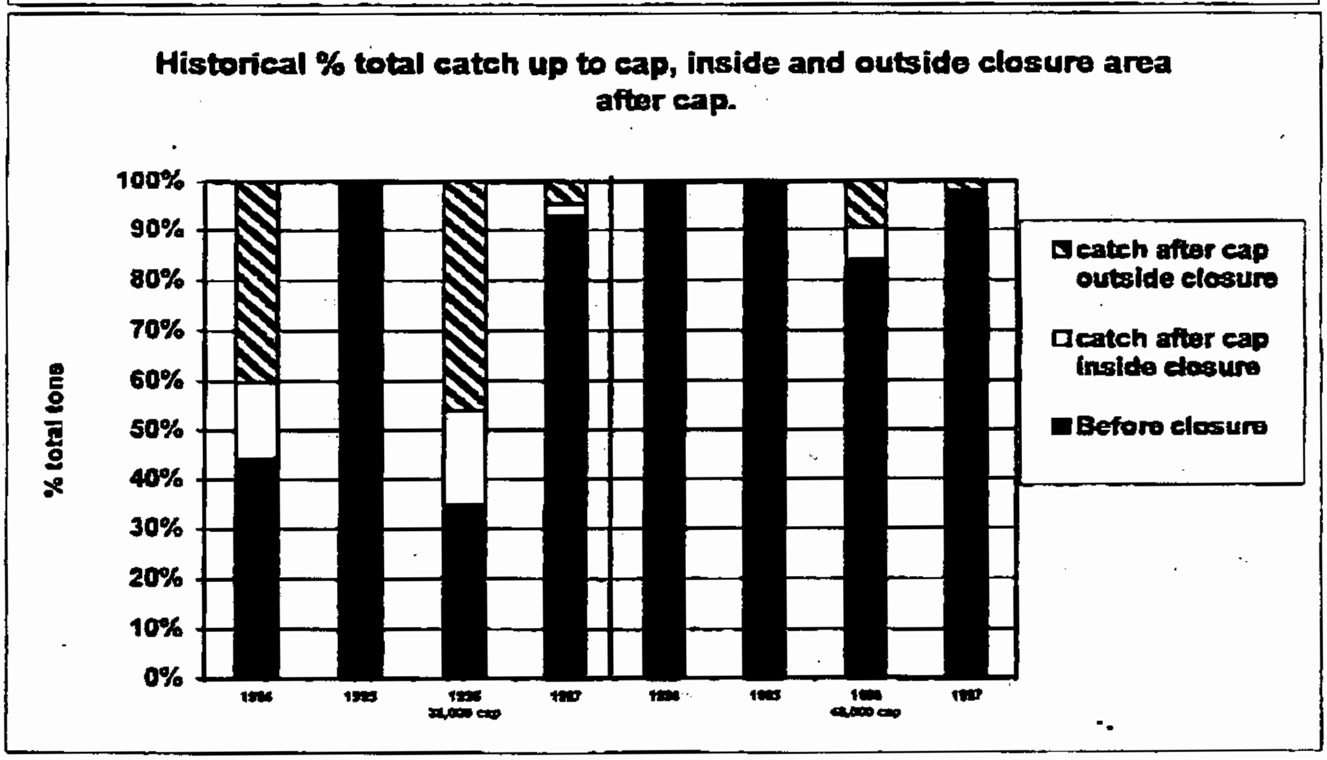


Figure 17. Pelagic pollock fishery catch and chinook bycatch within and outside of the Chinook Salmon Savings Area by week in 1994 (top panel); cumulative catch and bycatch (middle panel); and rates (bottom panel, number salmon per metric ton of groundfish). Vertical reference lines correspond to September 1 and October 1 dates.

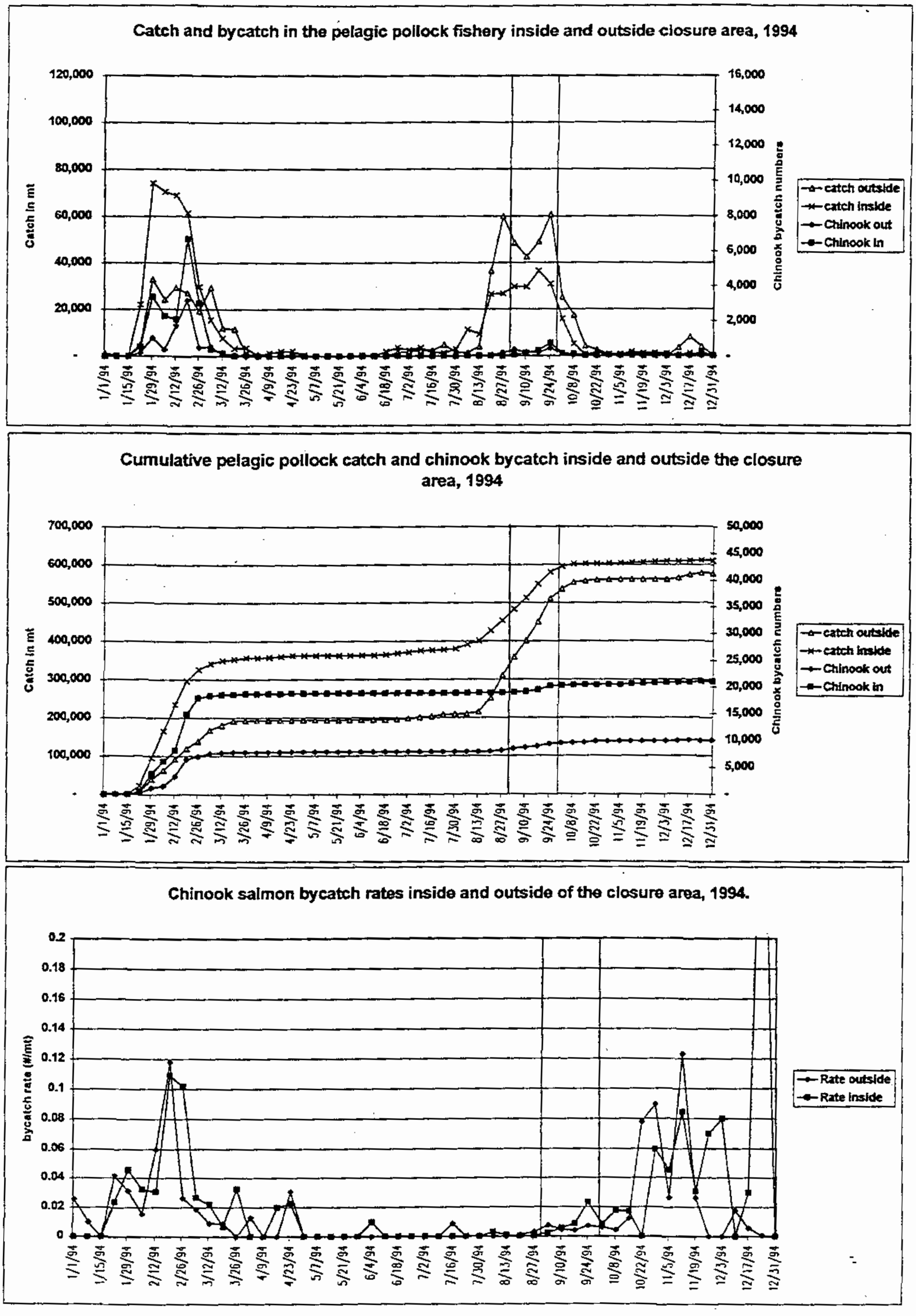


Figure 18. Pelagic pollock fishery catch and chinook bycatch within and outside of the Chinook Salmon Savings Area by week in 1995 (top panel); cumulative catch and bycatch (middle panel); and rates (bottom panel, number salmon per metric ton of groundfish). Vertical reference lines correspond to September 1 and October 1 dates.

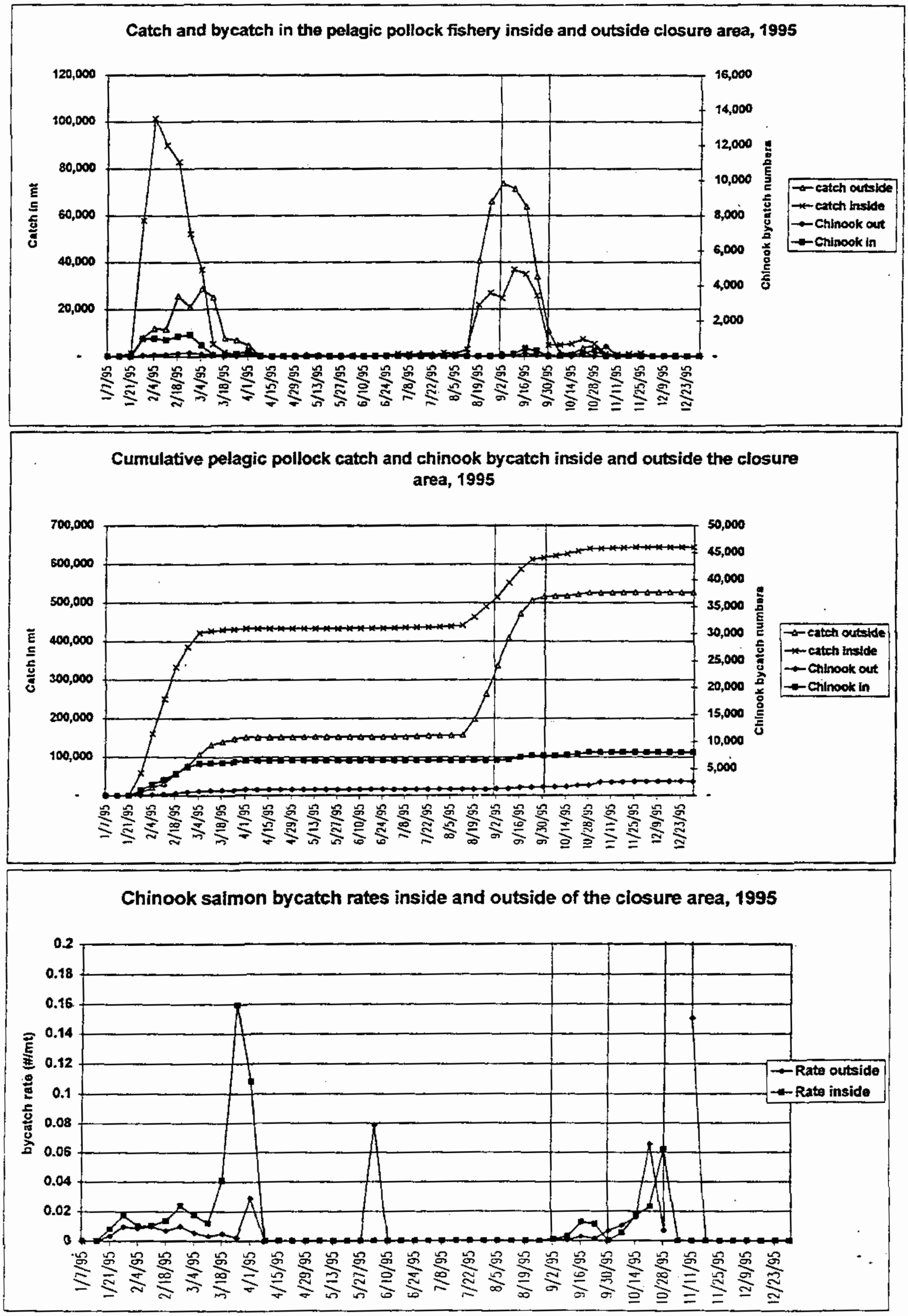


Figure 19. Pelagic pollock fishery catch and chinook bycatch within and outside of the Chinook Salmon Savings Area by week in 1996 (top panel); cumulative catch and bycatch (middle panel); and rates (bottom panel, number salmon per metric ton of groundfish). Vertical reference lines correspond to September 1 and October 1 dates.

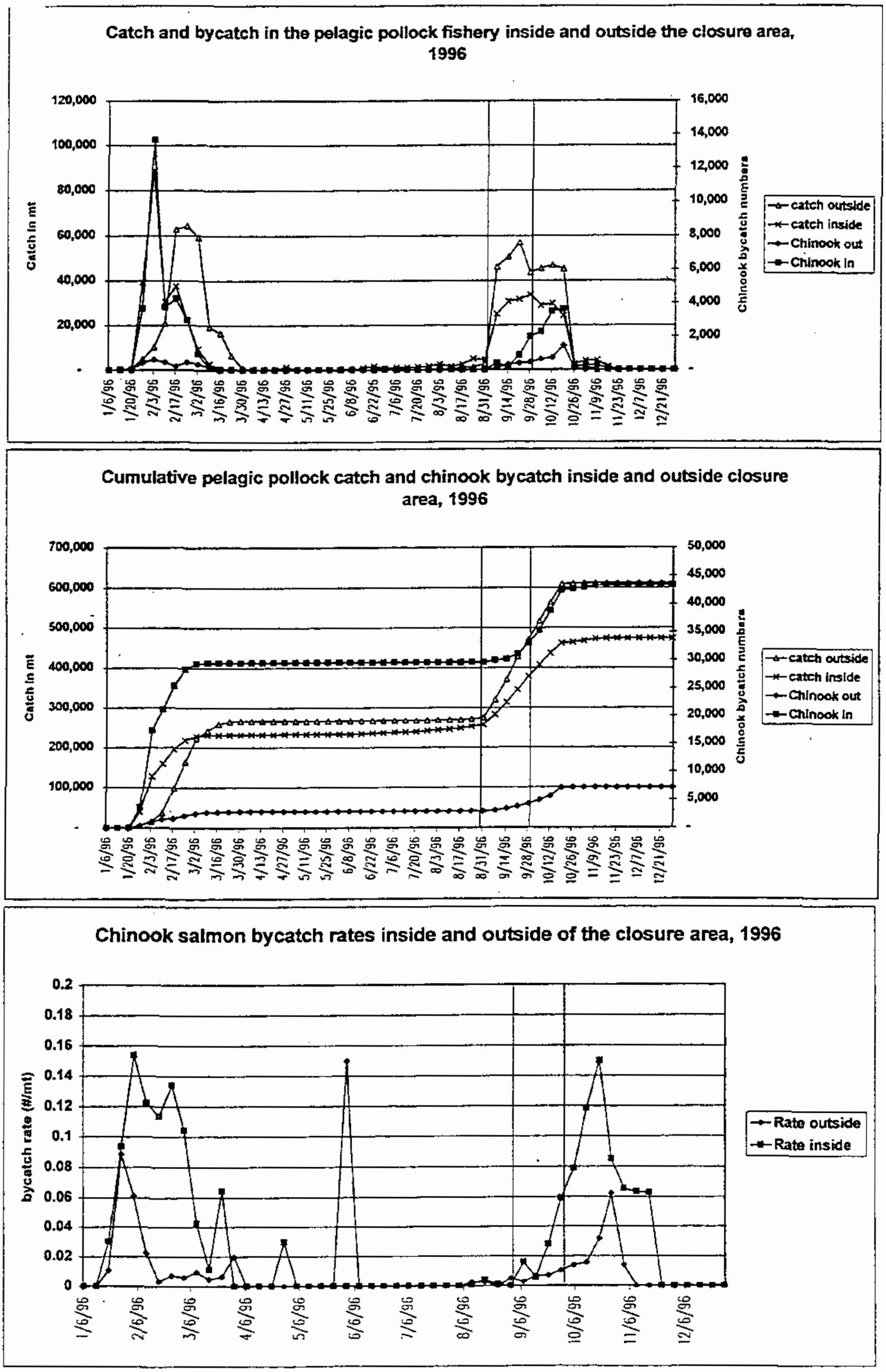


Figure 20. Pelagic pollock fishery catch and chinook bycatch within and outside of the Chinook Salmon Savings Area by week in 1997 (top panel); cumulative catch and bycatch (middle panel); and rates (bottom panel, number salmon per metric ton of groundfish). Vertical reference lines correspond to September 1 and October 1 dates.

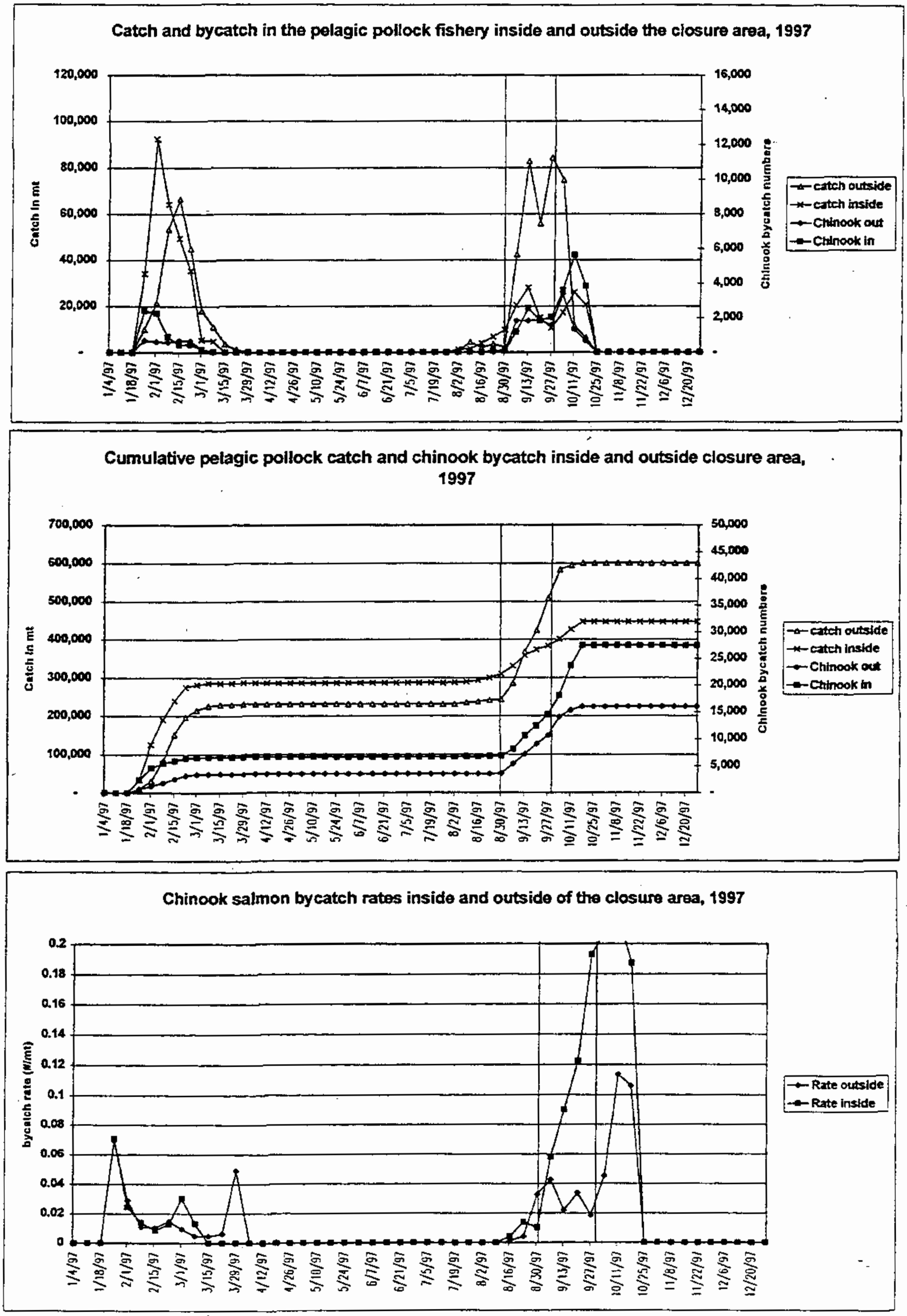


Figure 21. Cumulative trawl bycatch of chinook salmon in the Bering Sea by week and target fishery. Accounting period beginning September 1 and ending August 31 with week 37 corresponding to September 1.

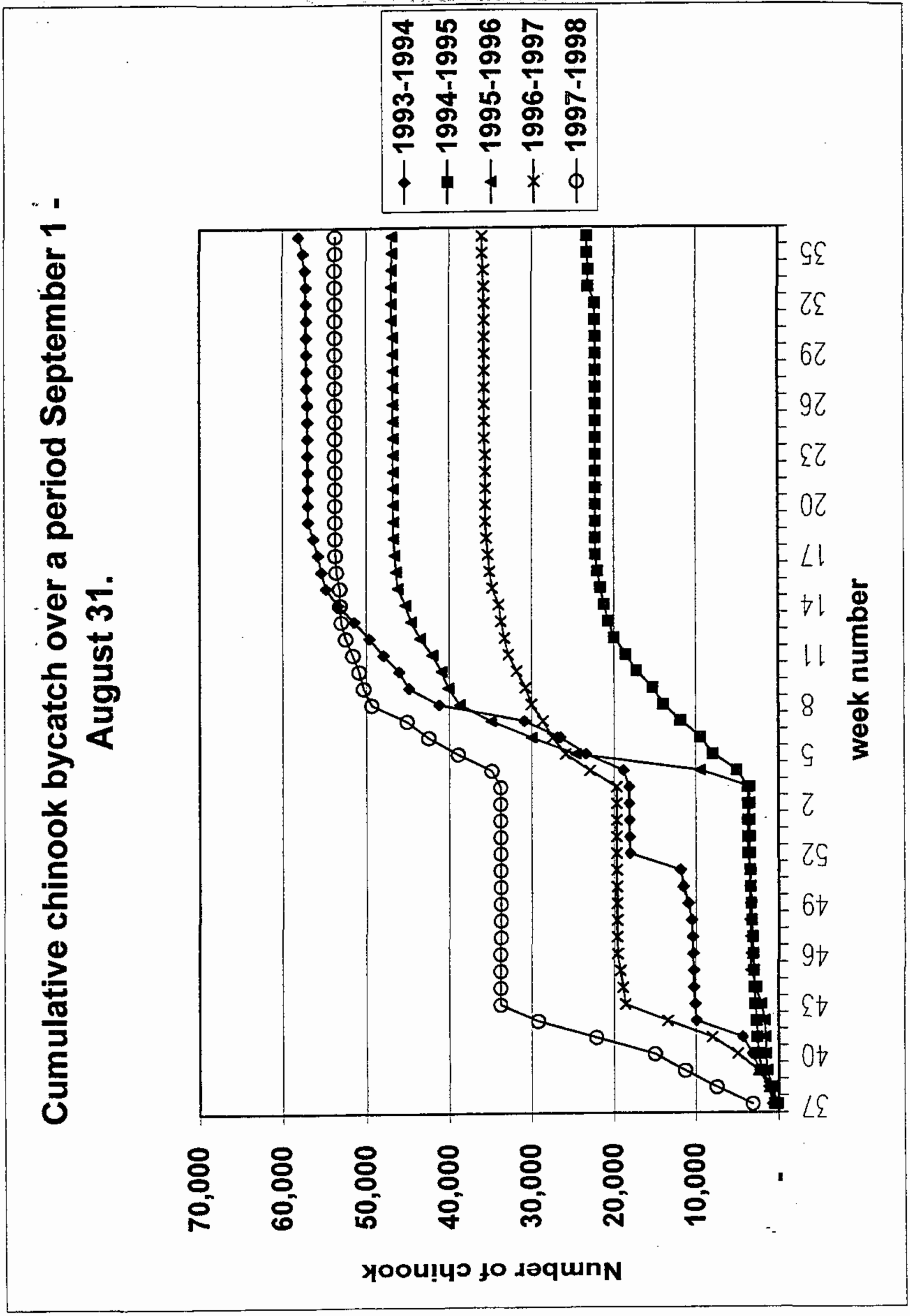


Figure 22. Cell reference codes used to identify individual 1/2° latitude by 1° longitude blocks in the Bering Sea. Note that cell 201 in sequence had been halved and recoded as 997 and 998.

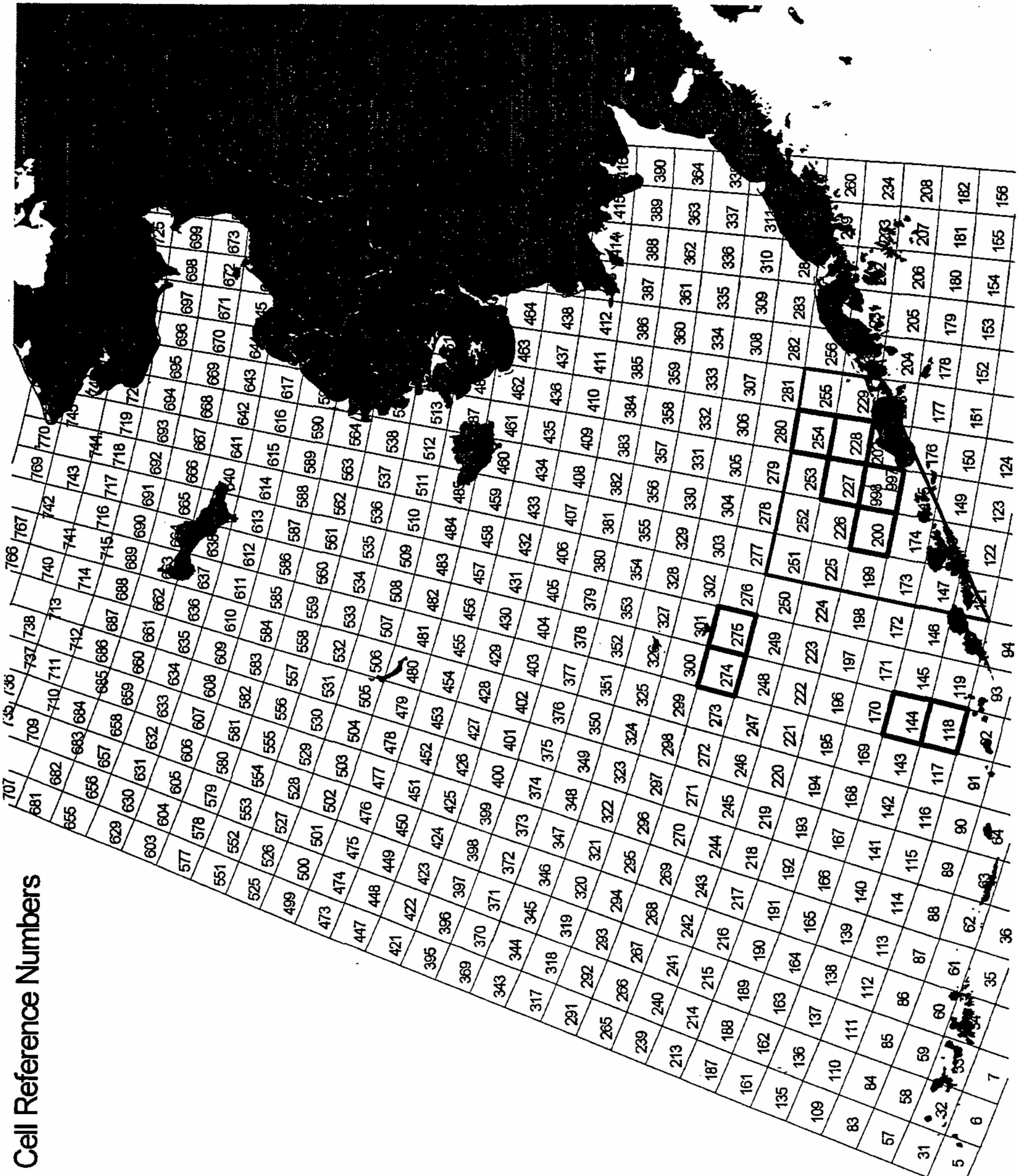


Figure 23. Locations of observed hauls with more than 25 chinook salmon in a haul, 1994-1997. Chinook Salmon Savings Area 9 blocks are very bold and the CVOA is outlined.

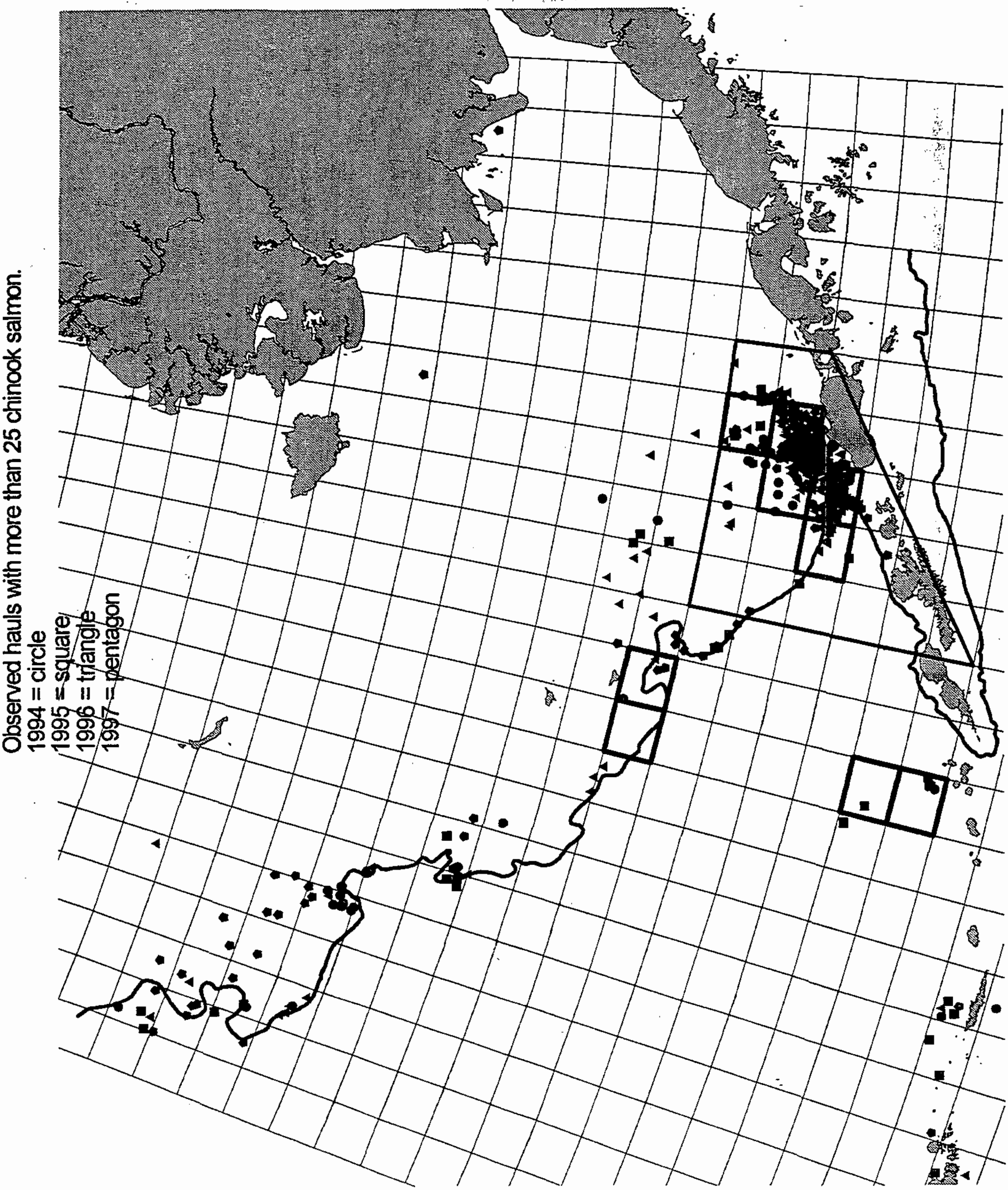


Figure 24. Blocks with trawl fishing by the pelagic pollock fishery in each year 1994 – 1997. Number of weeks a block was ranked number 1 (highest) for bycatch of chinook salmon as indicated by scale on each map.

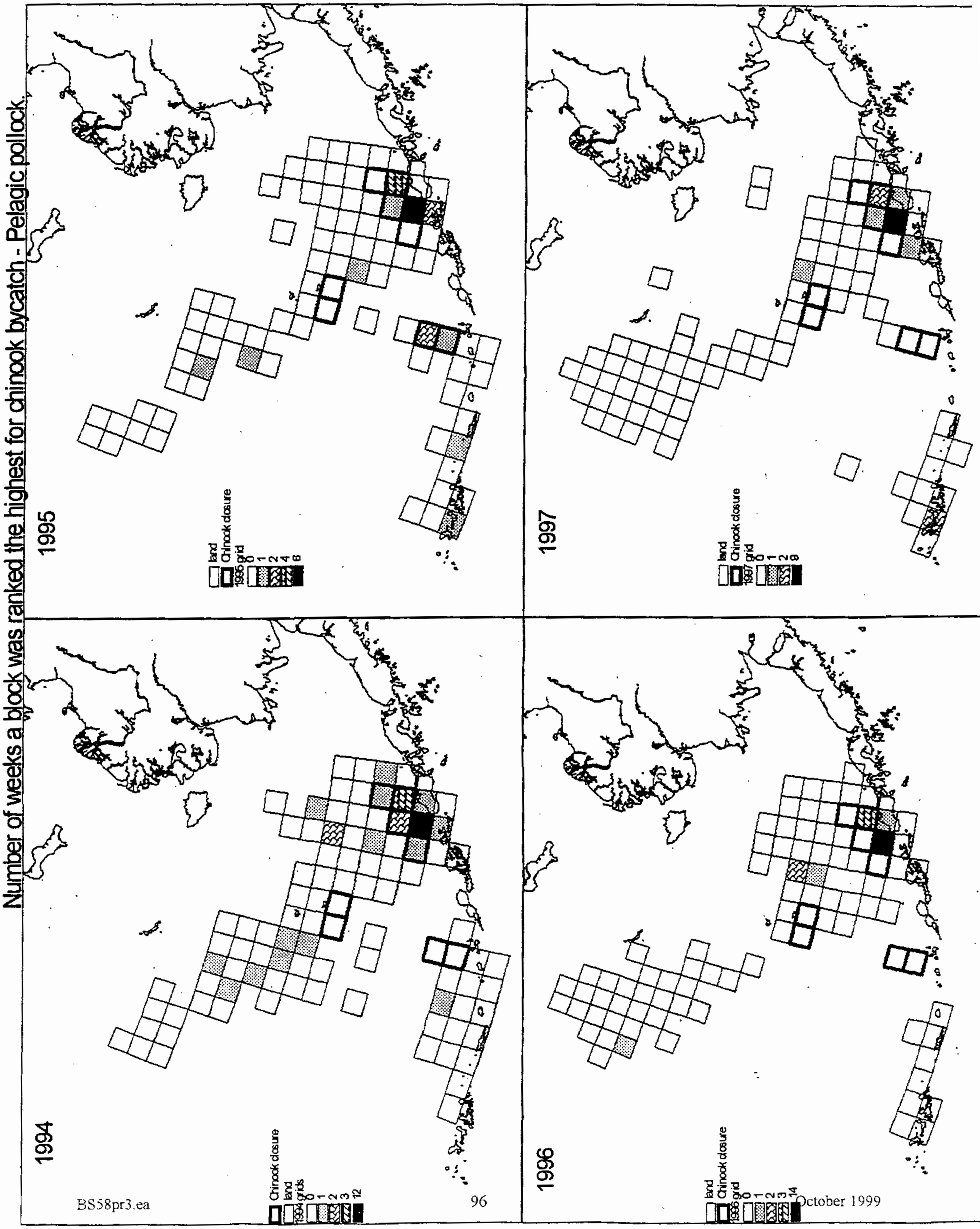


Figure 25. Blocks with trawl fishing by the pelagic pollock fishery in each year 1994 – 1997. Number of weeks a block was ranked 1, 2, or 3 (three highest) for bycatch of chinook salmon as indicated by scale on each map.

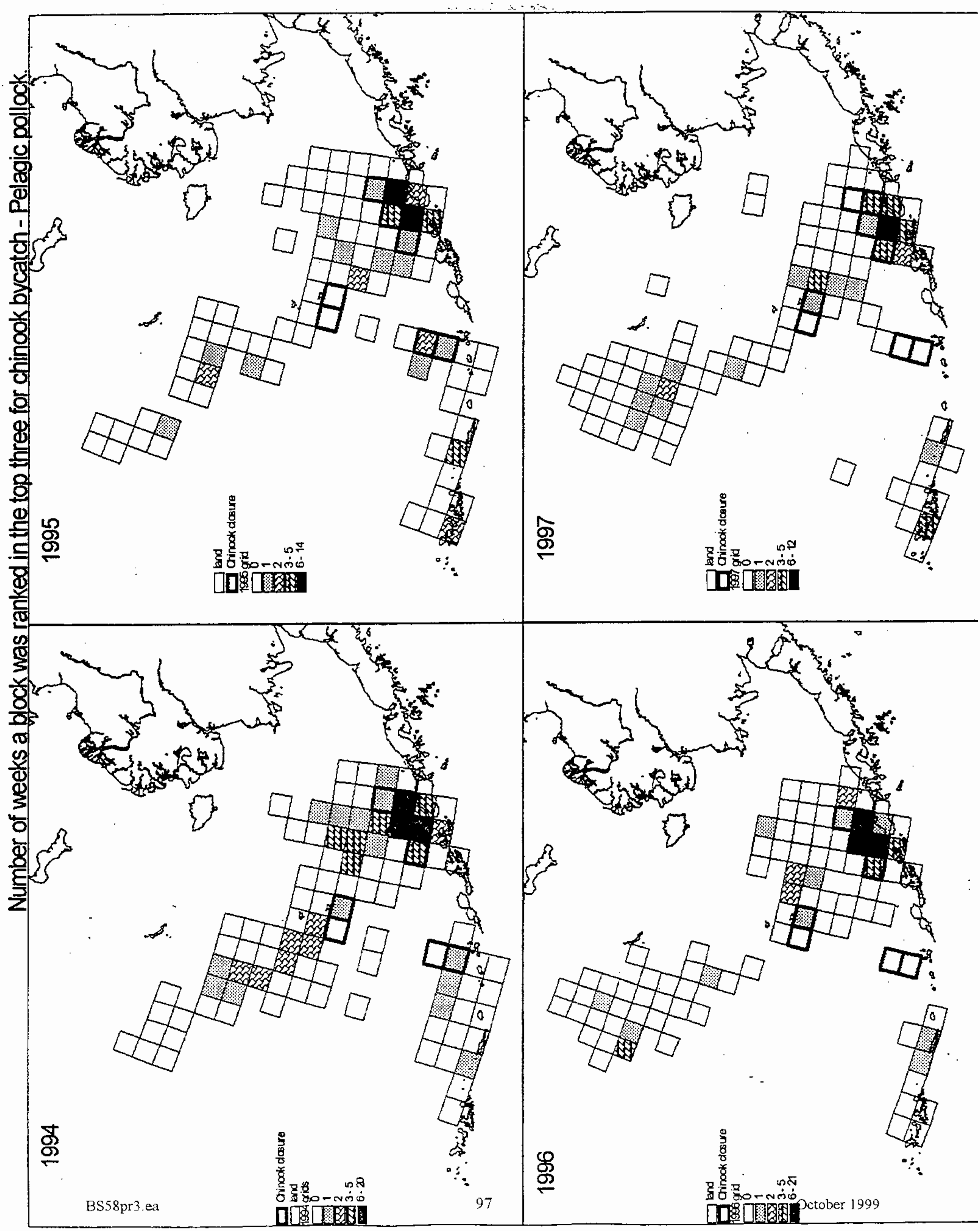


Figure 26. Blocks with trawl fishing by the pelagic pollock fishery in each year 1994 – 1997. Overall rank for chinook salmon bycatch over all weeks as indicated by scale on each map. Top 10 squares and top 20 squares in each year are indicated.

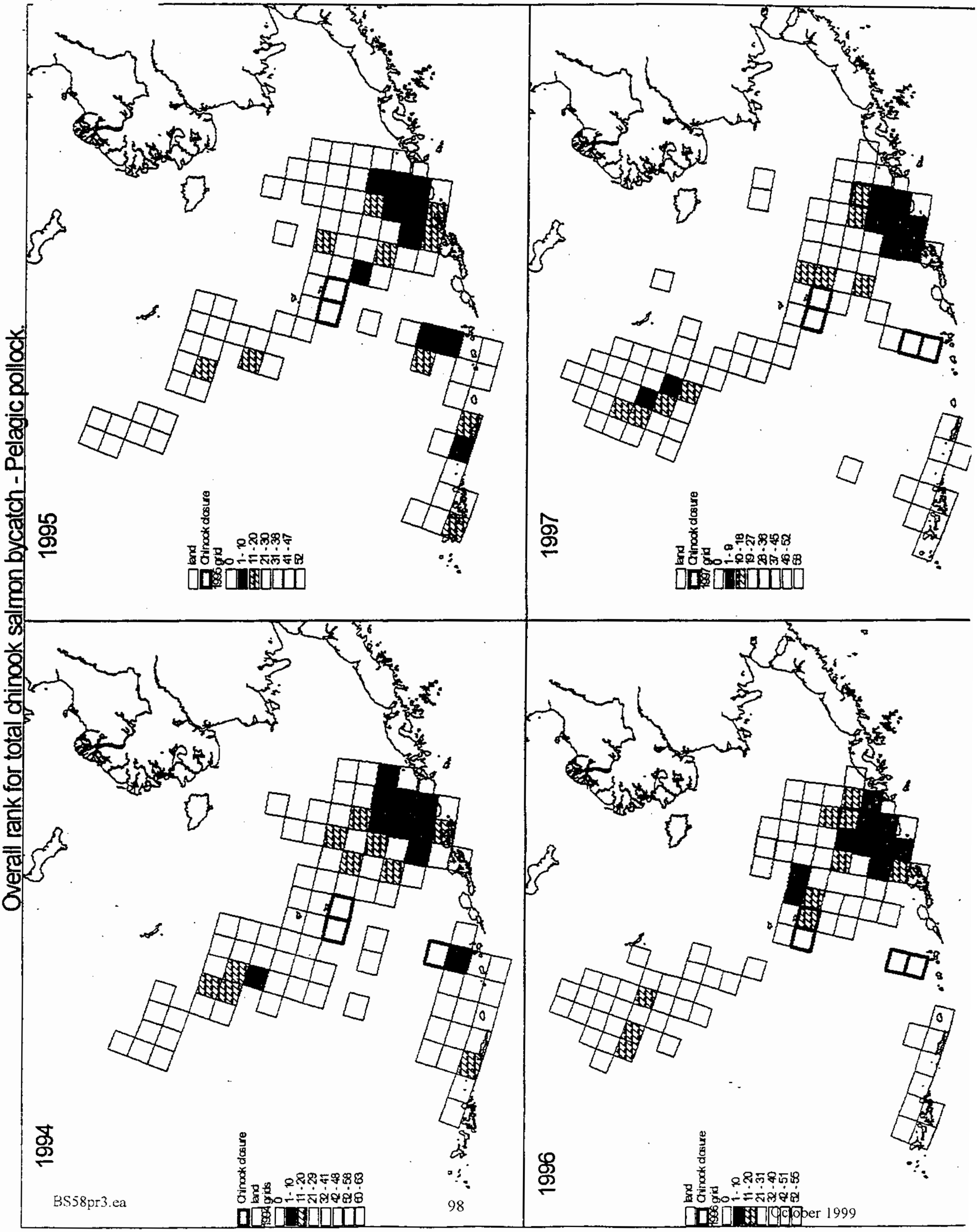
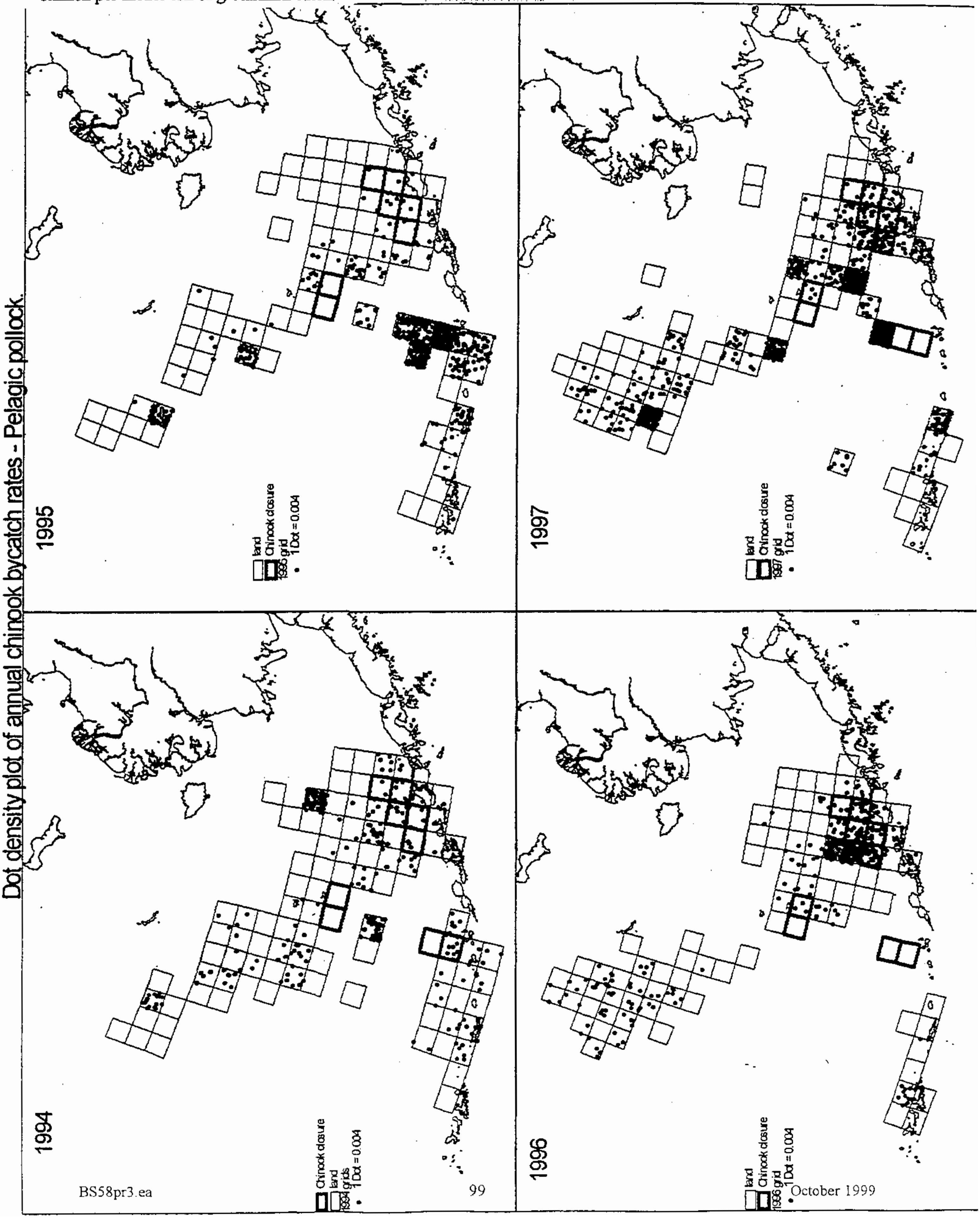


Figure 27. Blocks with trawl fishing by the pelagic pollock fishery in each year 1994 – 1997. Dot density map of chinook salmon bycatch rates with additional dots drawn at random in each square for every unit of .004 chinook salmon per metric ton of groundfish catch.



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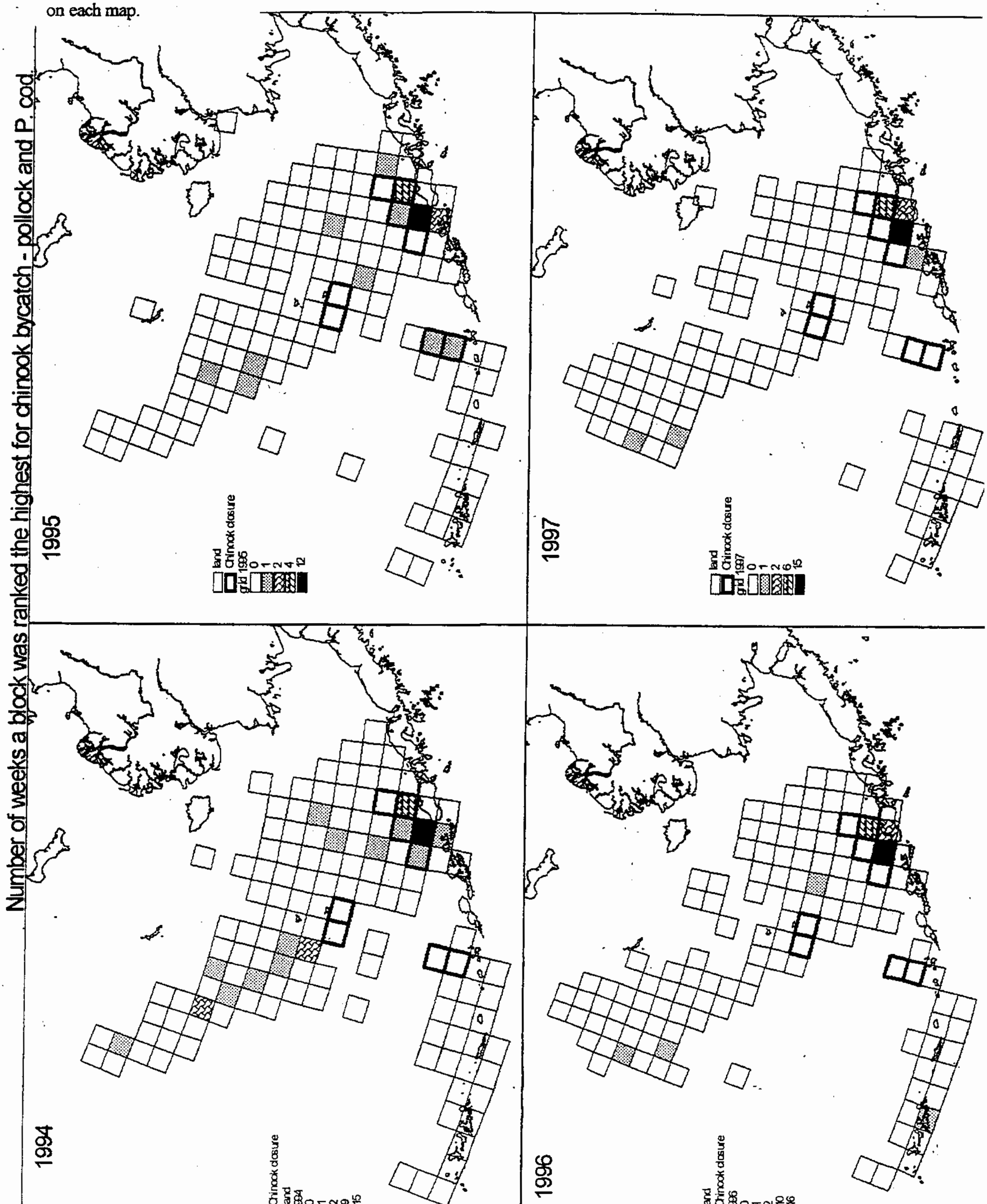

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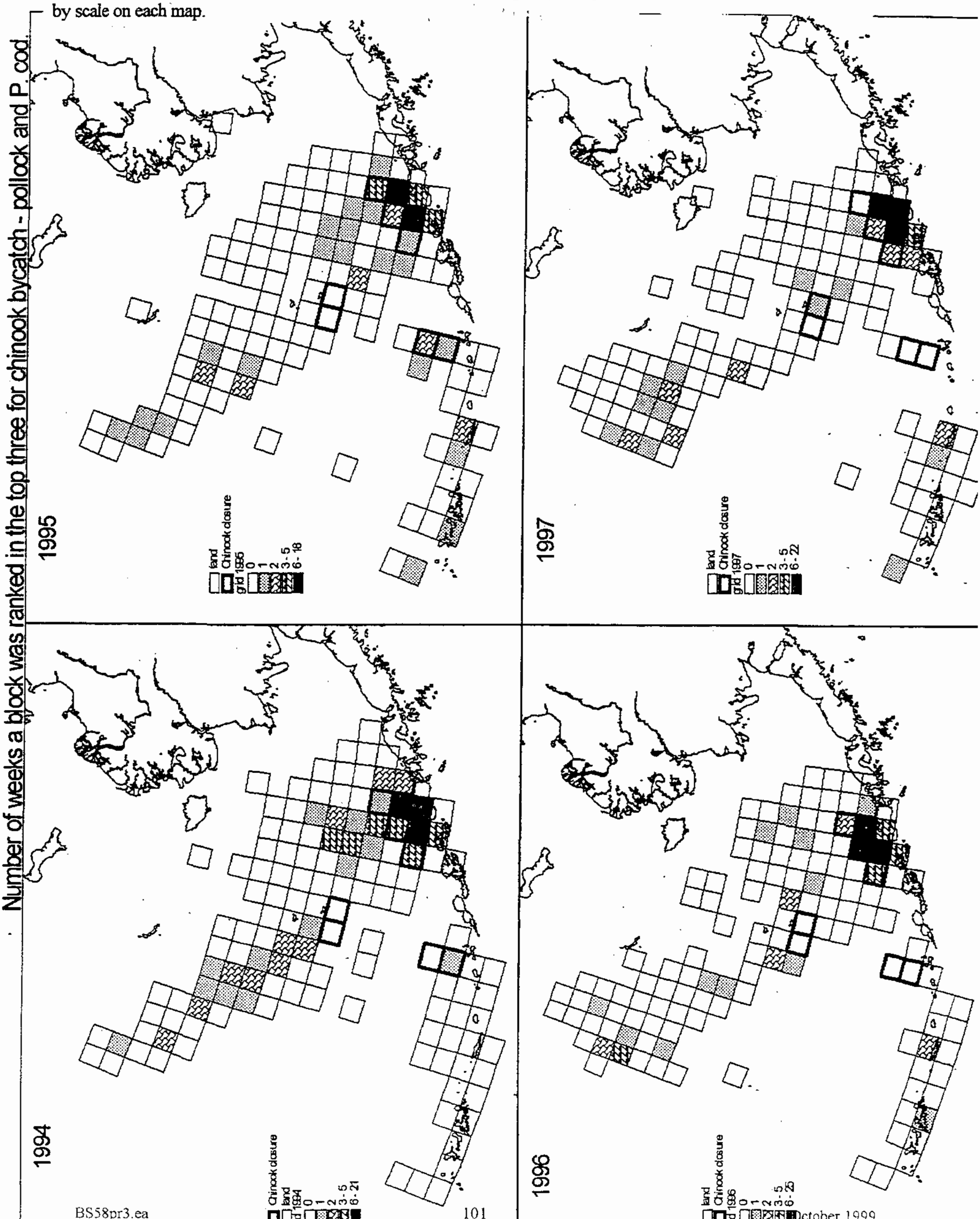

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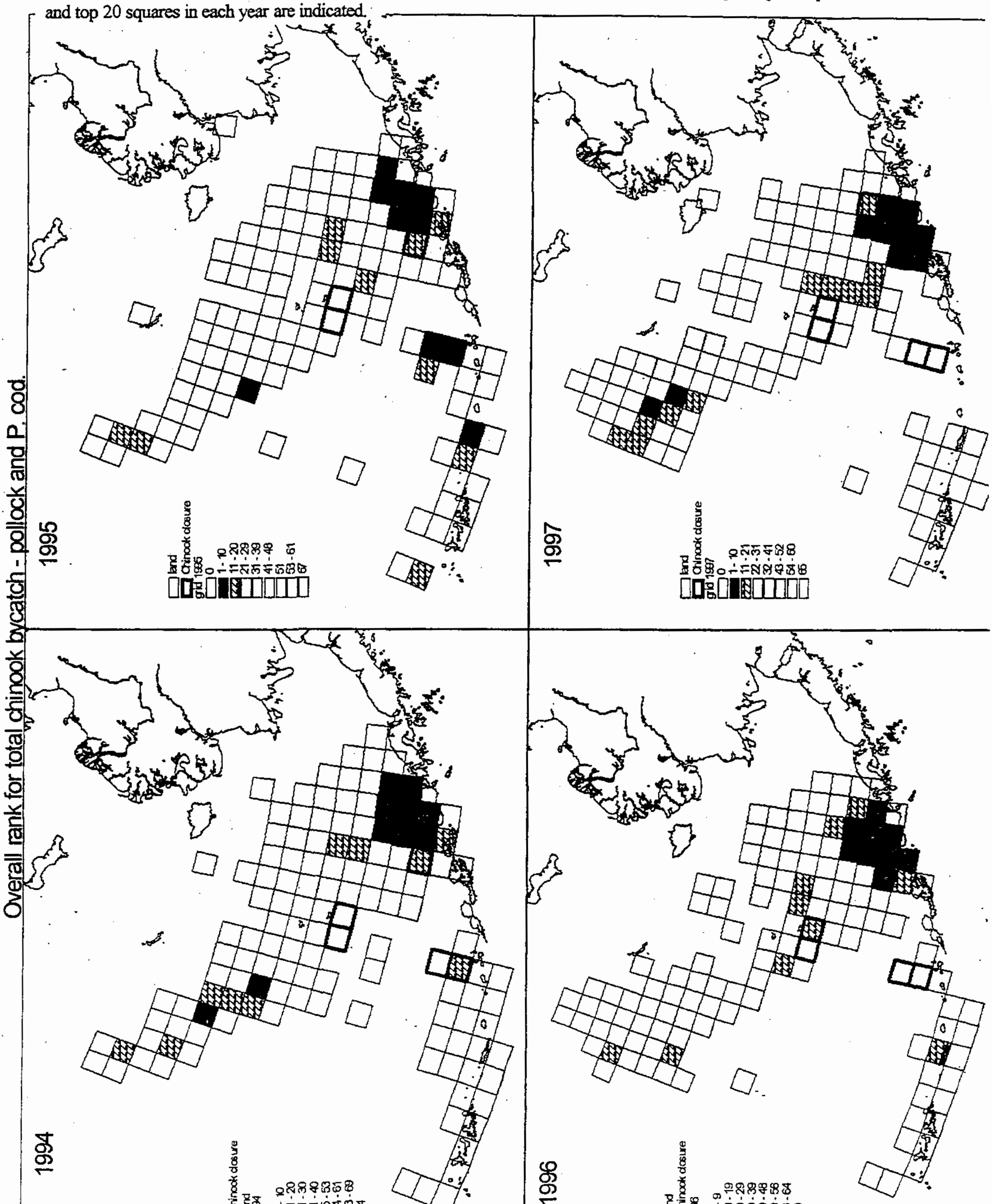

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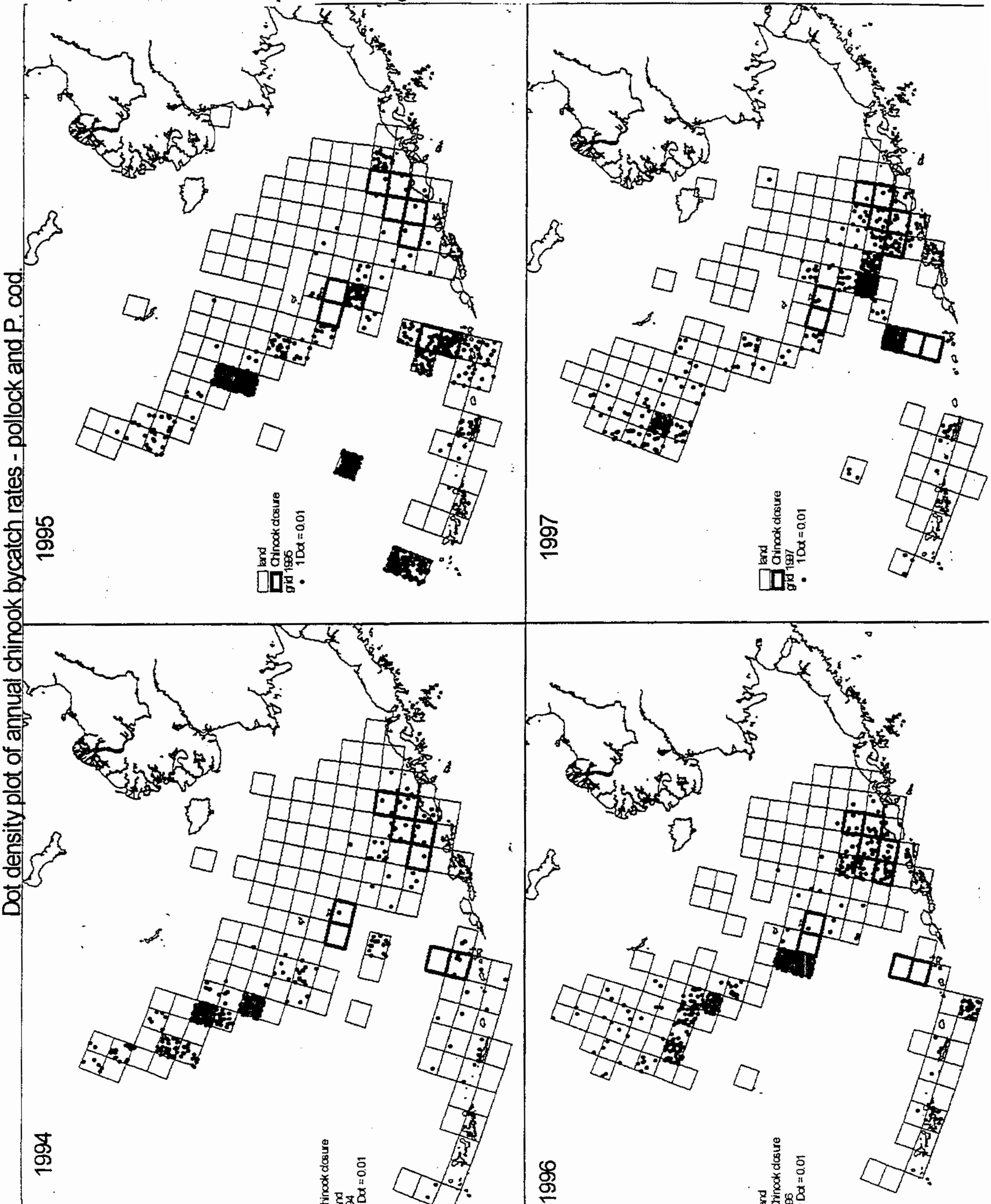


Figure 32. Diagram showing the levels of data included in the hotspot block closure simulation.

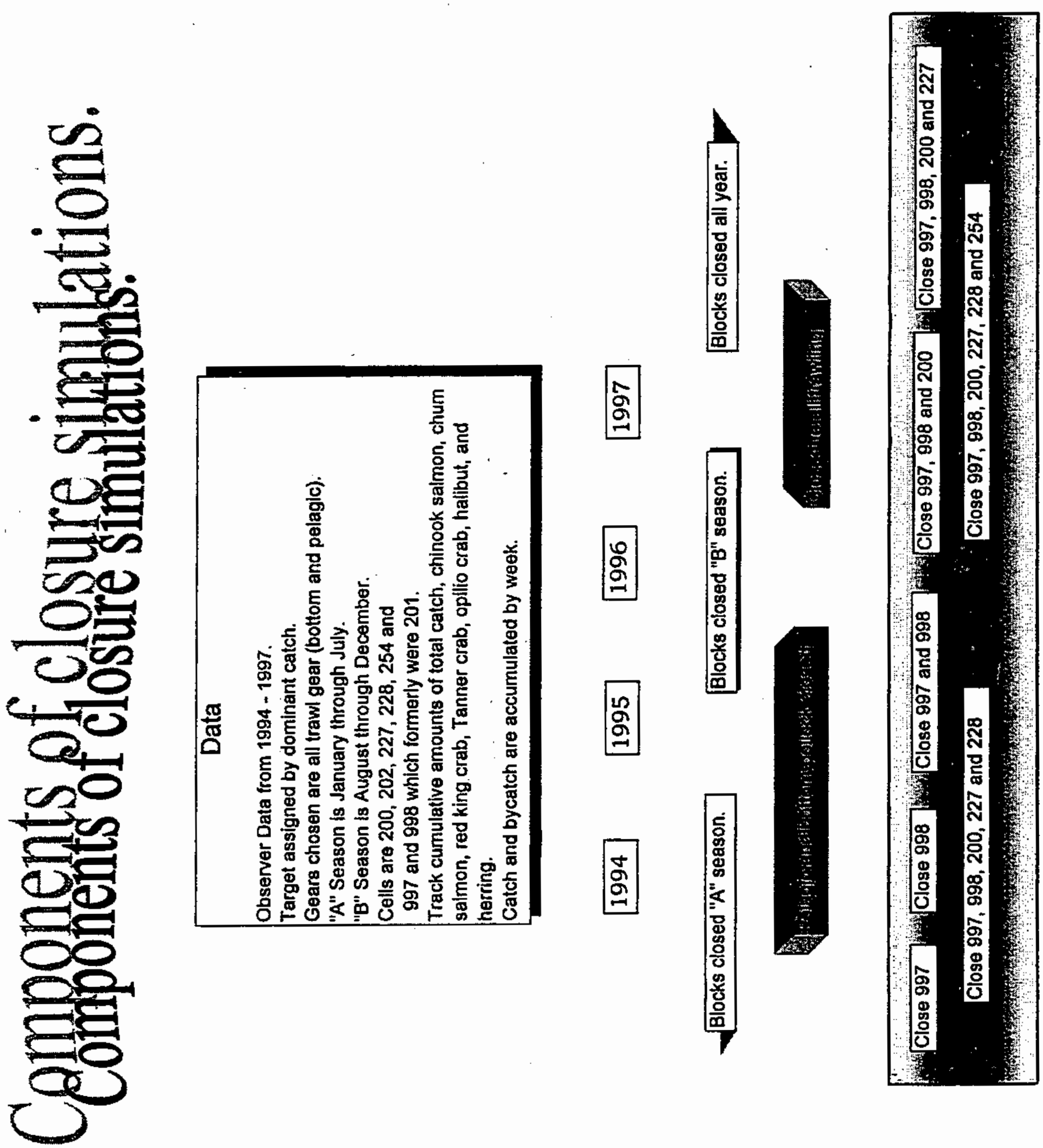


Figure 33. Percentage of observed total groundfish catch by gear type, target fishery, and year taken within the CHSSA. Target assignment is by dominant species catch and gear type as coded by NMFS observers.

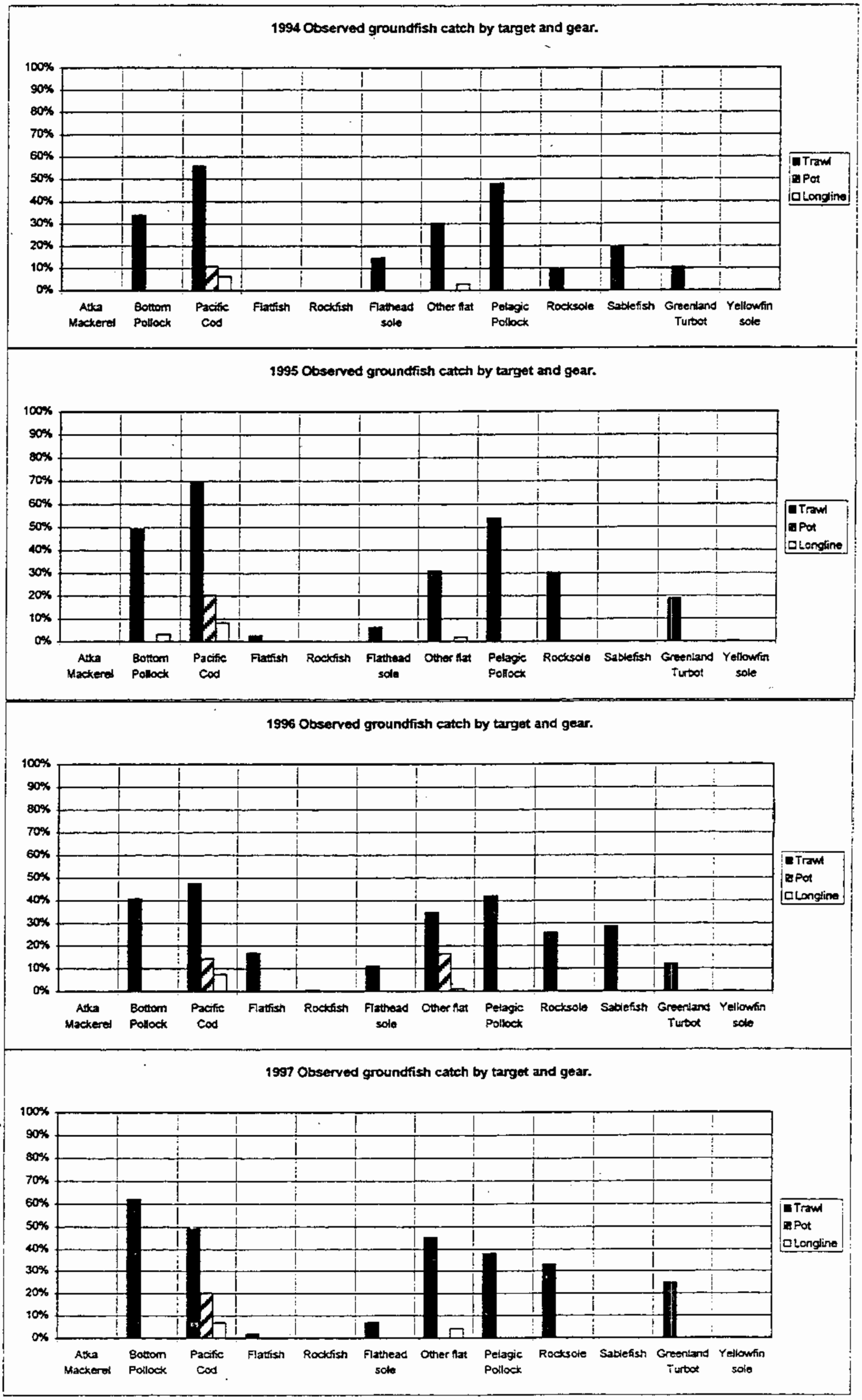
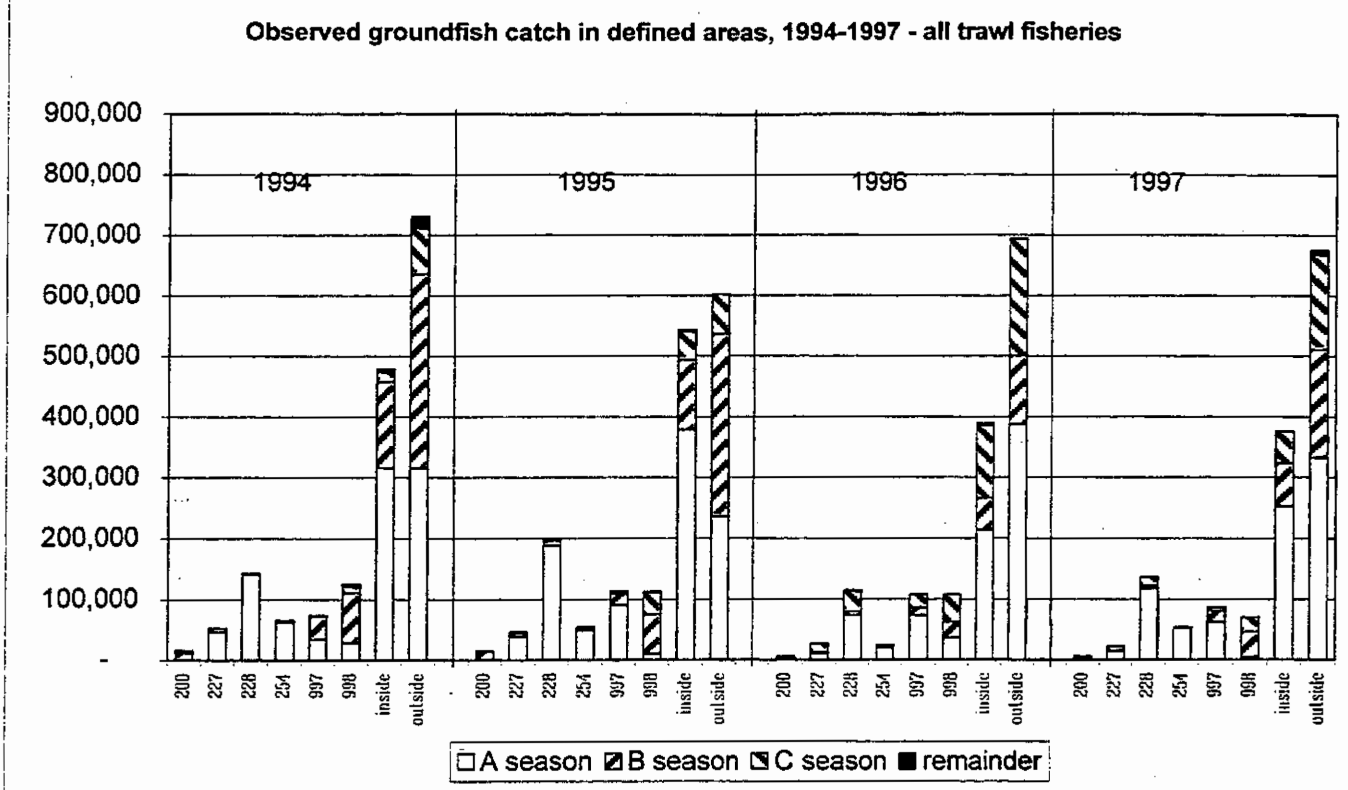
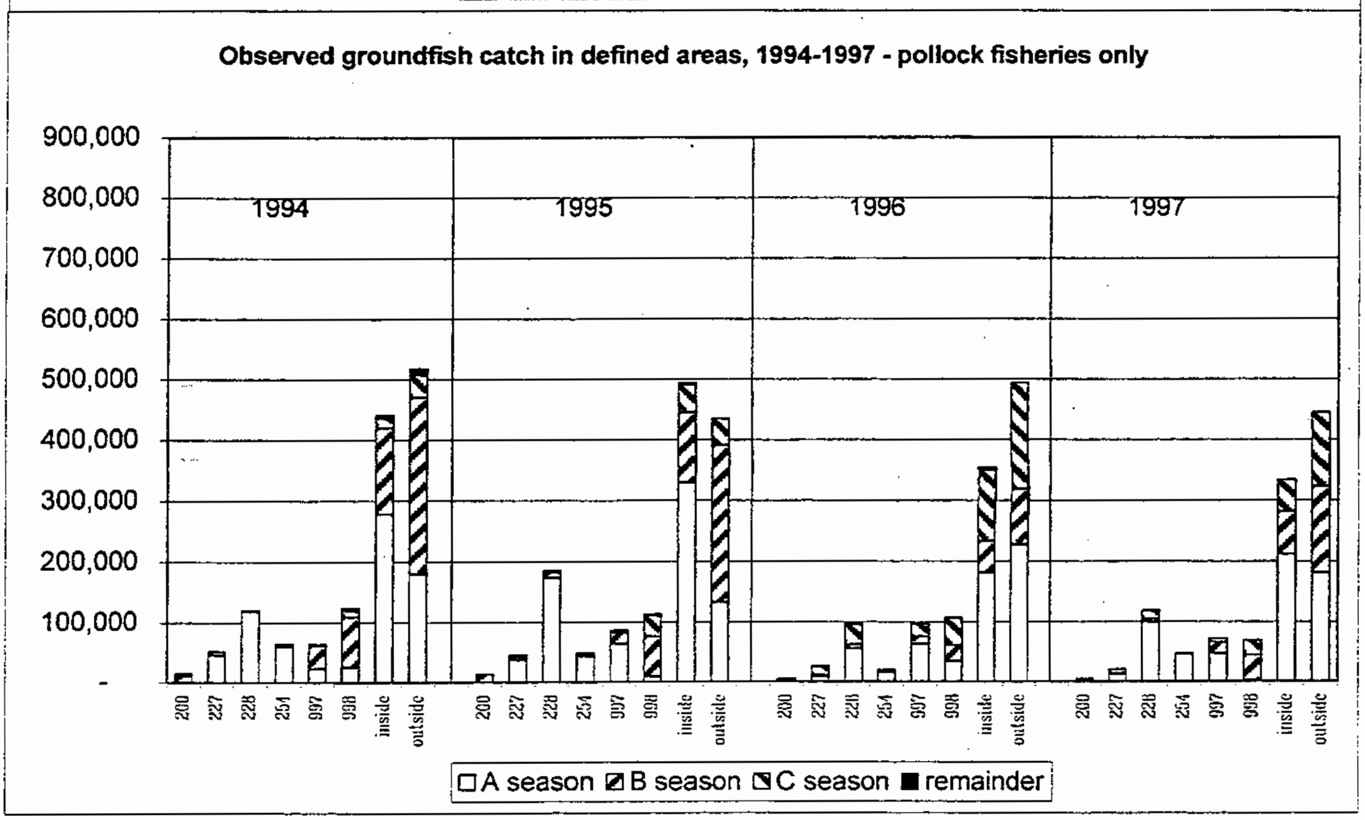


Figure 34. Observed groundfish catch in coded 1/2° latitude by 1° longitude cells (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six cells is as indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.





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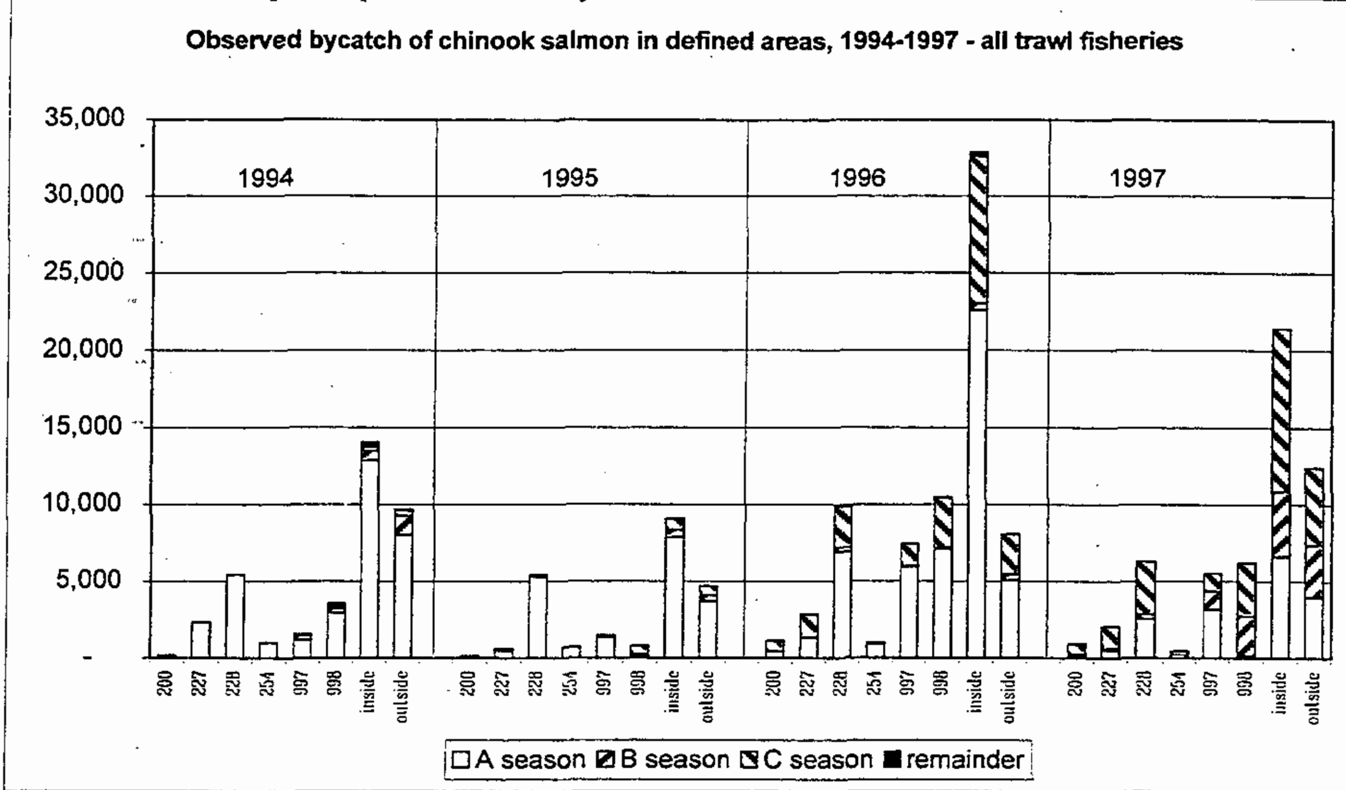


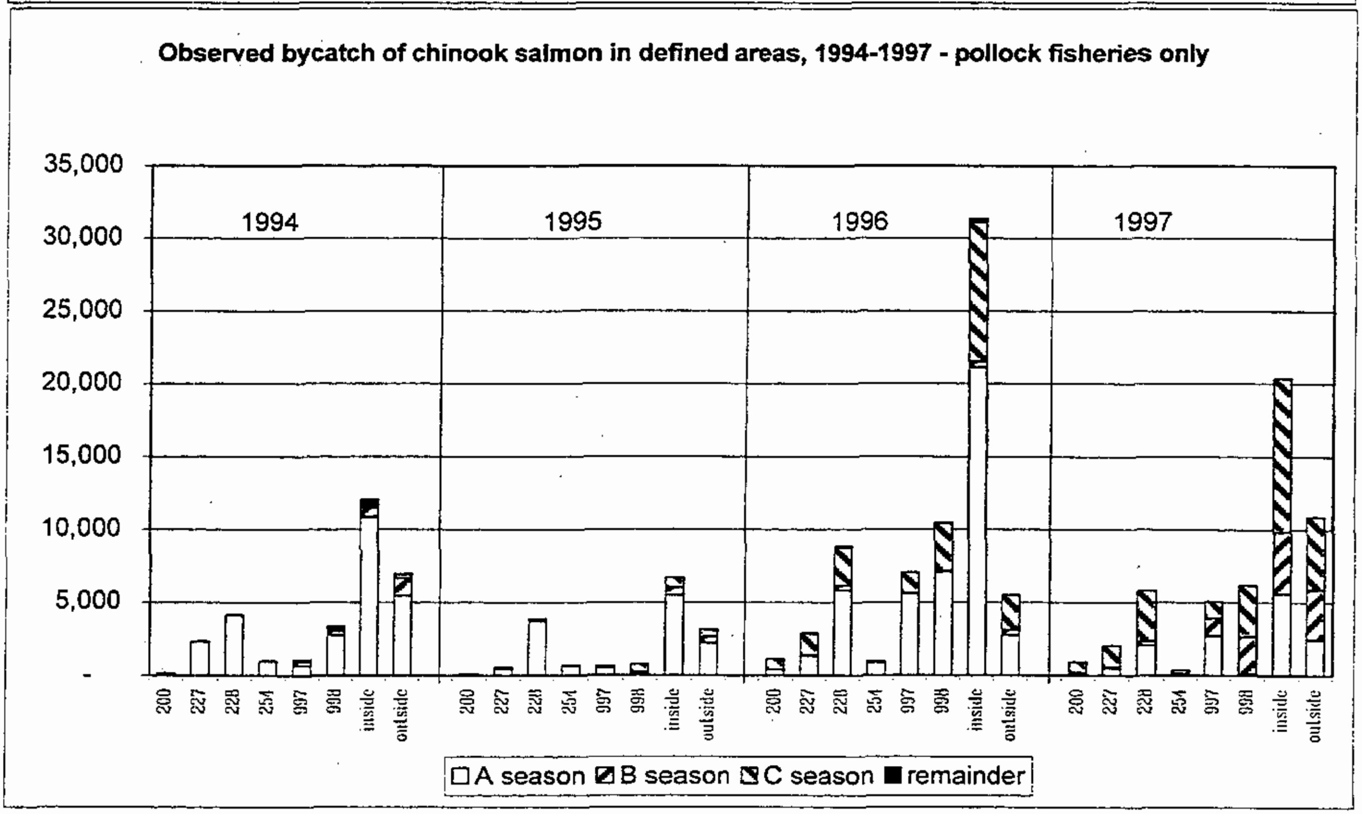
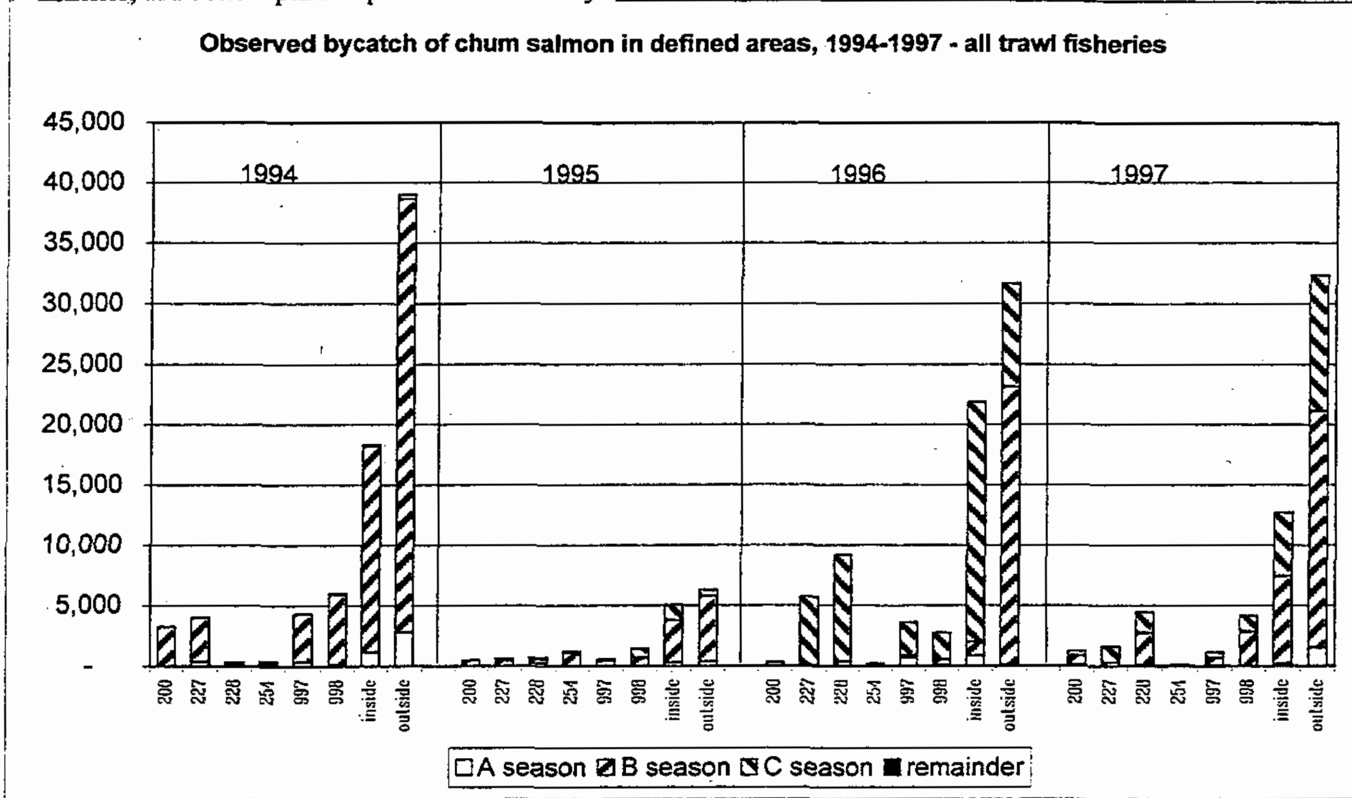


Figure 36. Observed chum salmon bycatch in coded 1/2° latitude by 1° longitude cells (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six cells is indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.



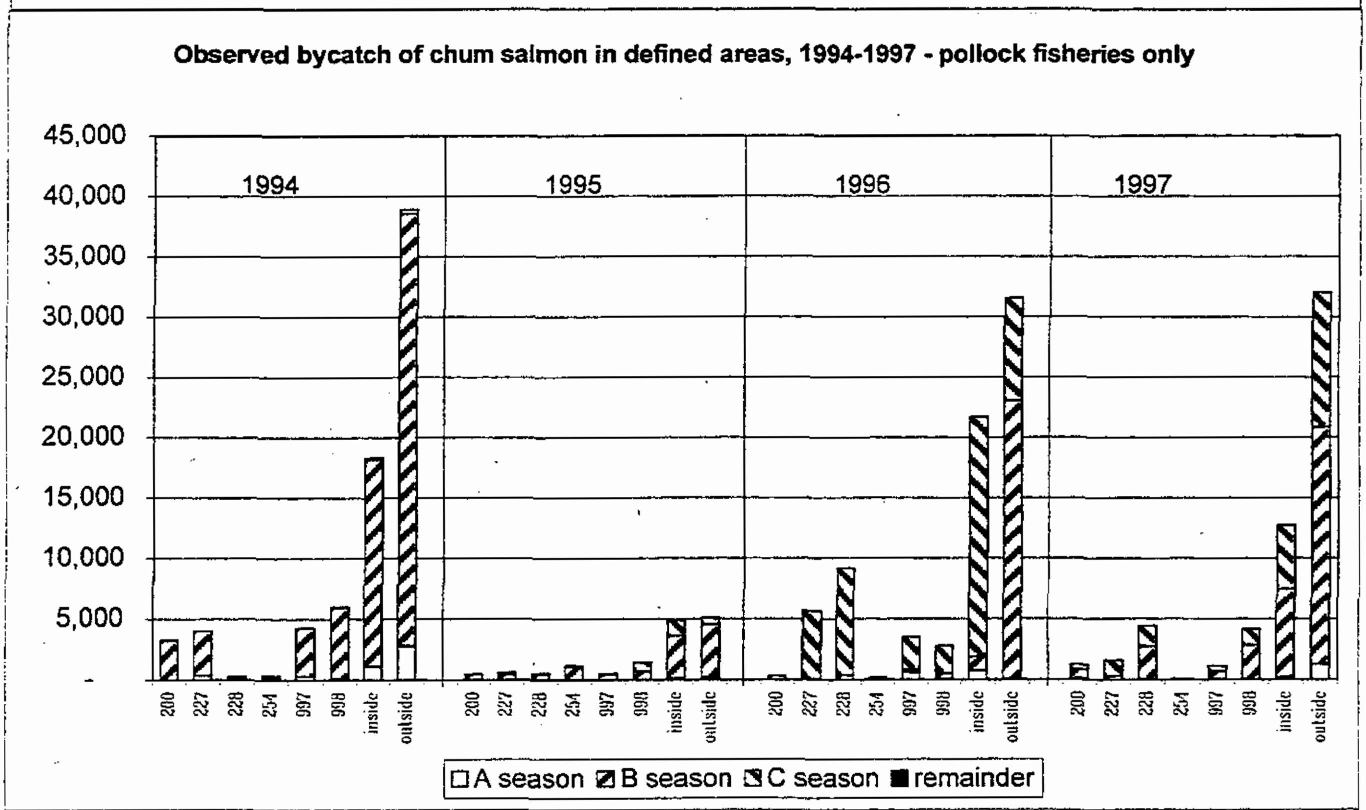


Figure 37. Observed halibut bycatch in coded 1/2° latitude by 1° longitude cells (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six cells is as indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

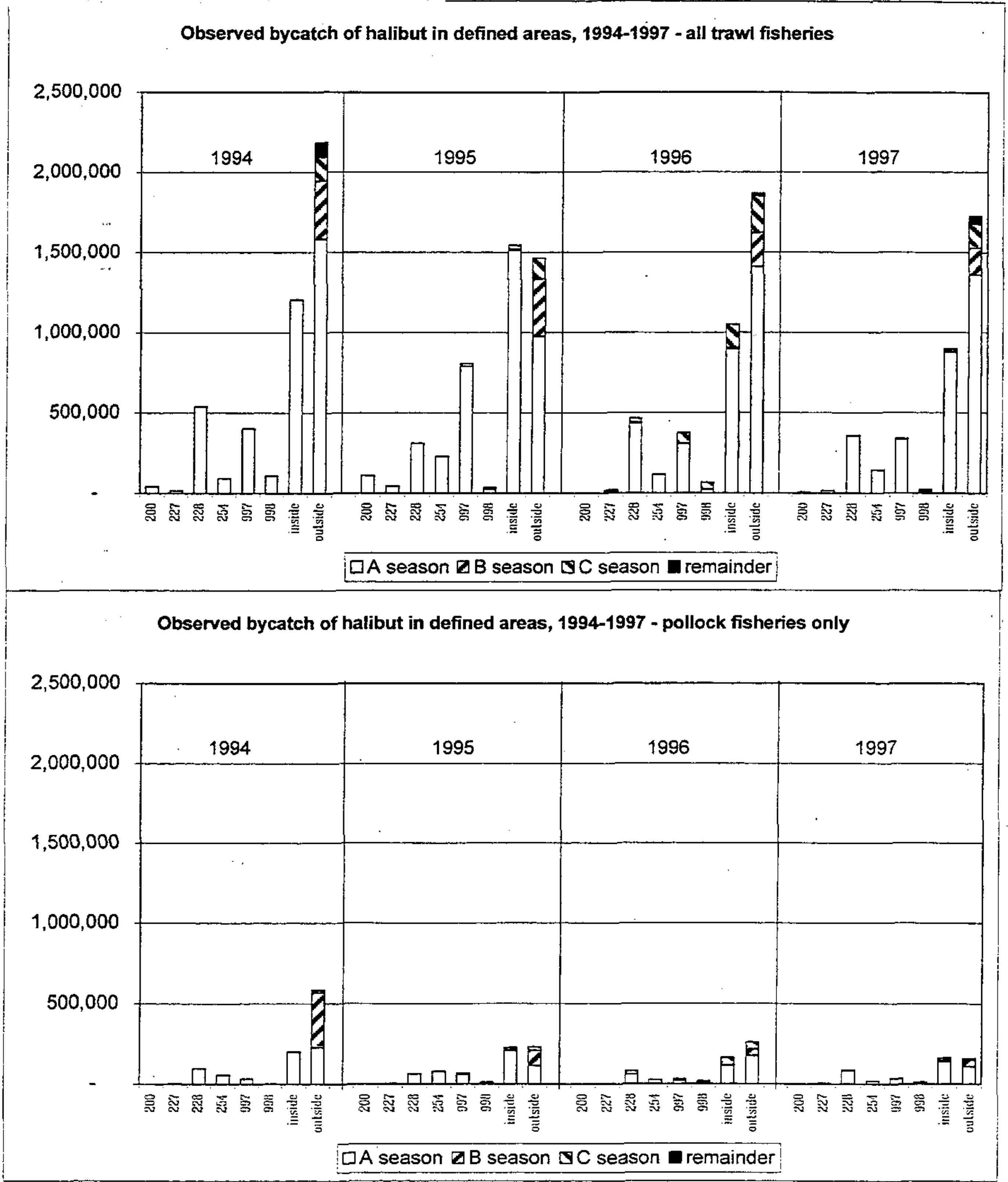
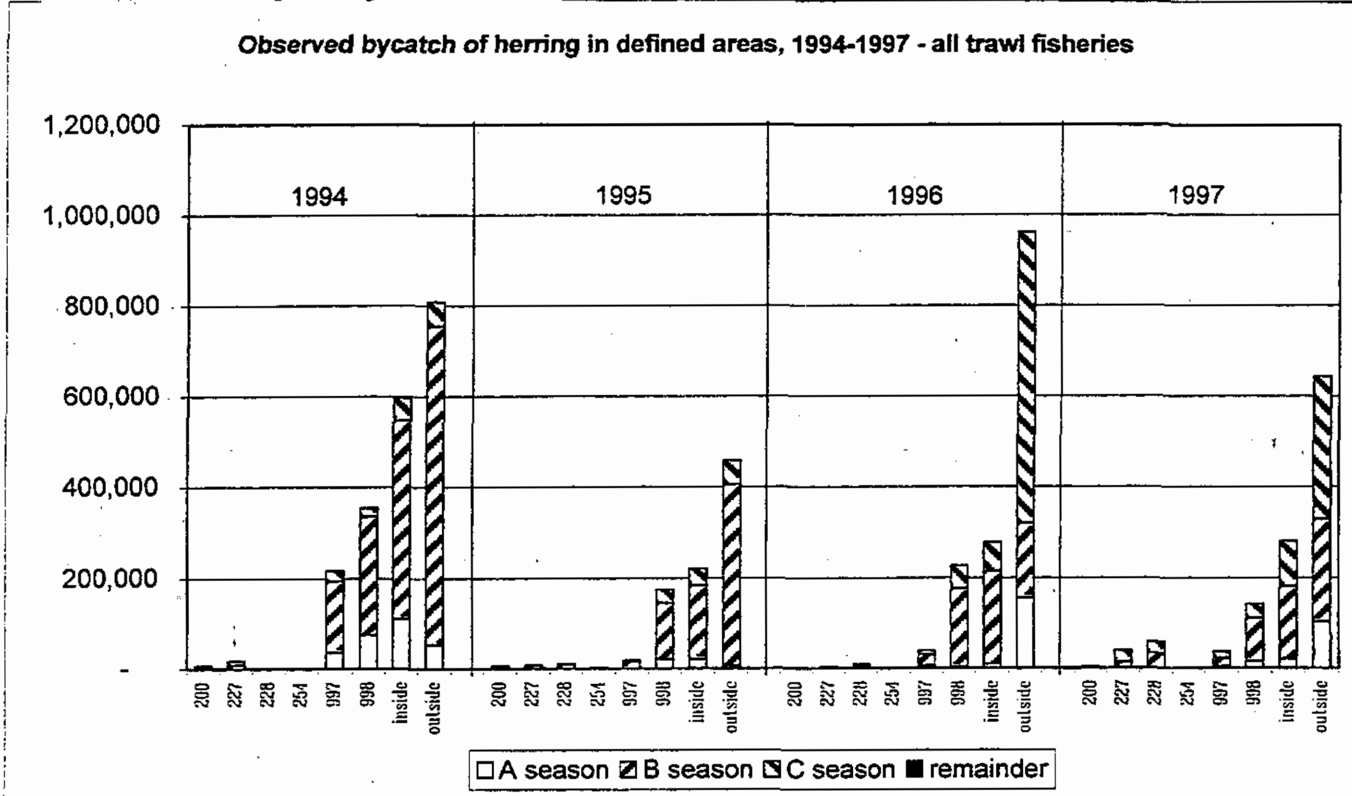


Figure 38. Observed herring bycatch in coded 1/2° latitude by 1° longitude cells (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six cells is as indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.



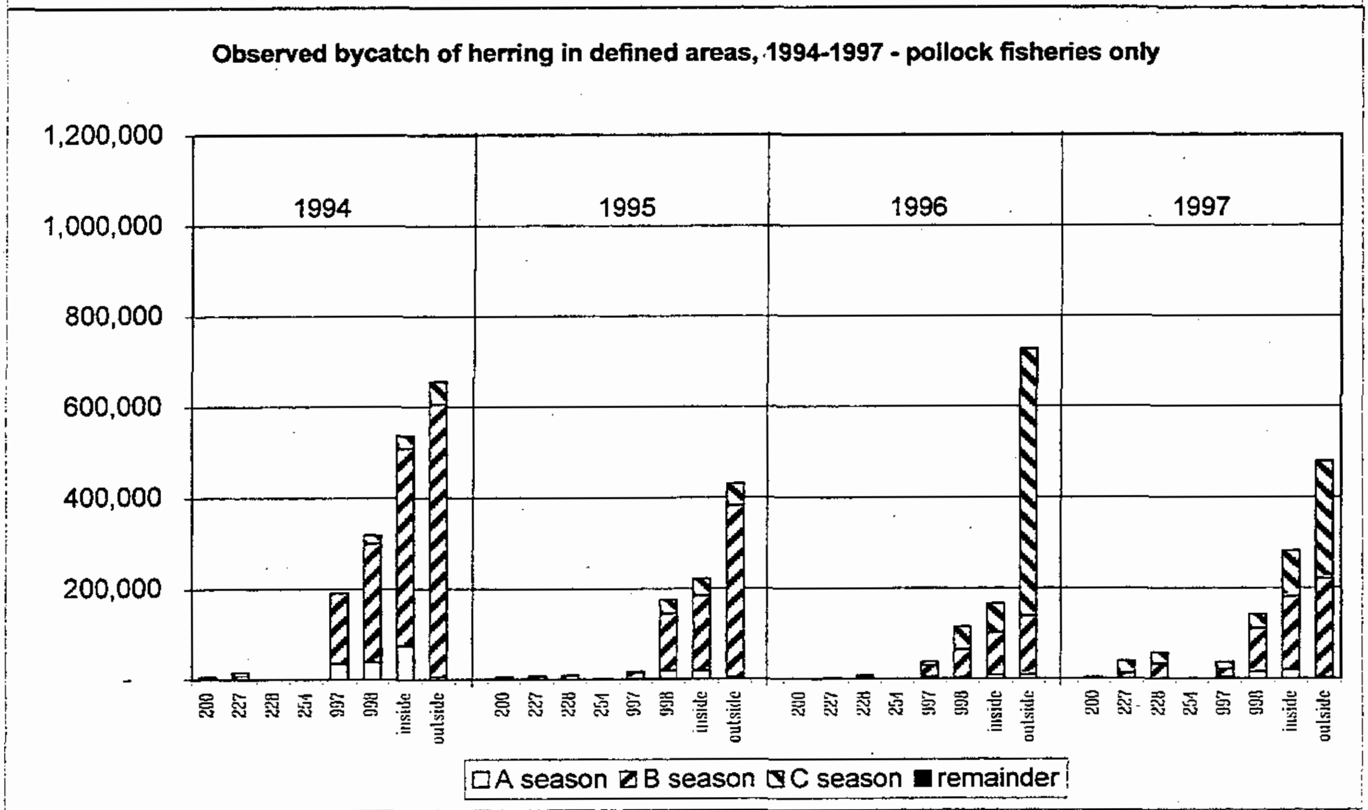


Figure 39. Observed bairdi crab bycatch in coded 1/2° latitude by 1° longitude cells (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six cells is as indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

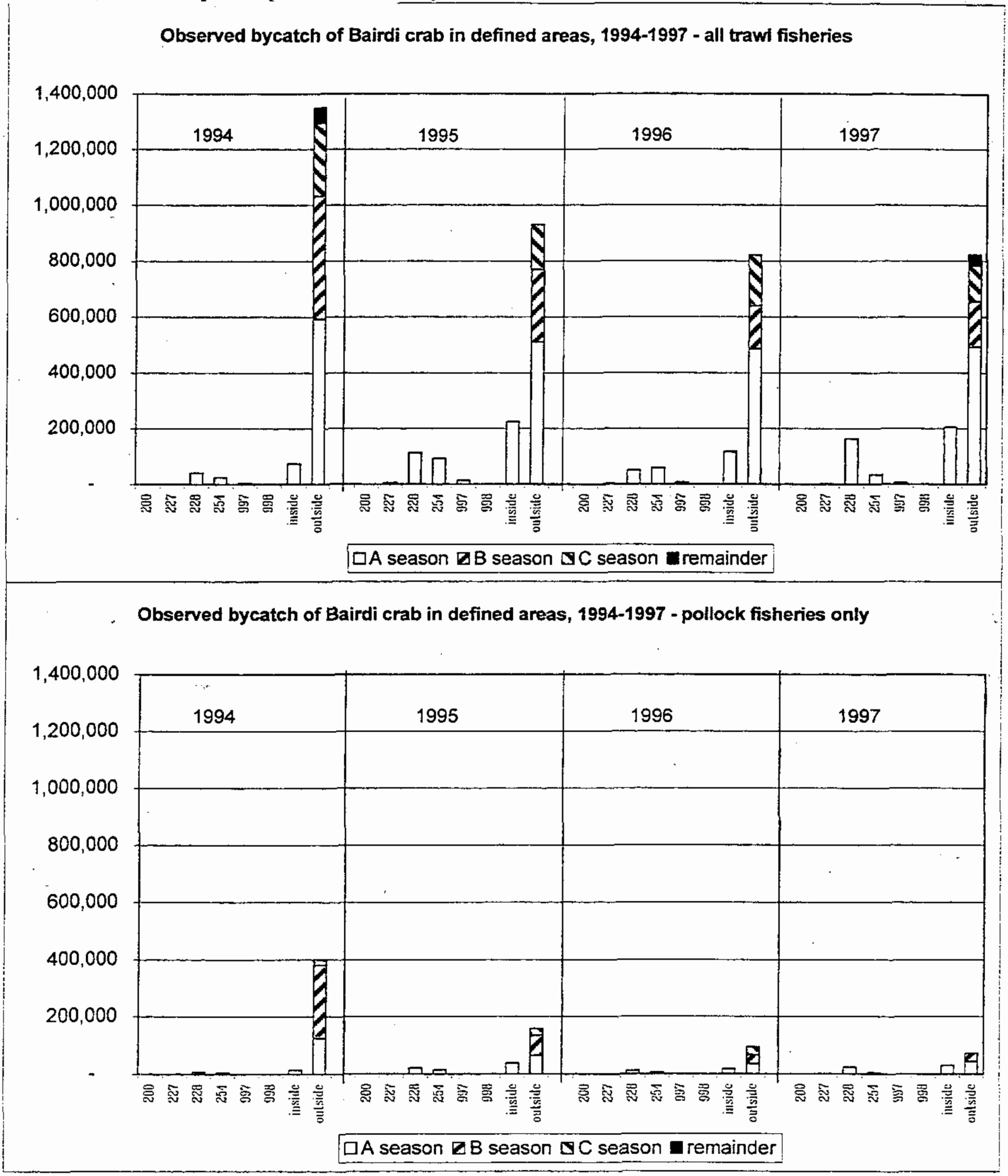


Figure 40. Observed opilio crab bycatch in coded 1/2° latitude by 1° longitude cells (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six cells is as indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

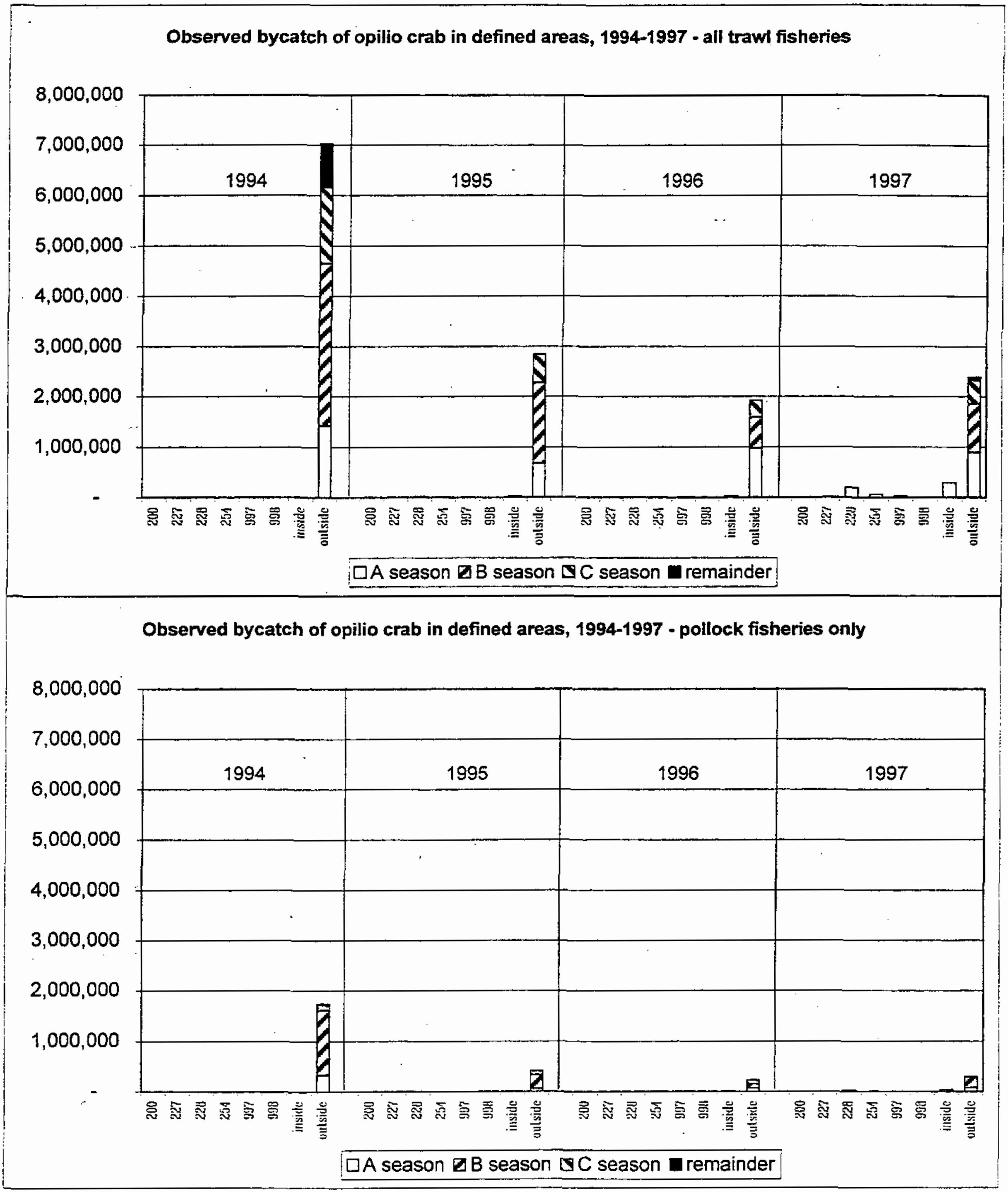


Figure 41. Observed red king crab bycatch in coded 1/2° latitude by 1° longitude cells (see Figure 20) during the A season and B season in 1994-1997. The total "inside" and "outside" all six cells is indicated. Top panel is all trawl fisheries, and bottom panel is pollock fisheries only.

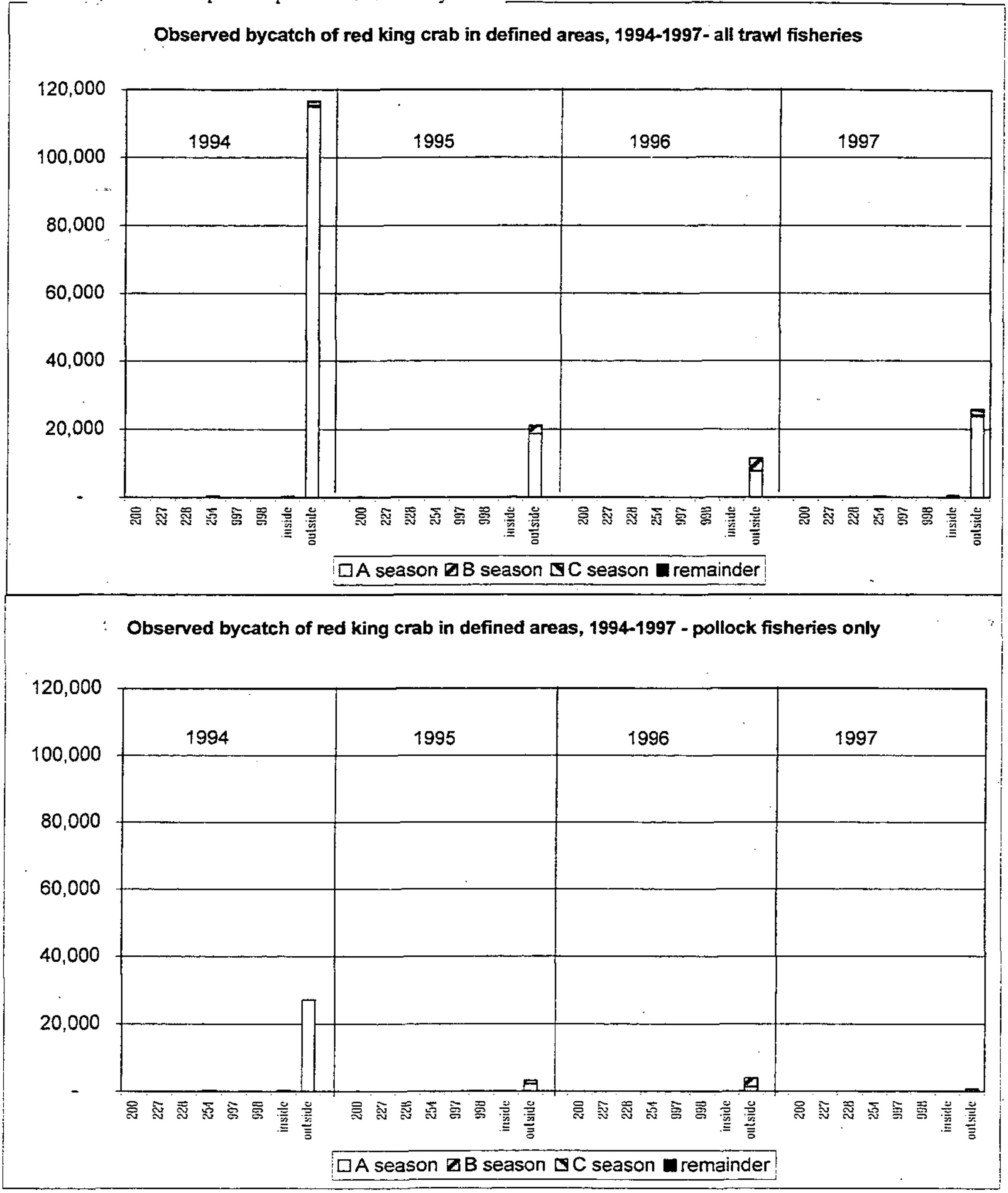


Figure 42. Expected chinook salmon bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

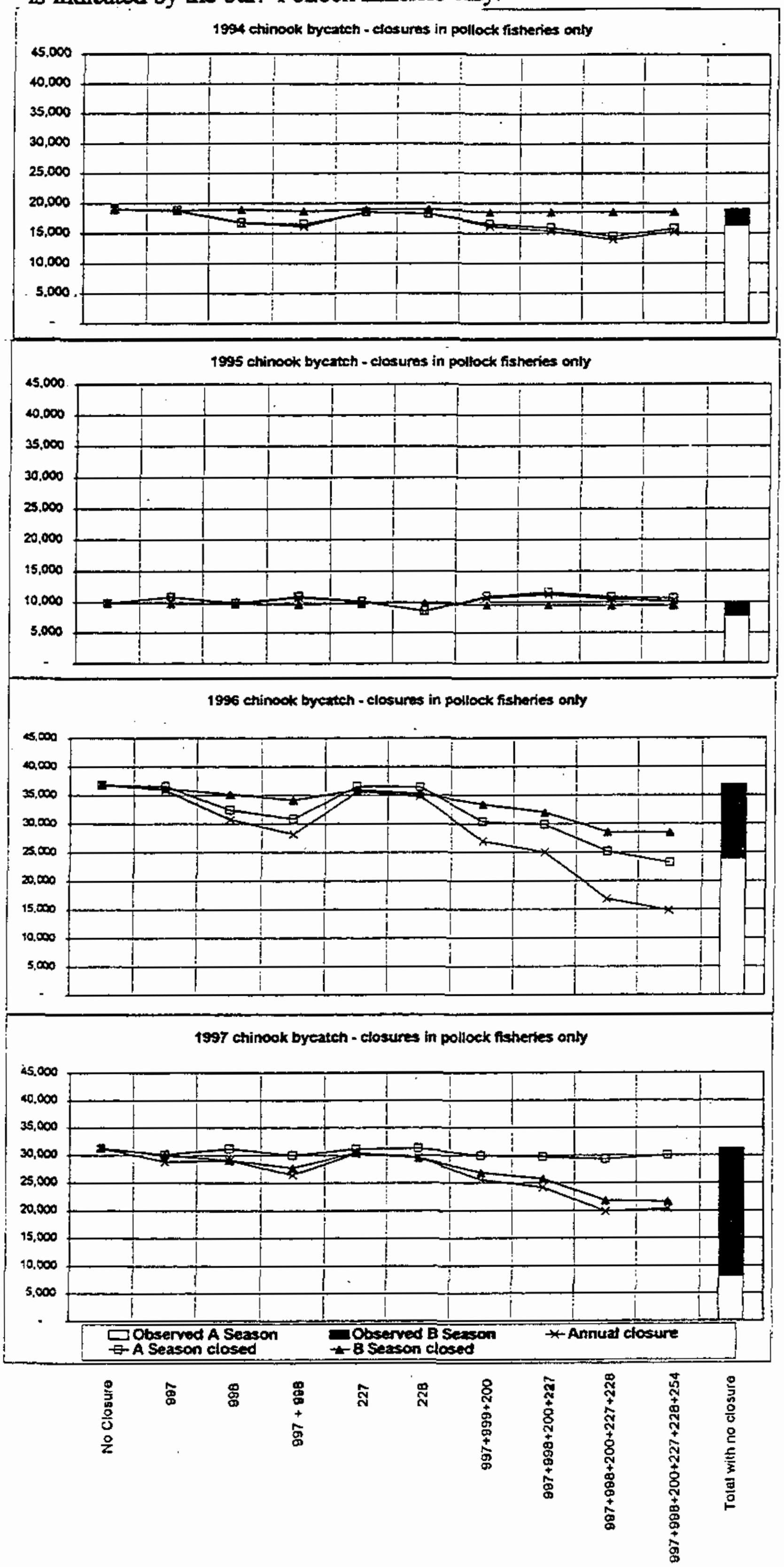


Figure 43. Expected chinook salmon bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

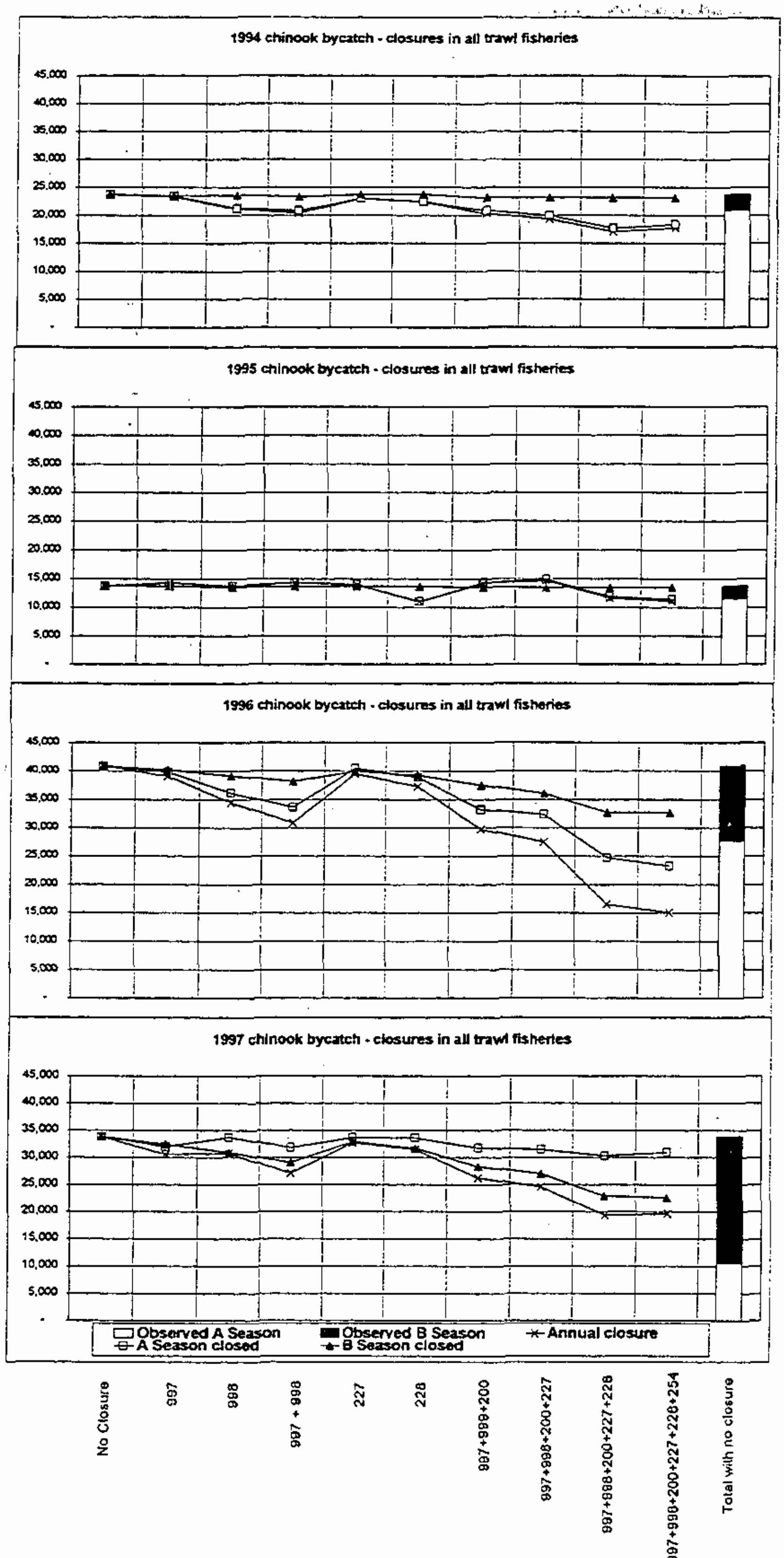


Figure 44. Expected chum salmon bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

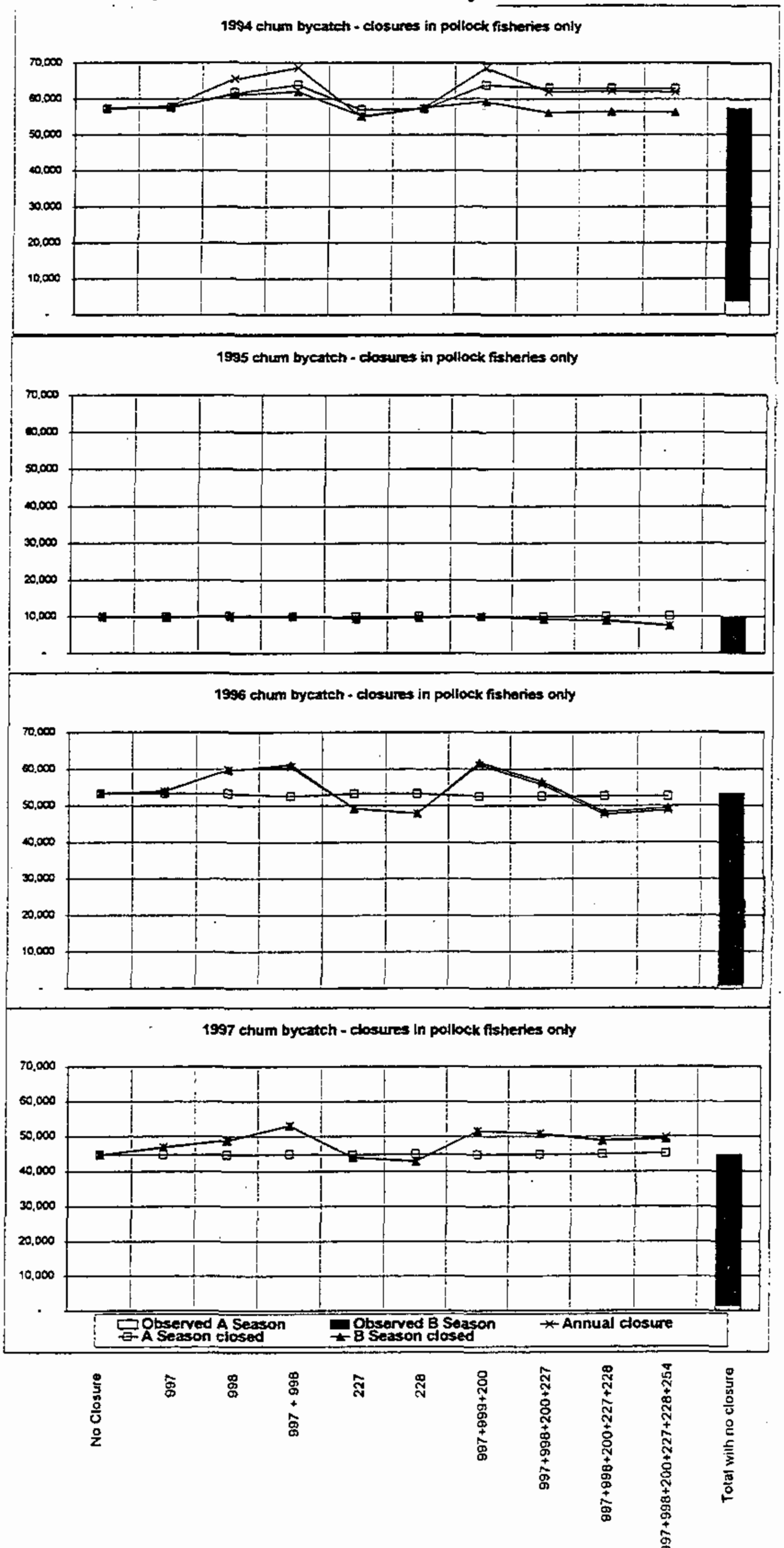


Figure 45. Expected chum salmon bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

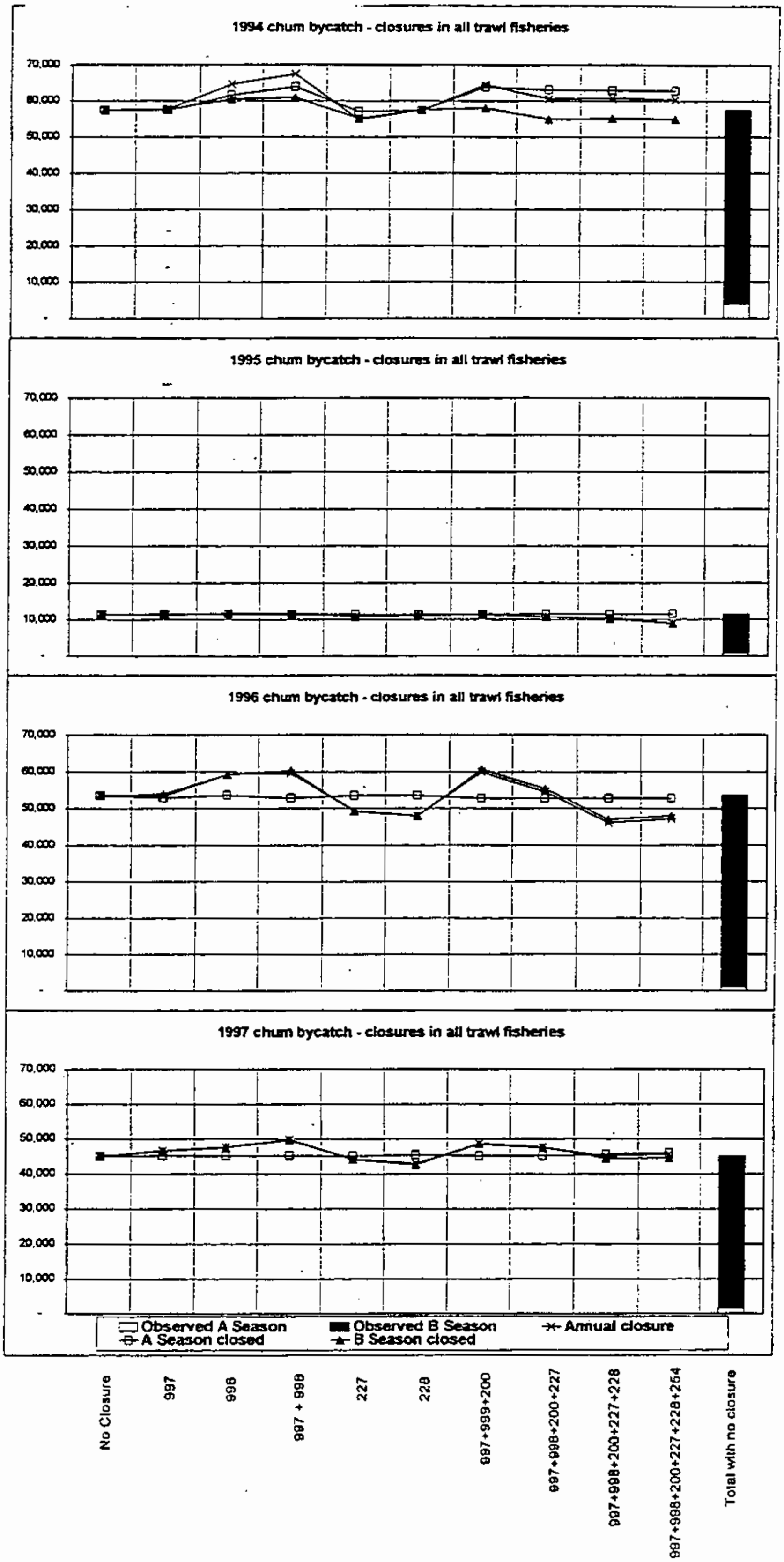


Figure 46. Expected halibut bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

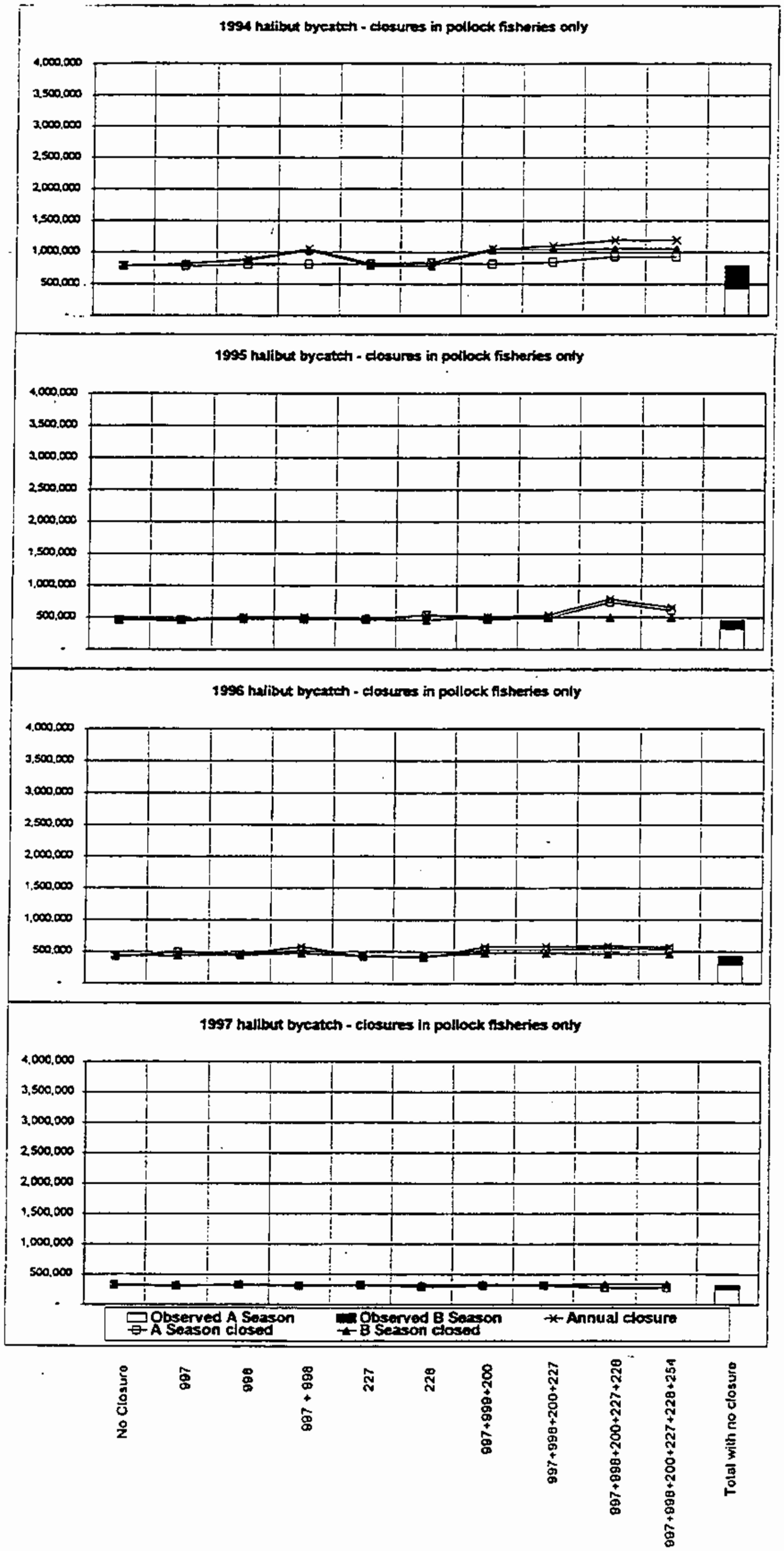


Figure 47. Expected halibut bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

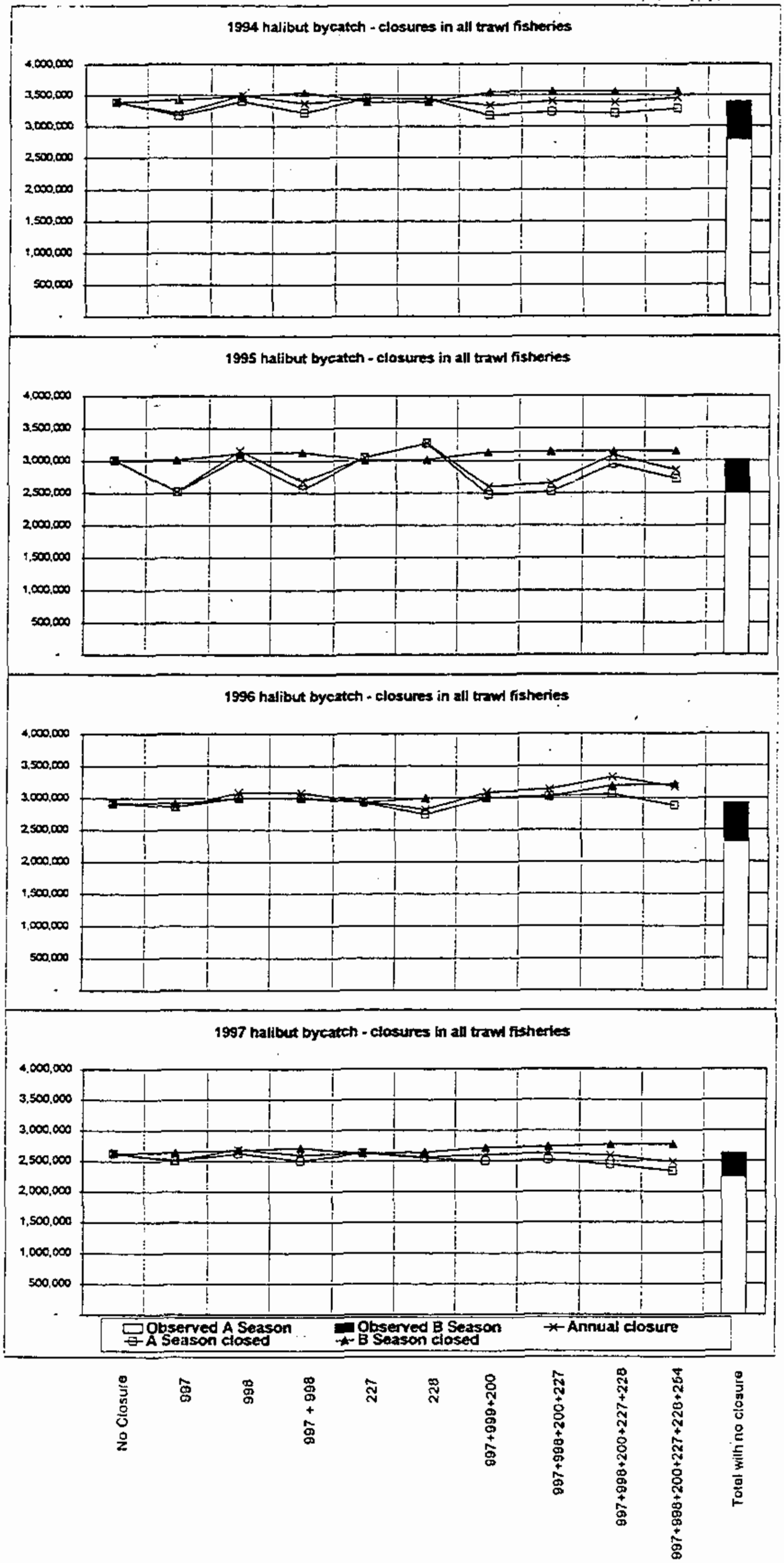


Figure 48. Expected herring bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

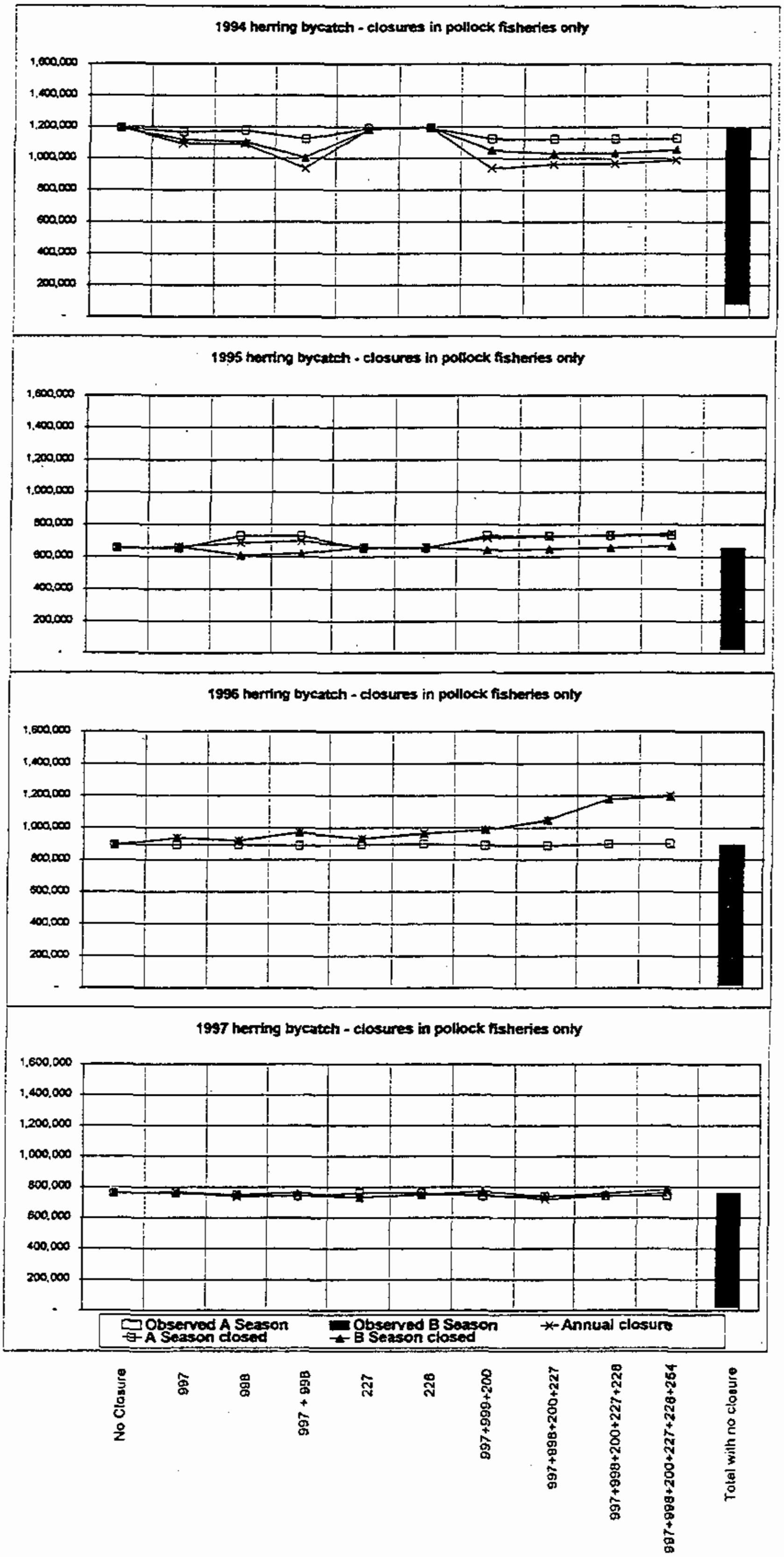


Figure 49. Expected herring bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

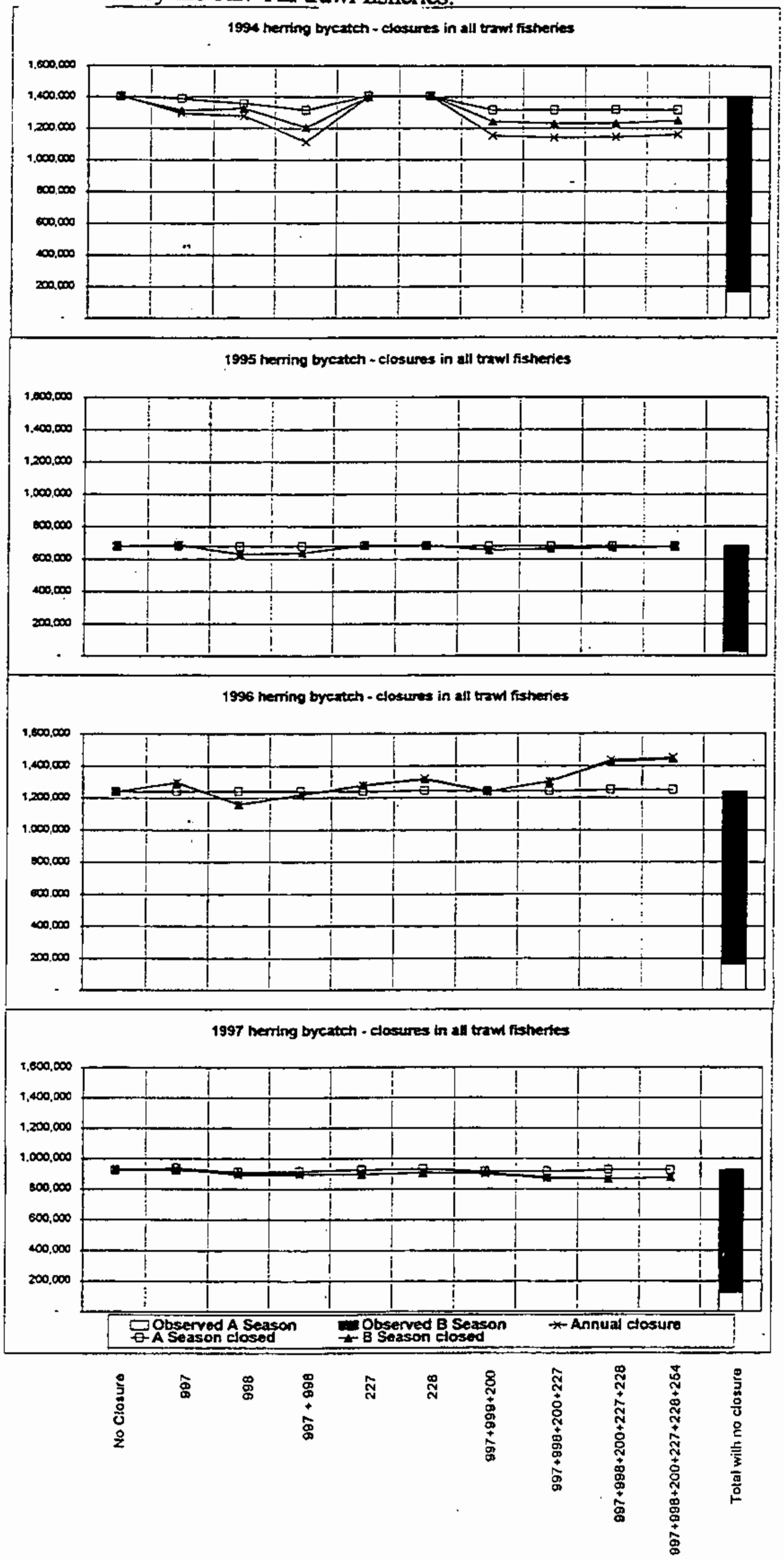


Figure 50. Expected bairdi crab bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

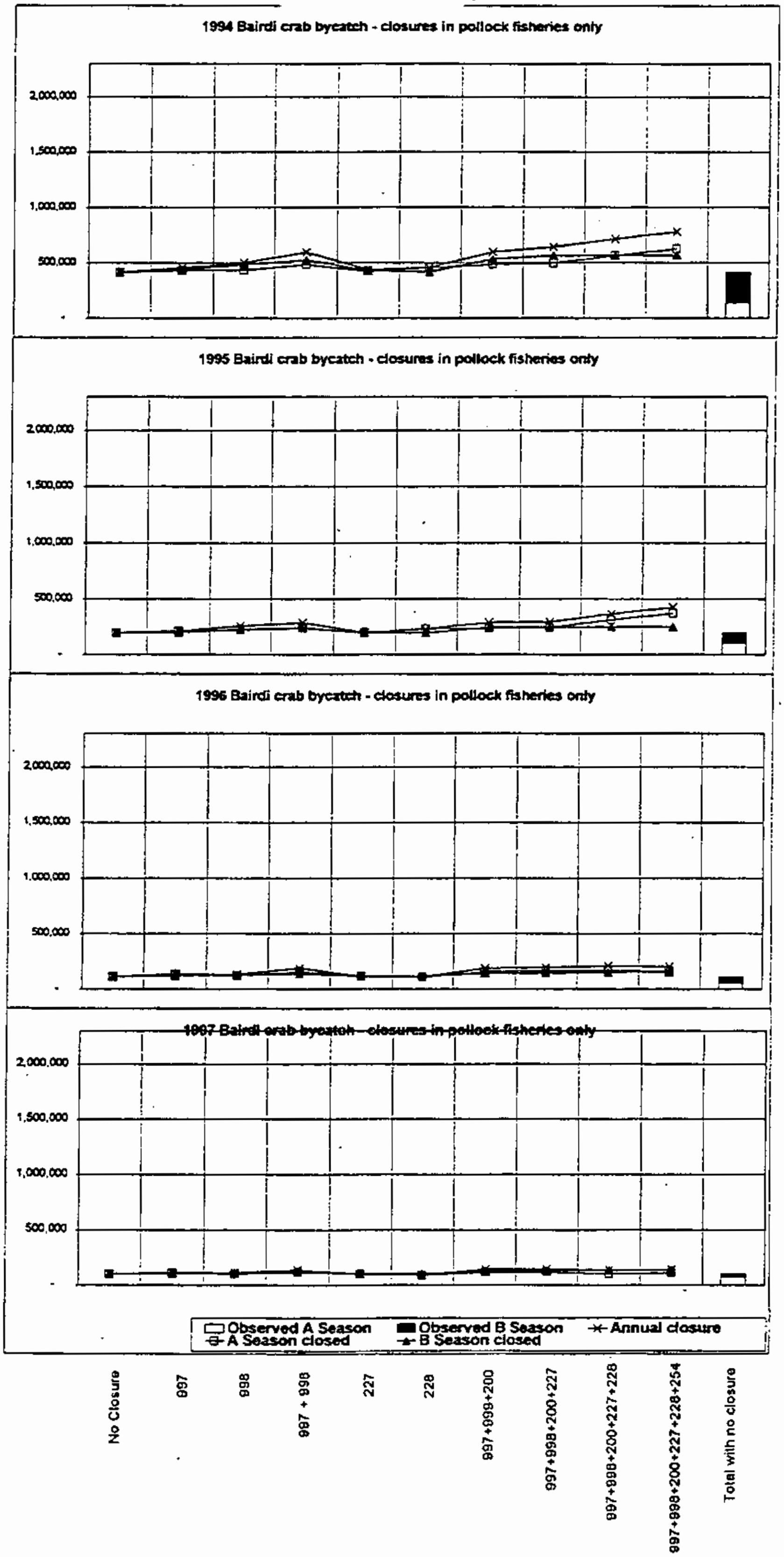


Figure 49. Expected herring bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

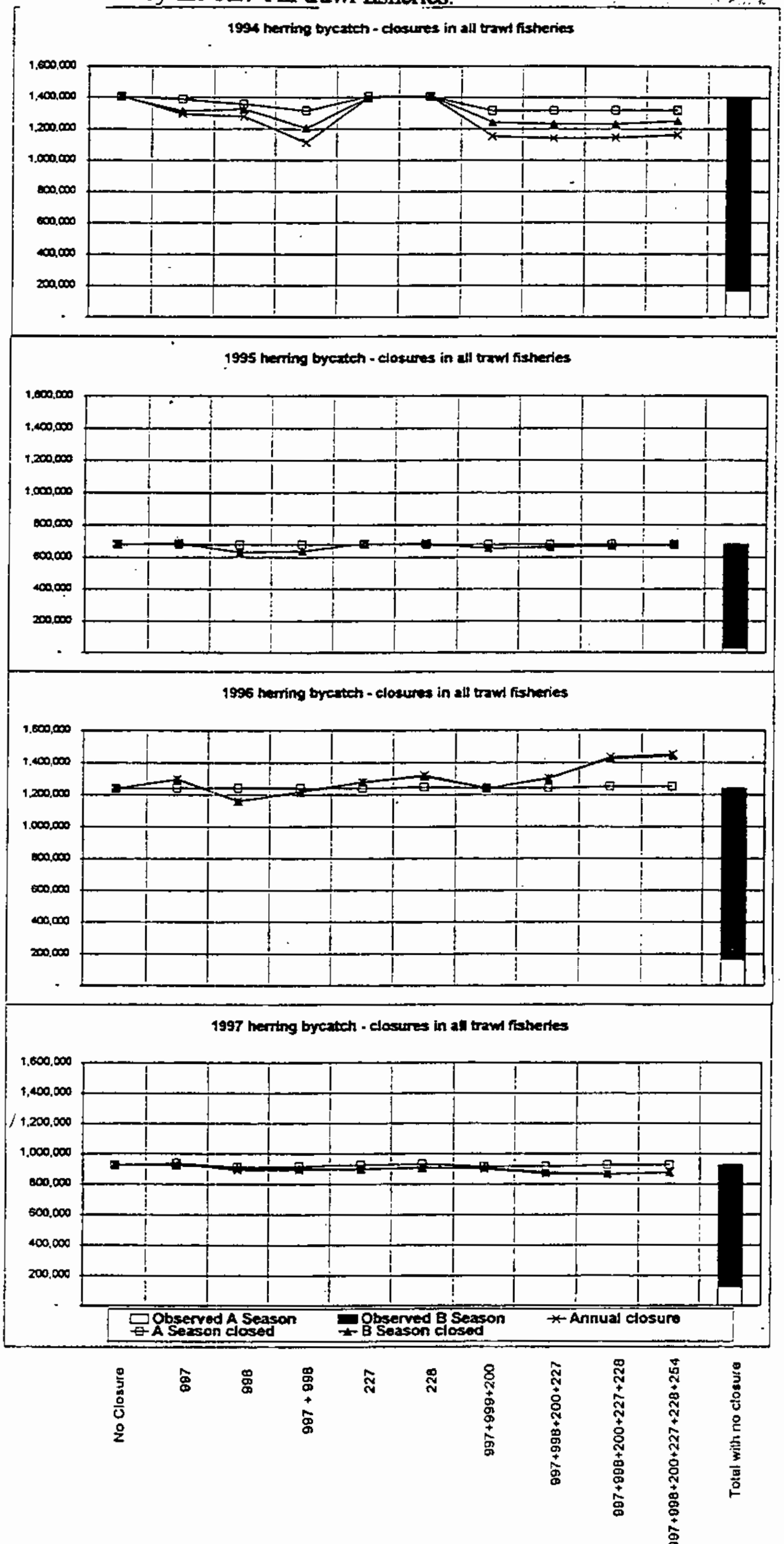


Figure 50. Expected bairdi crab bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

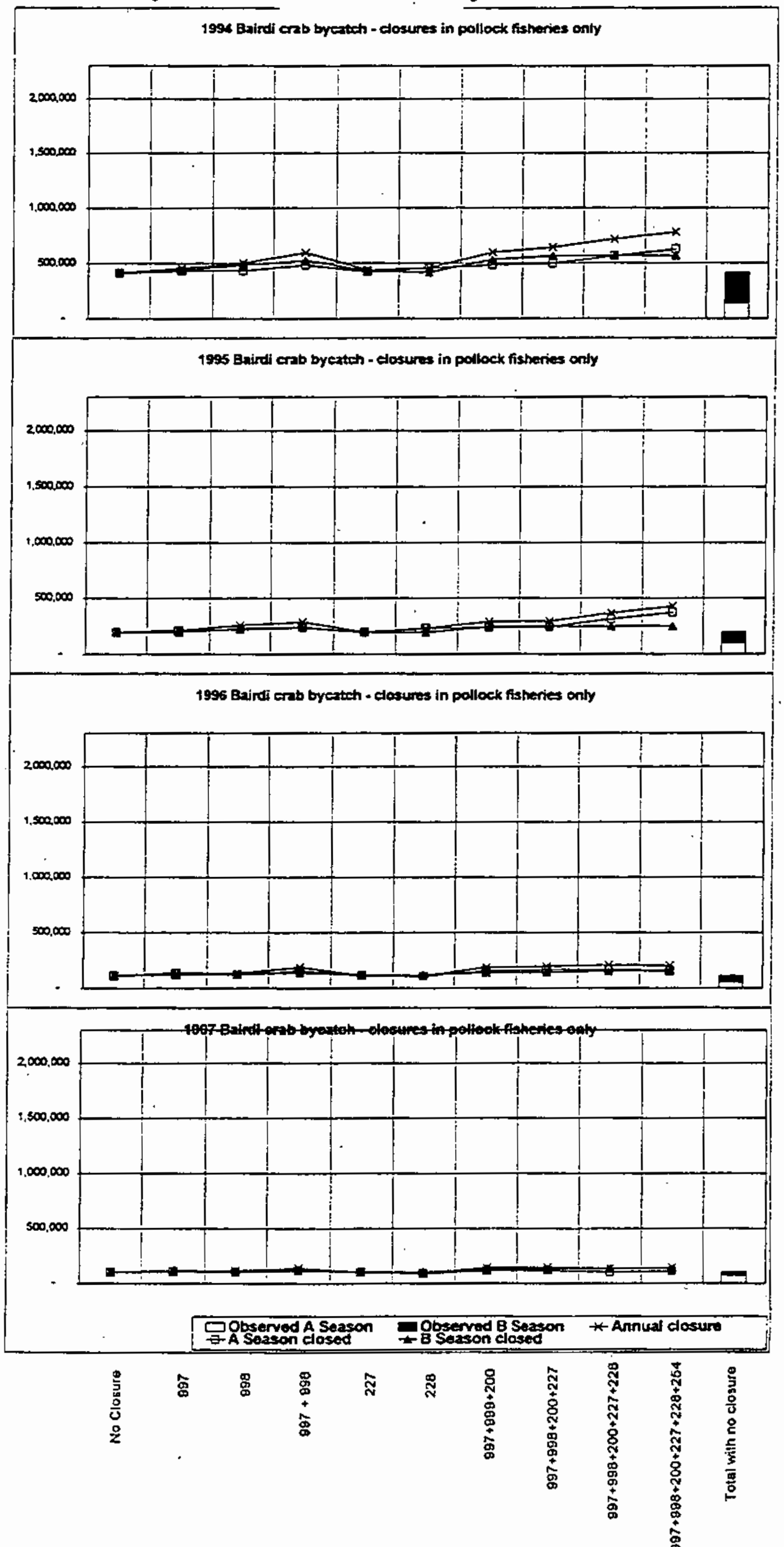


Figure 51. Expected bairdi crab bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

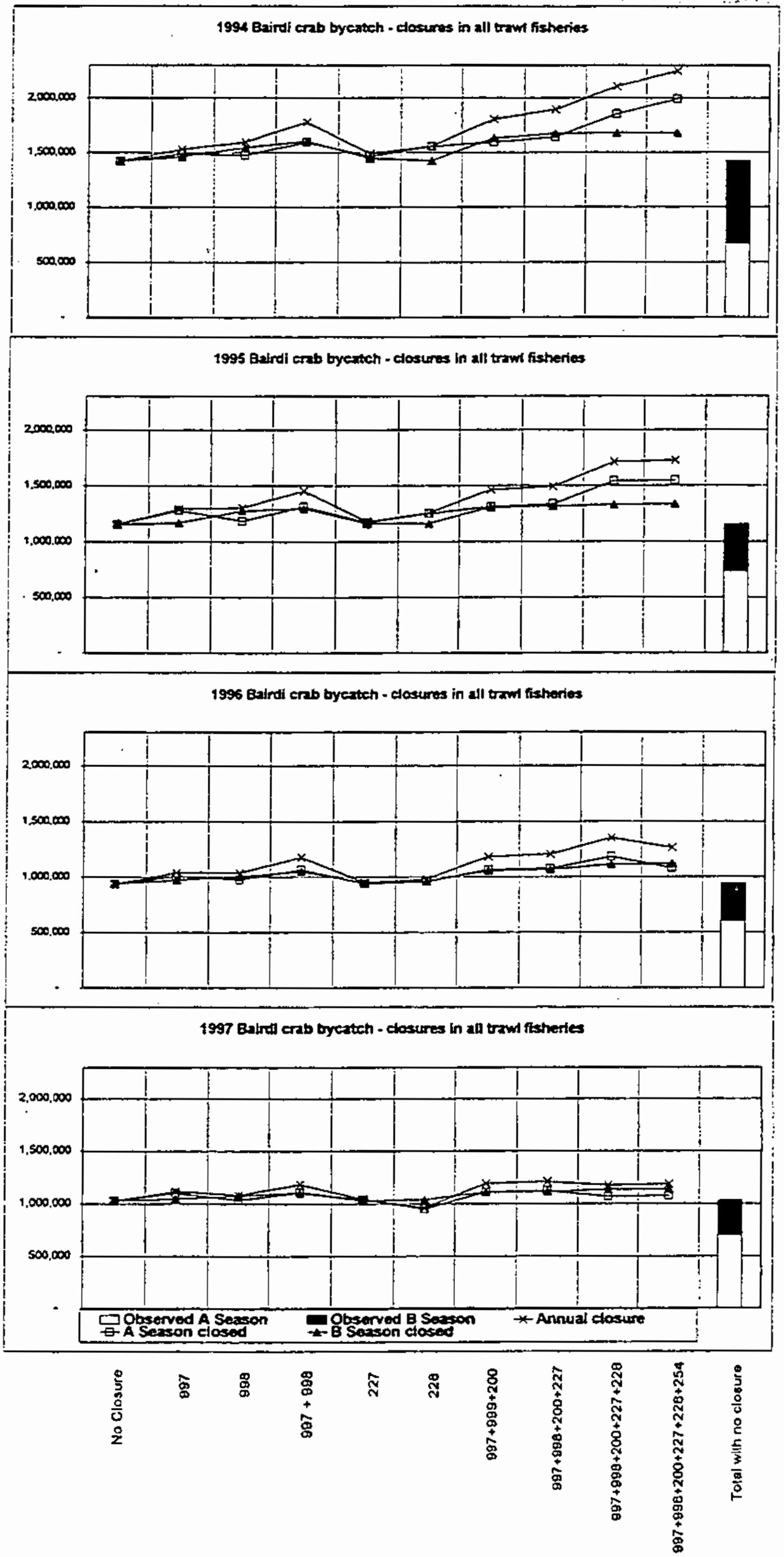


Figure 52. Expected opilio crab bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

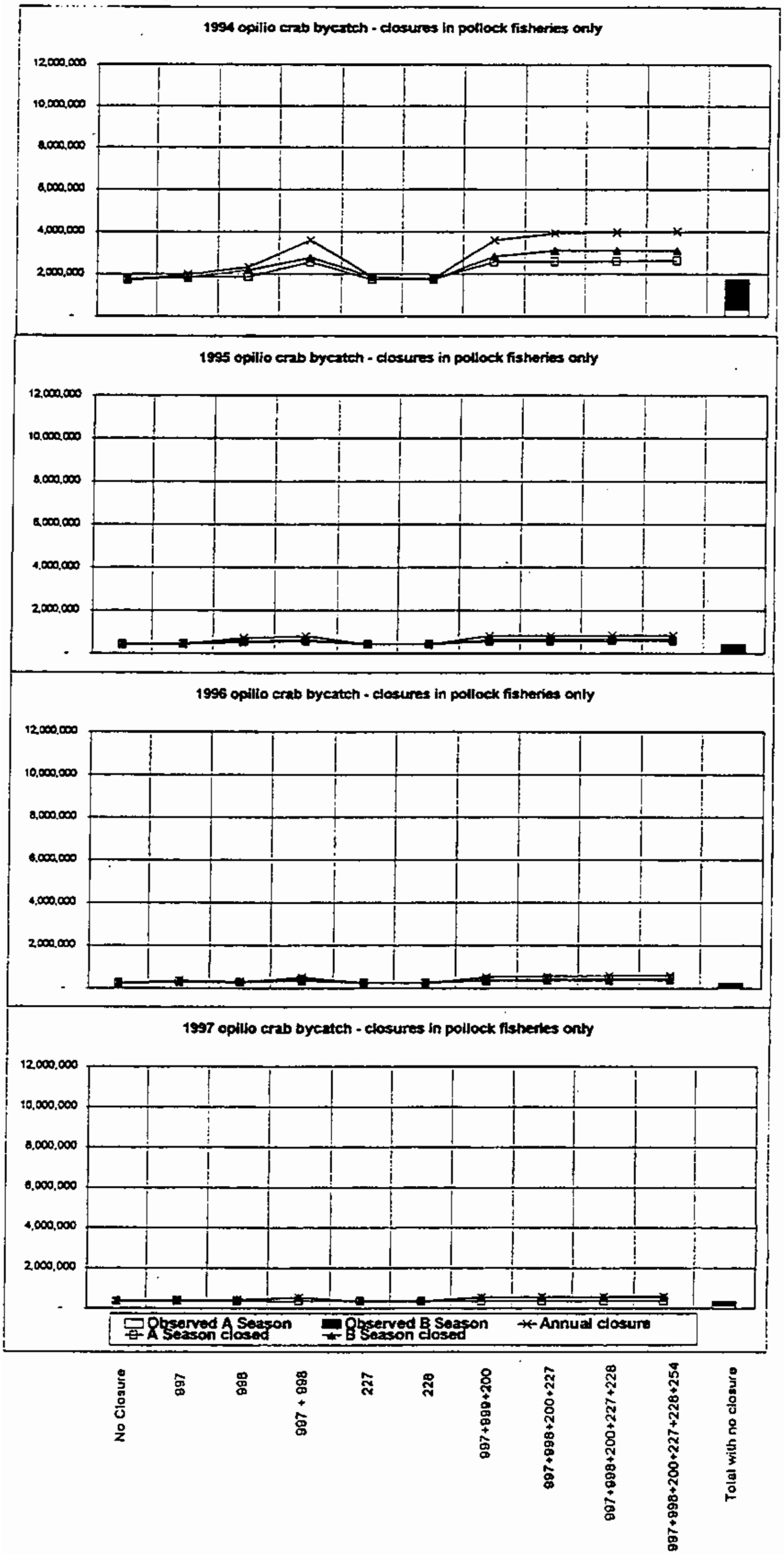


Figure 53. Expected opilio crab bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

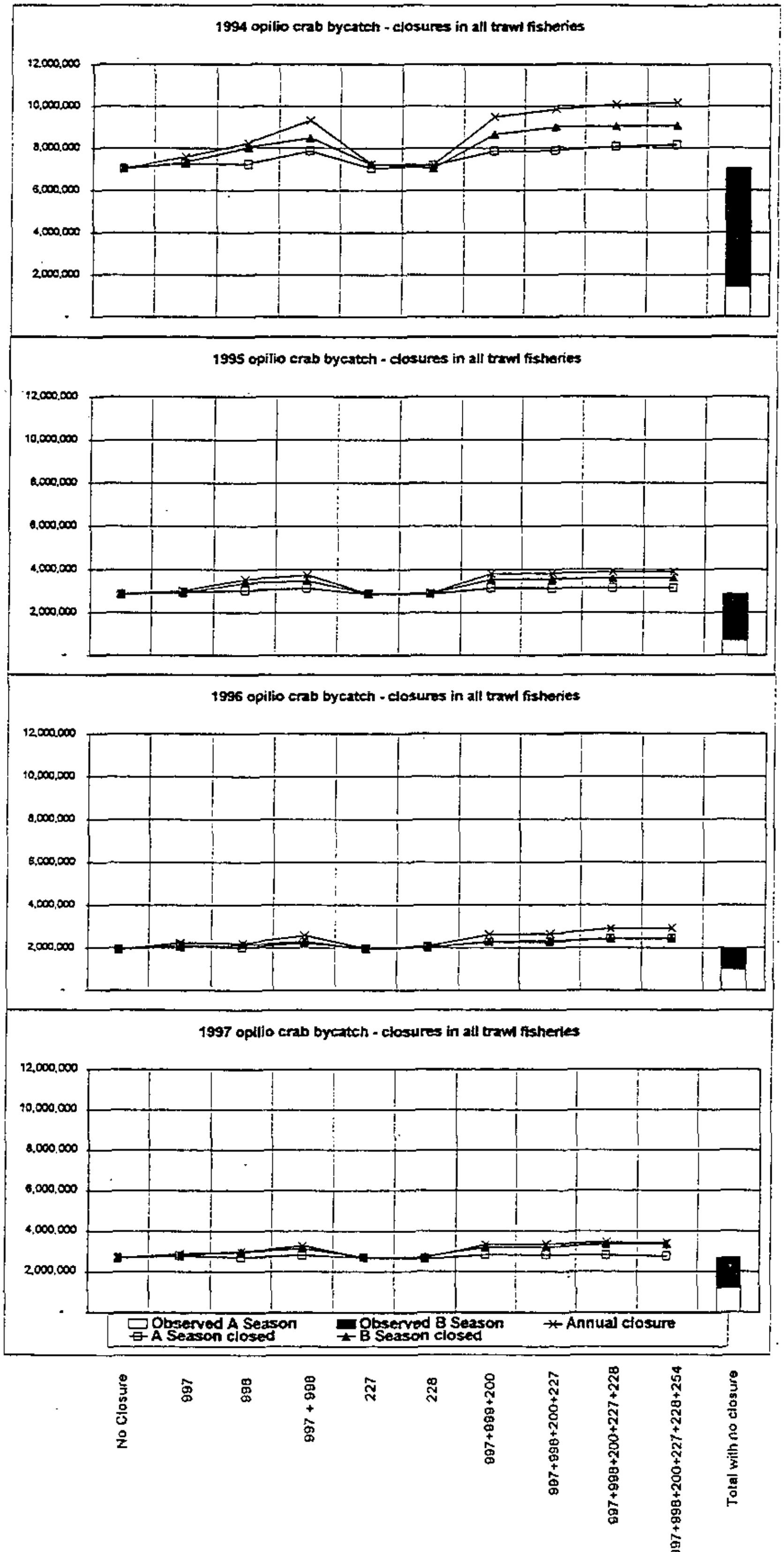


Figure 54. Expected red king crab bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

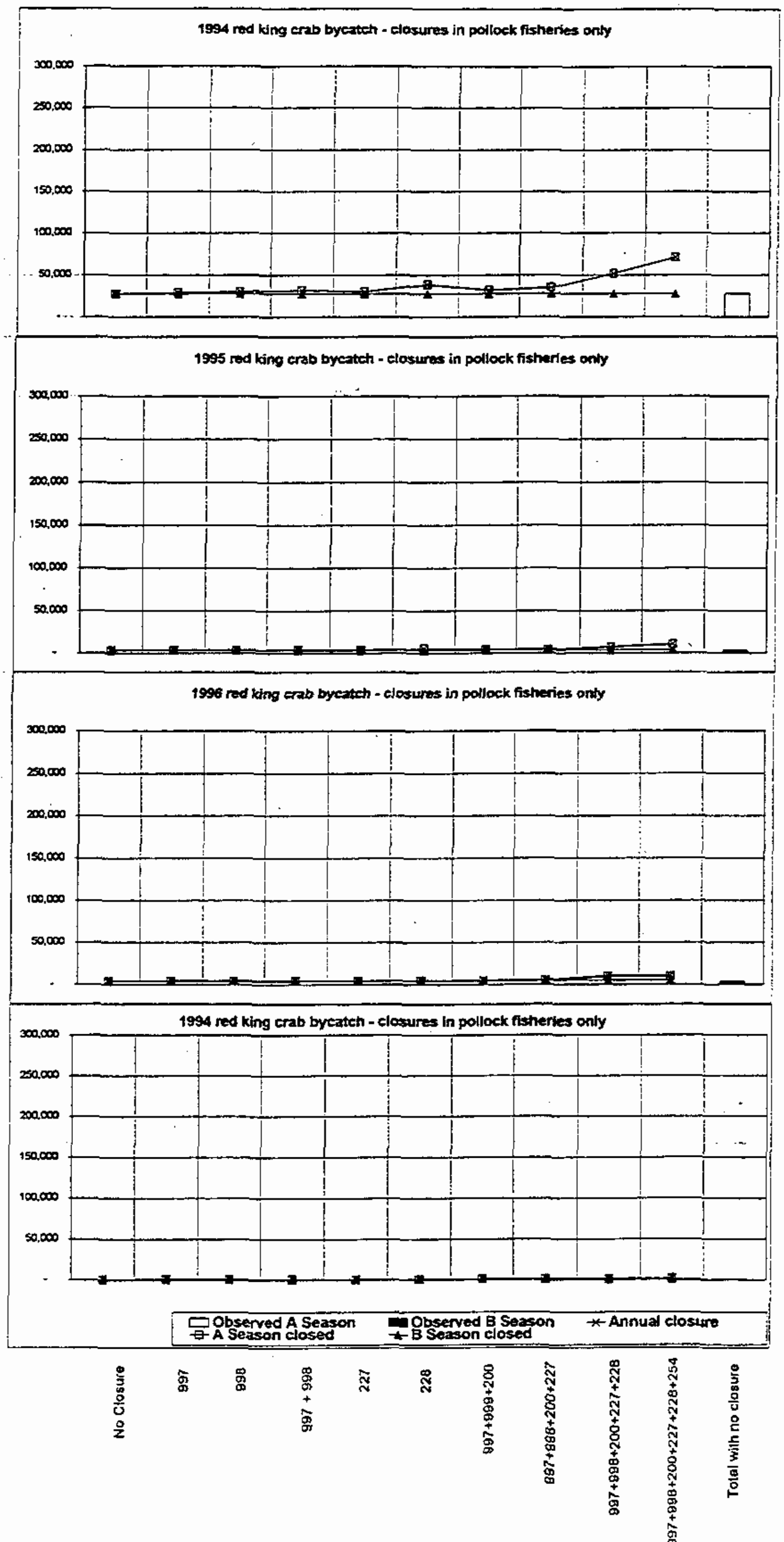


Figure 55. Expected red king crab bycatch from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.

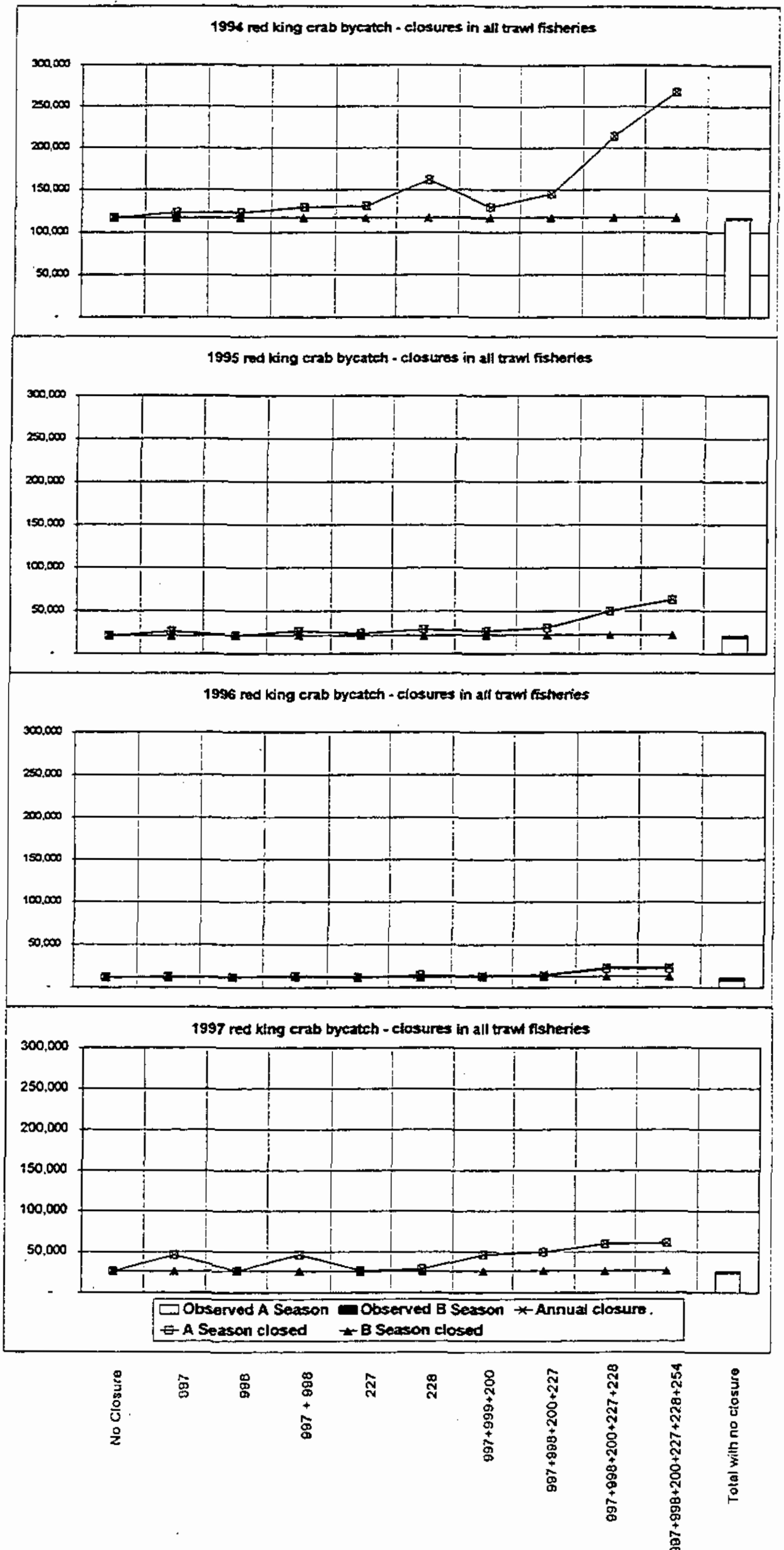


Figure 56. Expected number of hauls from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. Pollock fisheries only.

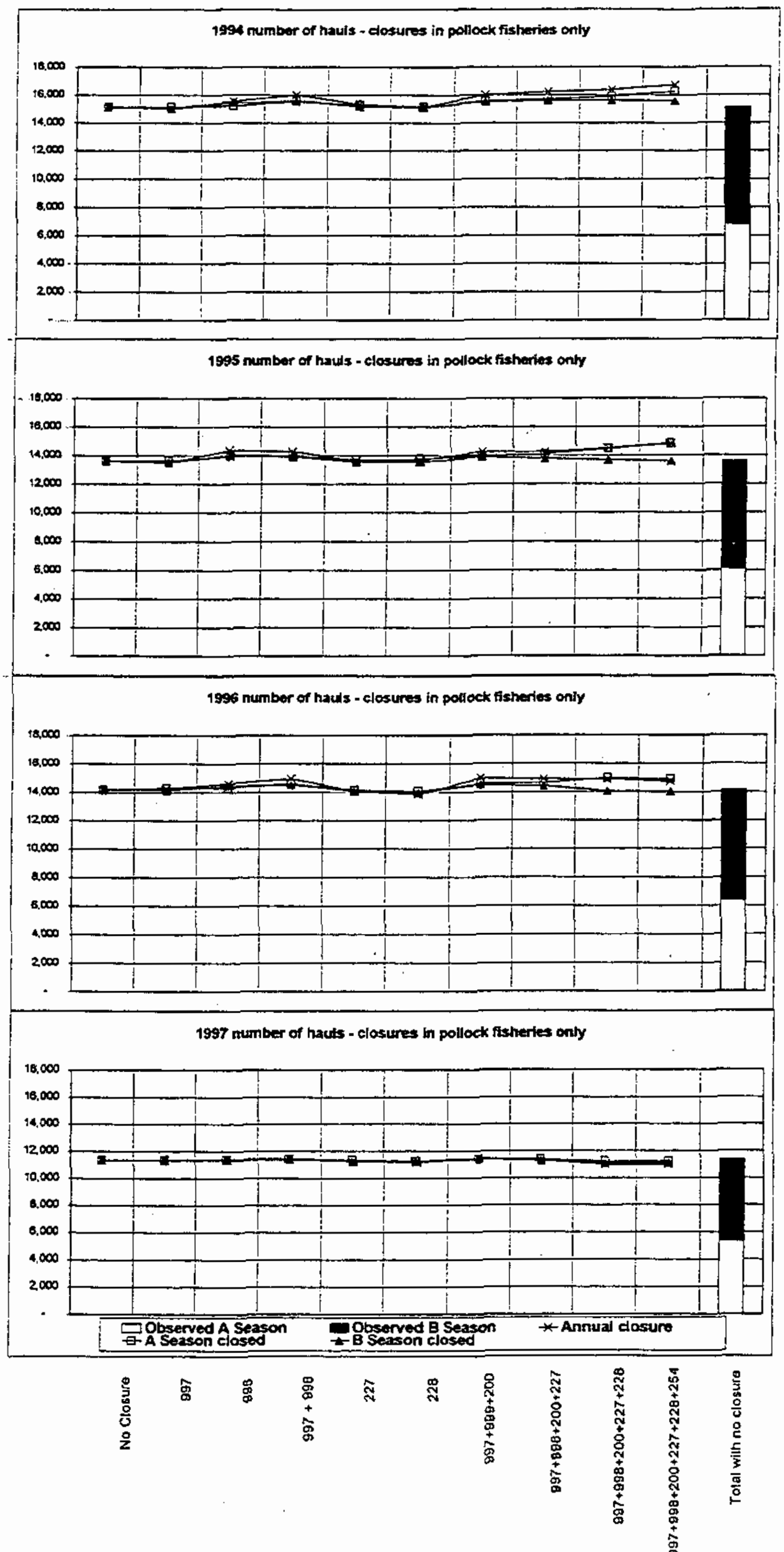
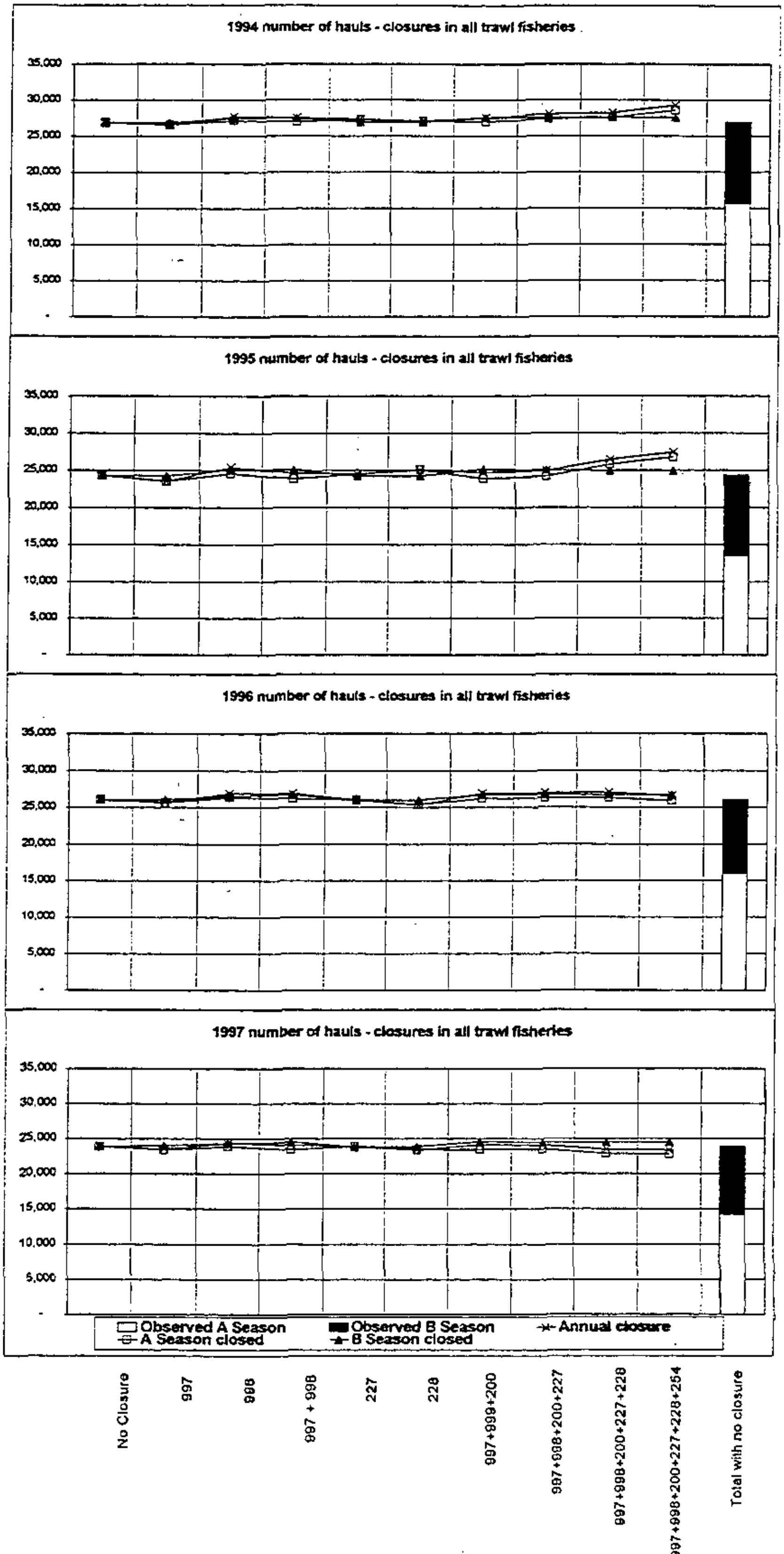


Figure 57. Expected number of hauls from simulation of cell closures (horizontal axis), based on 1994-1997 NMFS observer data. Annual and seasonal closure amounts indicated by lines and the amount taken with no closure is indicated by the bar. All trawl fisheries.



APPENDIX 1

Status of chinook salmon stocks in Western Alaska

This appendix consists of three sections, the first of which is a report provided by Alaska Department of Fish and Game staff on the status of Yukon River chinook salmon. The second section provides a brief description of the status of Kuskokwim River chinook stocks, and the third section provides background material on chinook salmon returns to the Nushagak and Togiak Rivers in Bristol Bay.

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Appendix 1. Section 1.

YUKON RIVER CHINOOK SALMON STOCK STATUS

A Report to the North Pacific Fishery Management Council

By

Alaska Department of Fish and Game

Regional Information Report[1] No. 3A98-26

Alaska Department of Fish and Game
Division of Commercial Fisheries, AYK Region
333 Raspberry Road
Anchorage, Alaska 99518

September 1998

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[1] The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. *Consequently, these reports should not be cited without prior approval of the author* or the Division of Commercial Fisheries.

OVERVIEW

The Yukon River chinook salmon resource is unique and important. The Yukon River (Figures 1 and 2) is the longest river in Alaska, flowing over 2,000 miles from its headwaters in Canada to the Bering Sea. With total annual inriver harvest typically over 150,000 chinook, and over 200,000 in some years, the Yukon River run is likely the largest wild run of chinook salmon in the world. These fish are utilized in traditional subsistence and Aboriginal fisheries of long-standing, and with their high oil content, they have long held a unique niche in commercial markets. In the Alaska portion of the drainage there are typically over 800 commercial salmon permits fished annually, and over 1,400 households harvest salmon for subsistence purposes. A very low chinook salmon return to the Yukon River in 1998 resulted in significant and unusual inriver management restrictions on harvest, difficulties in achieving subsistence harvests in some areas of the drainage, and some shortfalls in escapements from desired levels.

Despite average or better spawning escapements in the parent years for most stocks, the overall chinook salmon return to the Yukon River in 1998 was one of the smallest on record, judging from harvest and known escapement levels. Data for the 1998 season are still preliminary, and harvest data for some fisheries have not yet been compiled. However, the Alaska commercial harvest of 43,500 chinook salmon in 1998 was 32% less than the prior lowest harvest level ever under State management, and far below the 88,000 to 108,000 level expected preseason. Given the high dollar value of chinook salmon and limited alternative sources of income, the harvest shortfall in the commercial fishery poses a significant economic hardship for Yukon River fishers and communities.

Management of Yukon River chinook salmon is made particularly difficult by the mixed stock nature of the run, broad distribution of the spawning stocks, relatively compressed entry timing into the river, and multiple user groups. Commercial fisheries are managed in context with the need to maintain adequate abundance and quality of spawning stock escapements, provide for priority use in subsistence fisheries distributed throughout the 1,200 mile length of the mainstem Yukon River in Alaska and in tributary systems, and provide for passage to the Canadian portion of the drainage at agreed levels. Timely inseason stock assessment in the lower river is technically and logistically difficult given the small run size of chinook salmon, even in a strong year, relative to the overlapping and much larger run of summer chum salmon. While inseason run assessments are made to adjust management strategy, current management strategy relies heavily on the historic sustainability of chinook stocks within a relatively stable range of harvests, and on subsequent postseason assessment of escapements. The weak return in 1998, across all age classes, diminishes confidence in stability of production and raises concerns about harvest levels that can be allowed in upcoming years.

This special report to the North Pacific Fishery Management Council (NPFMC) by the Alaska Department of Fish and Game (ADF&G) provides a brief summary of the status of Yukon River chinook salmon. Since both harvest and escapement factor into a complete picture of stock status, and overall return estimates are not available in quantitative terms for an historical period, both components will be summarized in this report. In addition, a brief discussion of age composition is included in this report.

More detailed information on the Yukon River chinook salmon fishery can be found in the most recent annual management report by Bergstrom et al. (1997a), the most recent report to the Alaska Board of Fisheries by Bergstrom et al. (1997b), and the 1998 preseason fishery management plan by ADF&G (1998).

FISHERY HARVEST LEVELS

Total harvest of chinook salmon in the Yukon River drainage in Alaska and Canada combined since 1961 has ranged from lows of 83,000 in 1975 and 98,000 in 1970, to highs of 221,000 in 1980 and 217,000 in 1983 (Figure 3). Harvest estimates for 1998 are not yet complete, but the total is expected to be on the lower end of the range. Ten-year average total harvest levels were 113,000 chinook for 1968-77, 188,000 chinook for 1978-87, and 179,000 chinook for 1988-97.

Alaska Commercial Fishery

Commercial harvest of chinook salmon in the Alaska portion of the Yukon River drainage dates back in written records to 1918, with the largest harvests (70,000 to 105,000 chinook) during the early years taken from 1919 to 1921. The majority of these harvests were taken outside of the river mouth since harvest restrictions were imposed within the river during that time period. The early commercial fishery met opposition and was closed from 1925 to 1931 because of concerns for the existing large subsistence fishery. Commercial fishing for chinook salmon was resumed at a much reduced level in 1932, and has occurred annually since that time. During 1954-1960, a 65,000 chinook salmon quota was in effect. Of this total, not more than 50,000 fish could be taken below the mouth of the Anuk River (current boundary of Districts 1 and 2), 10,000 fish in the area between the mouths of the Anuk River and the Anvik River, and 5,000 fish above the Anvik River.

Since the onset of the inriver commercial fishery, the majority of the harvest has occurred in Districts 1 and 2, where fishing and processing effort is concentrated and flesh quality is optimal. Chinook salmon harvest quotas were eliminated in 1960. From 1961 through 1980 the fishery was regulated by scheduled weekly fishing periods with the season opened by a published regulatory date. Since 1981, a 60,000 to 120,000 chinook salmon guideline harvest range has been in effect for Districts 1 and 2 combined. Small guideline harvest ranges are in effect for other districts as well, such that the total for all districts is 67,350 to 129,150 chinook. Harvest may be managed for levels below lower ends or exceed upper ends of guideline harvest ranges based upon inseason assessments of run strength.

Prior to the 1998 season, commercial harvest in the Alaska portion of the Yukon River drainage since 1961 ranged from lows of 64,000 in 1975 and 75,000 in 1973, to highs of 158,000 in 1981 and 154,000 in 1980 (Figure 4). Ten-year average commercial harvest levels were 90,000 chinook for 1968-77, 131,000 chinook for 1978-87, and 106,000 chinook for 1988-97. The 1998 harvest of 43,500 chinook was one-third smaller than the prior lowest harvest level ever under State management, and the lowest annual total since 39,000 fish were harvested in 1952. Since 1990, commercial harvest figures for chinook salmon include estimates of the number of fish harvested to produce roe sold, but roe sales are a very small component of the overall commercial fishery for chinook salmon.

Alaska Subsistence and Personal Use Fisheries

Subsistence fishing occurs throughout most of the Yukon Area. Chinook salmon are used mainly for human consumption, whereas a large portion of chum and coho salmon harvests are also used to feed sled dogs. Comprehensive annual surveys of the subsistence salmon fishery were initiated by ADF&G in 1961. Survey methodology and technique have varied over the years, however, it is felt that the estimates reflect harvest trends. Normally, subsistence harvest data collected through the use of postseason household interviews, harvest calendars, mail out questionnaires, and telephone interviews have been expanded on a community basis and expanded community harvests summed for district and total drainage estimates on an annual basis (Walker et al. 1989). Current methodology for estimating subsistence salmon harvests can be found in Borba and Hamner (1998). Since the development of salmon roe fisheries, primarily for chum salmon, beginning in the late 1970's, distinguishing between subsistence and commercial harvests has been made more difficult because fish harvested to produce commercial roe sales are also used for subsistence purposes. This is not a substantial harvest component for chinook salmon, although it is for chum salmon in most years.

Personal use fishing is similar to subsistence fishing, but does not have the statutory priority that subsistence fishing has over other uses. There have been a series of statutes, regulations, and judicial rulings affecting the conduct of personal use fisheries since the late 1980's. In terms of harvest numbers, the personal use harvest of chinook salmon is very small in the Yukon River drainage as compared to the subsistence harvest.

Total estimated subsistence and personal use harvest of chinook salmon in the Alaska portion of the Yukon River drainage averaged 18,000 chinook for 1968-77, 39,000 chinook for 1978-87, and 51,000 chinook for 1988-97 (Figure 4). Harvest estimates for 1998 are not yet available. However, inseason reports from fishers indicates that there were difficulties in achieving subsistence harvests in some areas of the drainage. The personal use salmon fishery in subdistrict 6-C (the upper Tanana River) was closed effective 24 July in 1998 to further conserve chinook and summer chum salmon for spawning escapement.

Alaska Sport Fishery

Approximately 90% of the sport fishing effort in the Alaskan portion of the Yukon River drainage occurs in the Tanana River drainage. Most of the sport effort and harvest occurs in the Chena, Salcha, and Chatanika Rivers and other rivers along the road system. Sport fishing effort and harvests are monitored annually through a statewide sport fishing survey. In the past, on-site creel surveys have also been conducted on the Chena and Salcha Rivers, but none were conducted during 1998. The annual sport harvest of chinook salmon in the Alaska portion of the Yukon River drainage averaged about 2,000 fish for the 1992-97 period. Harvest estimates for 1998 are not yet available. To further conserve chinook salmon for spawning escapement, the sport fisheries in the Chena, Salcha, and Chatanika Rivers were restricted to catch and release only fishing effective 25 July 1998.

Canadian Fisheries

Fisheries harvesting chinook salmon in the Canadian portion of the Yukon River drainage include commercial, Aboriginal, domestic, and sport fisheries in the mainstem Yukon drainage, and an Aboriginal fishery in the Porcupine River drainage. A guideline harvest range of 16,800 to 19,800 chinook salmon was established in 1990 for all fisheries combined in the Canadian portion of the mainstem Yukon drainage (excluding the Porcupine River drainage). This guideline harvest range was agreed to in the U.S./Canada Yukon River negotiation process, and included in the Interim Yukon River Salmon Agreement, which was in effect from February 1995 through March 1998. The U.S. has said it would continue to endeavor to deliver border passages consistent with the now-lapsed Interim Agreement while the negotiation process continues.

Prior to the 1998 season, total harvest in the Canadian portion of the mainstem Yukon drainage since 1961 ranged from lows of less than 3,000 in 1969 and less than 5,000 in 1966, 1970, and 1973, to highs of 21,000 in 1980, 1988, and 1994 (Figure 5). Ten-year average total harvest levels were 5,000 chinook for 1968-77, 16,000 chinook for 1978-87, and 19,000 chinook for 1988-97. Total harvest estimates for 1998 are not yet available. However, the commercial fishery, which was closed after only two fishing periods in 1998, harvested only 390 chinook, which was the lowest since commercial harvest records have been maintained by DFO and its predecessor agency beginning in 1958. The commercial, domestic, and sport fisheries in the Canadian mainstem Yukon drainage were closed effective 25 July in 1998, to further conserve chinook salmon for spawning escapement. The Aboriginal fishery remained open. Typically, the Aboriginal fishery harvest in the Canadian mainstem Yukon drainage has been on the order of 8,000 chinook annually in recent years, while in the Porcupine drainage it has typically been less than 1,000 chinook annually.

ESCAPEMENT LEVELS

Although chinook salmon spawning has been documented in over 100 locations in the Yukon River drainage, escapement surveys and stock identification information indicate that the largest concentrations occur in three distinct geographic regions of the drainage. The lower river run or stock group consists of tributary streams in Alaska that drain the Andreafsky Hills and Kaltag Mountains between river miles 100 and 500. Upper Koyukuk River and Tanana River tributaries in Alaska between river miles 800 and 1,100 make up the middle river run or stock group. Tributary streams in Canada that drain the Pelly and Big Salmon Mountains between river miles 1,300 and 1,800 are considered the upper river run or stock group. The Yukon River drainage is too large for comprehensive escapement coverage of all individual salmon spawning streams. Consequently, low-level aerial surveys from single-engine fixed-wing aircraft still form an important component of the escapement assessment program.

Biological escapement goals (BEG's) have been established for eight Yukon River chinook salmon spawning streams or index areas in the Alaska portion of the Yukon River drainage, and all are based on aerial survey indices of abundance. These goals represent the approximate minimum number of spawners considered necessary to maintain the historical yield from the stocks and are based upon historical levels. Goals are noted on the graphs of escapement trends (Figure 6). Escapement population size for the Canadian mainstem Yukon is estimated by a mark-recapture project operated by the Canadian Department of Fisheries and Oceans (DFO) immediately upstream from the U.S./Canada border, taking into account harvest in Canadian fisheries upstream of the project. The JTC recommended a long-term escapement goal of 33,000 to 43,000 chinook for the Canadian mainstem Yukon. The negotiation process established a stabilization level minimum goal of 18,000 chinook annually for the period 1990-95, and the Yukon River Panel established a rebuilding step minimum goal of 28,000 chinook annually for the period 1996-2001. DFO also indexes chinook escapement at selected spawning locations by helicopter aerial survey, and counting is conducted at the fish ladder at the Whitehorse dam.

In recent years several additional escapement assessment projects have been established in the Alaska portion of the Yukon River drainage, including federal and cooperative projects with regional organizations. These projects have targeted chum salmon, with special funding support following chum salmon run failures. However, for most of these new projects, significant chinook salmon stocks are also present and assessed.

Prior to 1998, the overall assessment was that lower river stocks have been in good condition, with spawning escapement goals typically achieved in recent years, except for 1996; middle river stocks were rebuilt from some lower levels in prior years with escapement goals readily achieved since 1993; and the upper river stock was meeting or exceeding the stabilization and rebuilding level targets after low escapements in the mid-1980's. Figure 6 provides a record of escapement indices and estimates for selected spawning stocks in the Alaska portion of the Yukon River drainage, Figure 7 provides a record of Canadian Yukon mainstem escapement population estimates, and

Figure 8 provides a record of escapement indices and estimates for selected spawning stocks in the Canadian portion of the Yukon River drainage.

Conservative management actions taken in both the Alaskan and Canadian commercial fisheries generally resulted in chinook salmon escapements at or near escapement goal levels for some of the spawning areas in the Yukon River drainage in 1998, while others were further below desired levels. The most substantial shortfalls appear to have been in the Canadian portion of the drainage (upper river stock) and in portions of the upper Koyukuk River drainage (middle river stock). Aerial survey estimates are nearly all considered minimal indices for 1998 due to sub-optimal visibility, survey timing, or a combination of factors which precluded more complete data collection.

For the lower river stock group, aerial survey estimates of the East and West Fork Andreafsky River escapement (1,027 and 1,249 fish) were 35% and 11% below minimum goal, while the Anvik River index area estimate (648 fish) was 30% above minimum goal. Of these estimates, only the East Fork Andreafsky River aerial survey was classified as a "good" quality survey. The East Fork Andreafsky weir passage estimate (3,984 fish) was 19% below the average number (4,946 fish) counted through the weir during the previous four years, but above the levels of 1996 and 1997.

For the middle river stock group, spawning assessments are less certain as all aerial surveys were classified as "fair" or "poor" survey ratings due to conditions and/or timing. Observations of spawning chinook salmon on an aerial survey classified as "fair" for the North and South Fork Nulato Rivers totaled 507 and 546 fish, respectively, roughly 37% below and 9% above minimum goals. The number of chinook estimated to have passed the mainstem Nulato River tower, downstream from the confluence of the two forks, was 1,536 fish or 33% below the average number (2,300 fish) estimated from observations at that project since 1994. In the Koyukuk River drainage, the number of chinook observed during a "poor" quality aerial survey of the Gisasa River (889 fish) was 48% greater than the 600 fish minimum goal for that river. In the Tanana River drainage, 427 and 2,055 chinook were recorded during sub-optimal aerial surveys of the Chena and Salcha Rivers, respectively, or 75% and 18% below established minimum goals of 1,700 and 2,500 fish. The counting tower estimate for the Chena River of 4,423 chinook was 65% below the three year (1993, 1994, and 1997) average of 12,500 fish, while the Salcha River counting tower estimate of 4,990 chinook was 67% below the four year (1993, 1994, 1995, and 1997) average of 15,100 fish. There were incomplete counting tower estimates for the Chena River in 1995 and 1996, and for the Salcha River in 1996, because of high water conditions.

In addition to the significant spawning streams for which minimum escapement goals have been established, additional information from a number of aerial surveys on smaller spawning streams indicates that in some selected areas such as Jim and Henshaw Creeks in the upper Koyukuk River drainage, escapements appear to be some of the lowest on record.

It appears that the spawning escapement estimate for the upper river stock group will be approximately 18,000 chinook salmon in the Canadian portion of the drainage, based upon preliminary information from the DFO mark-recapture project near the border, and likely harvest levels. This spawning escapement level falls well short of the rebuilding step minimum escapement goal of 28,000 fish, but is equal to the former six year stabilization level of 18,000 chinook. The low chinook border passage into Canada was realized despite conservative management of the Alaskan commercial fishery. The total commercial harvest in the Alaska portion of the drainage was only 2,000 chinook salmon during the early portion of the run, from ice break-up in the lower river on 22 May through 23 June. Upper river stocks (Canadian) generally contribute a larger portion of the early segment of the Yukon River chinook salmon run than during the later segment of the run. Canada took unprecedented management actions to conserve chinook salmon from the low border passage for spawning escapement.

AGE COMPOSITION

Typically, the majority of chinook salmon returning to the Yukon River are 6-year-old fish. However, 5- and 7-year-old fish contribute significantly to the run. For 1998, the preseason outlook was for an overall run near average in strength, with age-5 expected to be average to above average, age-6 perhaps below average based on their showing as age-5 fish in 1997, and age-7 expected to be strong given the strong showing as age-6 in 1997. While not all age data have been compiled for the 1998 season, it appears that all three major age classes were weak in abundance. As a percentage of sample totals, ages 6 and 7 were lower, and age 5 was higher, than typical. However, coupled with the low overall abundance as judged by harvest and escapement levels, it appears that all three major age classes were weak. There were also observations and reports of an unusually high incidence of poor condition fish during the 1998 season, but there has not been a quantitative assessment of fish condition.

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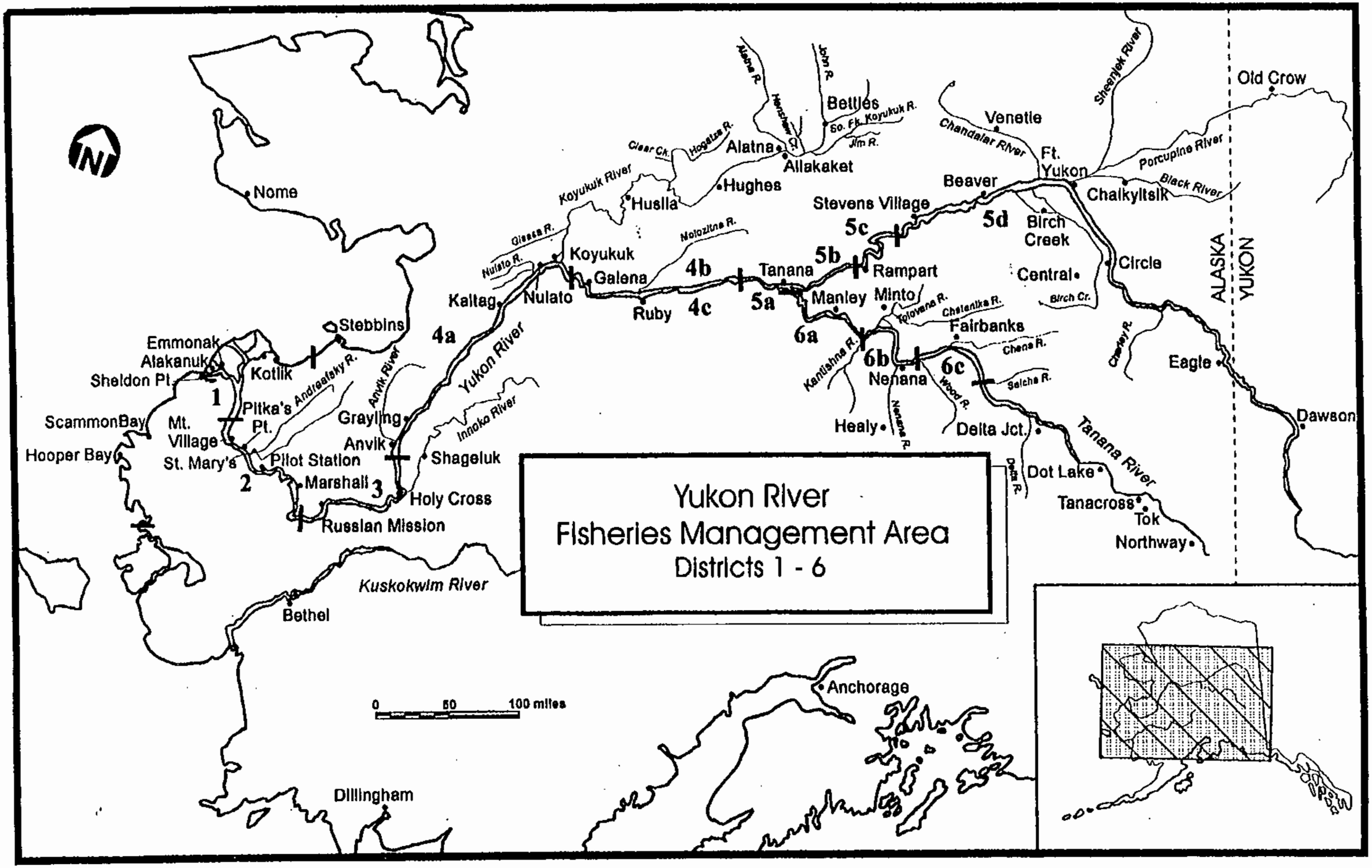


Figure 1. Map of the Alaska portion of the Yukon River Drainage.

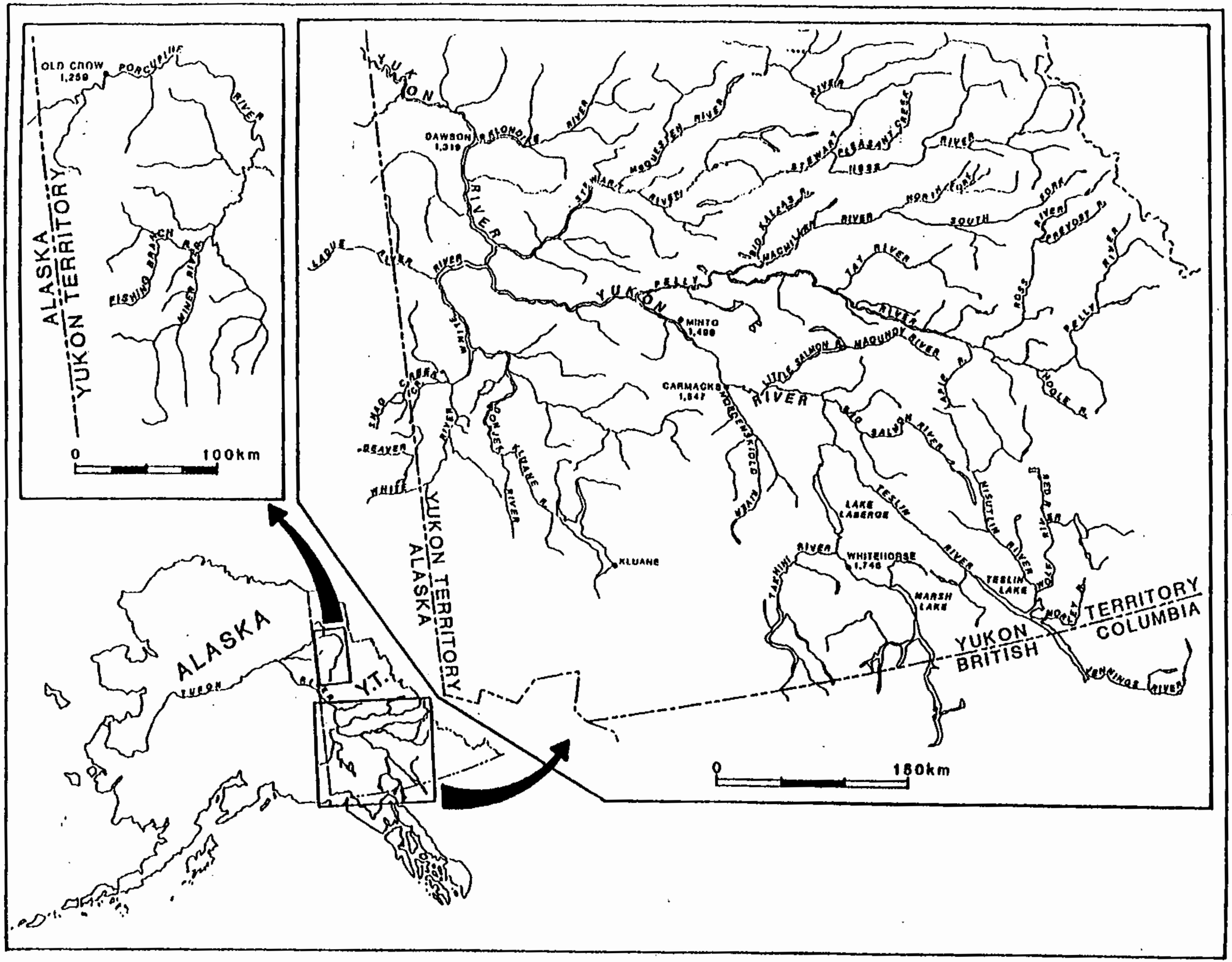


Figure 2. Map of the Canadian portion of the Yukon River drainage.

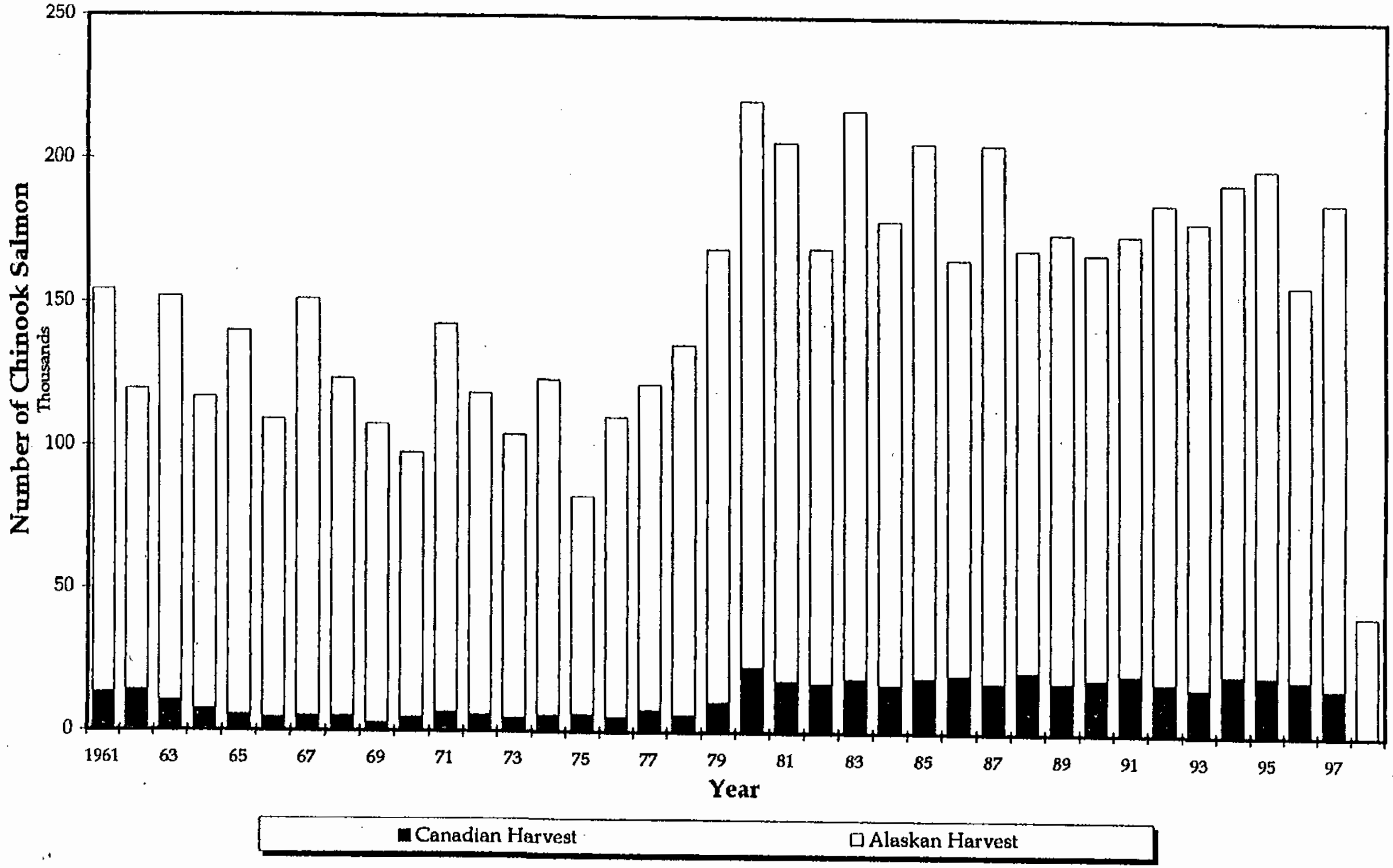


Figure 3. **Total harvest of chinook salmon, Yukon River, 1961-1998. Data for 1998 are not yet available for fisheries other than the commercial fisheries.**

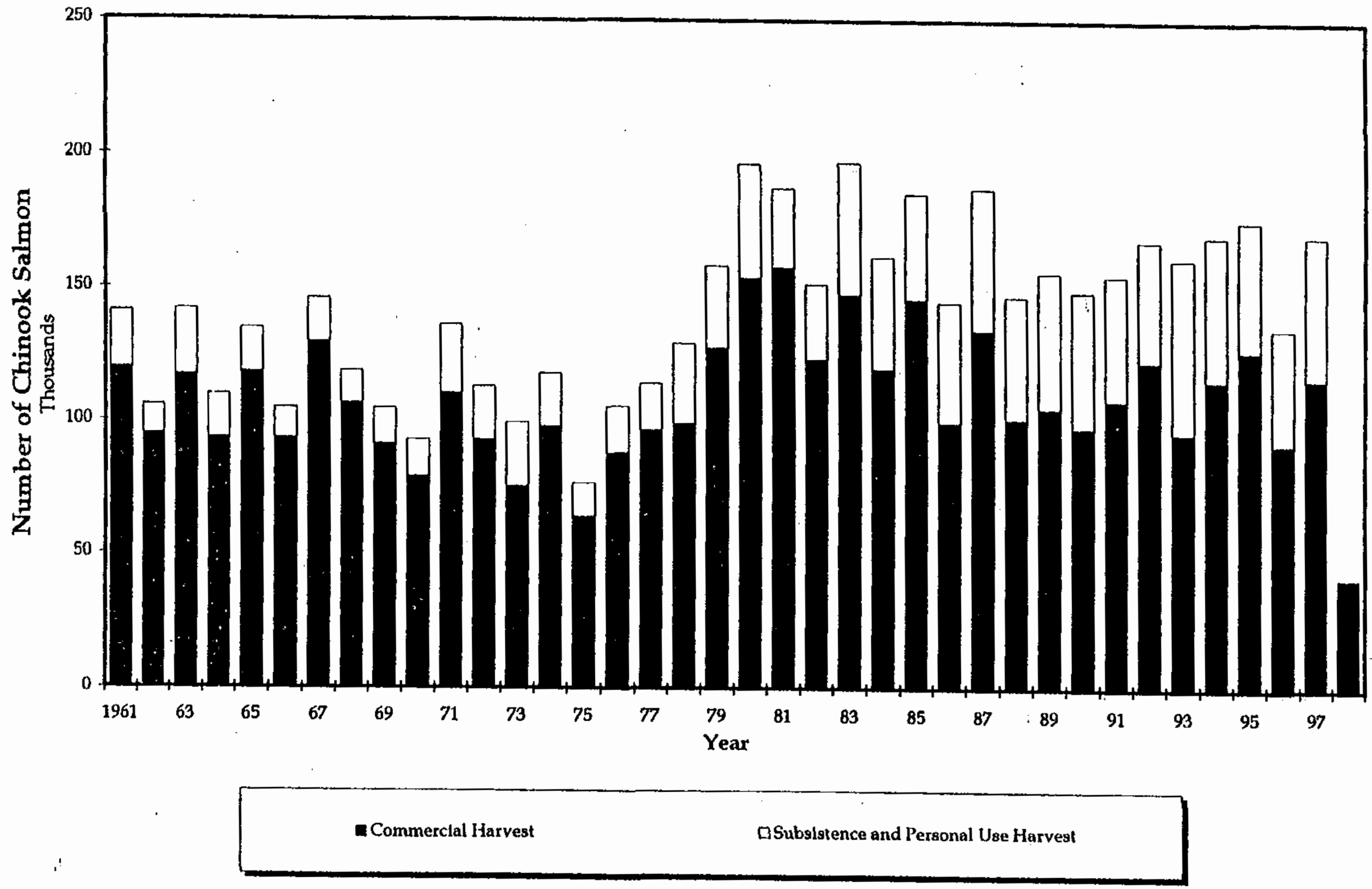


Figure 4. Alaskan harvest of chinook salmon, Yukon River, 1961-1998. The 1998 harvest includes only commercial harvest data. Other Alaskan harvest estimates are unavailable at this time.

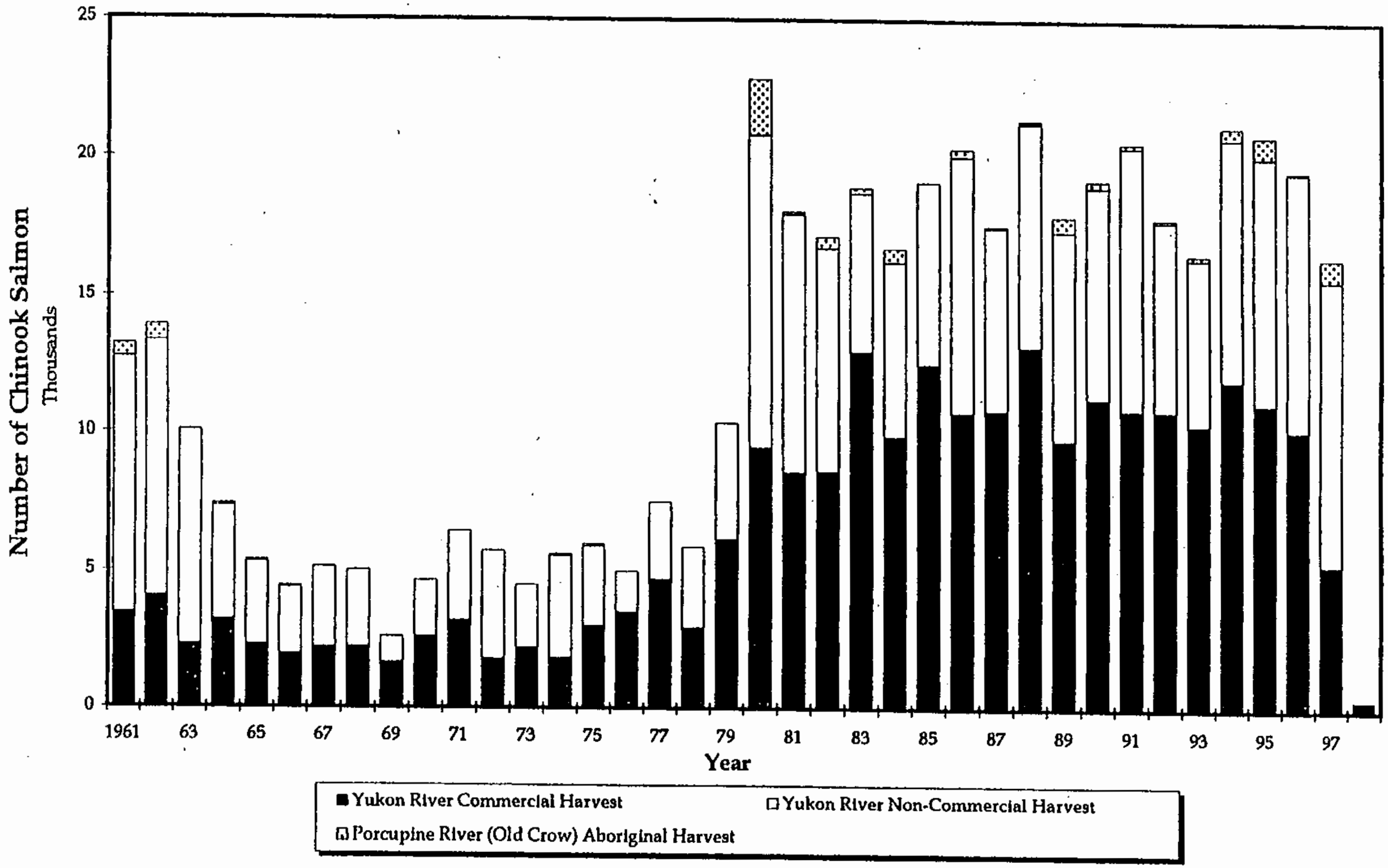


Figure 5. **Canadian harvest of chinook salmon, Yukon River, 1961-1998. The 1998 harvest includes only commercial harvest data. Other Canadian harvest estimates are unavailable at this time.**

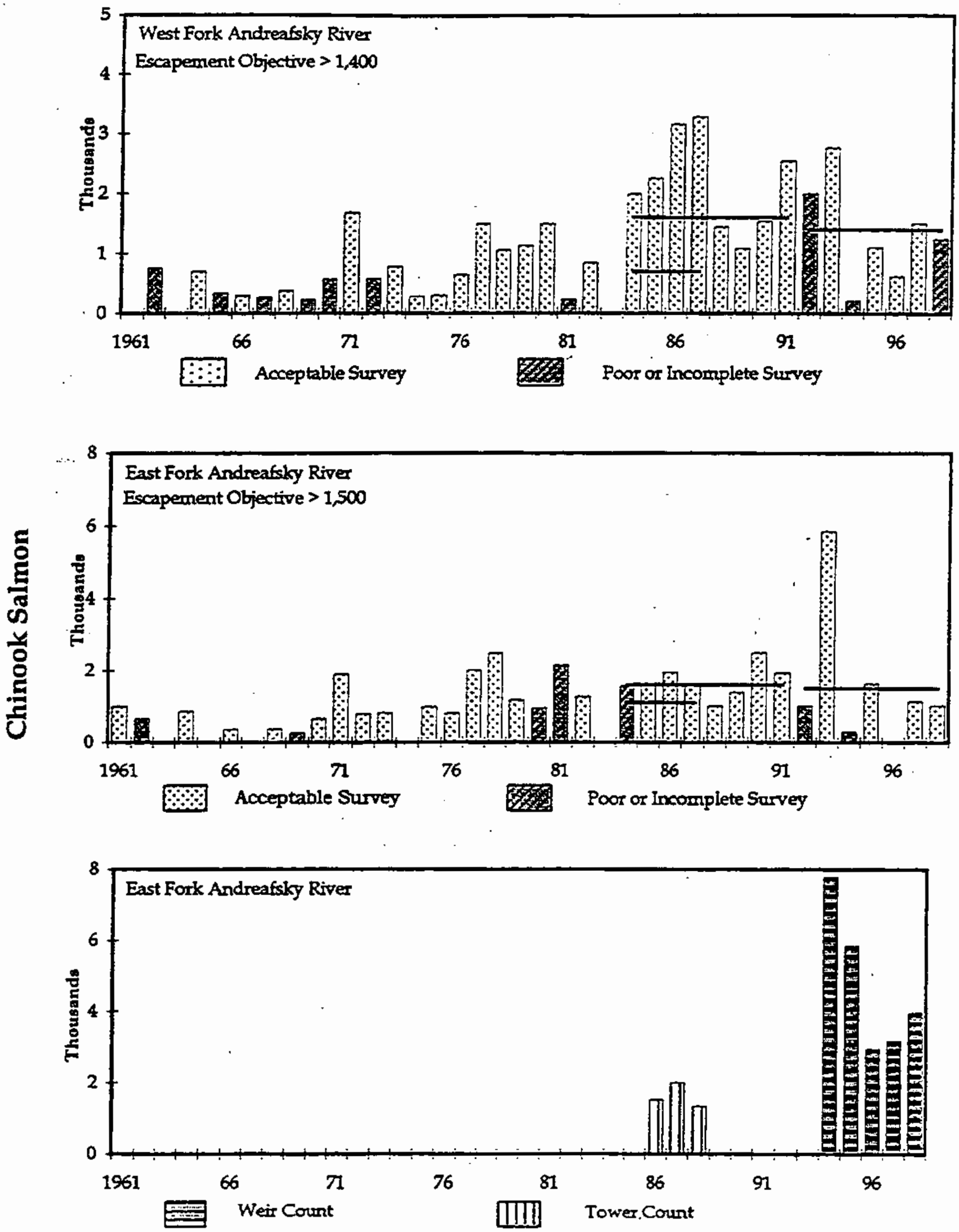


Figure 6. Chinook salmon escapement data for selected spawning areas in the Alaskan portion of the Yukon River drainage, 1961-1998. Data are aerial survey observations unless noted otherwise. Horizontal lines represent interim escapement goal objectives or ranges. Note that the scale of the vertical axis is variable.

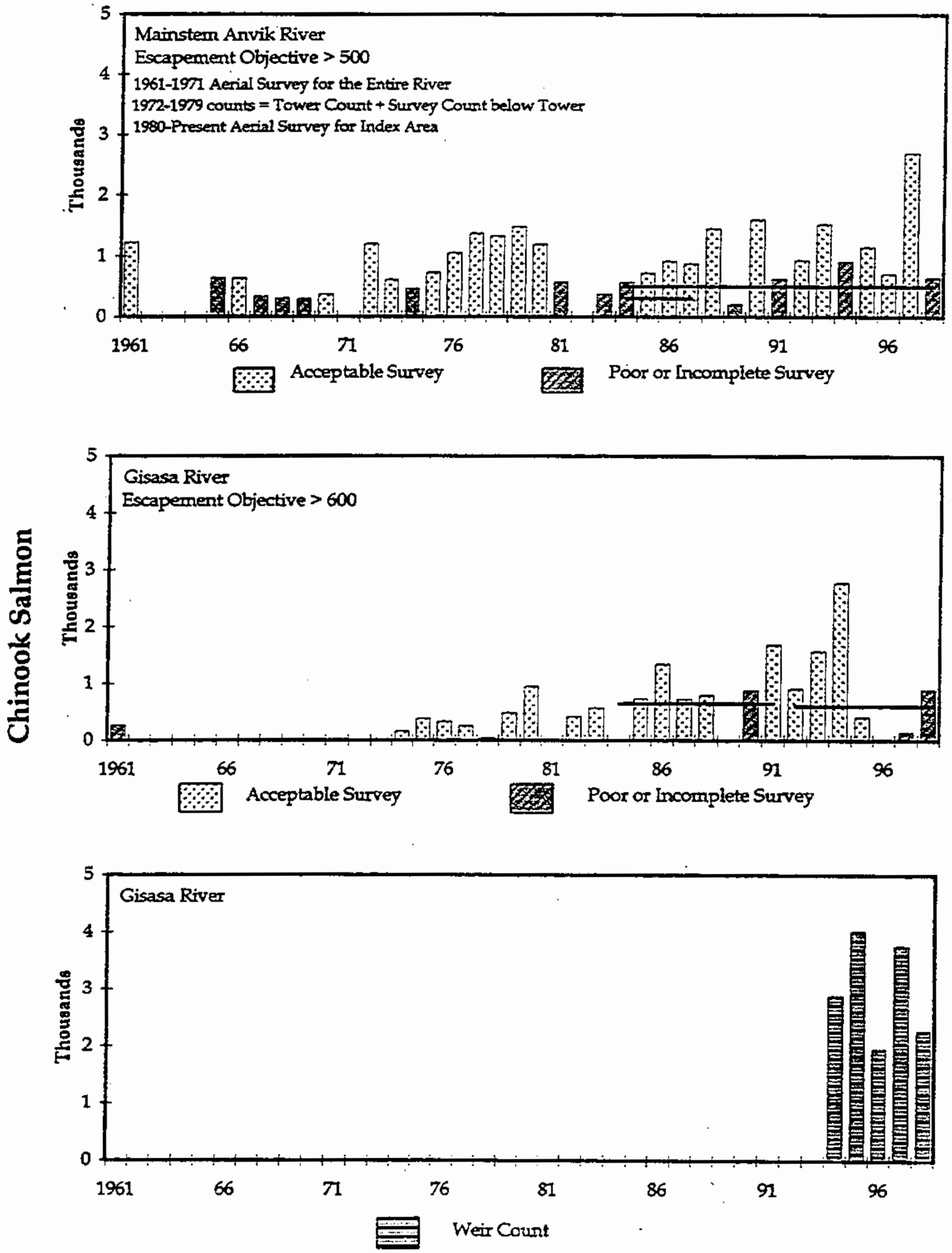
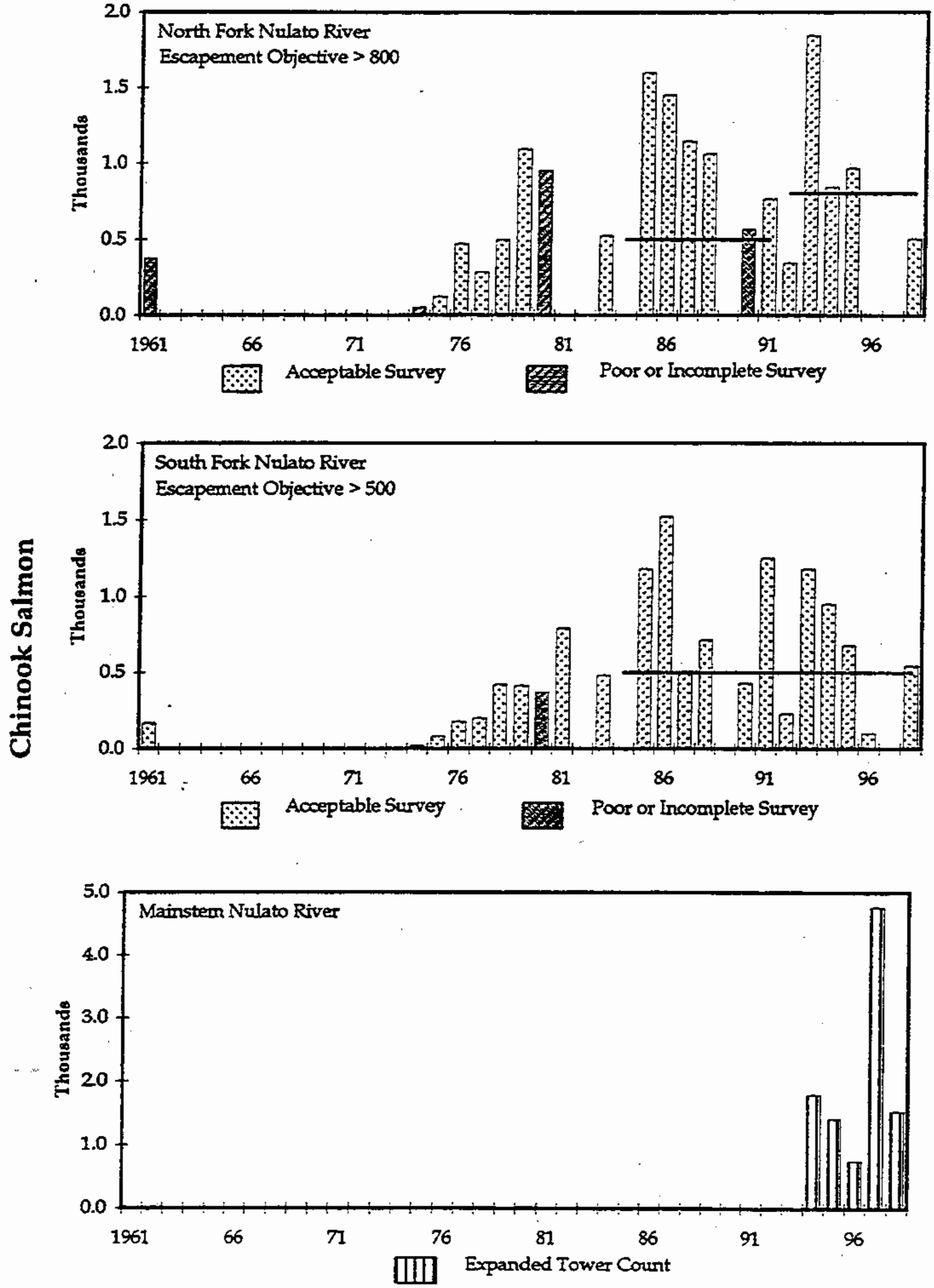


Figure 6 (page 2 of 4).



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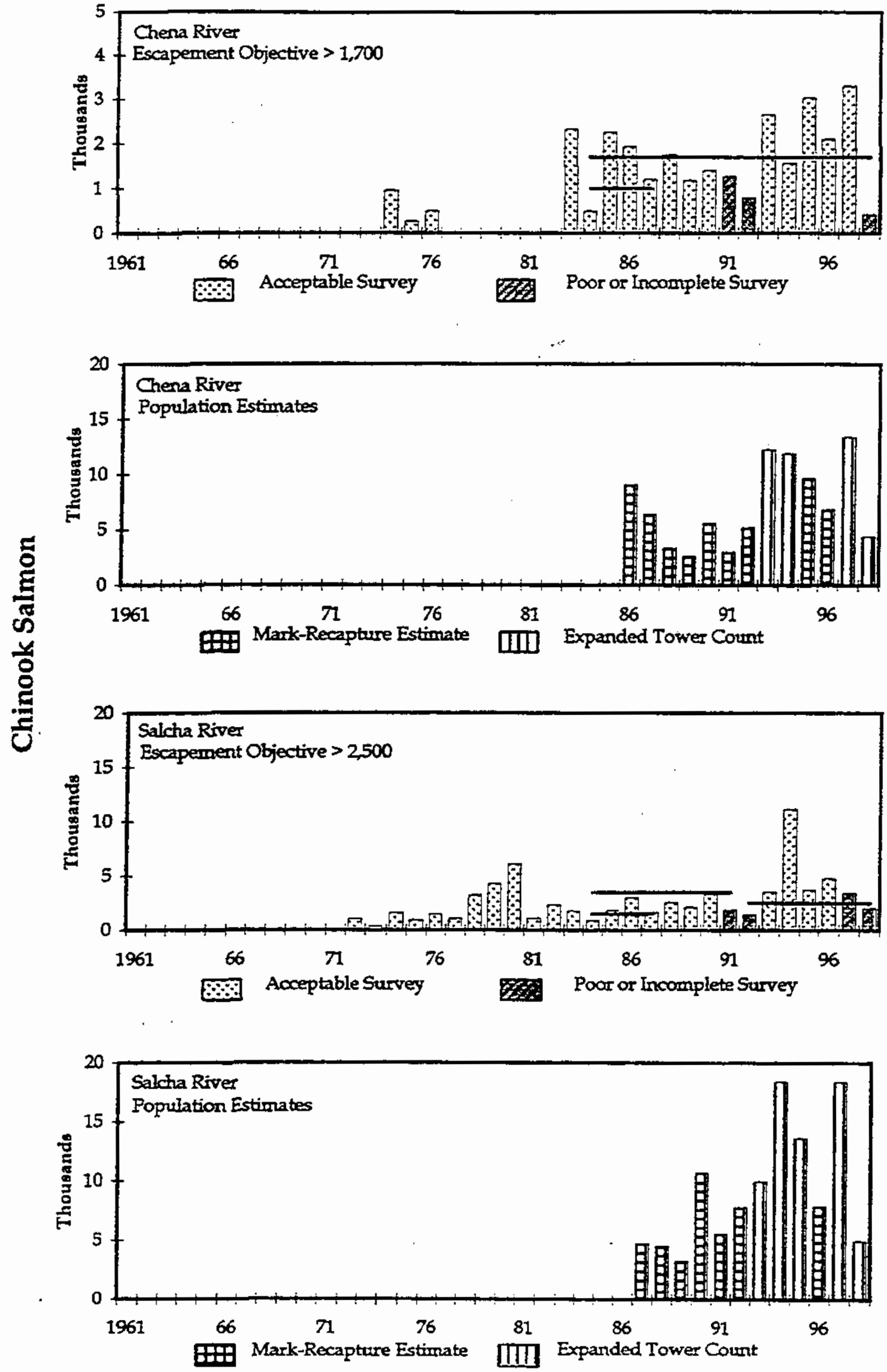


Figure 6 (page 4 of 4).

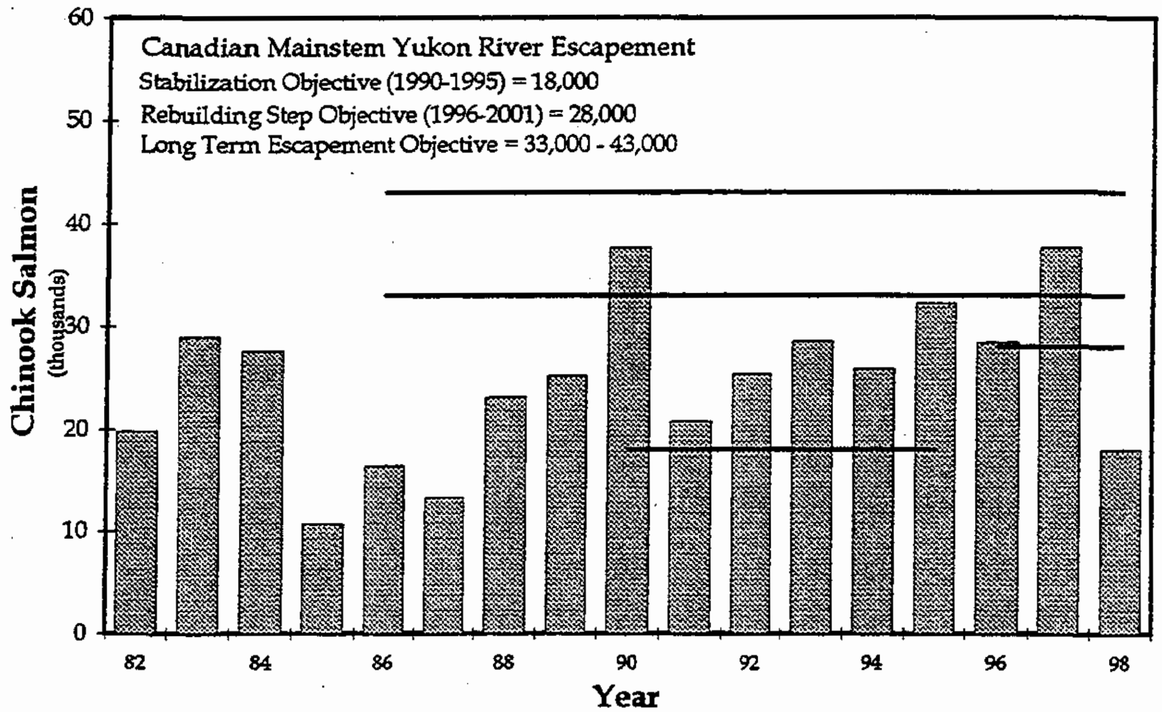


Figure 7. Estimated total chinook salmon escapement to the Canadian portion of the mainstem Yukon River, 1982-1998. Horizontal lines represent the interim escapement goal range of 33,000-43,000 salmon, the stabilization objective of 18,000 salmon, and the rebuilding step objective of 28,000 salmon.

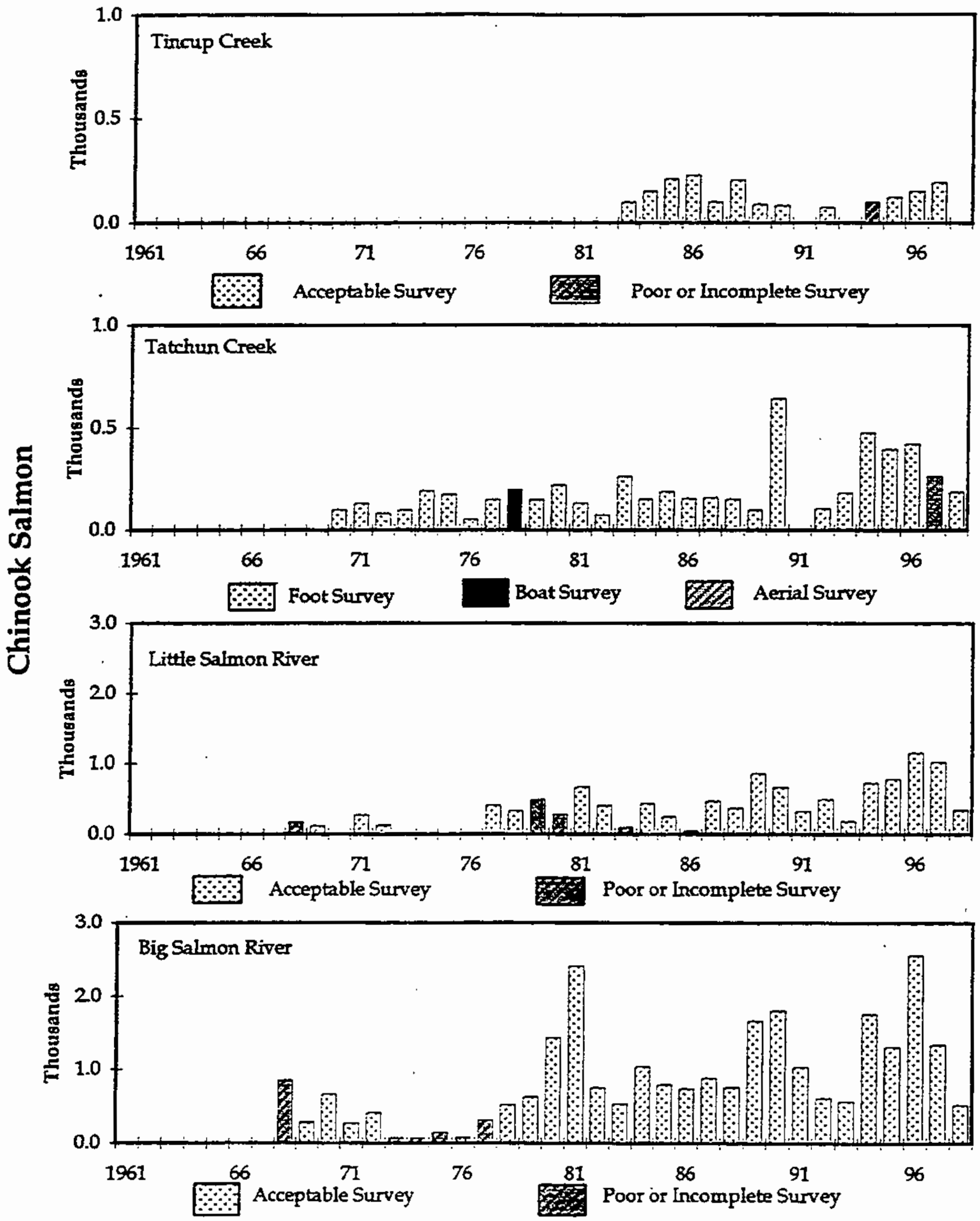


Figure 8. Chinook salmon escapement data for selected spawning areas in the Canadian portion of the Yukon River drainage, 1961-1998. Data are aerial survey observations unless noted otherwise. Note the scale of the vertical axis is variable.

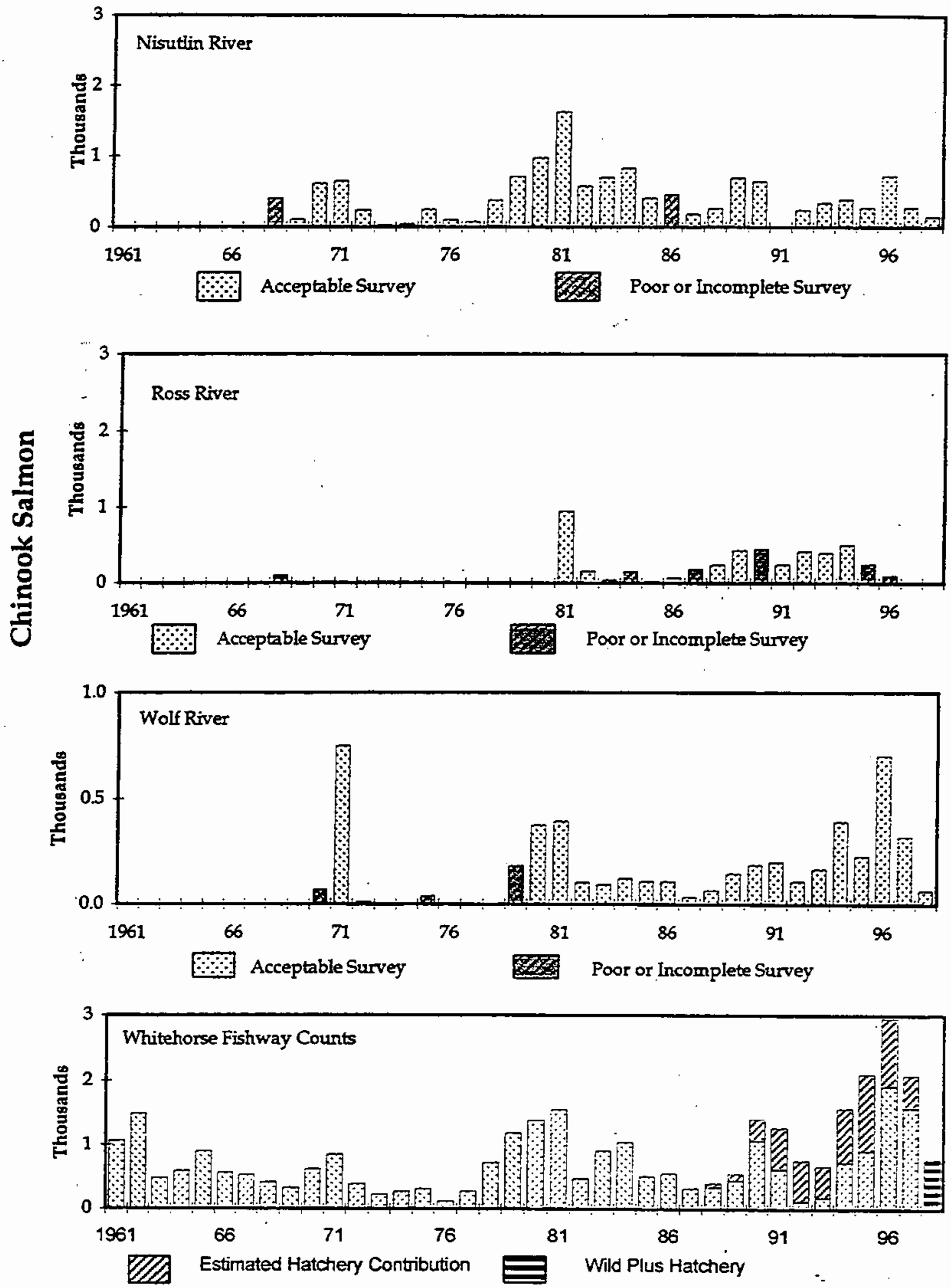


Figure 8 (page 2 of 2).

Appendix 1. Section 2.

Status of chinook salmon in the Kuskokwim River.
(Source: Burkey C. Jr. et al. 1998. Annual Management Report for the Subsistence and Commercial Fisheries of the Kuskokwim Area, 1996. Regional Information Report No. 3A98-11. Alaska Department of Fish and Game, CFMD, AYK Region, 333 Raspberry Rd., Anchorage, AK 99518. April 1998.
and Charles Burkey Jr. personal communication.)

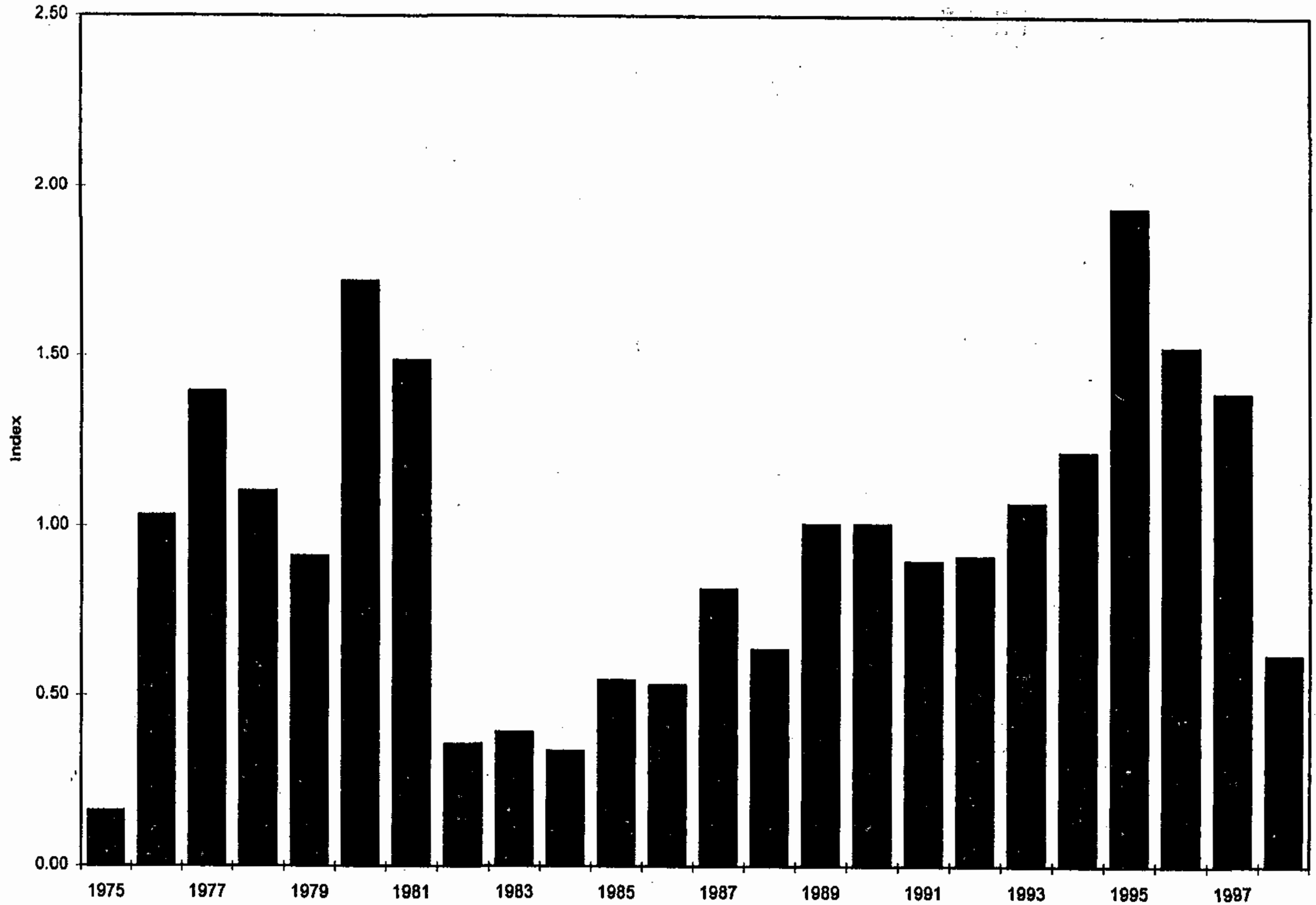
The strategy used to manage Kuskokwim Area salmon fisheries moved from guideline harvest levels prior to 1984 to a plan emphasizing spawning escapement objectives. All of the escapement objectives are derived from average historical escapement estimates. These objectives have more recently been described as biological escapement goals (BEG). The BEGs are considered the minimum escapement levels needed to maintain salmon stocks at past levels of abundance. Continued evaluation of the escapement data provides for periodic refinements to the BEGs, but most are still based on aerial surveys. Most of these surveys are conducted from late July through early August when chinook are thought to be at peak abundance on the spawning grounds. In addition to aerial surveys are weirs on the Kogrukluk and George Rivers, and counting towers on the Kwethluk and Takotna Rivers. Fishery managers rely heavily on commercial fishery data for inseason management decisions, but the escapement projects allow for postseason and some inseason assessment of management actions.

The combined commercial and subsistence chinook salmon harvest has increased from an average of 56,000 fish from 1960-1969 to 114,000 during 1986-1995. A conservation concern for Kuskokwim River chinook salmon arose following a series of years with poor chinook salmon escapements in the mid 1980s. Besides poor escapements, the low number of female chinook salmon in the escapement, as indicated by the Kogrukluk River weir, compounded the conservation concern. In 1985 a shift to 6-inch or smaller mesh-size commercial gillnets was enacted to reduce the harvest of larger female chinook salmon. The directed commercial harvest of chinook salmon was prohibited in 1987 but chinook salmon continued to be harvested in the chum salmon directed fishery. Overall, the conservation measures and improved survival have resulted in improved chinook salmon runs in the late 1980's and most of the 1990's.

The figure on the following page provides an historical view of the Kuskokwim River salmon escapement index. The Kuskokwim River chinook salmon escapement index represents the relative escapement of 13 possible index streams for which adequate historical data is available. The index scale represents the escapement relative to the proportion of the BEG, if a BEG has been established, otherwise it represents the proportion of the median historical escapement.

The figure indicates that during the period 1989 – 1997 the escapements were generally adequate. In 1998, however, the escapement index dropped to levels comparable to the mid-1980's.

Kuskokwim River Chinook Salmon Escapement Index



Appendix 1. Section 3.

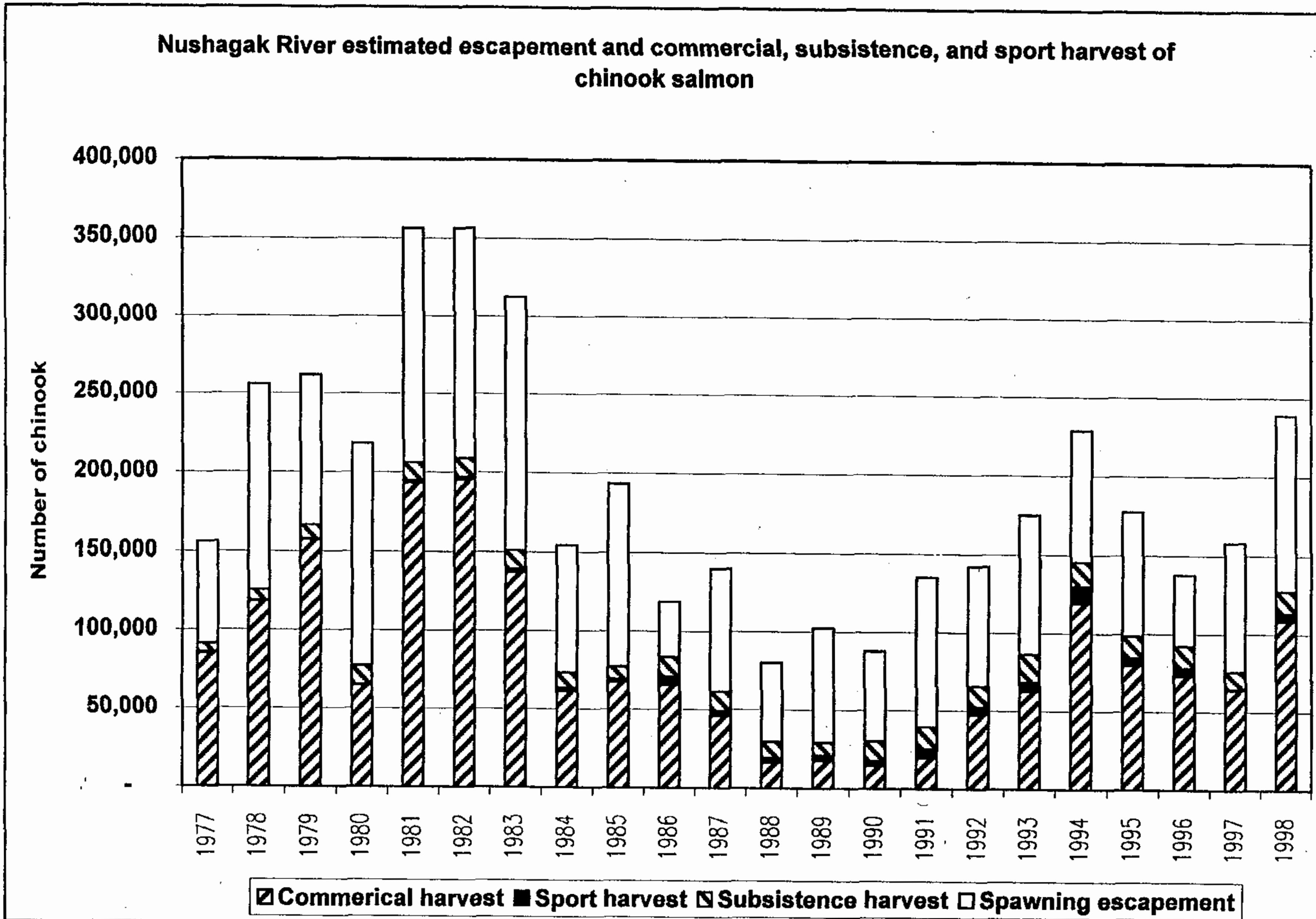
The status of chinook stocks in the Nushagak and Togiak Rivers of Bristol Bay.
(source: Alaska Department of Fish and Game, *1998*. Annual Management Report, 1997, Bristol Bay Area. Regional Information Report No. 2A98-08. Alaska Department of Fish and Game, CFMD, Central Region, 333 Raspberry Rd., Anchorage, AK 99518. April 1998.
and Beverly Cross, Alaska Department of Fish and Game, CFMD, personal communication)

The Nushagak River is the largest producer of chinook salmon in Bristol Bay, accounting on average for 70% of total Bristol Bay commercial harvest during the past twenty years. Total runs of chinook salmon to the Nushagak River ranged from 72,000 to 356,000 and averaged 169,000 from 1968-1997 (see following figure). The inriver escapement goal for Nushagak River is 75,000 chinook salmon (65,000 spawners and 10,000 upriver subsistence and sport harvests).

The preseason prediction for the 1998 total run to the Nushagak River was 159,000 chinook salmon which was slightly below the 20-year average. The preliminary estimate of the actual run is approximately 238,000 chinook salmon of which 109,000 were harvested by the commercial fishery, 11,000 were taken by the subsistence fishery downriver of the counting site, and 118,000 were counted inriver. The 1998 total run of chinook salmon to the Nushagak River was almost 50% greater than expected.

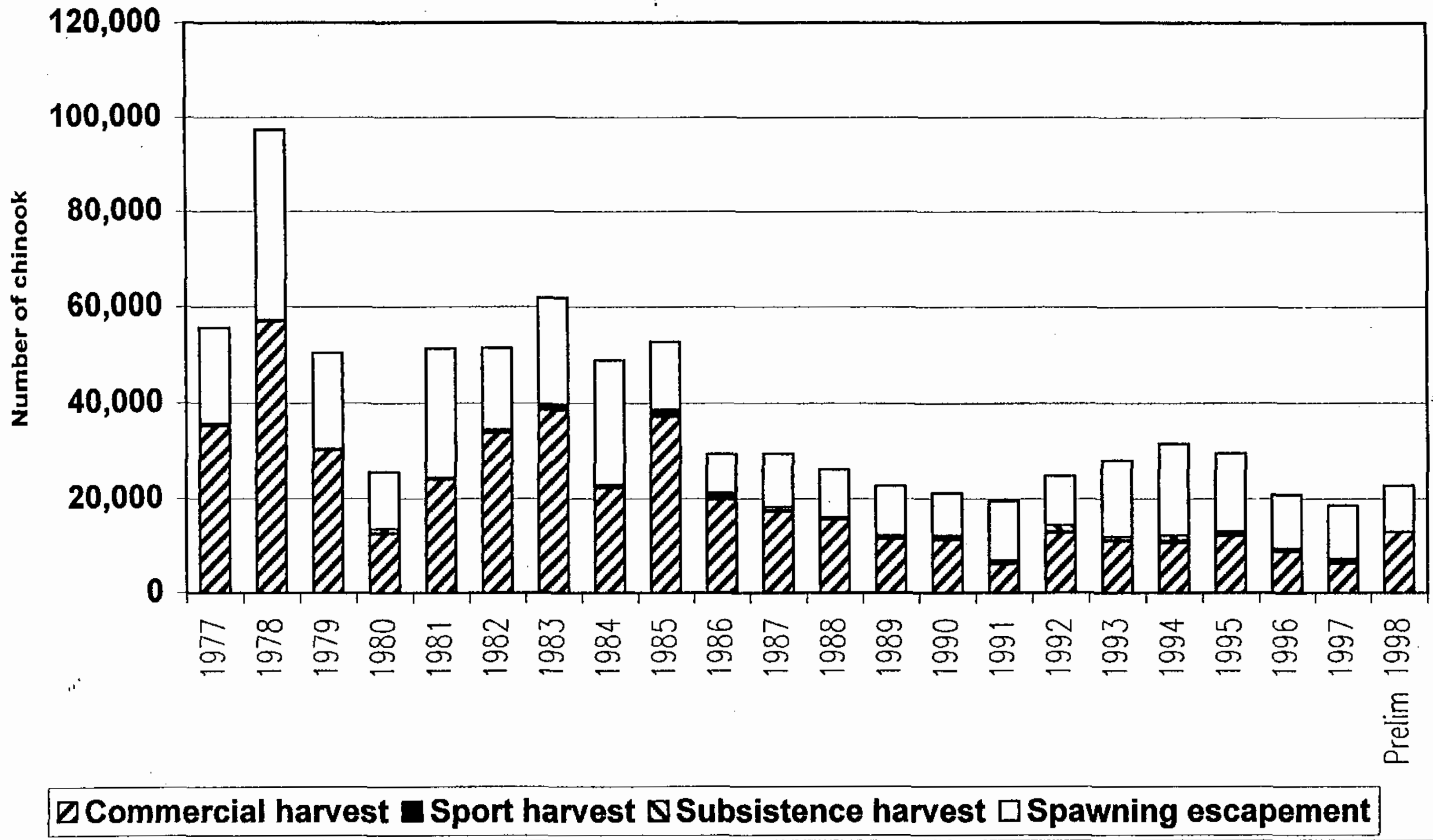
The run timing of the chinook run to the Nushagak River in 1998 was close to average. In 1998, 50% of the chinook escapement was counted through June 29, while the average date for 50% of the escapement is June 27.

The Togiak River chinook run strength declined from 1984 through 1991 and was below escapement goals of 10,000 fish from 1985 through 1992 and in 1996. The escapement goal was reached in 1997 although harvest levels were well below the 1977-1996 average. The combined total run to Togiak District was 30% below the recent 5-year average. Initial indications are that the 1998 escapement was slightly below the escapement goal of 10,000 fish.



Nushagak River estimated escapement and commercial, subsistence, and sport harvest of chinook salmon
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
Number of chinook
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Commerical harvest
Sport harvest
Subsistence harvest
Spawning escapement

Togiak River estimated escapement and commerical, subsistence, and sport harvest of *chinook salmon.*



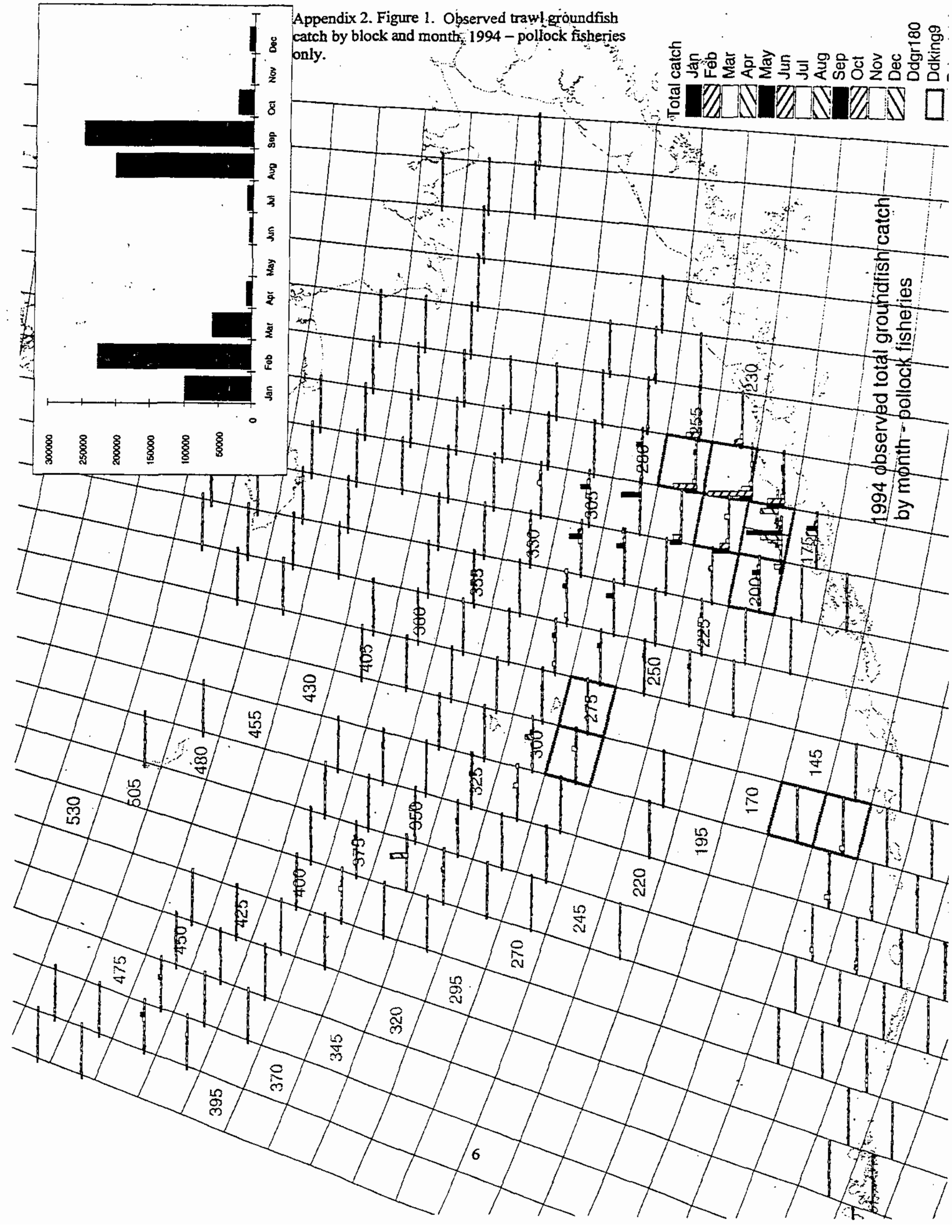
APPENDIX 2

Maps were prepared based on NMFS observer data. Within each 1/2° latitude by 1° block, the total groundfish catch and the total bycatch of chinook salmon, chum salmon, halibut, herring, bairdi (Tanner) crab, opilio (snow) crab, and red king crab as well as salmon bycatch rates by month were calculated. This information from 1994-1997 is provided for the trawl pollock fisheries alone and for all trawl fisheries combined. The data is displayed as bar graphs with each bar being a single month (January to the far left of each group of bars and December to the far right). A flat line is displayed if there was effort in a block but no or little catch or bycatch. All bars are scaled so that the maximum month in a year is the same height across all maps. An insert is provided on each map to show the total catch or bycatch by month across all areas. A key to the lower left of each map allows the identification of individual months.

APPENDIX 2

List of Figures

Appendix 2. Figure 1. Observed trawl groundfish catch by block and month, 1994 – pollock fisheries only.



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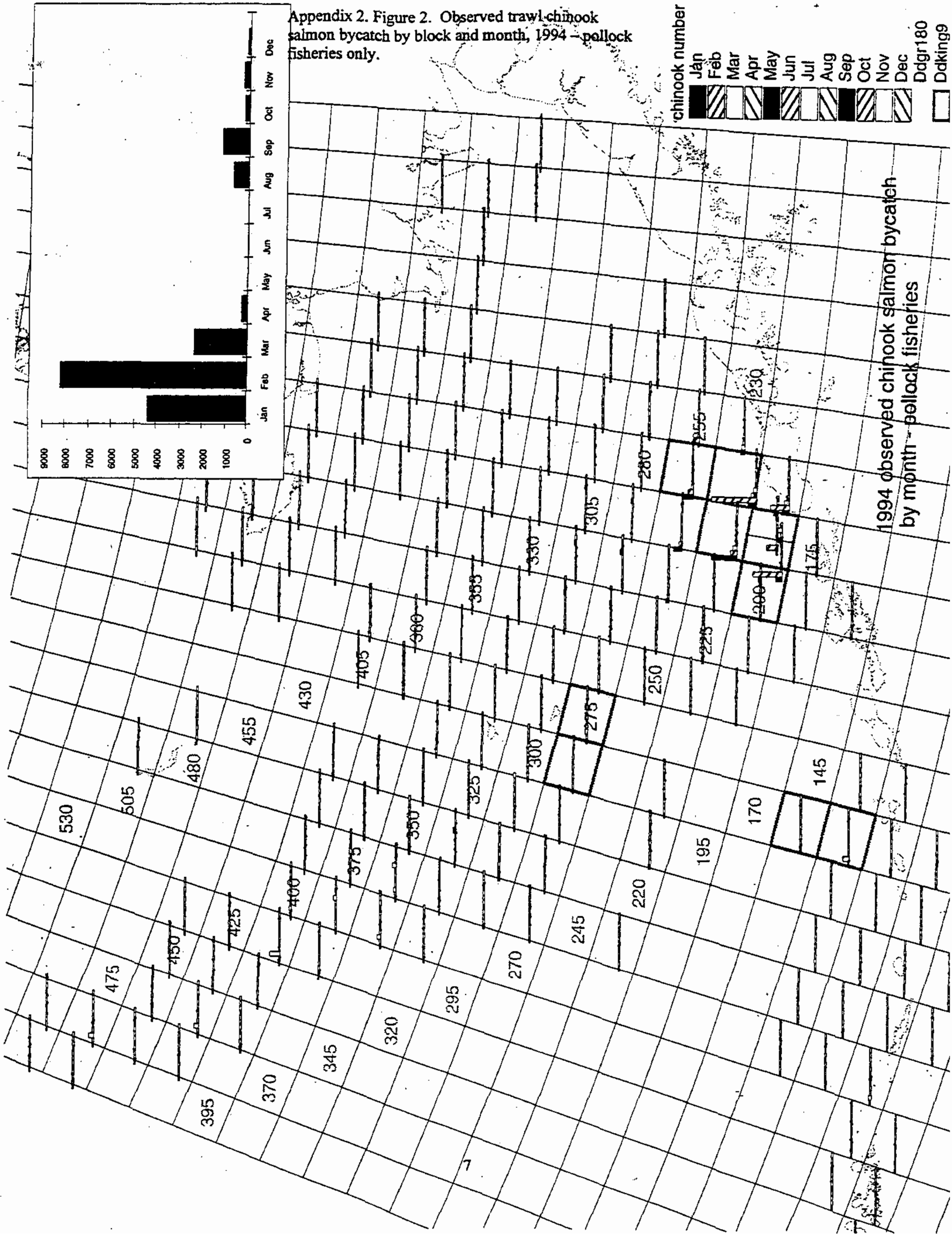

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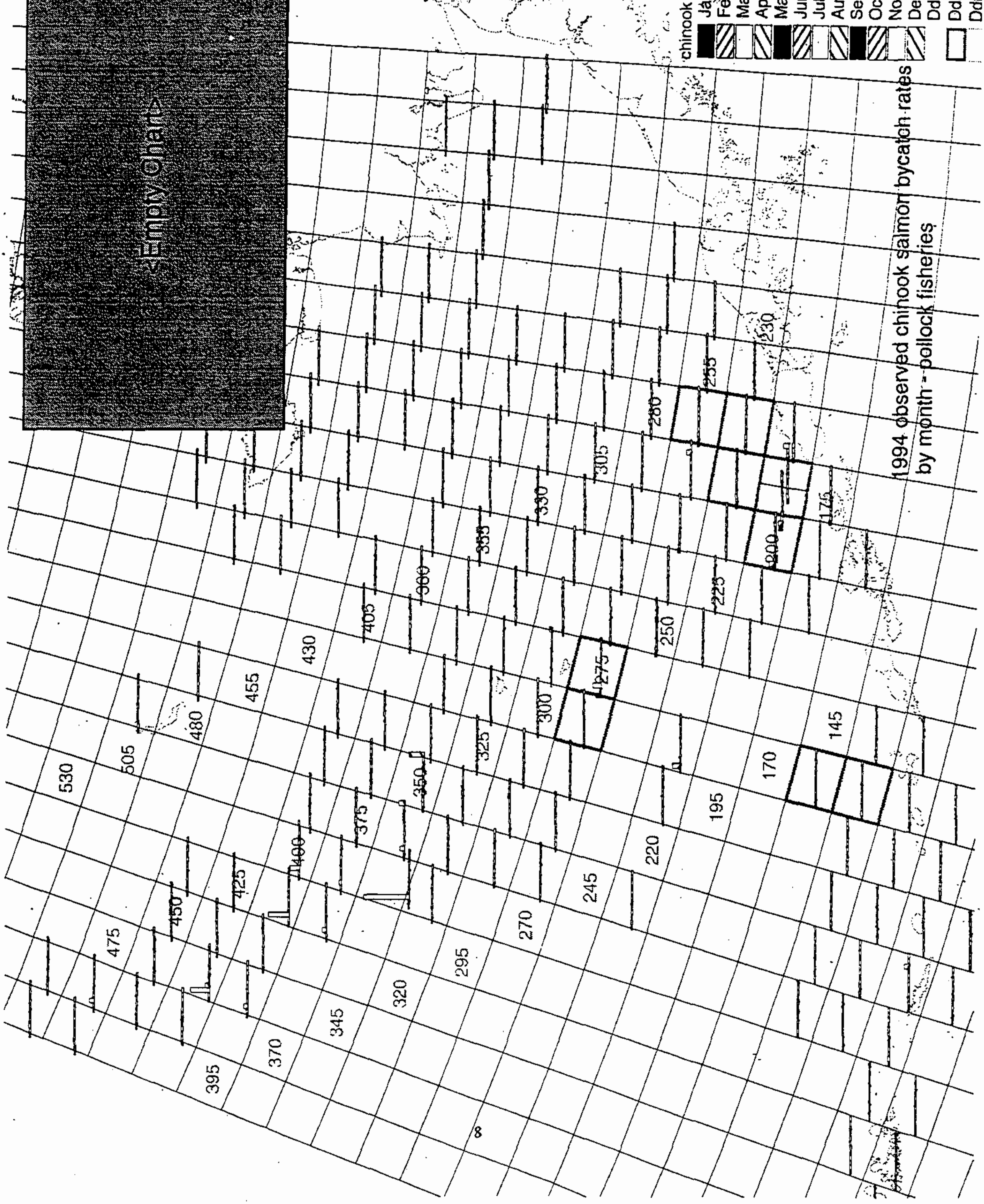

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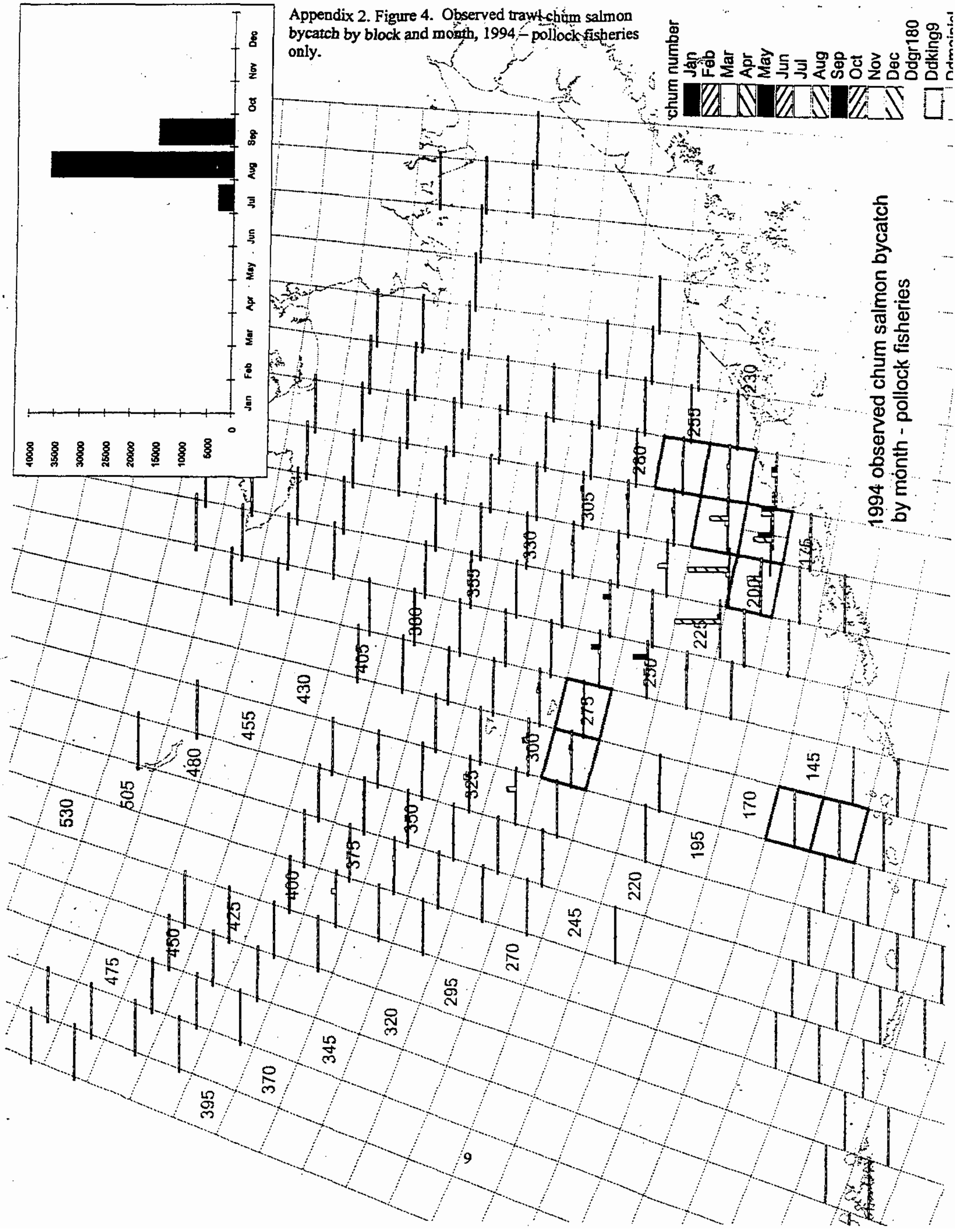

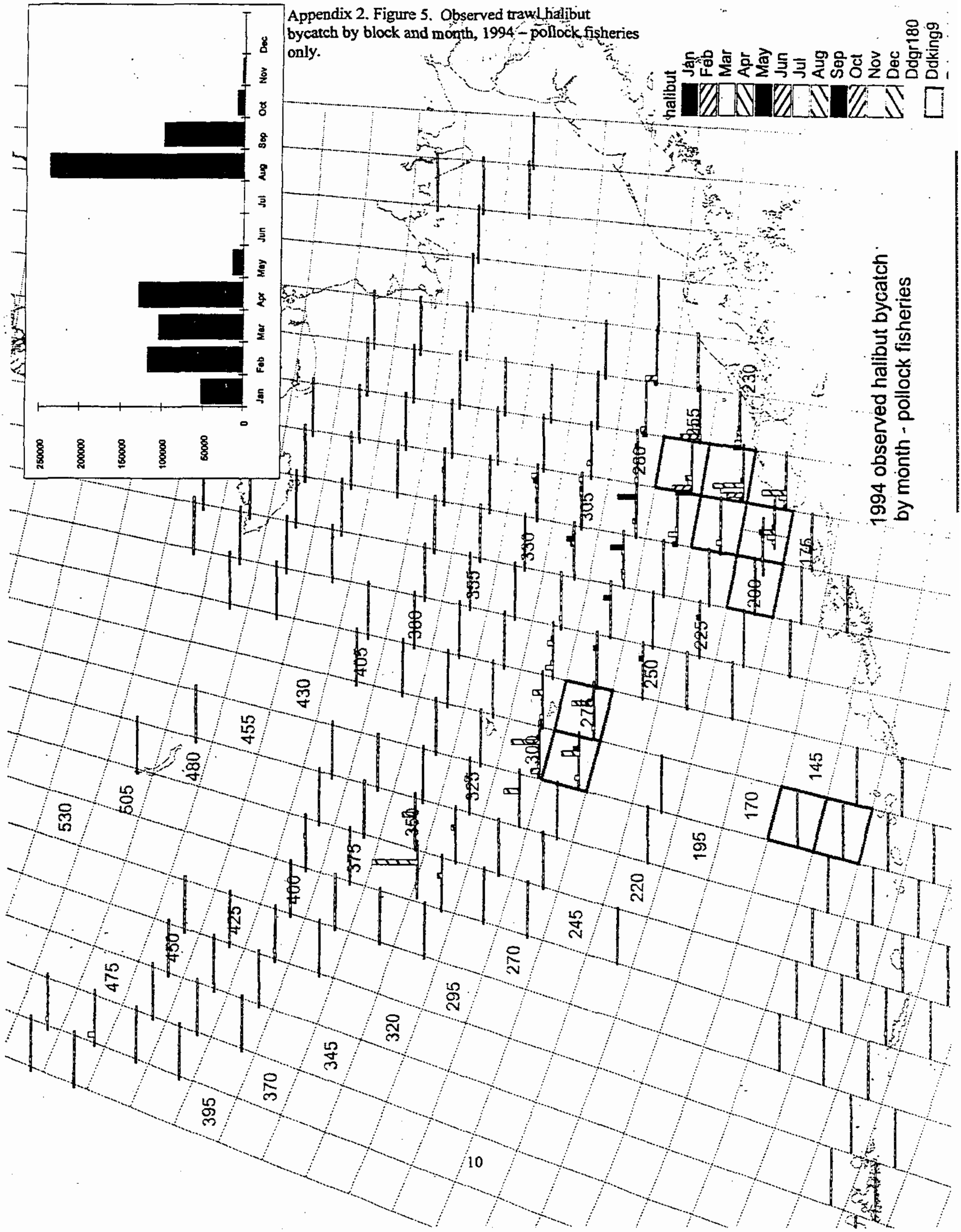

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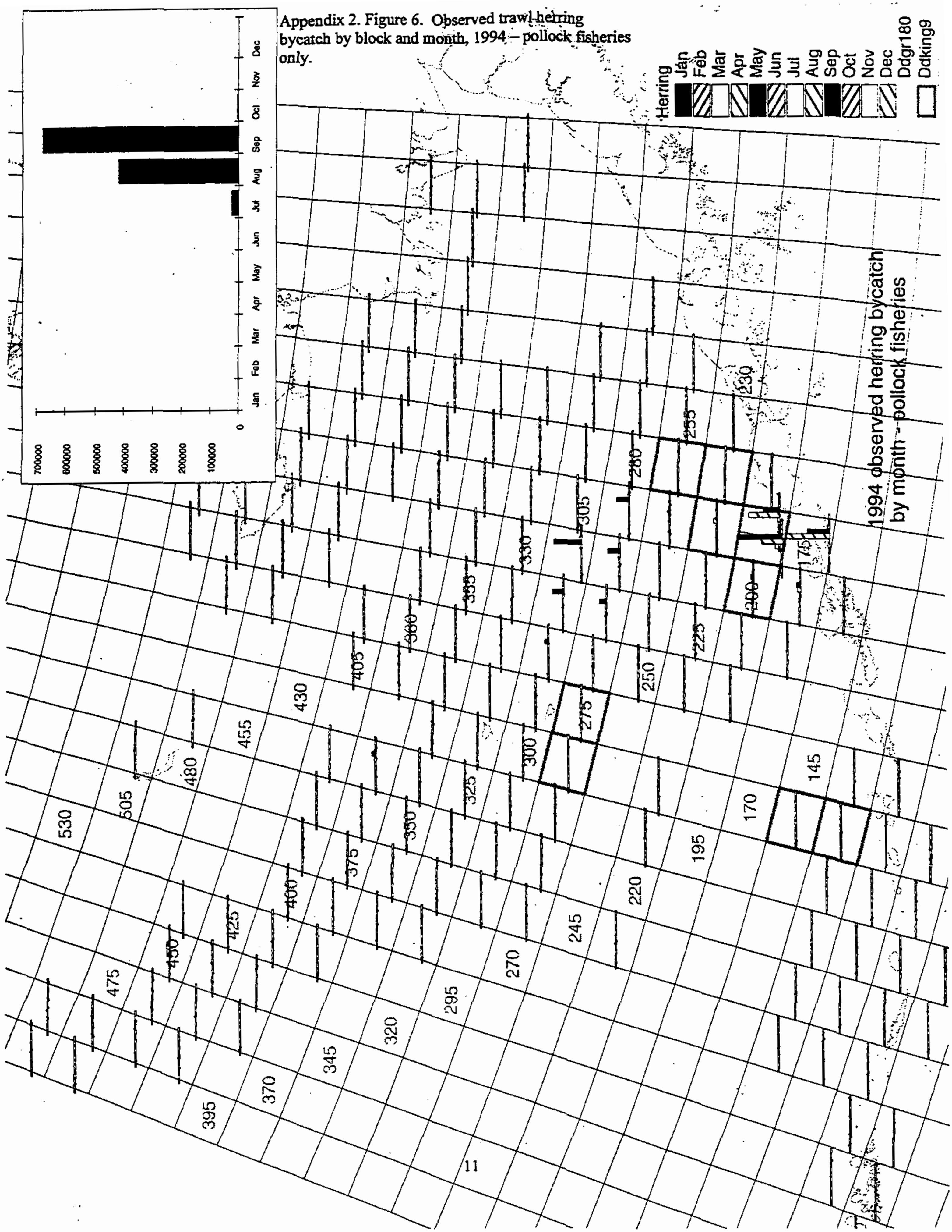
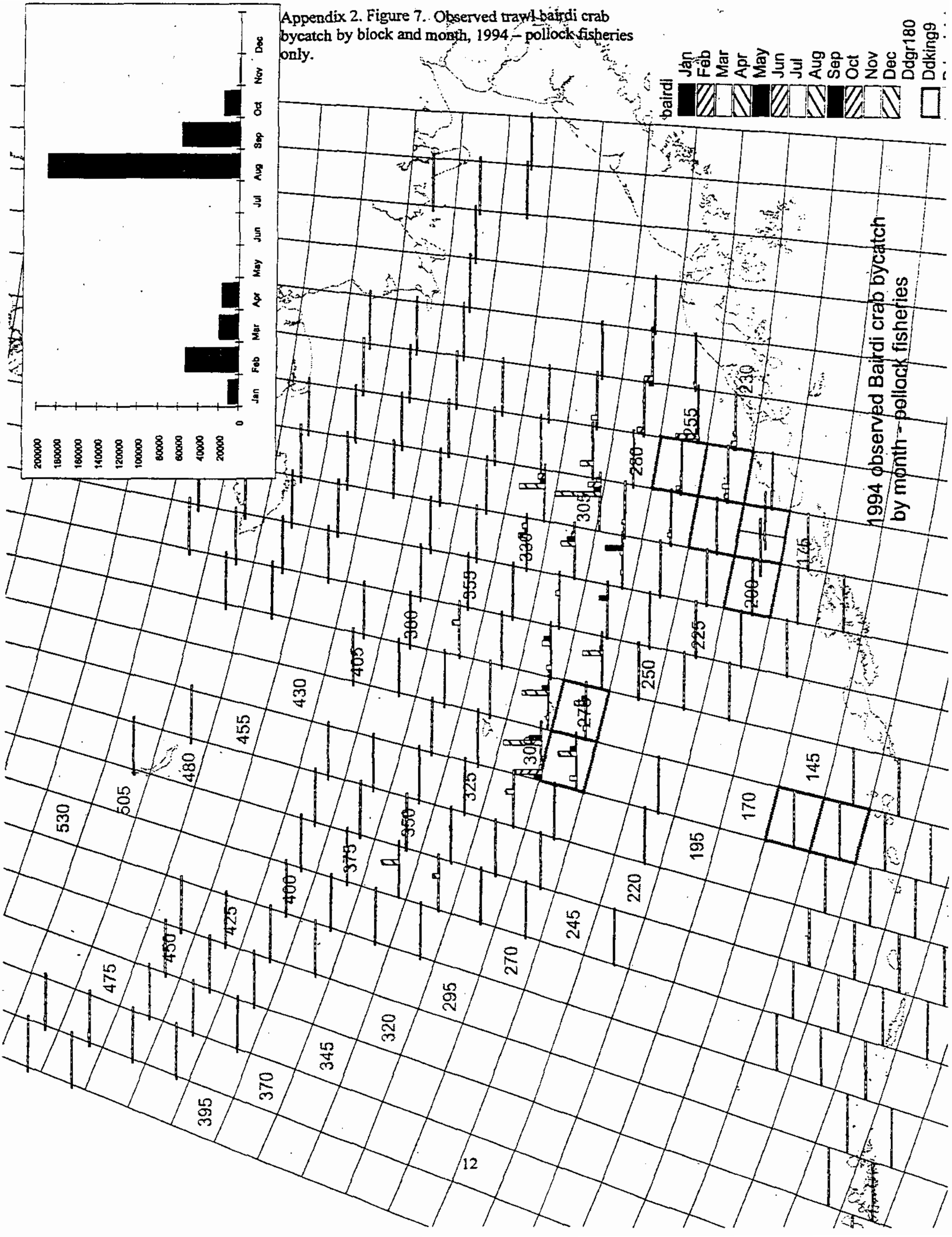


Appendix 2. Figure 7. Observed trawl bairdi crab bycatch by block and month, 1994 – pollock fisheries only.



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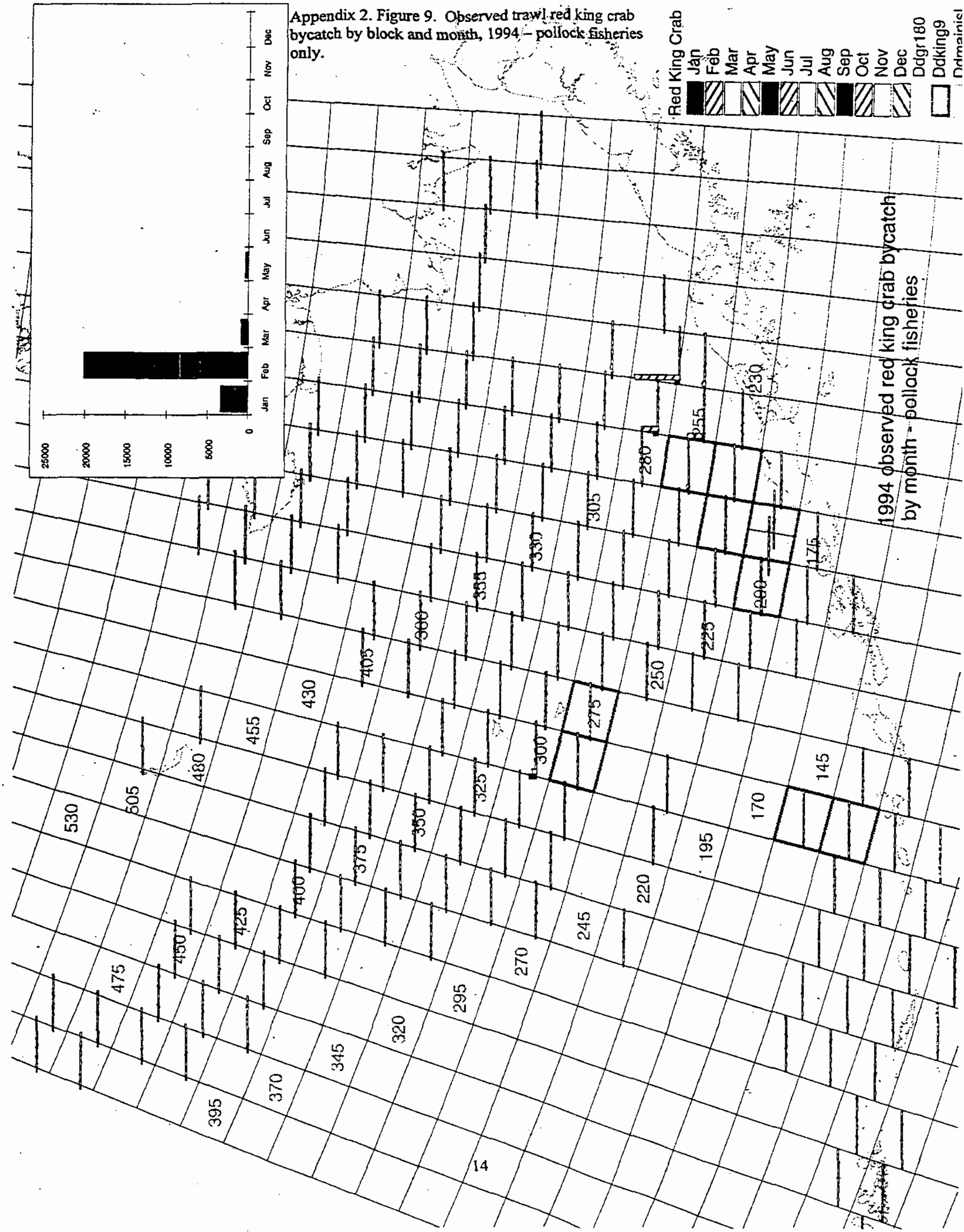
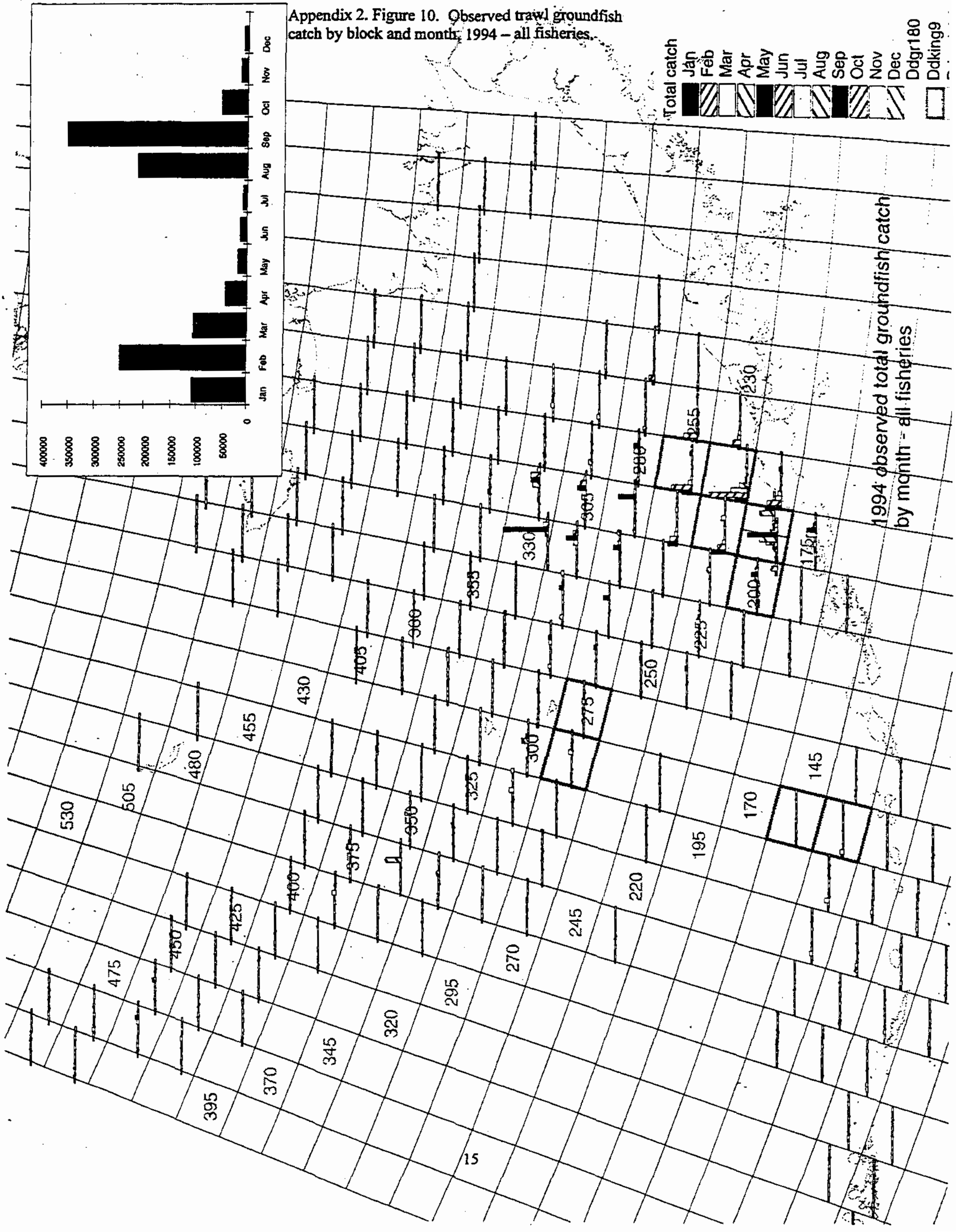


Appendix 2. Figure 10. Observed trawl groundfish catch by block and month, 1994 – all fisheries.



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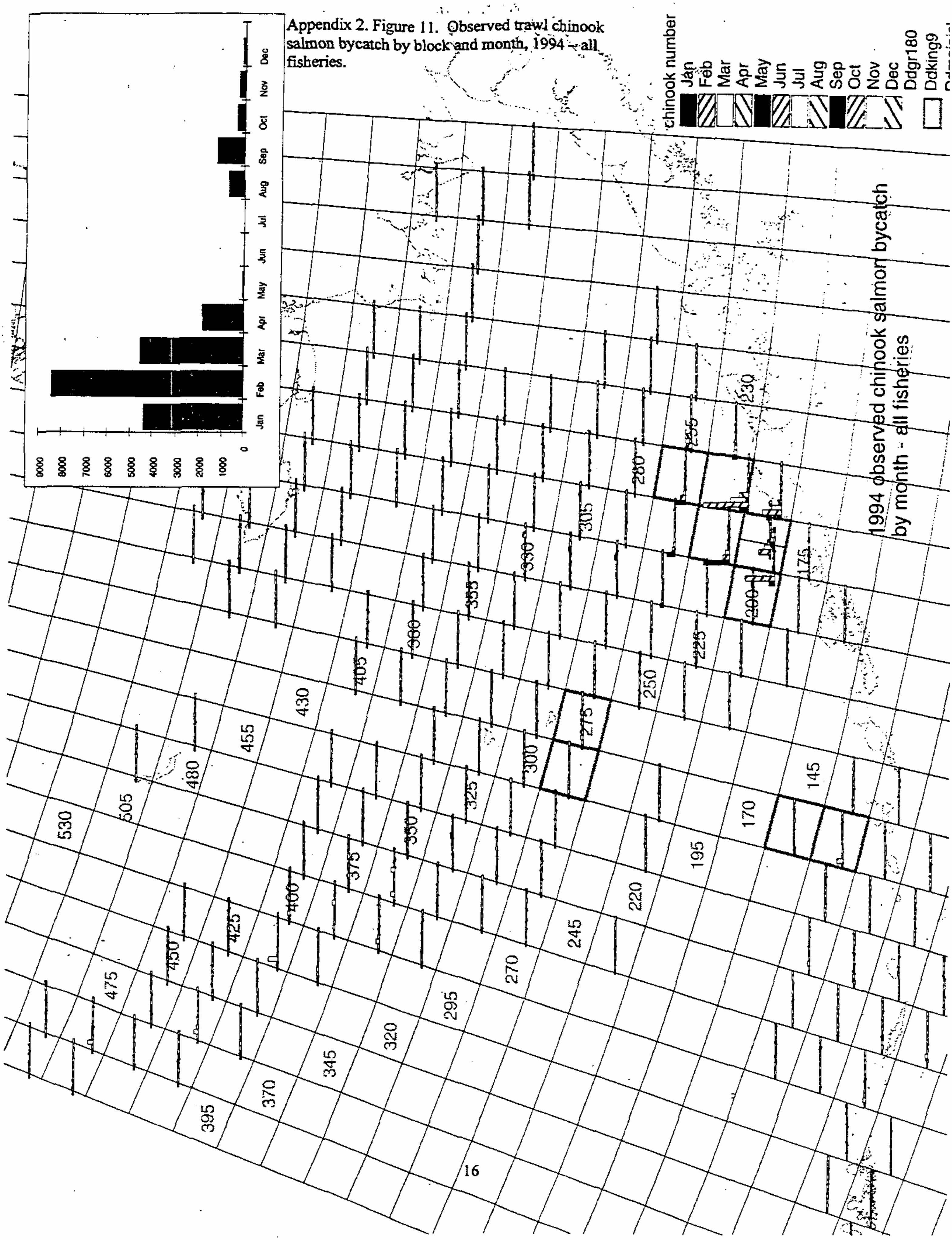

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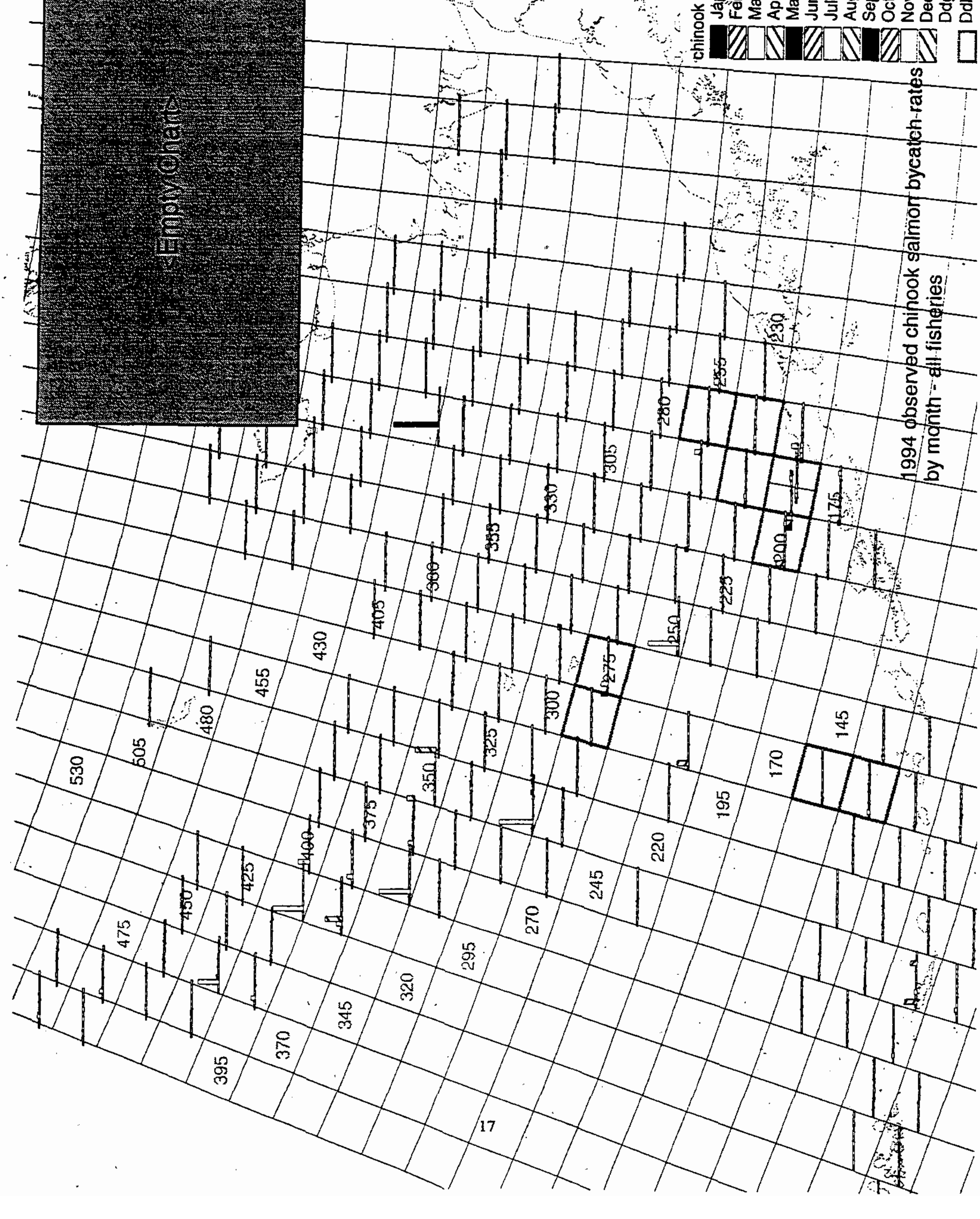

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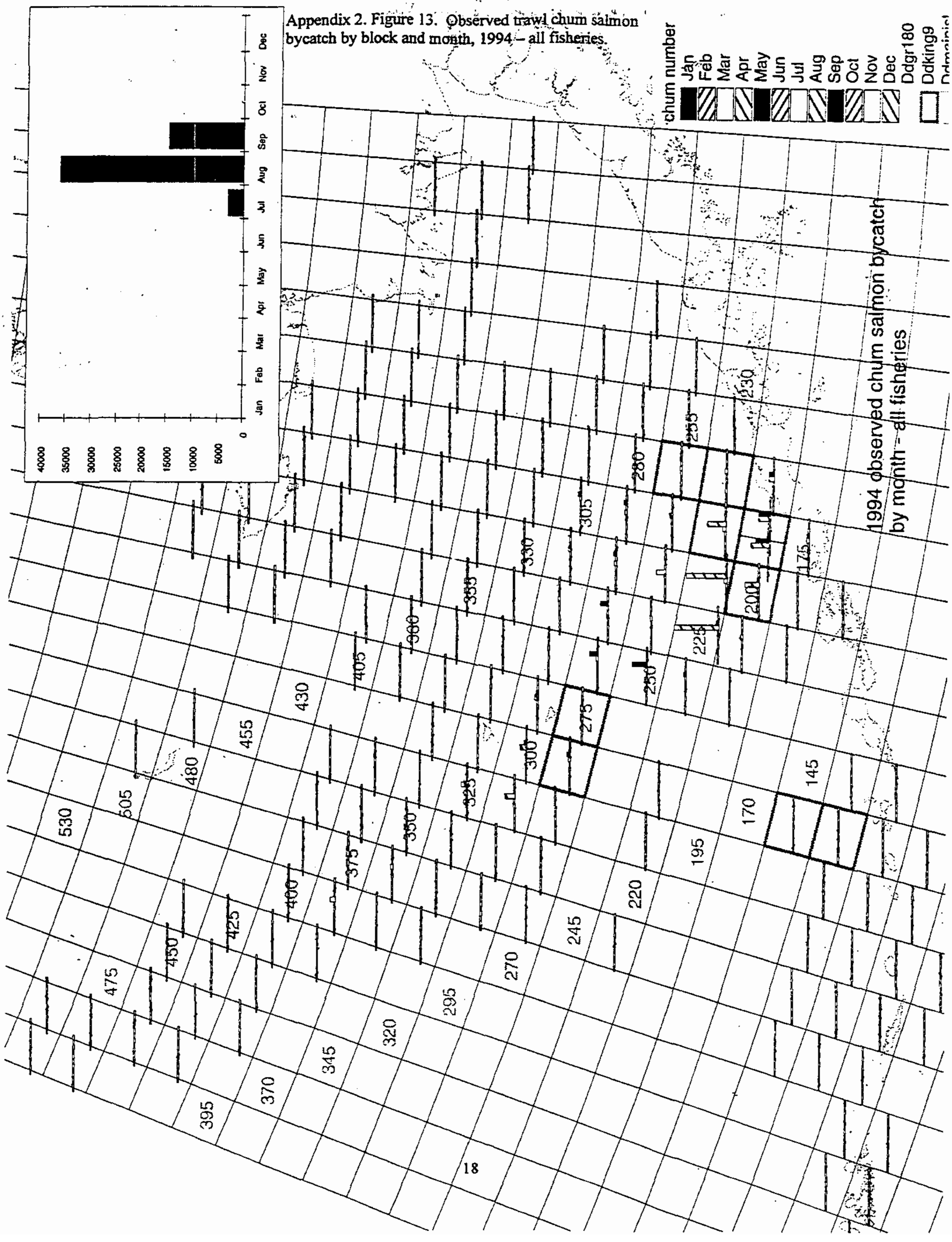

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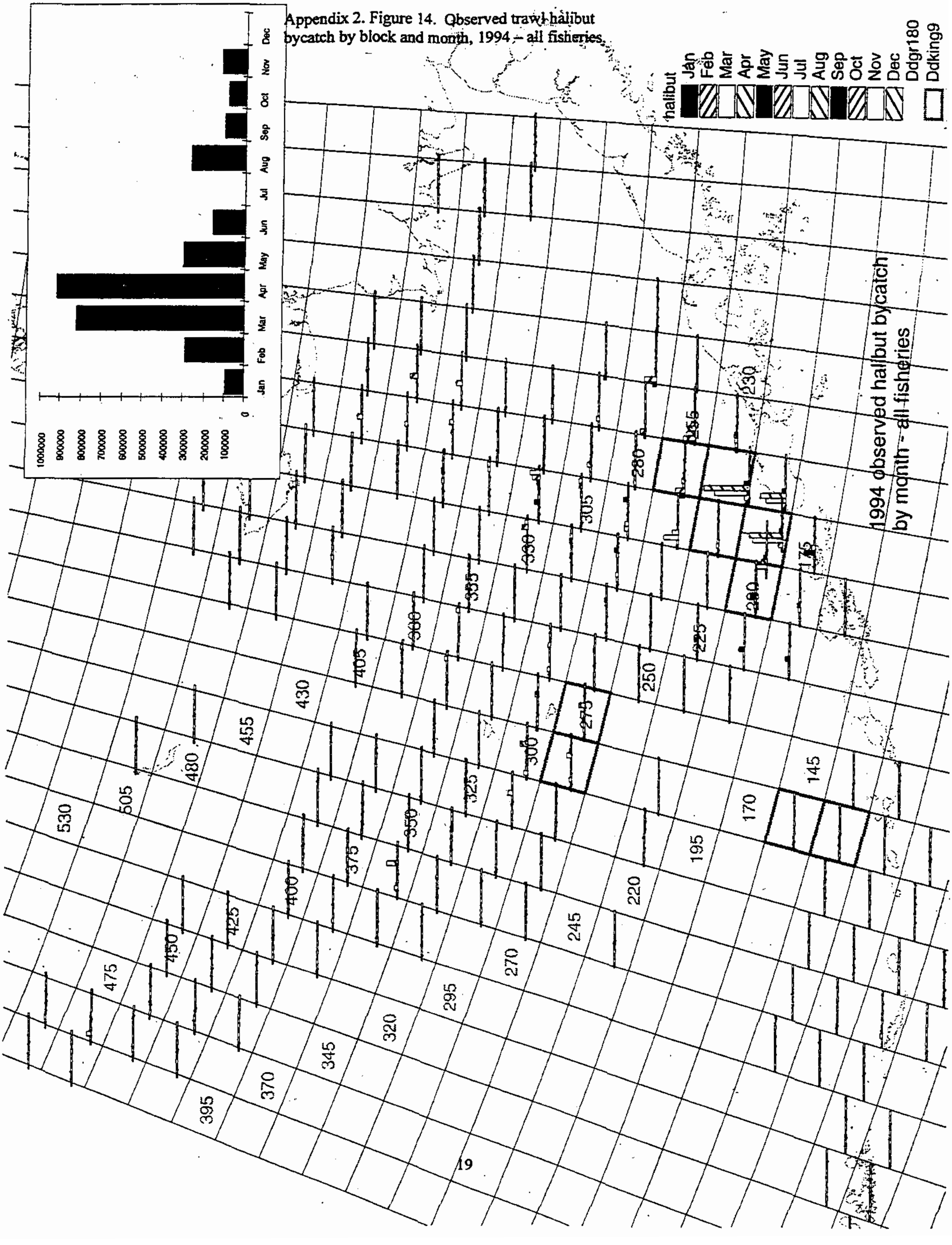

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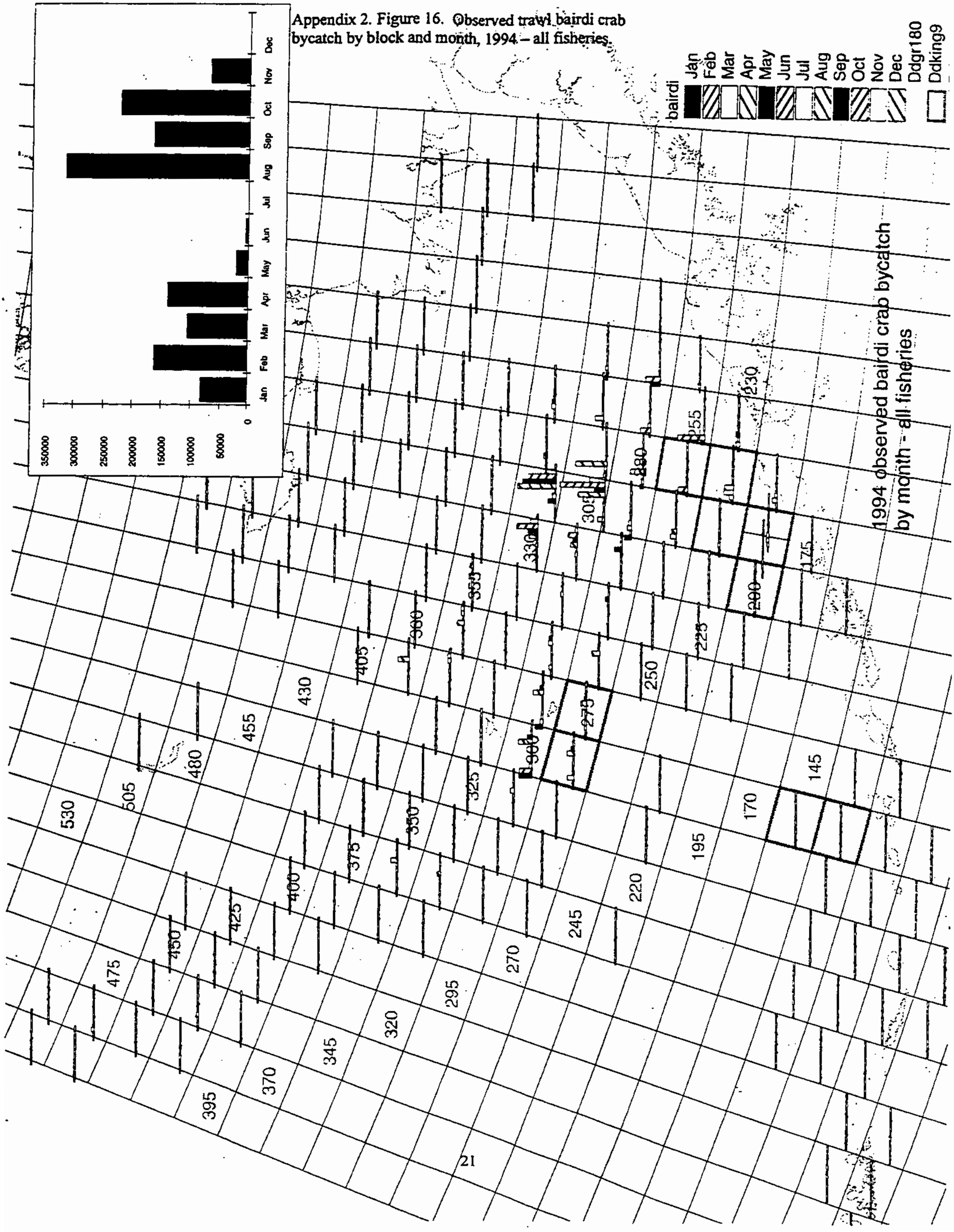

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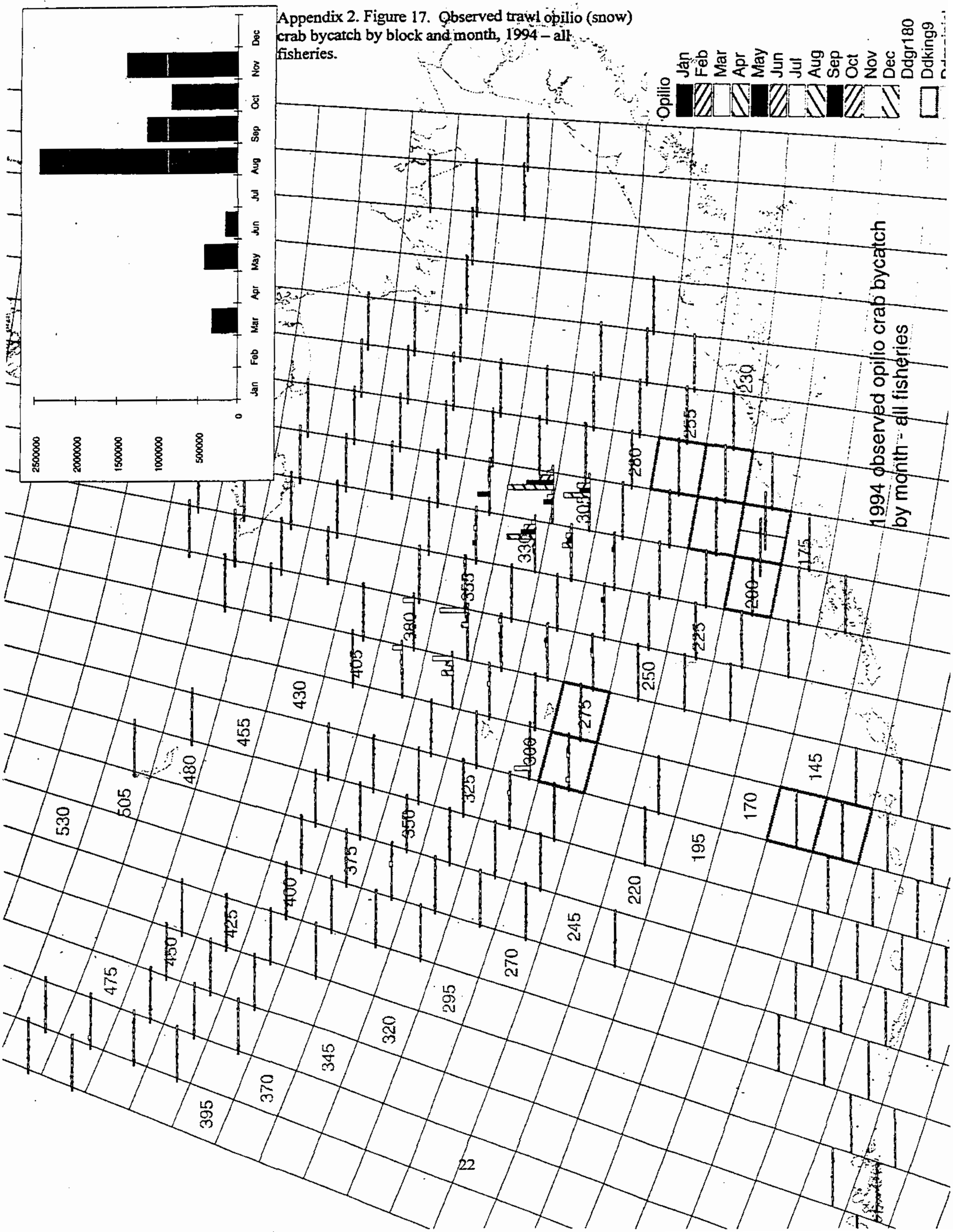

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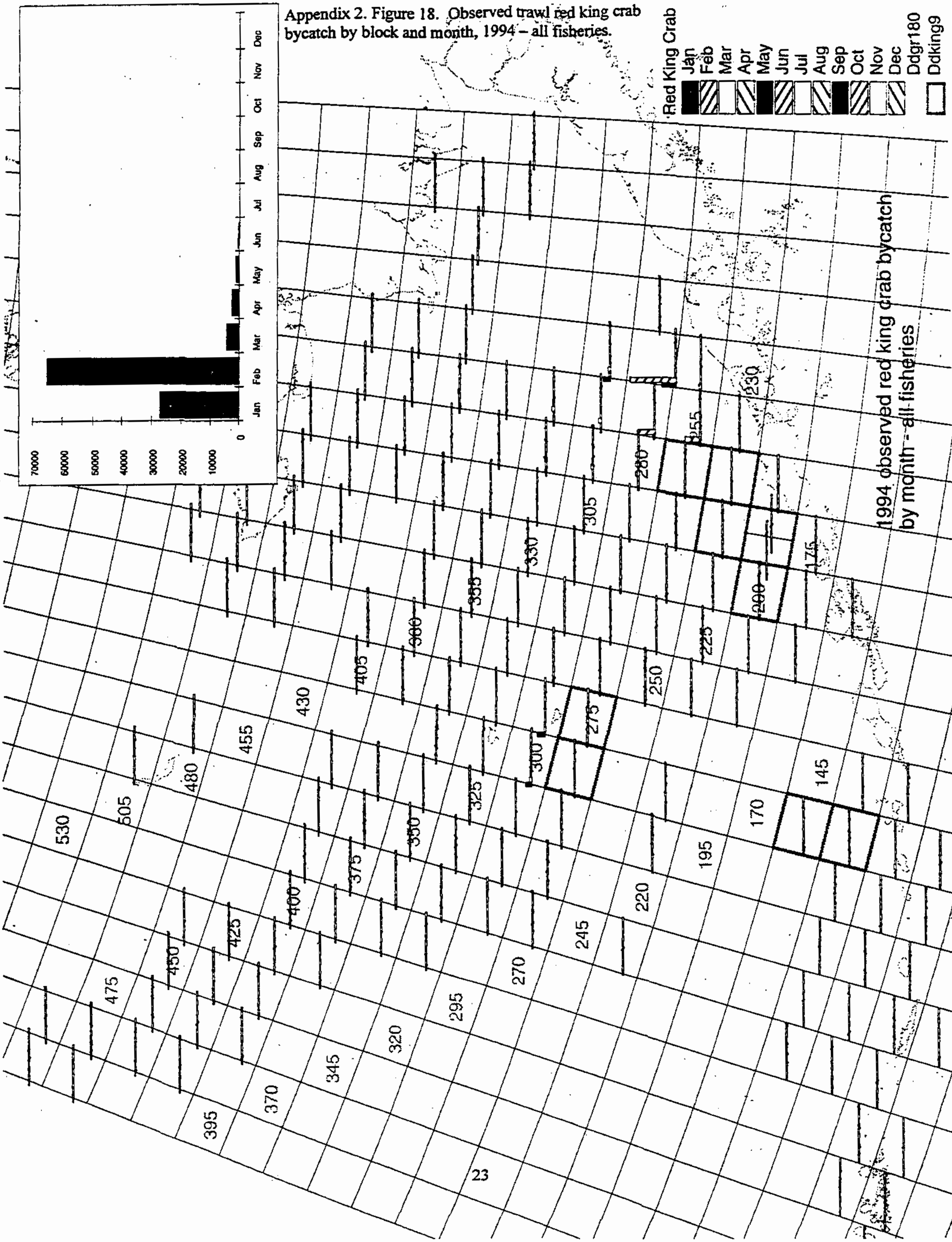

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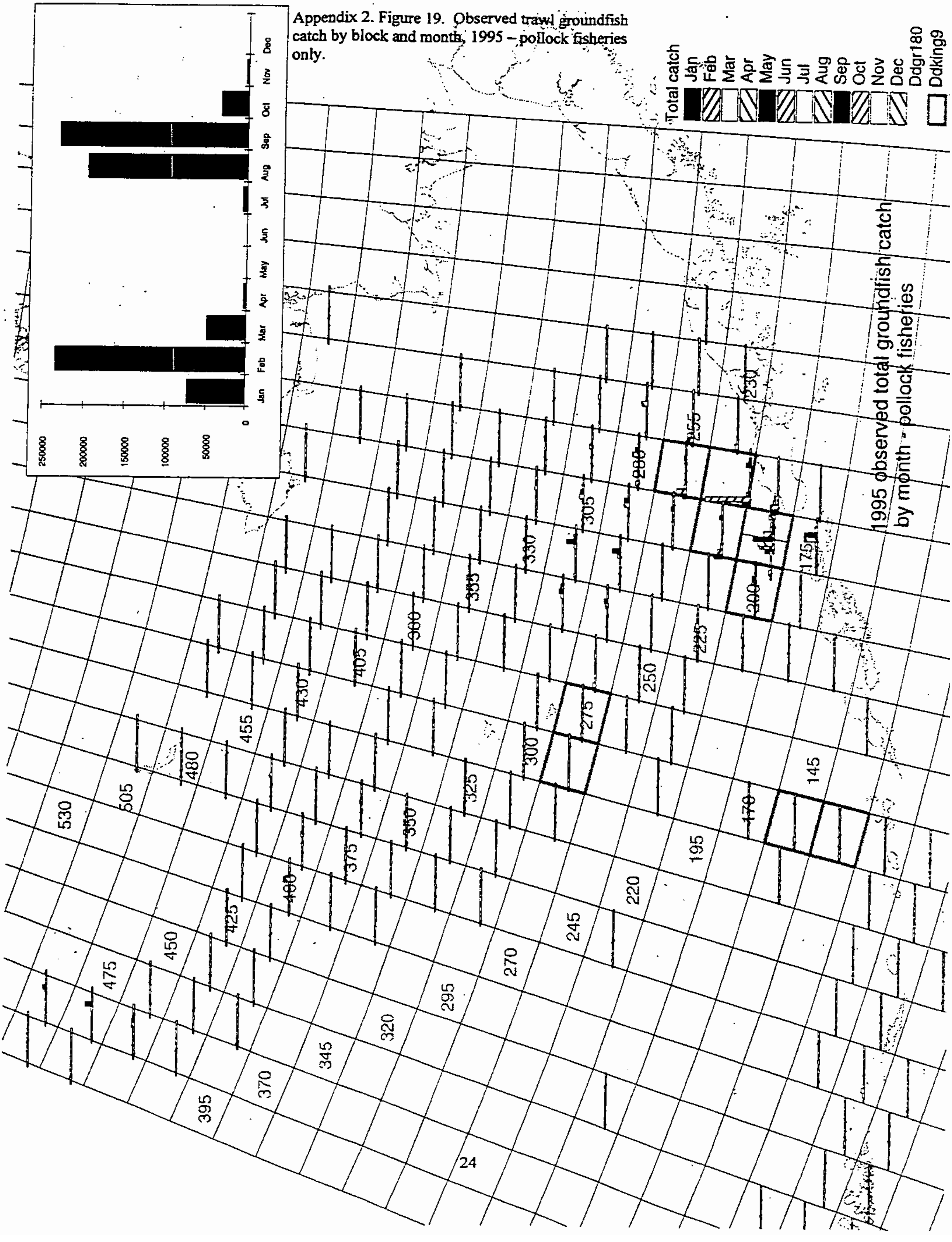

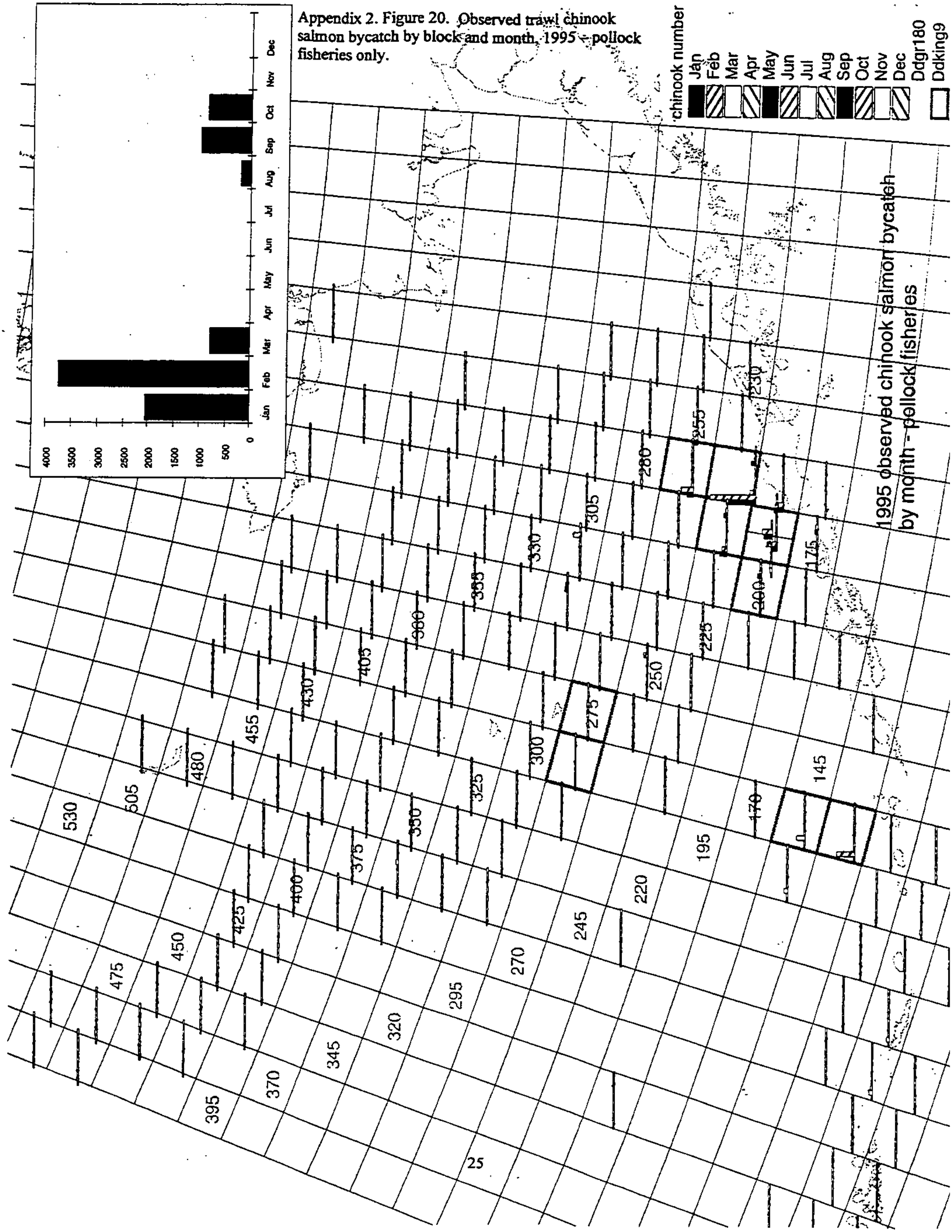

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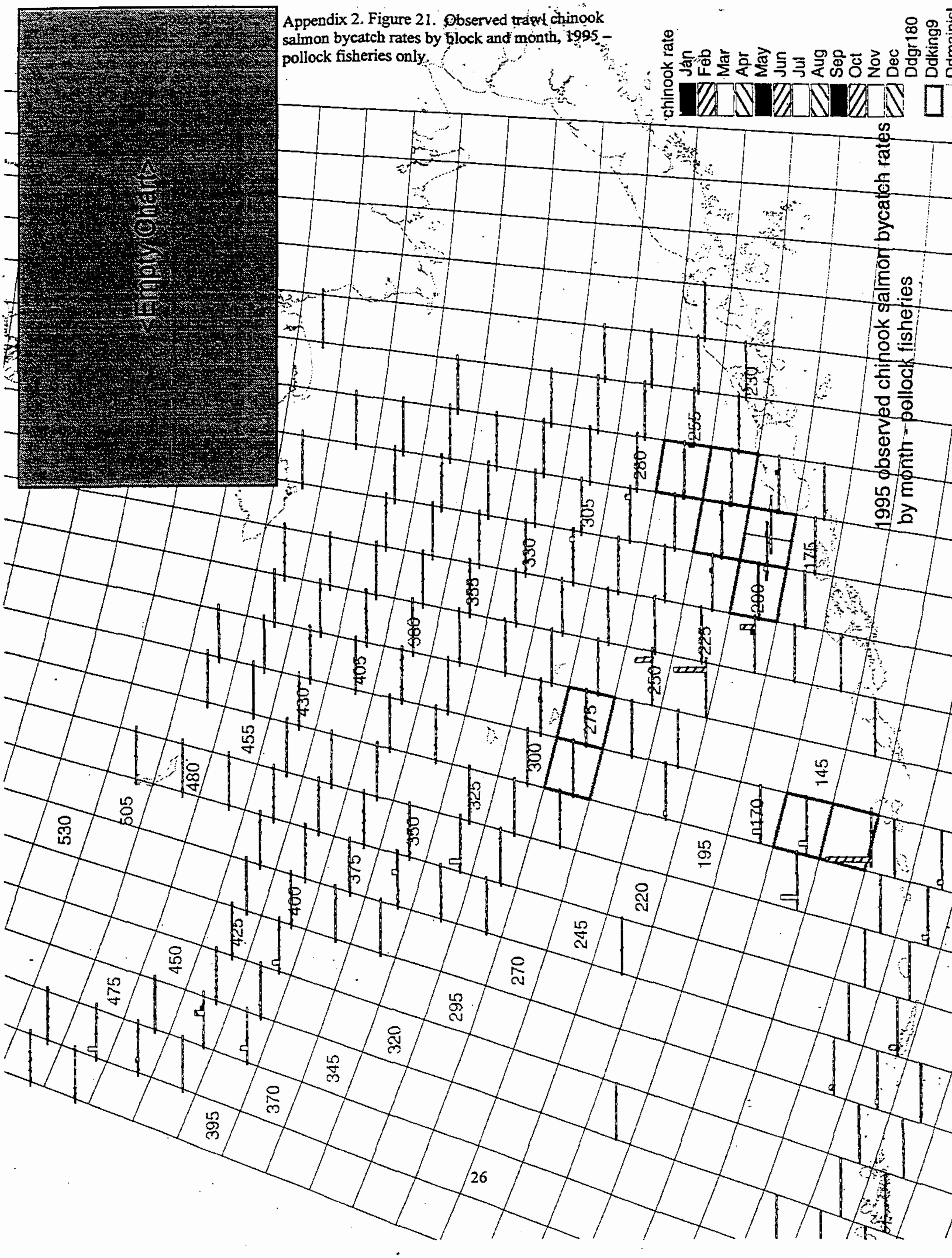

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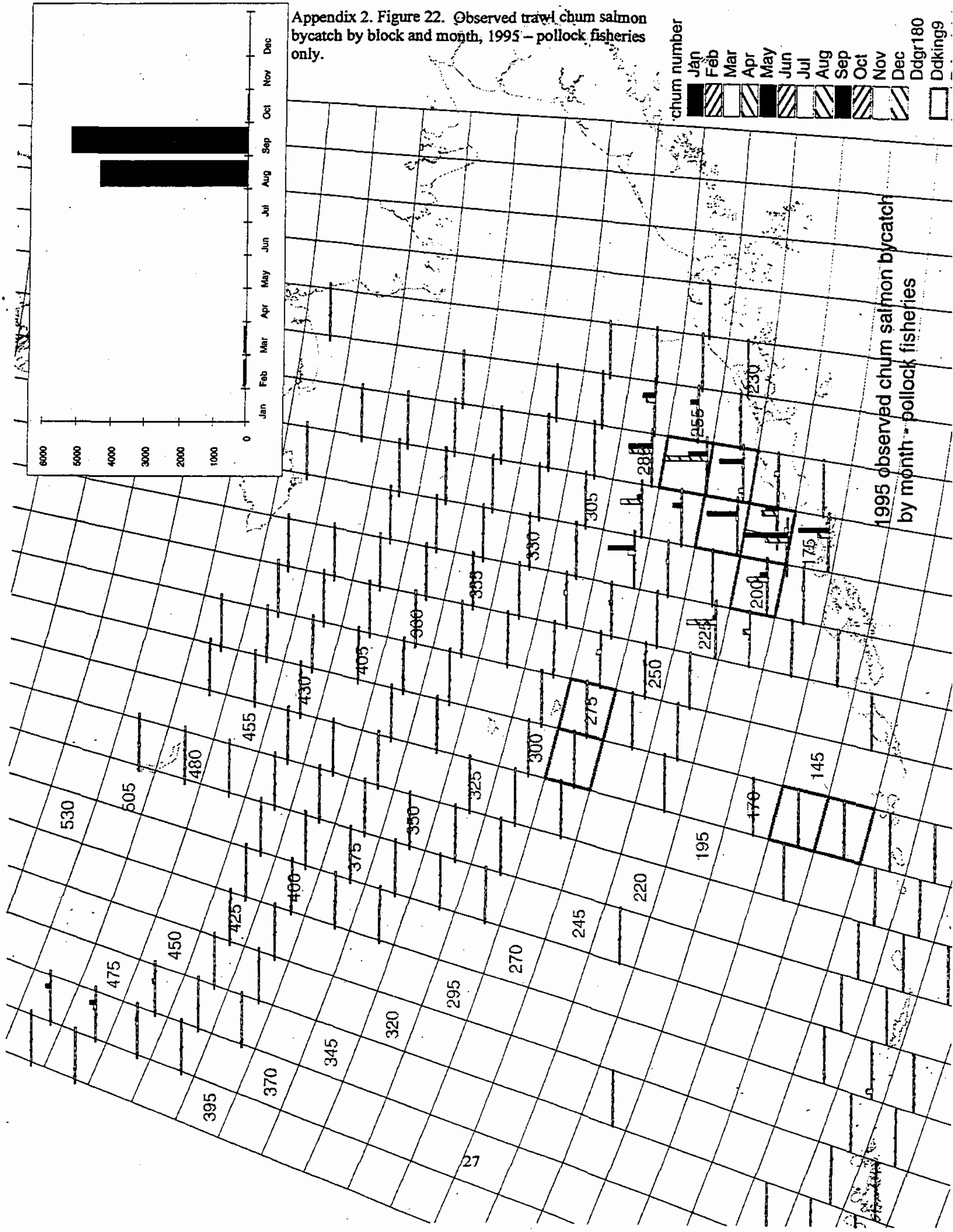

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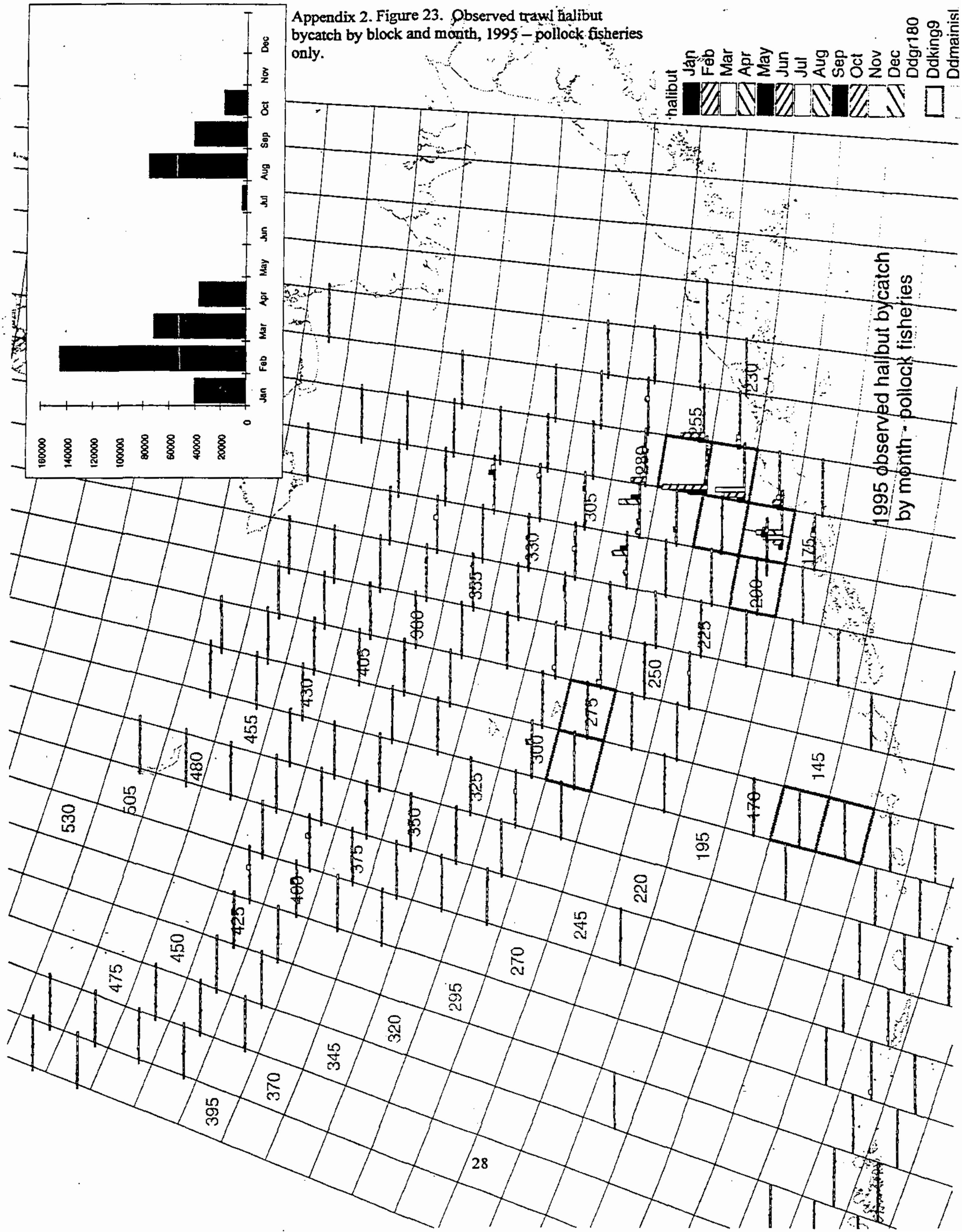

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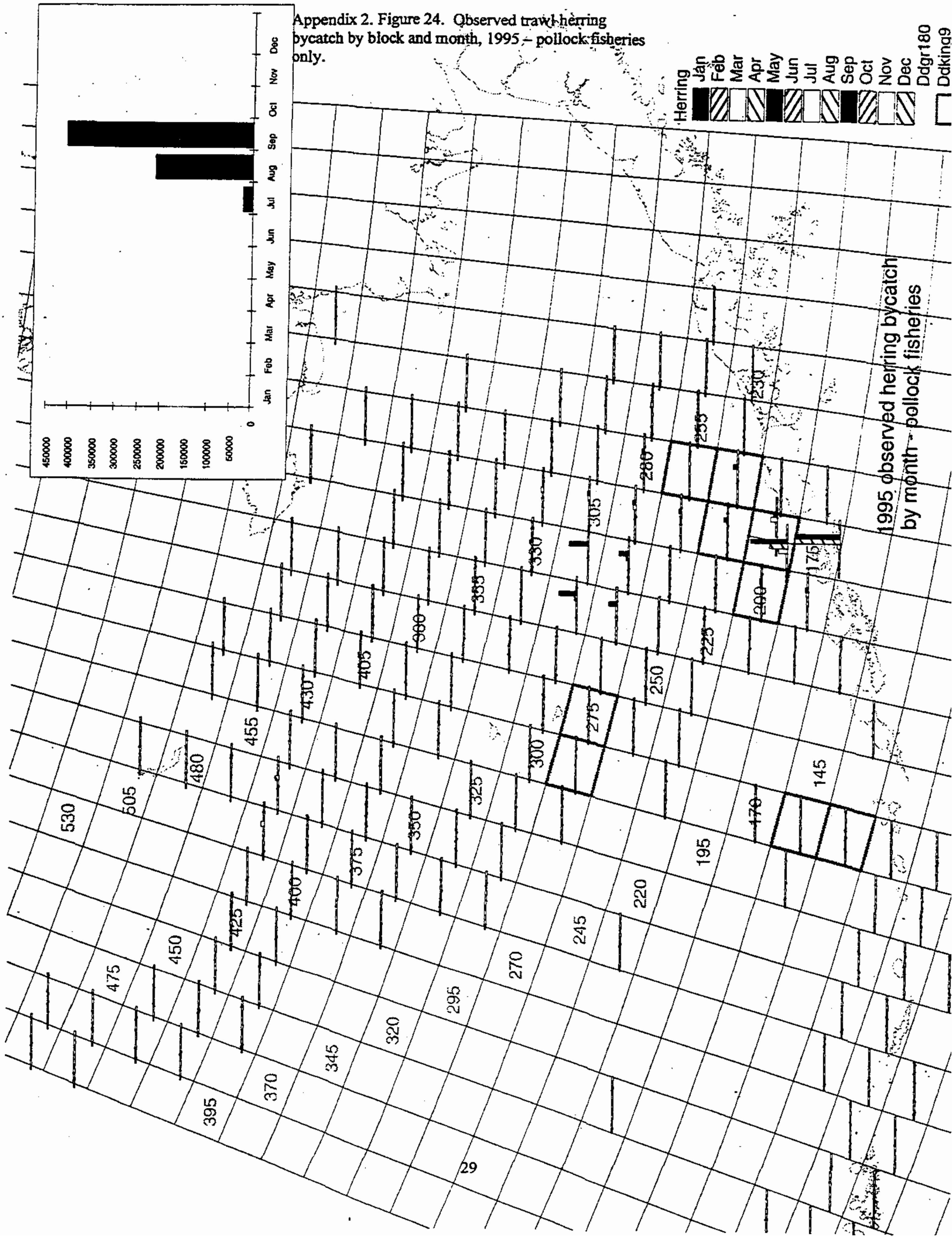
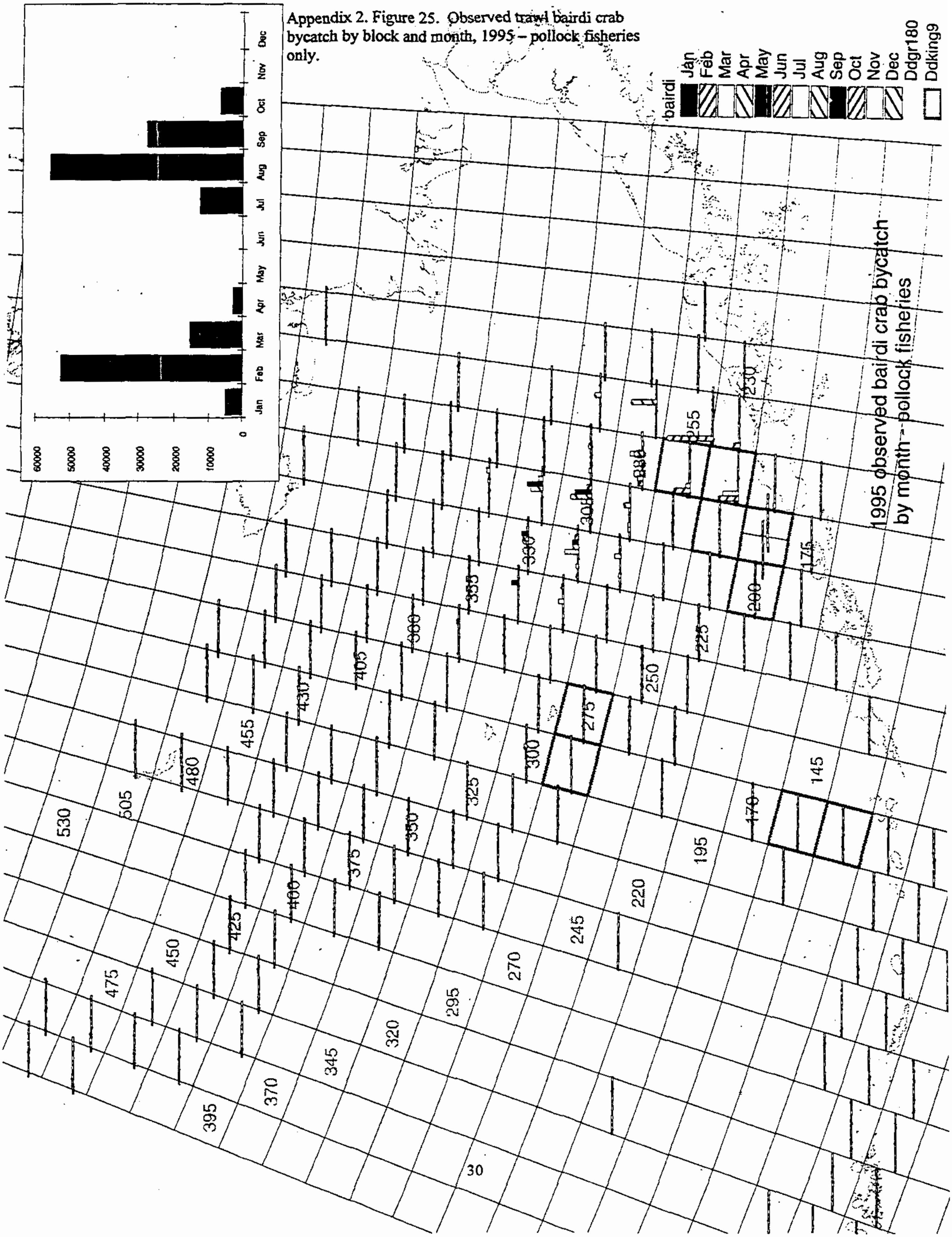
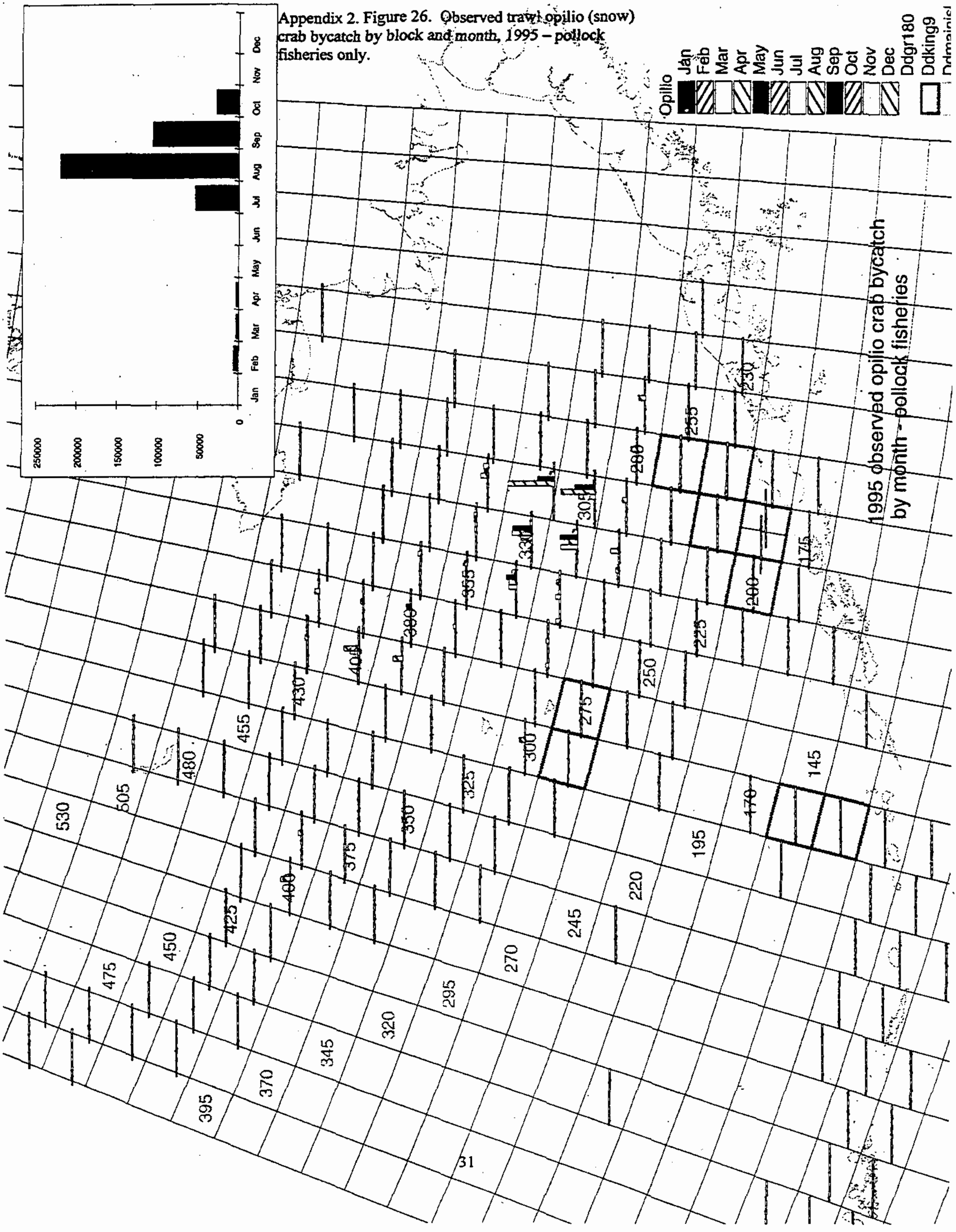


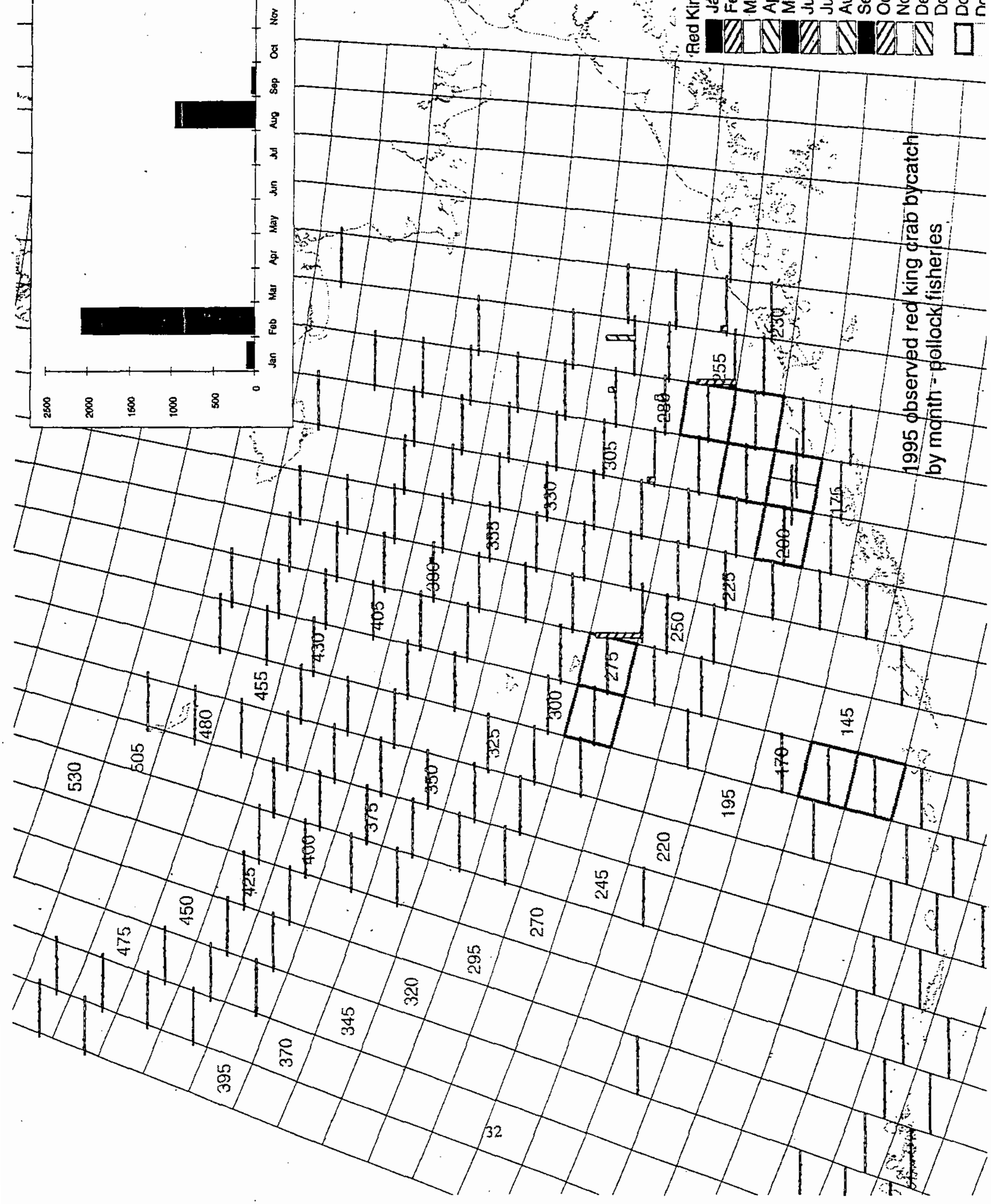
Appendix 2. Figure 25. Observed trawl bairdi crab bycatch by block and month, 1995 – pollock fisheries only.



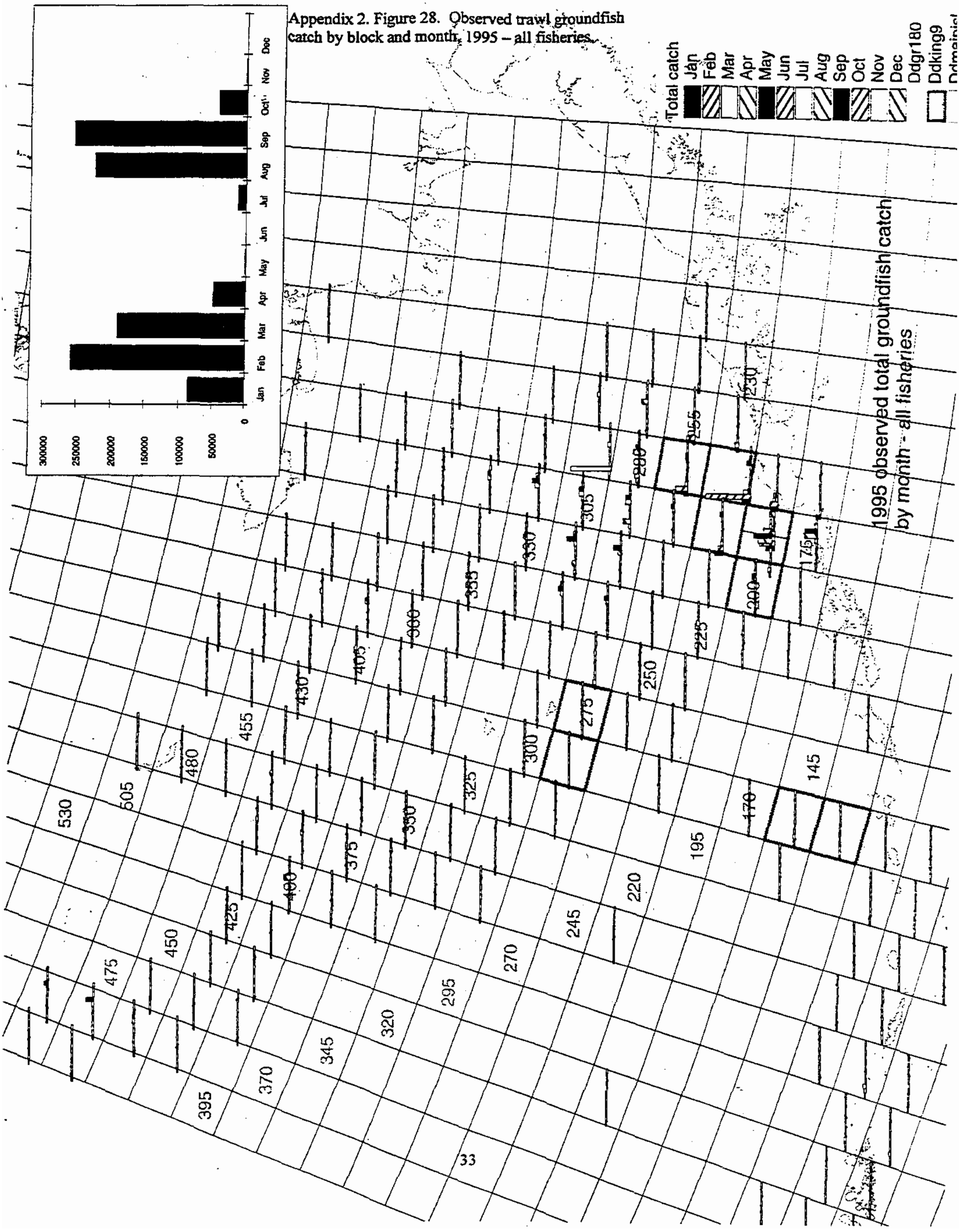
Appendix 2. Figure 26. Observed trawl opilio (snow) crab bycatch by block and month, 1995 – pollock fisheries only.



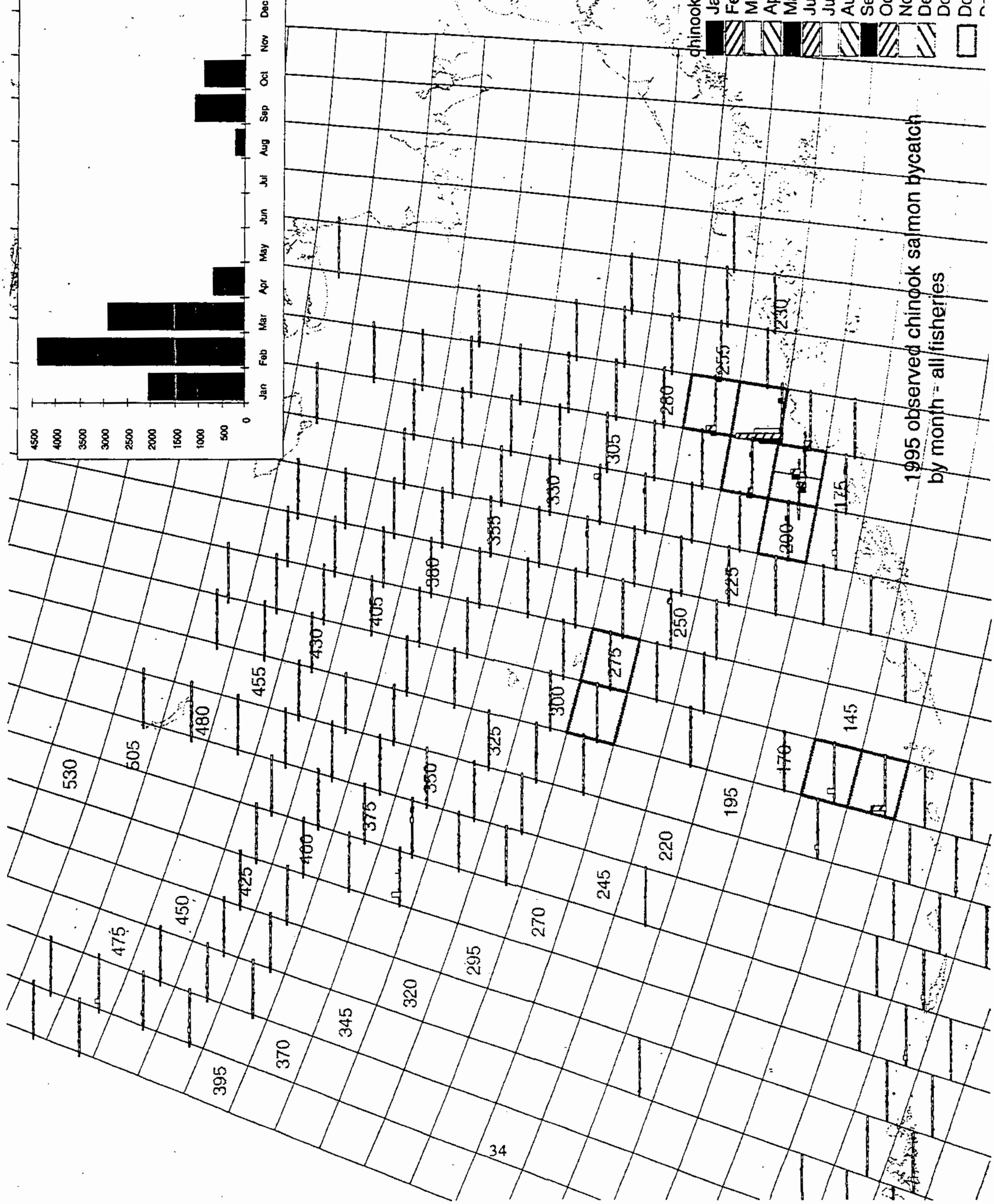
Appendix 2. Figure 27. Observed trawl red king crab bycatch by block and month, 1995 – pollock fisheries only.



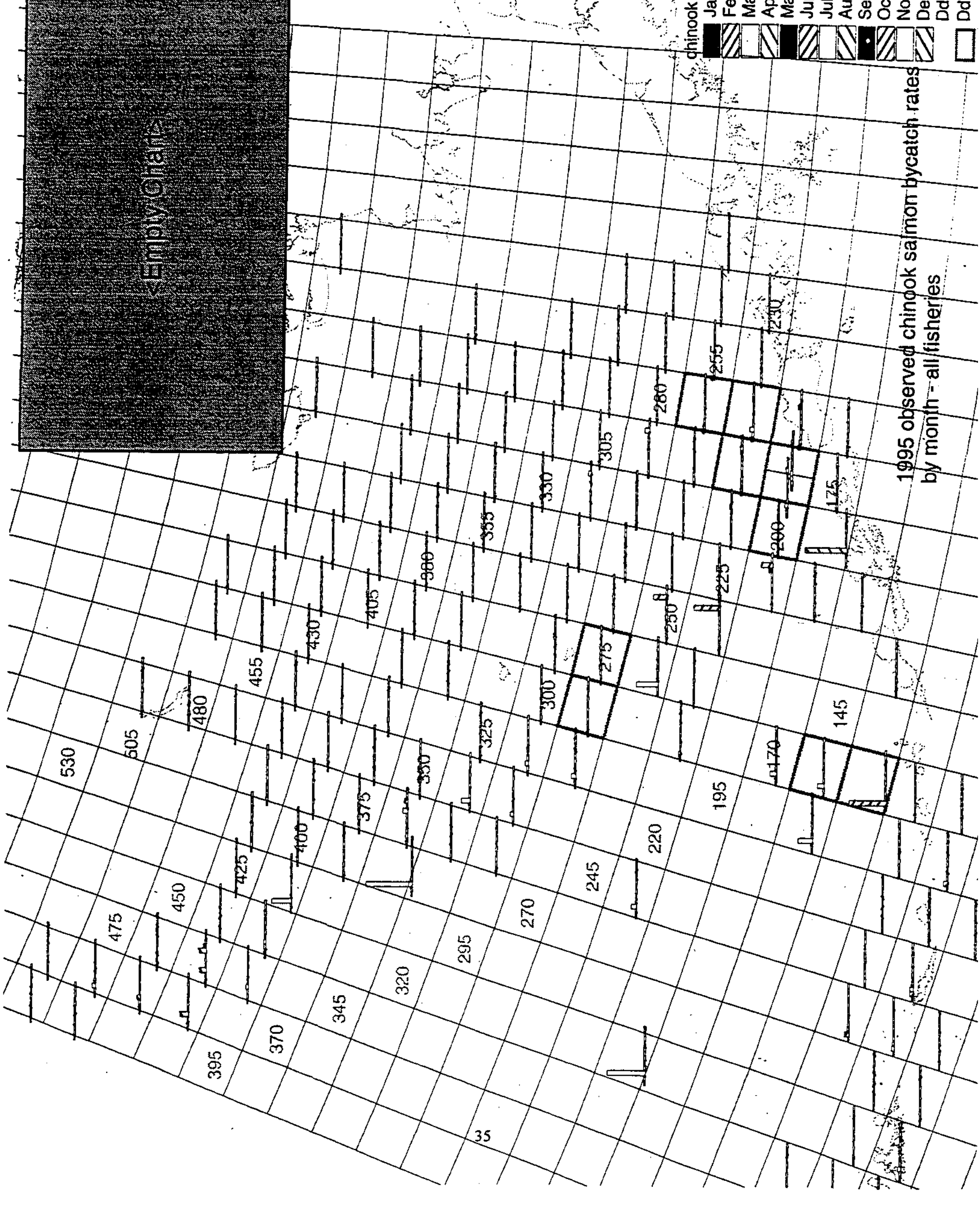
Appendix 2. Figure 28. Observed trawl groundfish catch by block and month, 1995 – all fisheries.



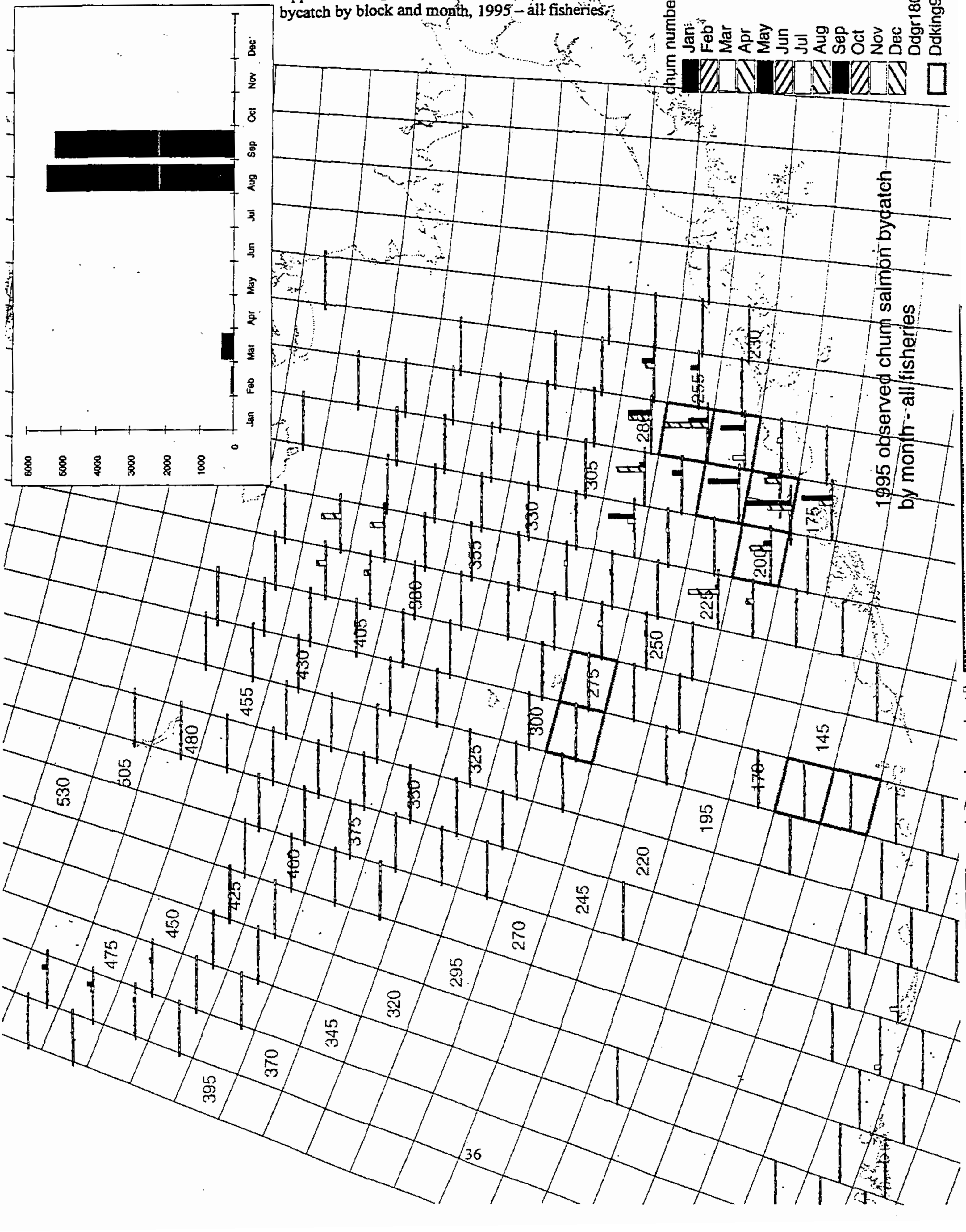
Appendix 2. Figure 29. Observed trawl chinook salmon bycatch by block and month, 1995 – all fisheries.



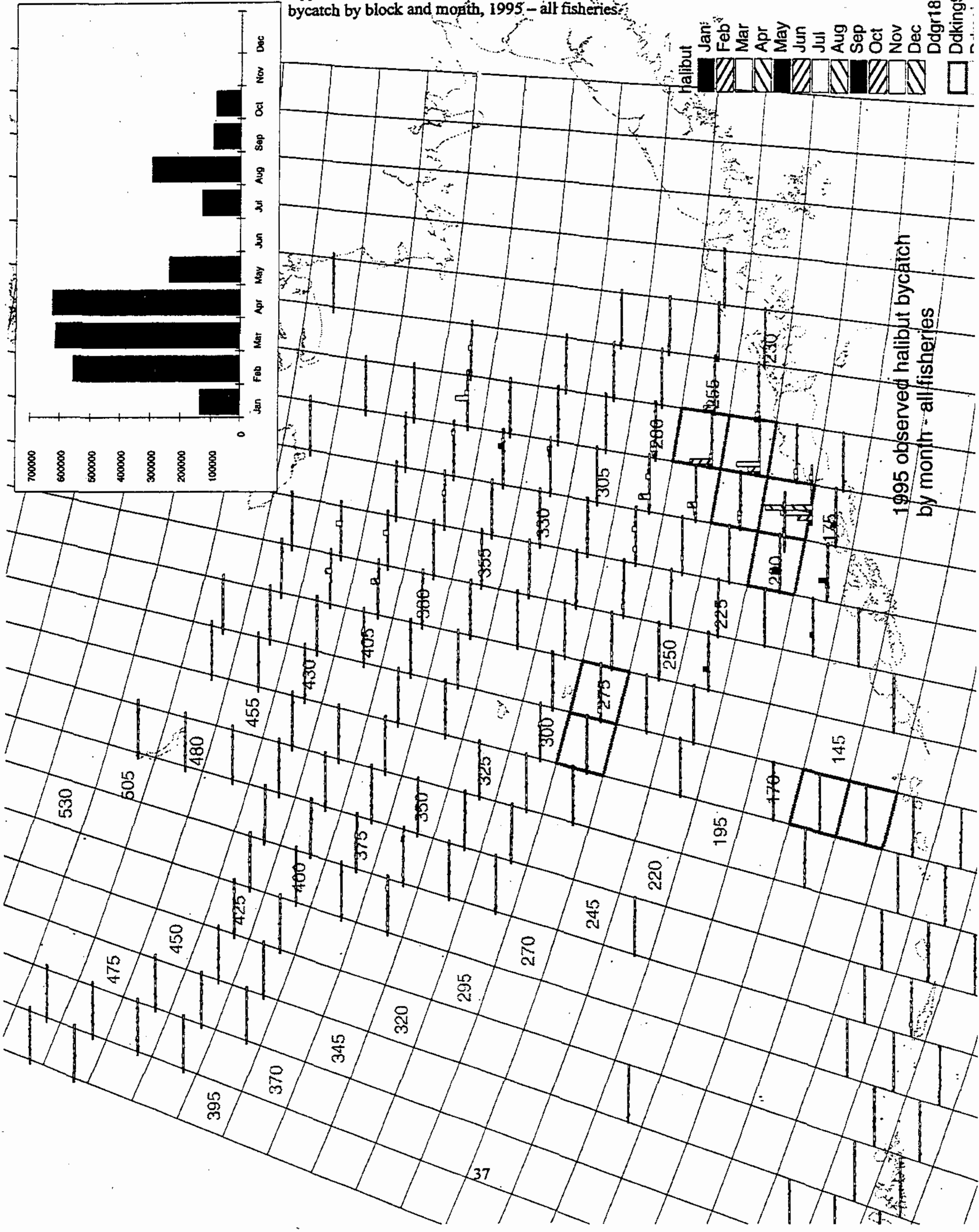
Appendix 2. Figure 30. Observed trawl chinook salmon bycatch rates by block and month, 1995 – all fisheries.



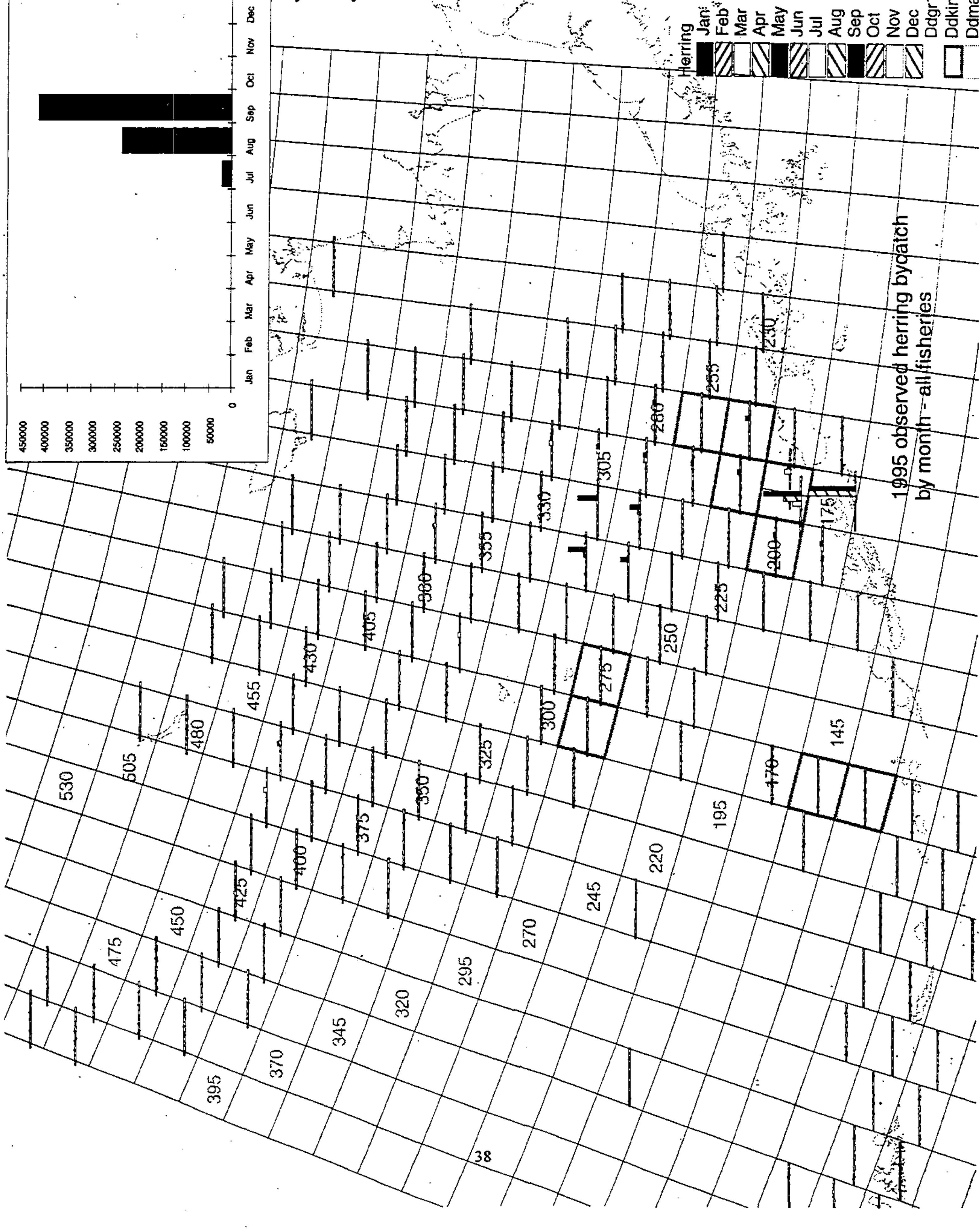
Appendix 2. Figure 31. Observed trawl chum salmon bycatch by block and month, 1995 – all fisheries.



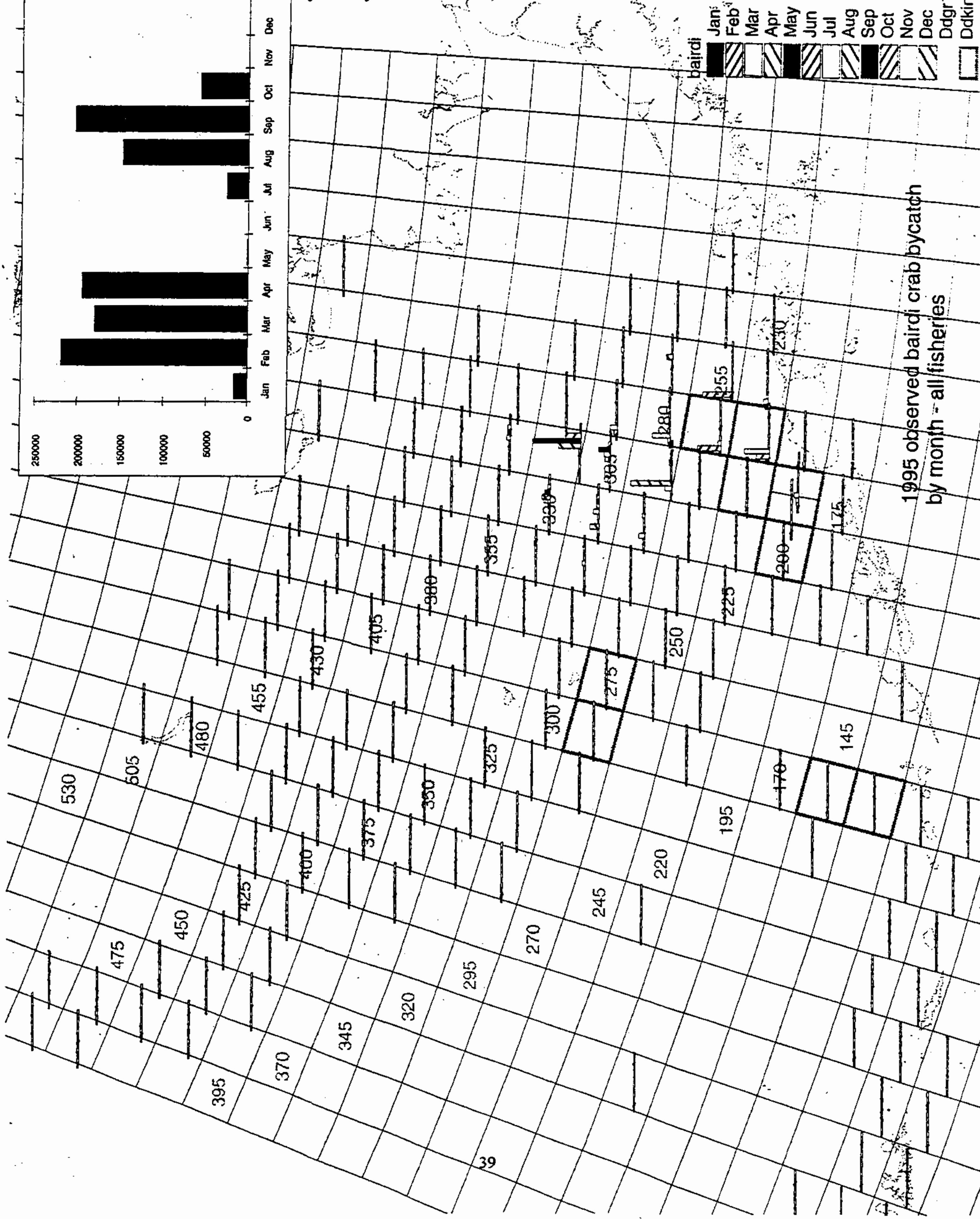
Appendix 2. Figure 32. Observed trawl halibut bycatch by block and month, 1995 – all fisheries.



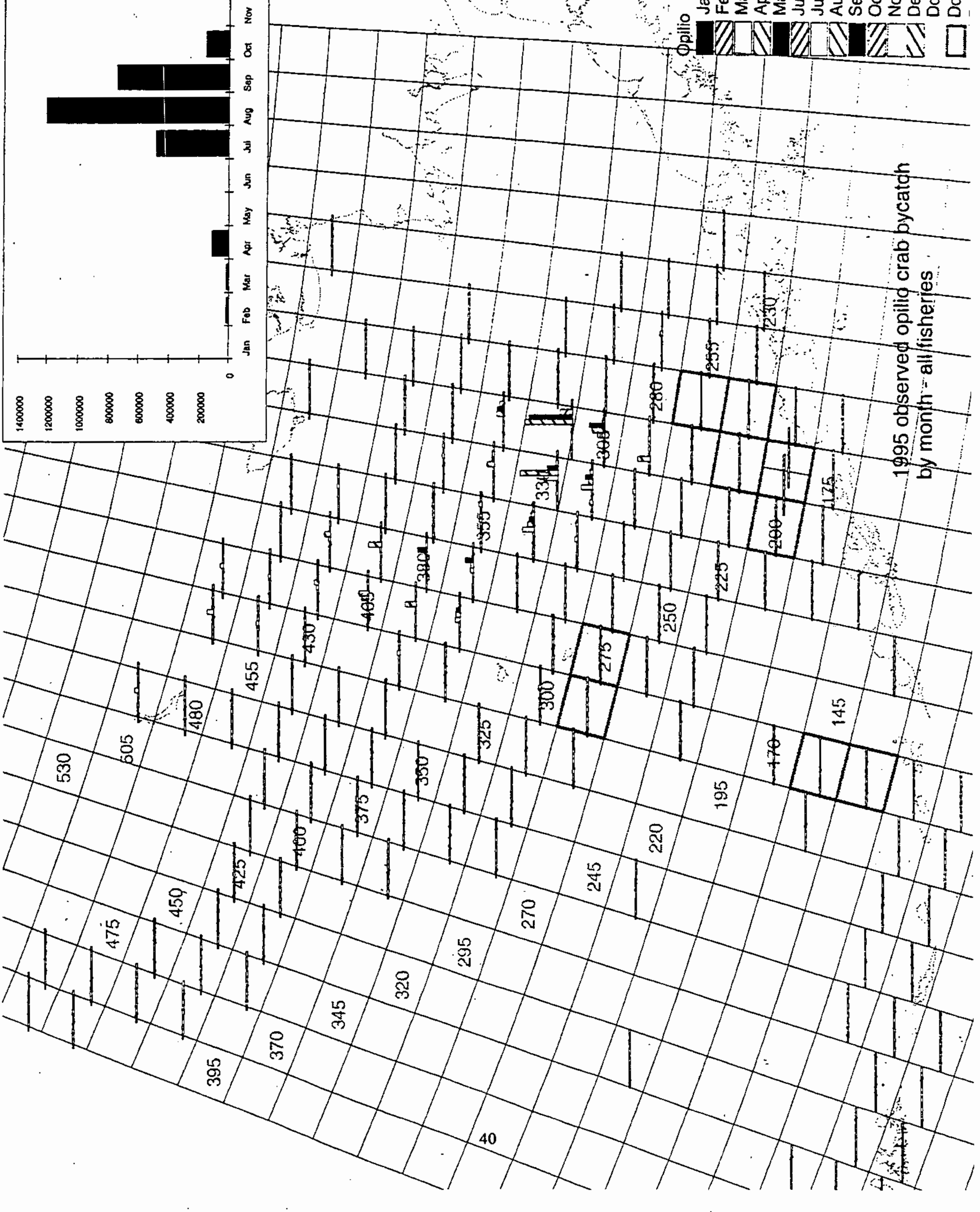
Appendix 2. Figure 33. Observed trawl herring bycatch by block and month, 1995 – all fisheries.



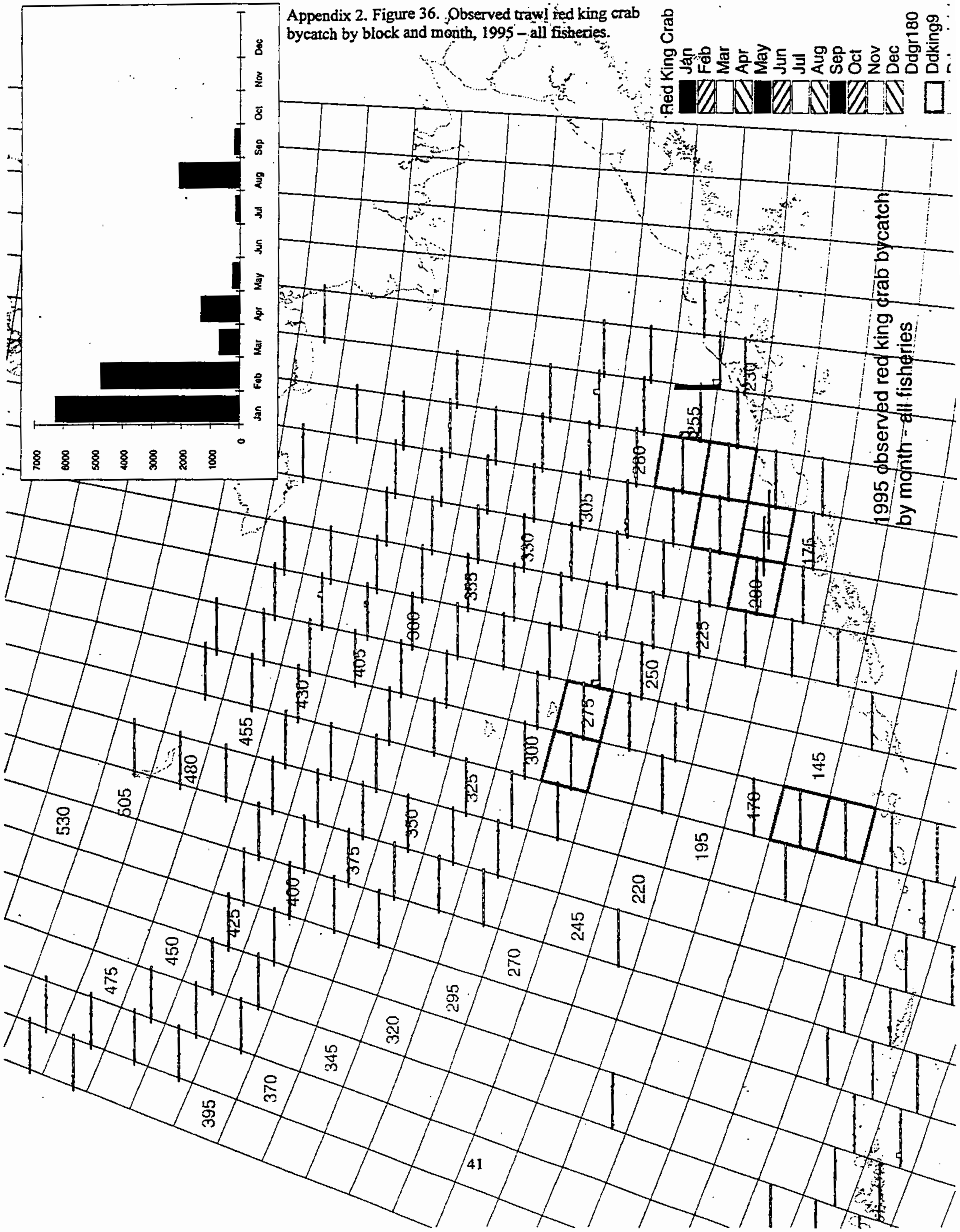
Appendix 2. Figure 34. Observed trawl bairdi crab bycatch by block and month, 1995 – all fisheries.



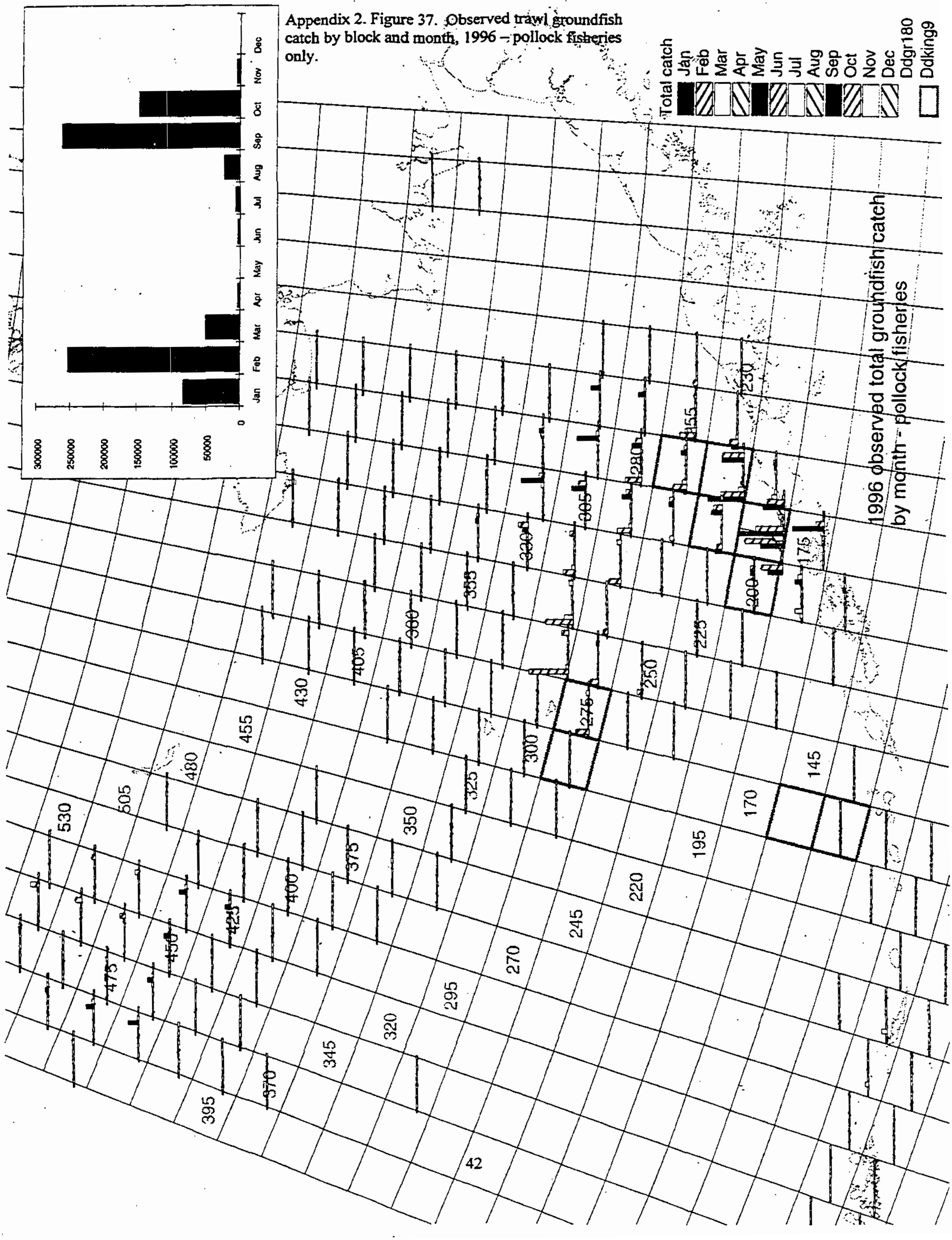
Appendix 2. Figure 35. Observed trawl opilio (snow) crab bycatch by block and month, 1995 – all fisheries.



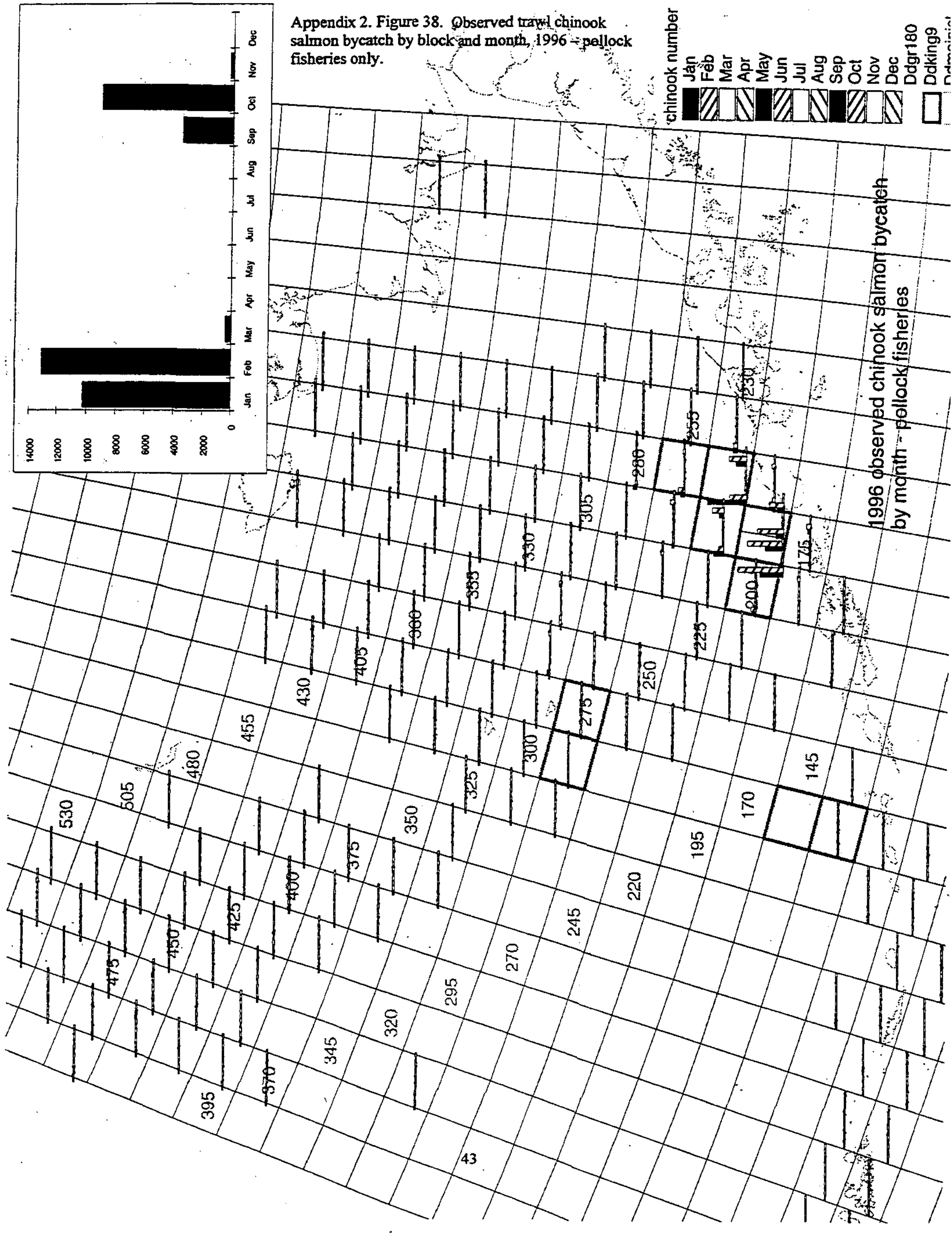
Appendix 2. Figure 36. Observed trawl red king crab bycatch by block and month, 1995 – all fisheries.



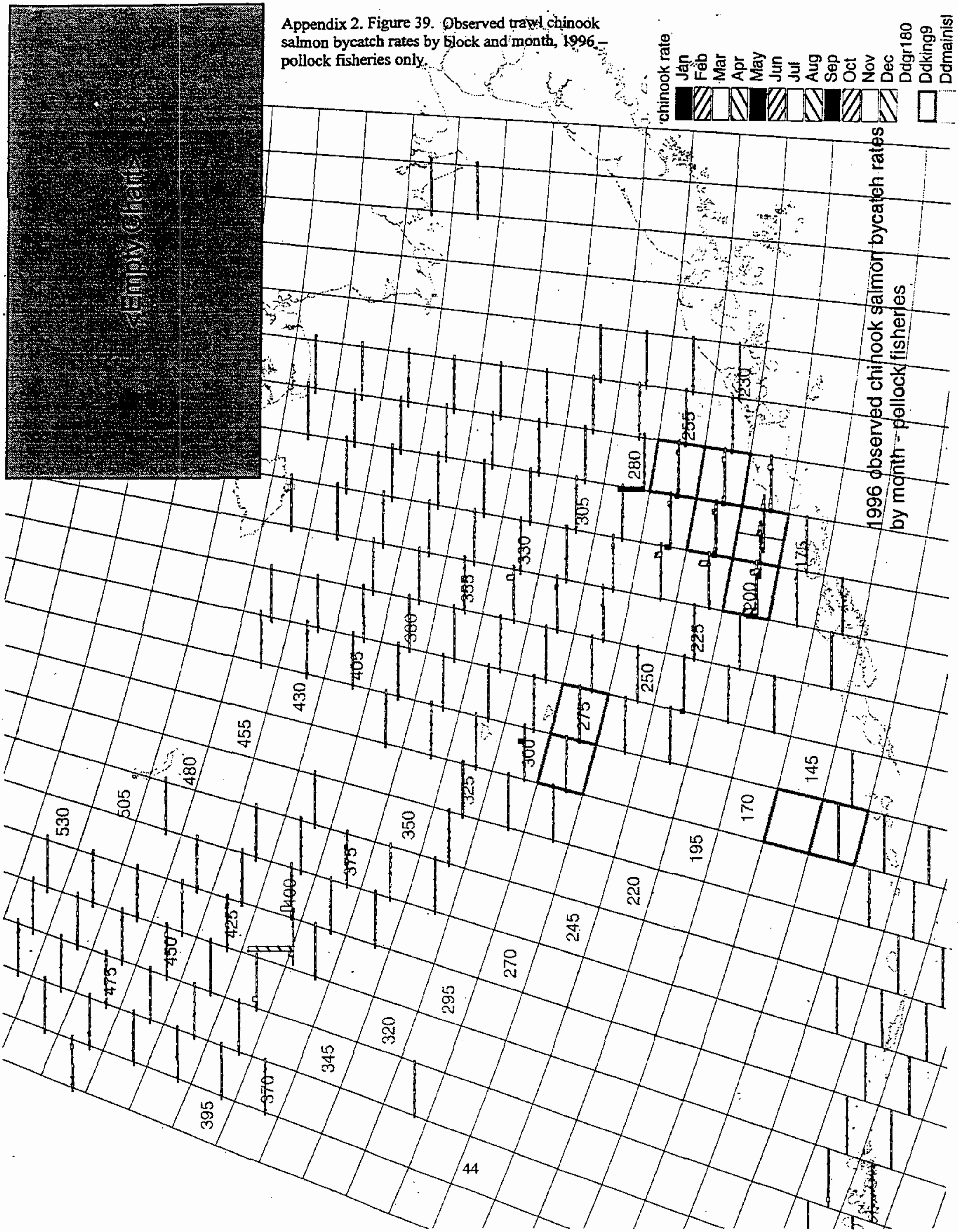
Appendix 2. Figure 37. Observed trawl groundfish catch by block and month, 1996 – pollock fisheries only.



Appendix 2. Figure 38. Observed trawl chinook salmon bycatch by block and month, 1996 – pollock fisheries only.

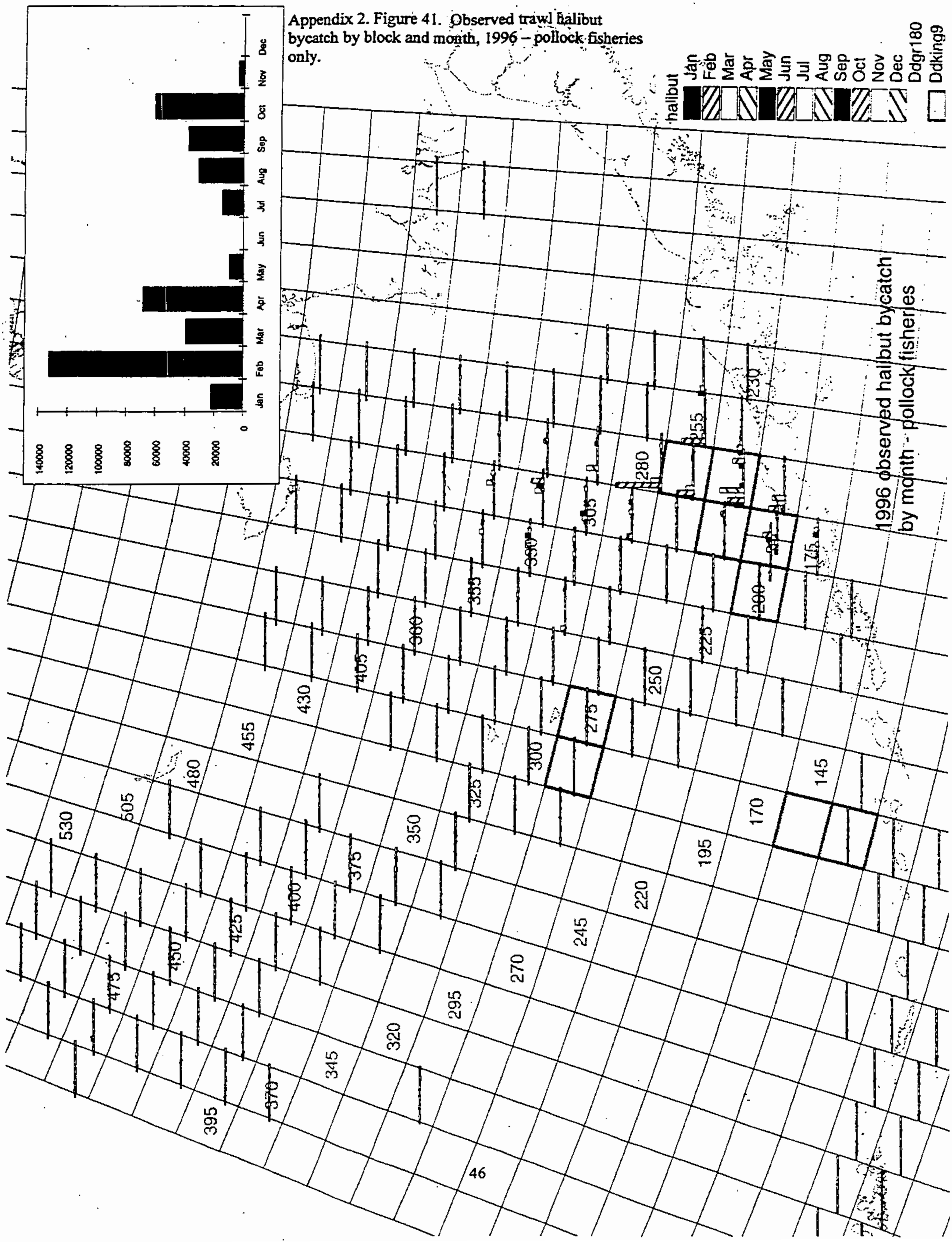


Appendix 2. Figure 39. Observed trawl chinook salmon bycatch rates by block and month, 1996 – pollock fisheries only.

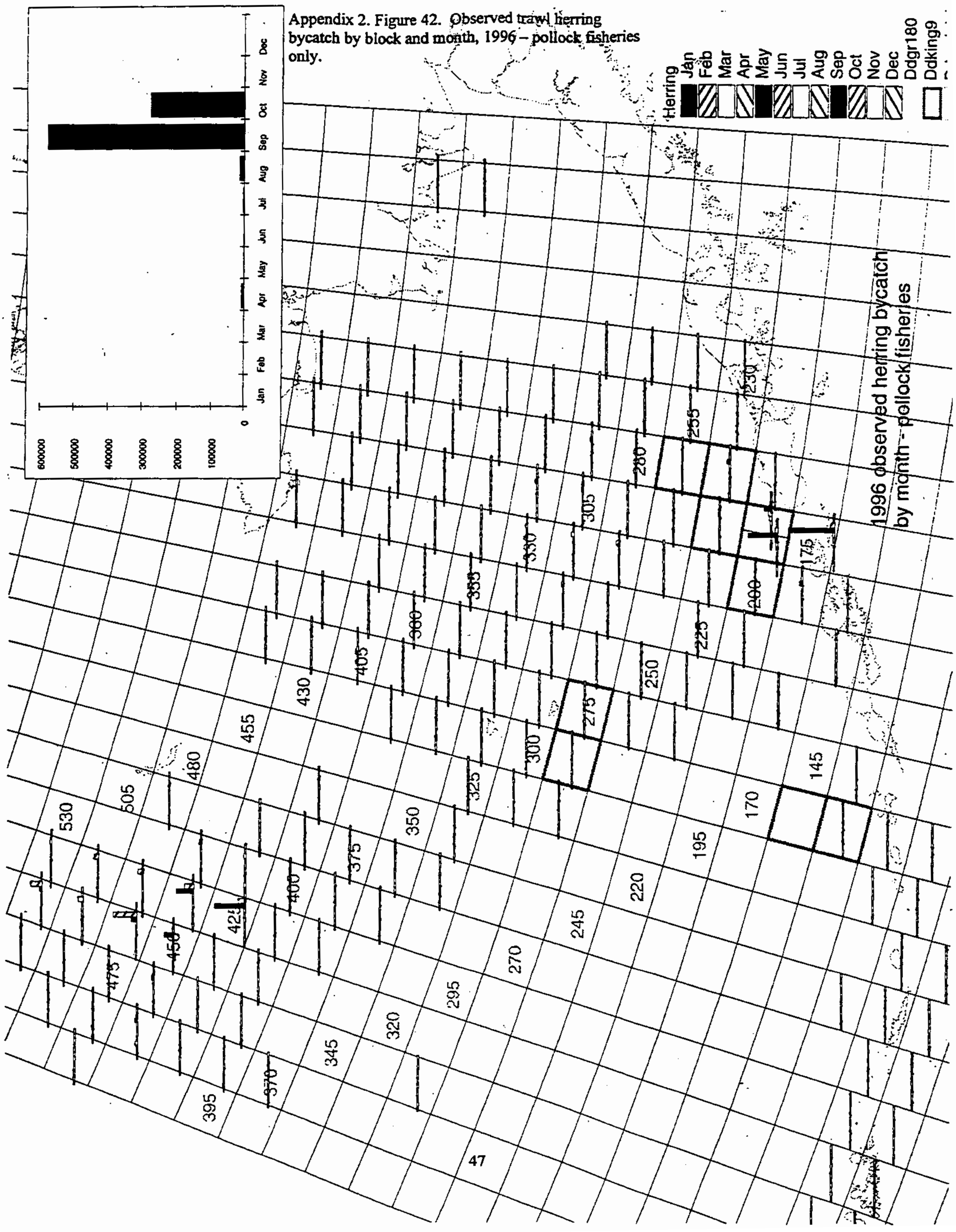


Appendix 2. Figure 40. Observed trawl chum salmon bycatch by block and month, 1996 – pollock fisheries only.

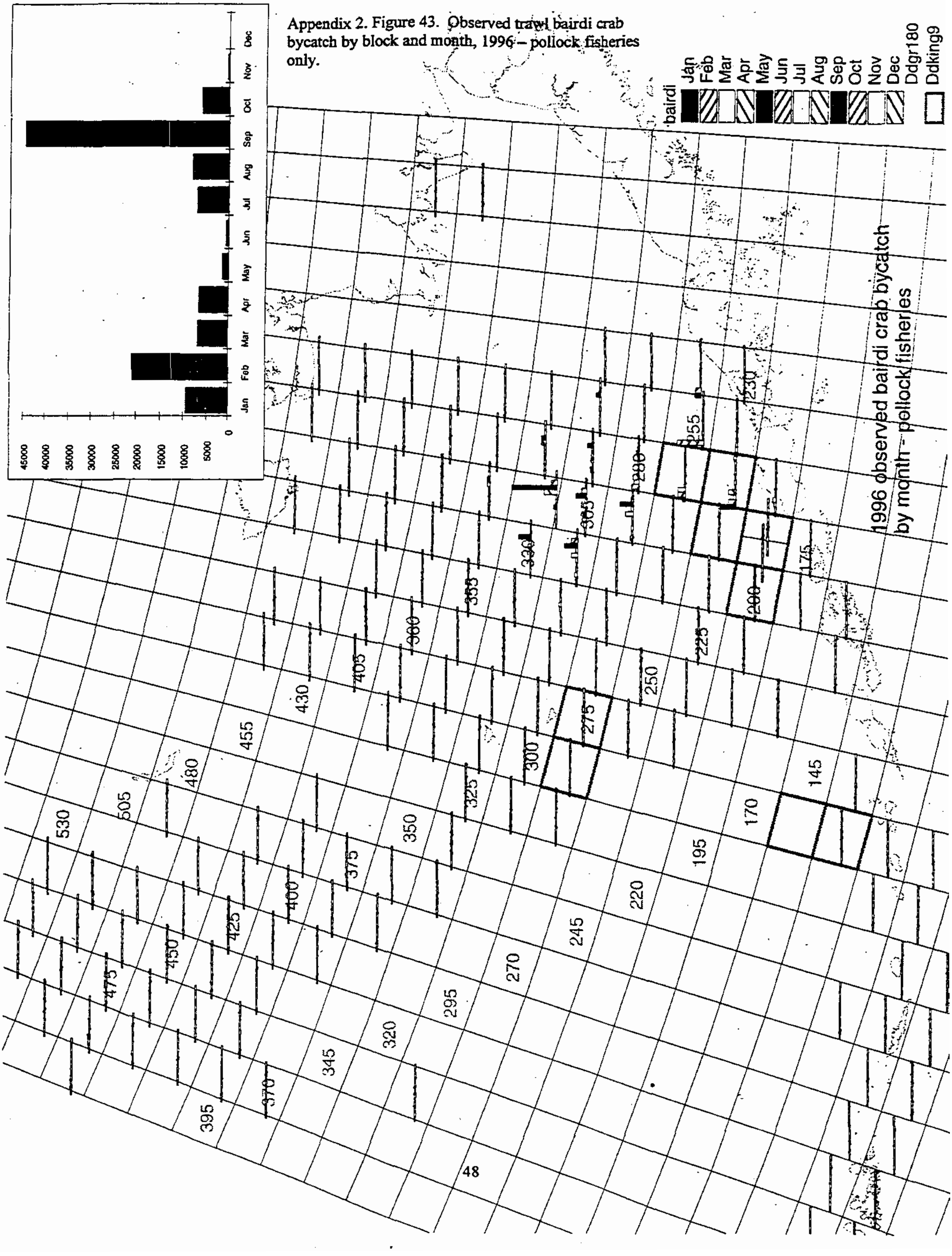
Appendix 2. Figure 41. Observed trawl halibut bycatch by block and month, 1996 – pollock fisheries only.

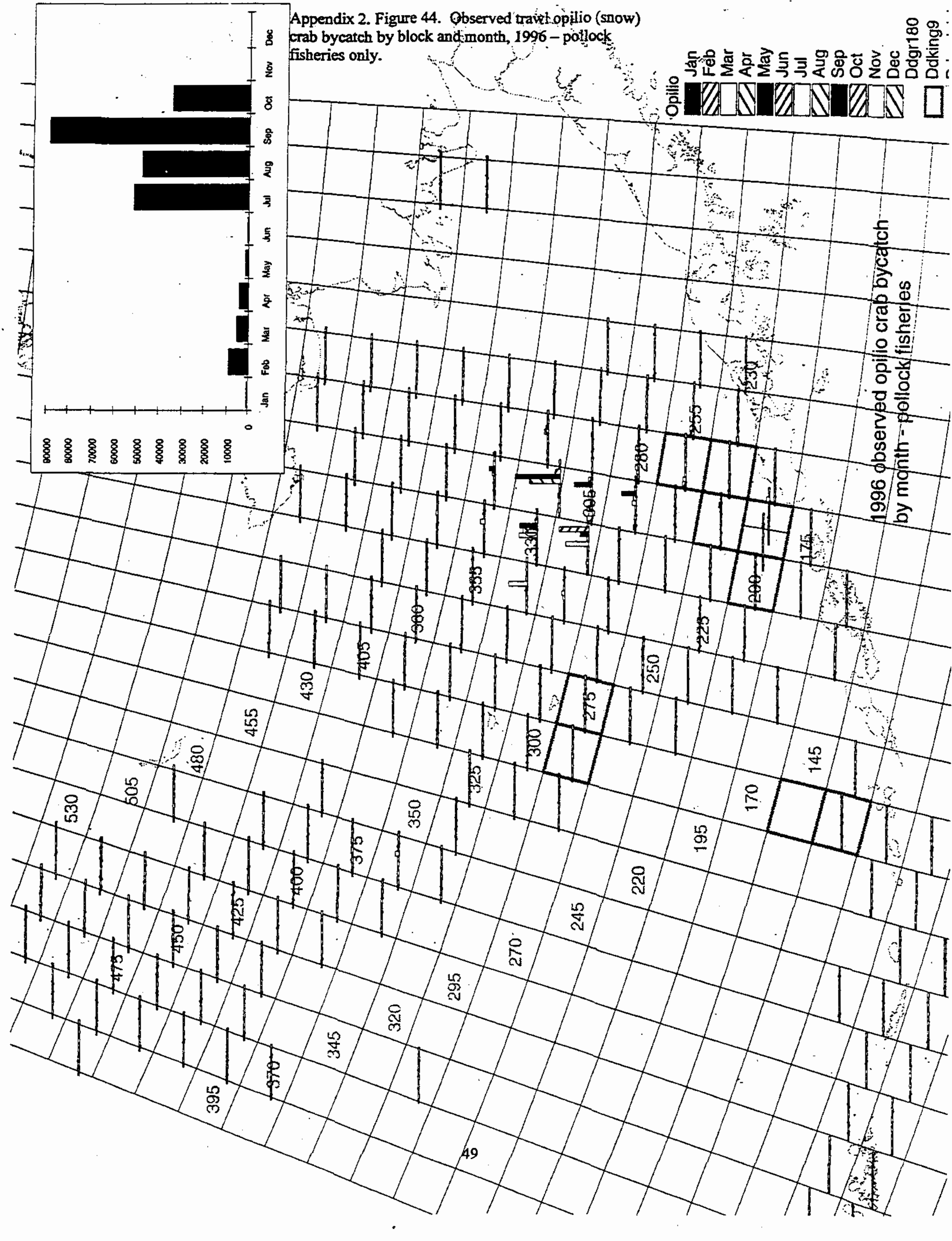


Appendix 2. Figure 42. Observed trawl herring bycatch by block and month, 1996 – pollock fisheries only.



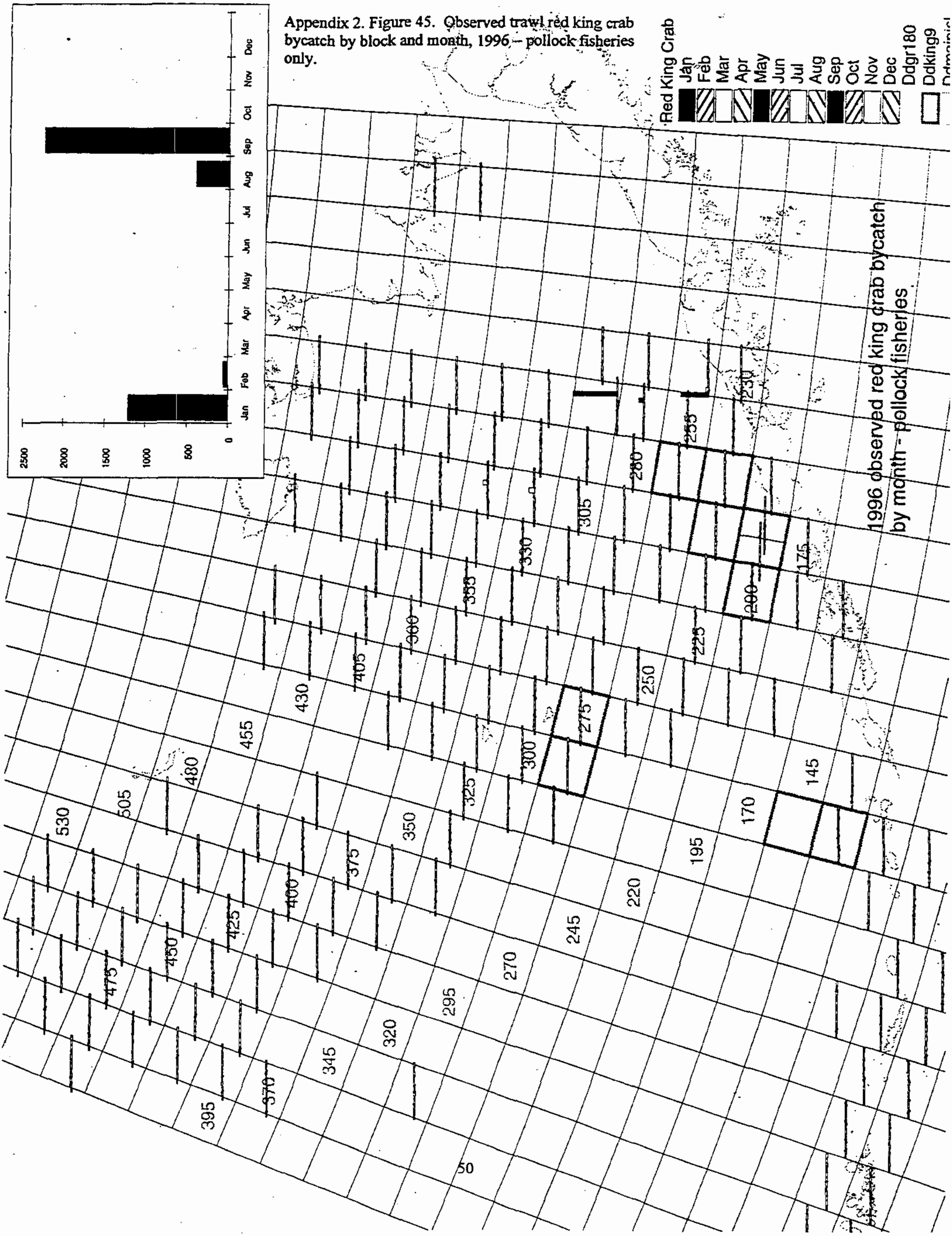
Appendix 2. Figure 43. Observed trawl bairdi crab bycatch by block and month, 1996 – pollock fisheries only.



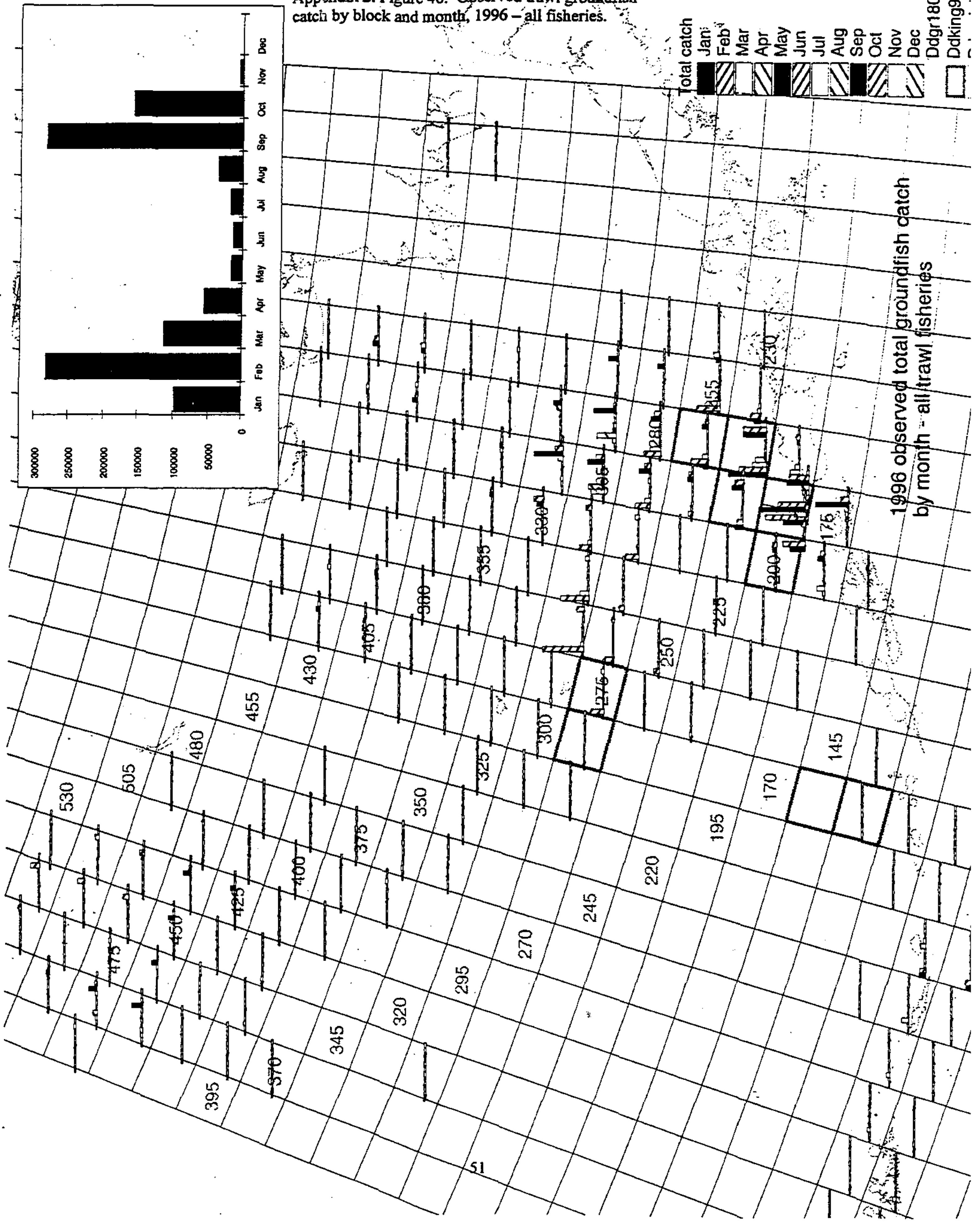


Appendix 2. Figure 44. Observed trawl opilio (snow) crab bycatch by block and month, 1996 – pollock fisheries only.

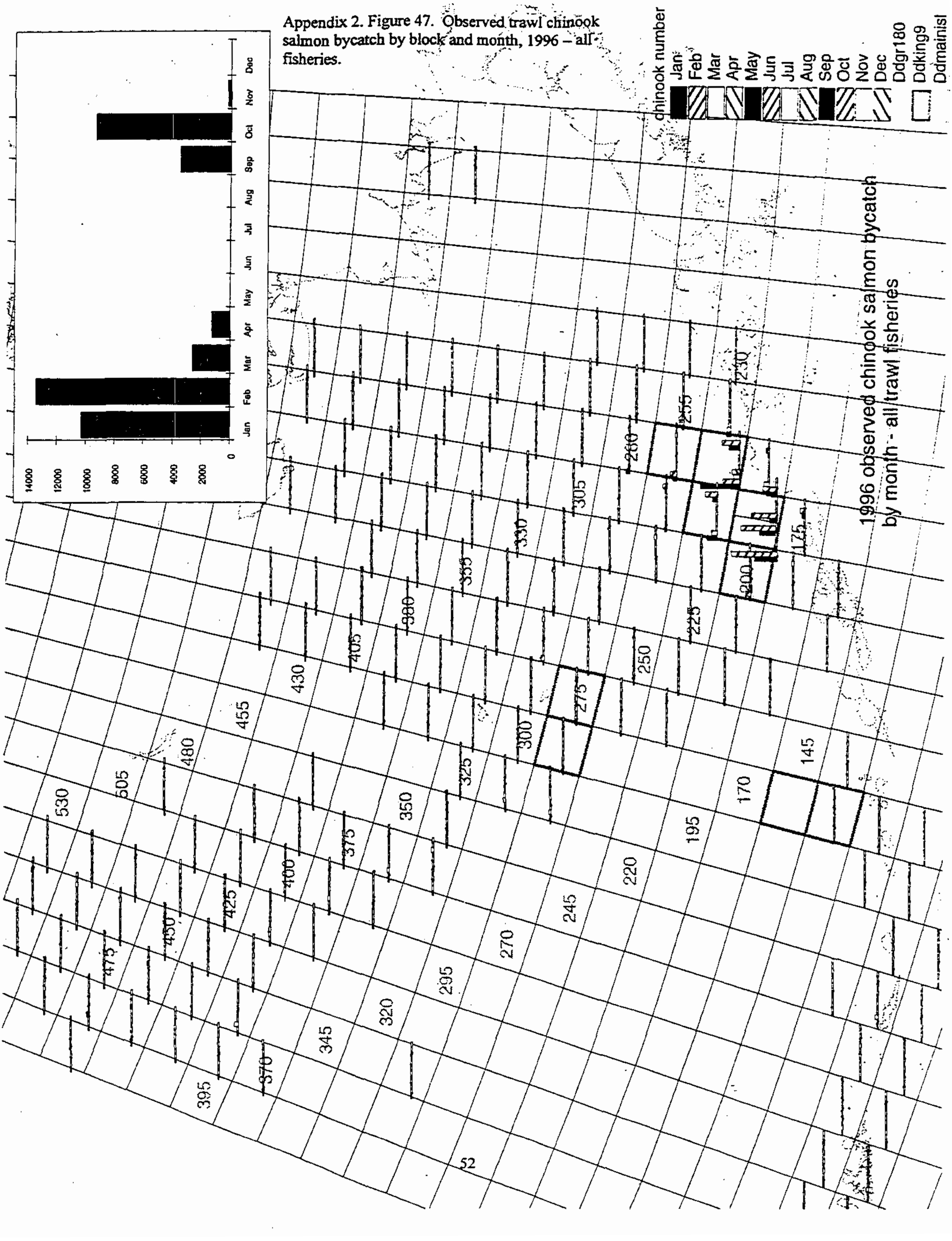
Appendix 2. Figure 45. Observed trawl red king crab bycatch by block and month, 1996 – pollock fisheries only.



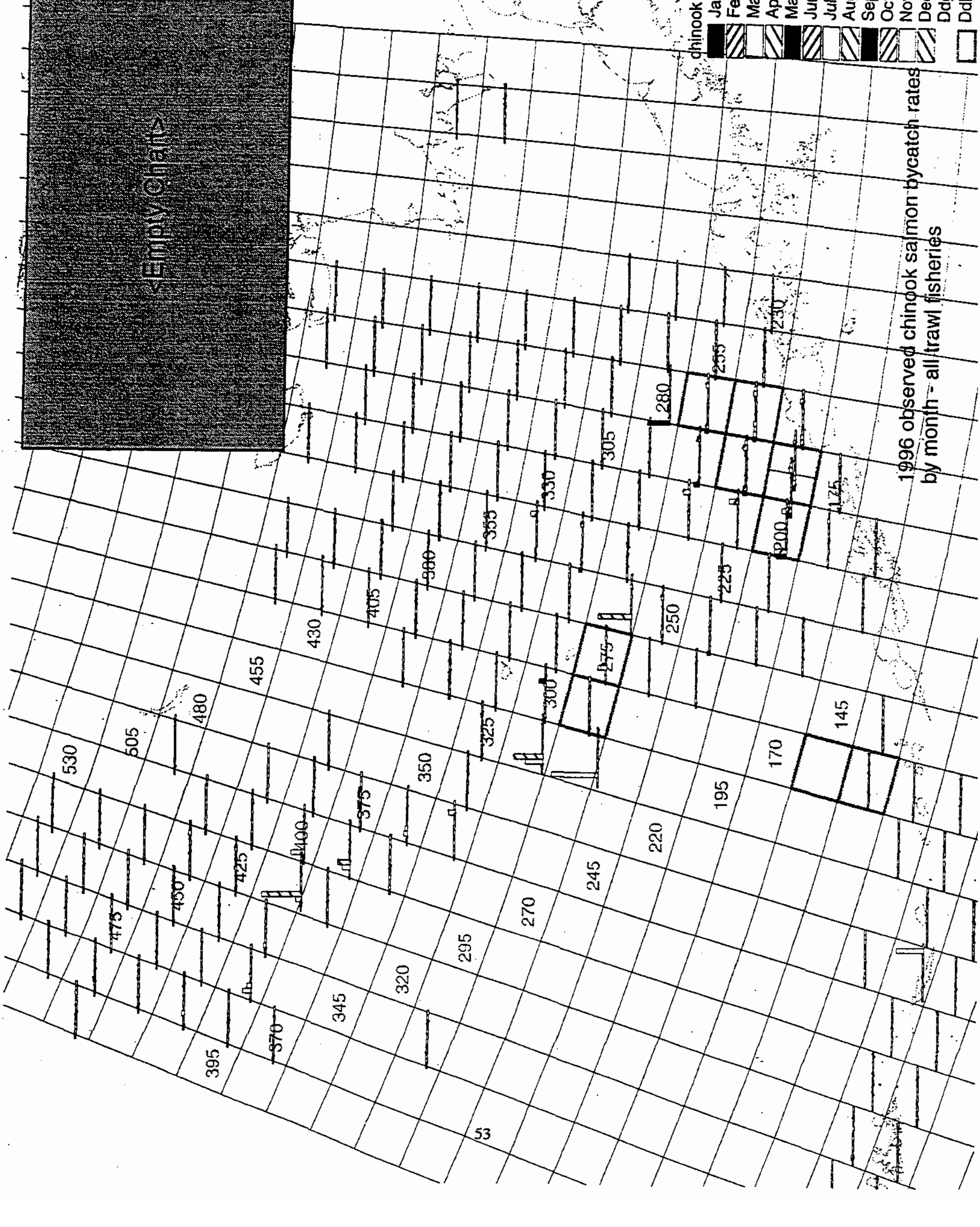
Appendix 2. Figure 46. Observed trawl groundfish catch by block and month, 1996 – all fisheries.



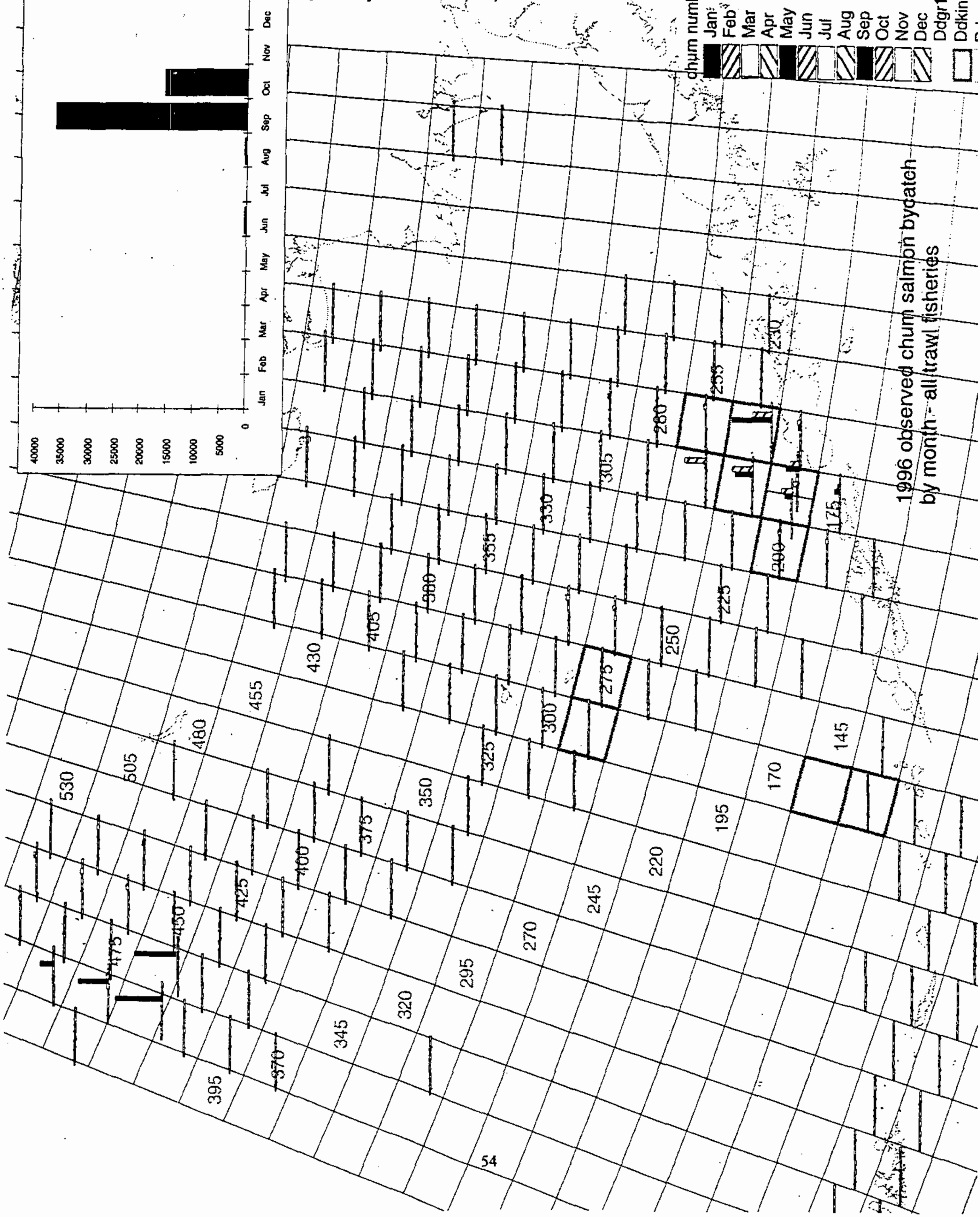
Appendix 2. Figure 47. Observed trawl chinook salmon bycatch by block and month, 1996 – all fisheries.



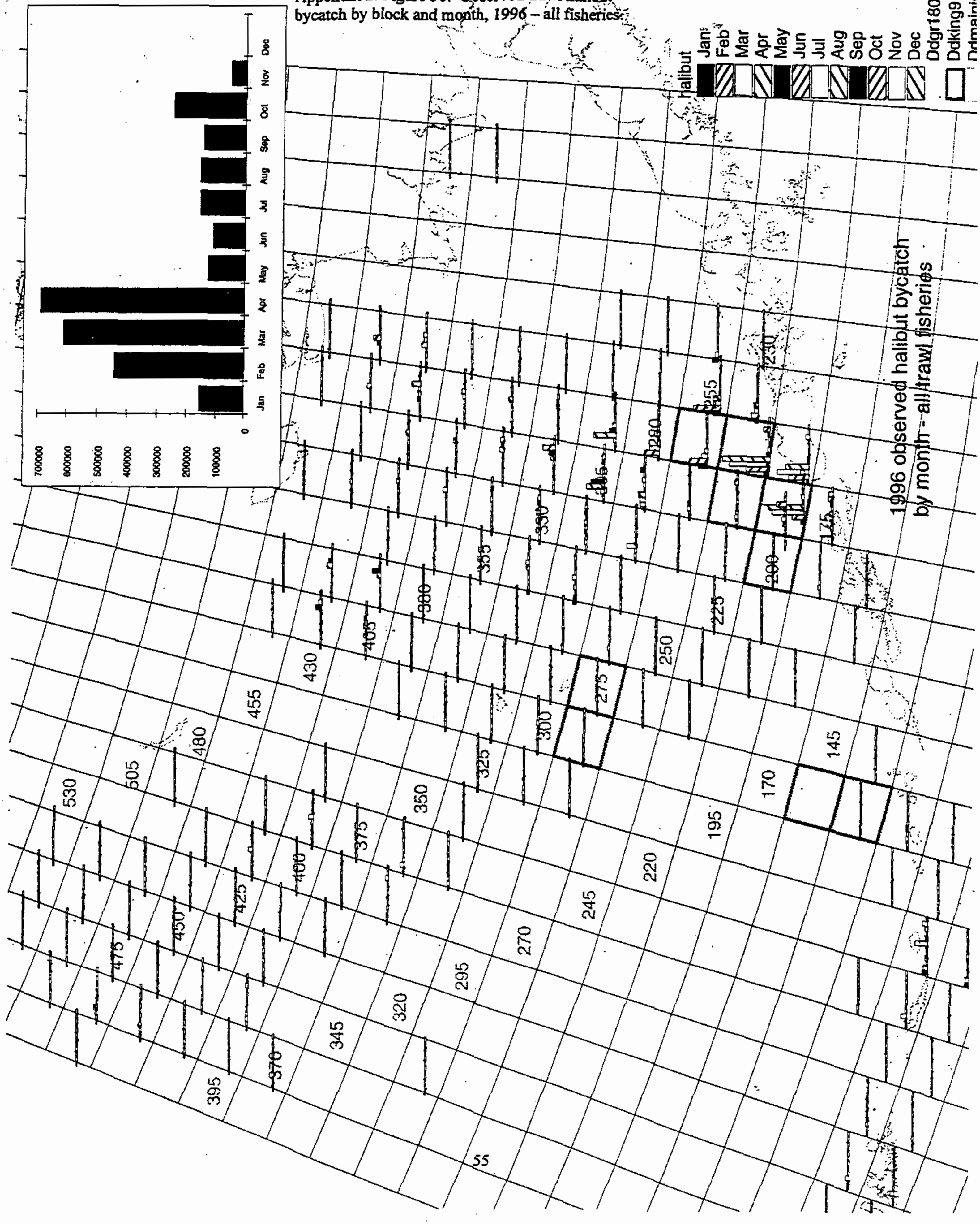
Appendix 2. Figure 48. Observed trawl chinook salmon bycatch rates by block and month, 1996 -- all fisheries.



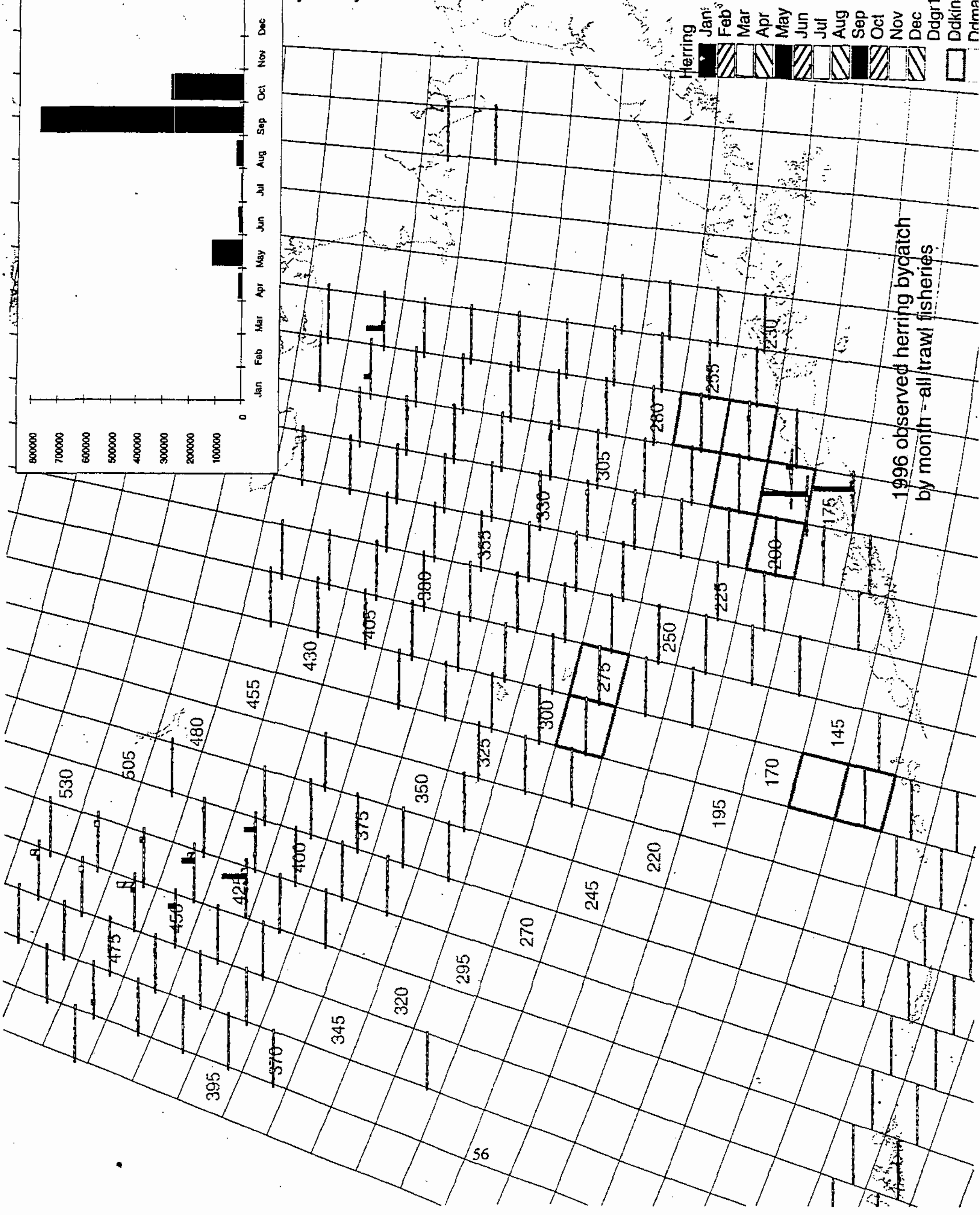
Appendix 2. Figure 49. Observed trawl chum salmon bycatch by block and month, 1996 – all fisheries.



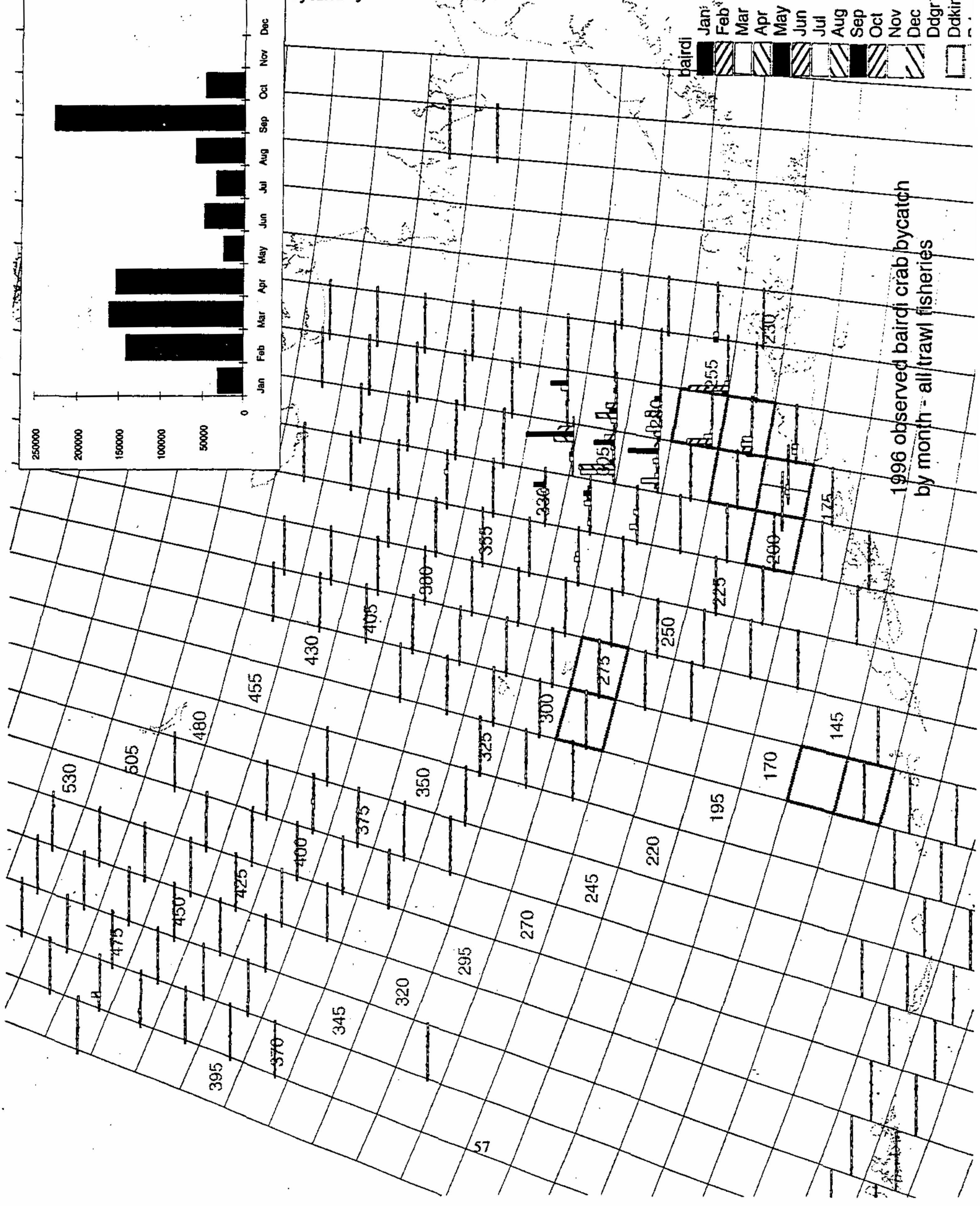
Appendix 2. Figure 50. Observed trawl halibut bycatch by block and month, 1996 – all fisheries.



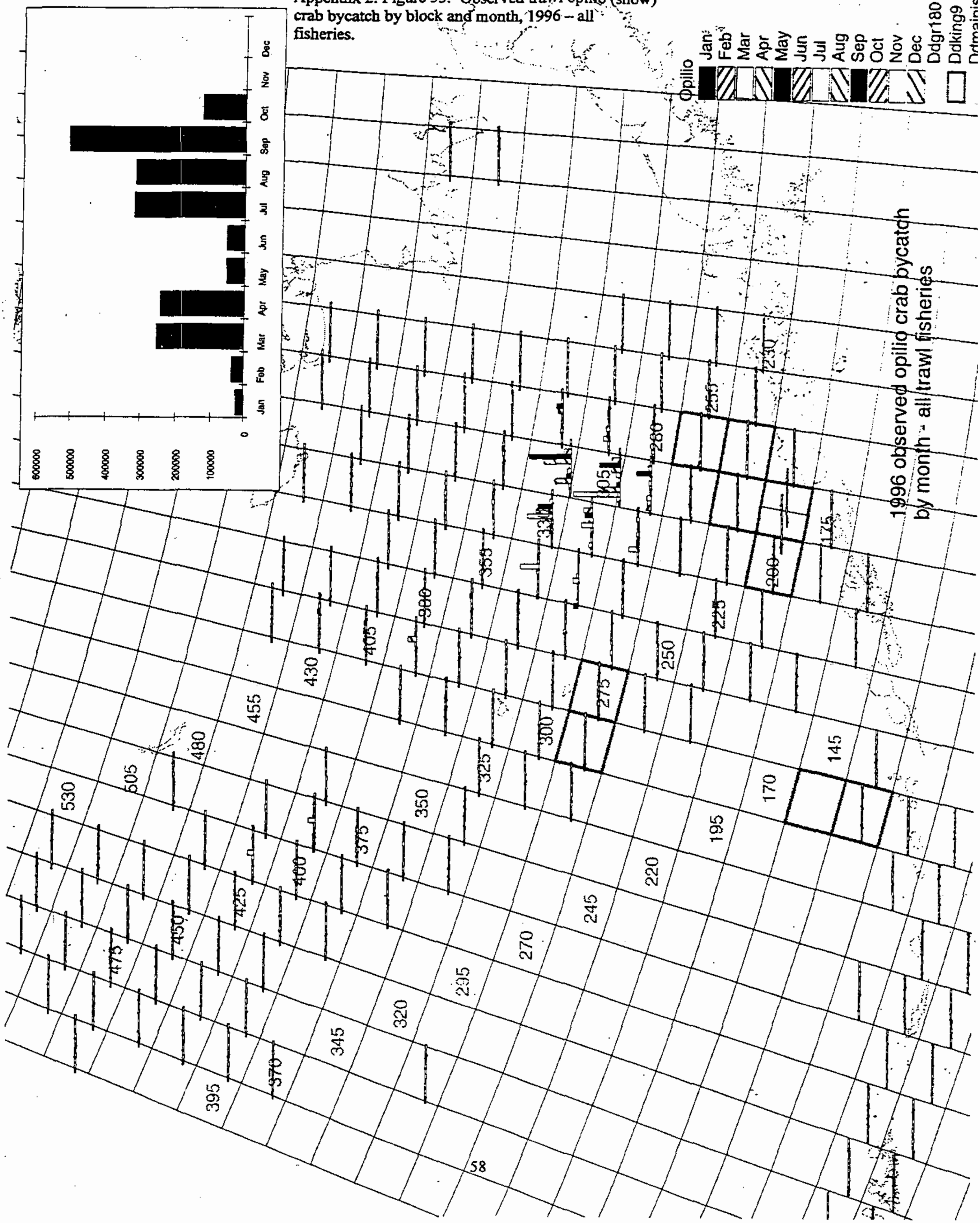
Appendix 2. Figure 51. Observed trawl herring bycatch by block and month, 1996 – all fisheries.



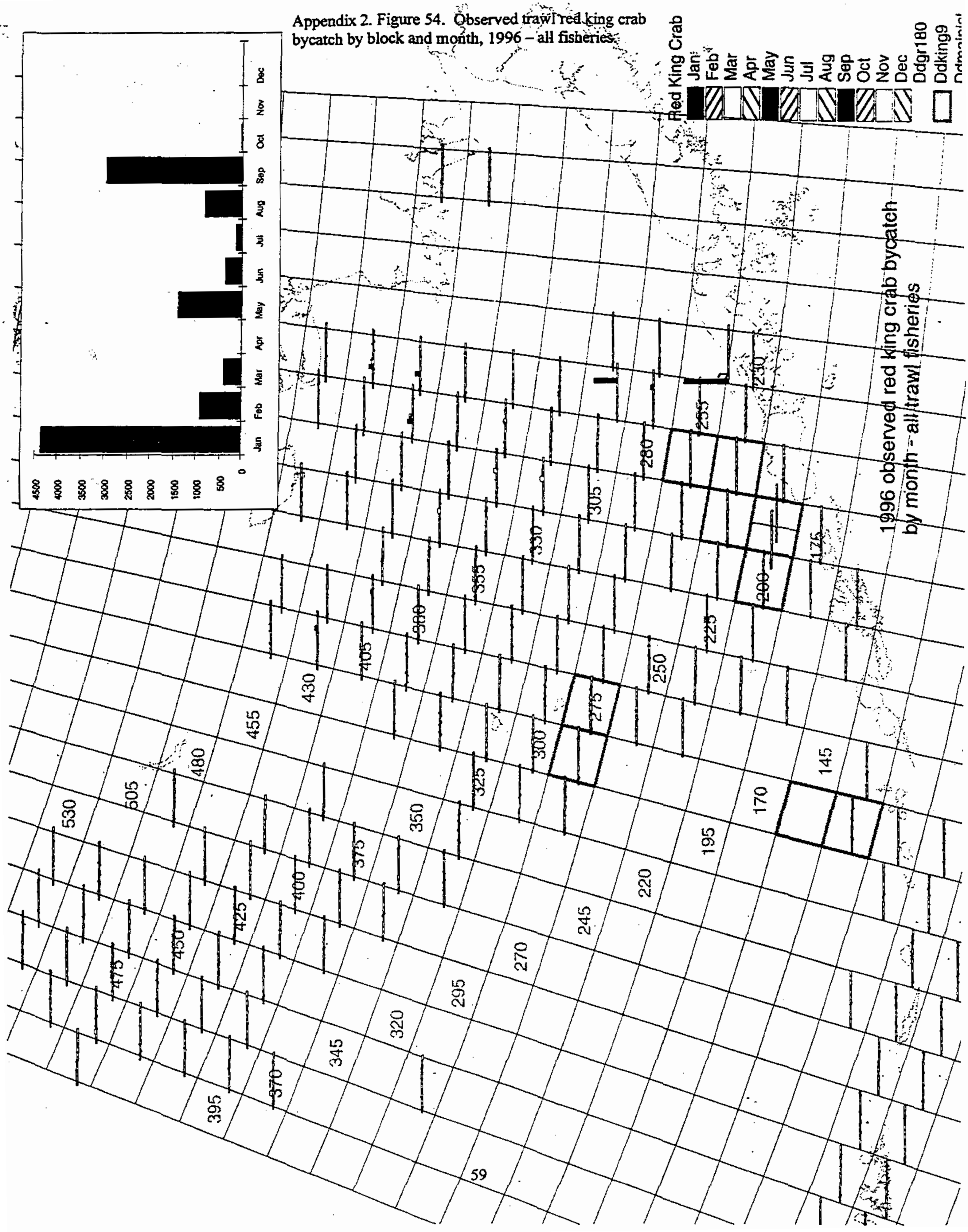
Appendix 2. Figure 52. Observed trawl bairdi crab bycatch by block and month, 1996 – all fisheries.



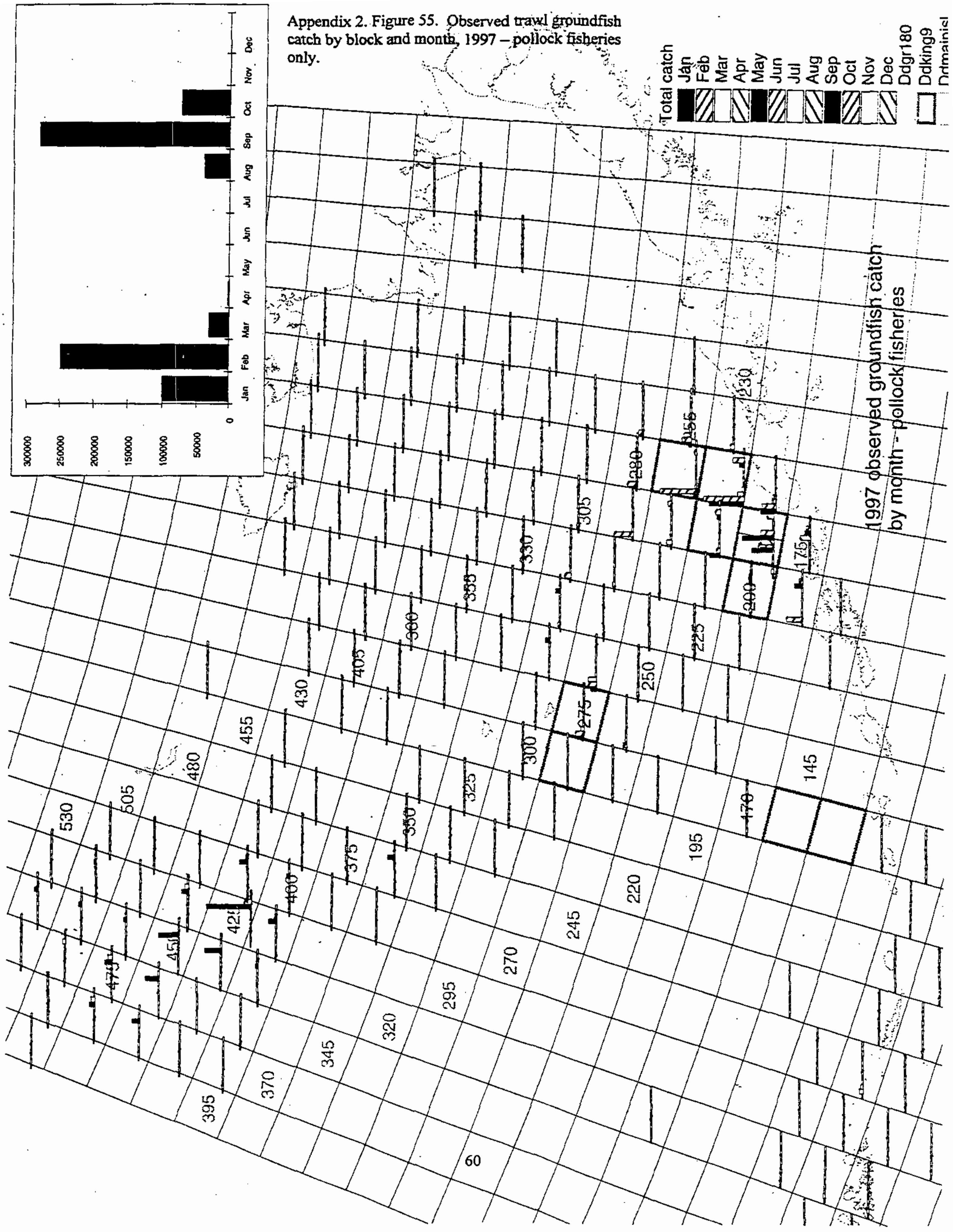
Appendix 2. Figure 53. Observed trawl opilio (snow) crab bycatch by block and month, 1996 -- all fisheries.



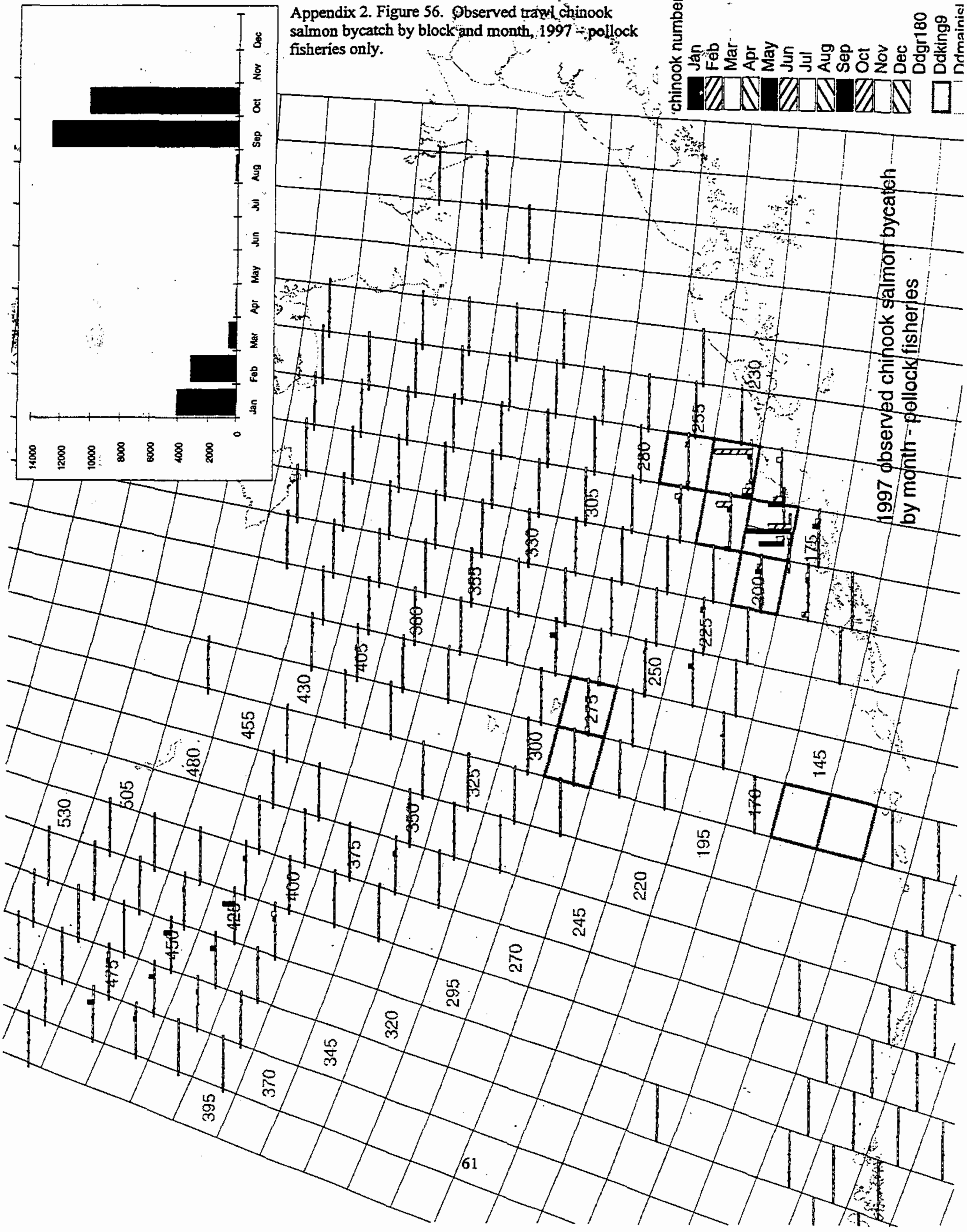
Appendix 2. Figure 54. Observed trawl red king crab bycatch by block and month, 1996 – all fisheries.



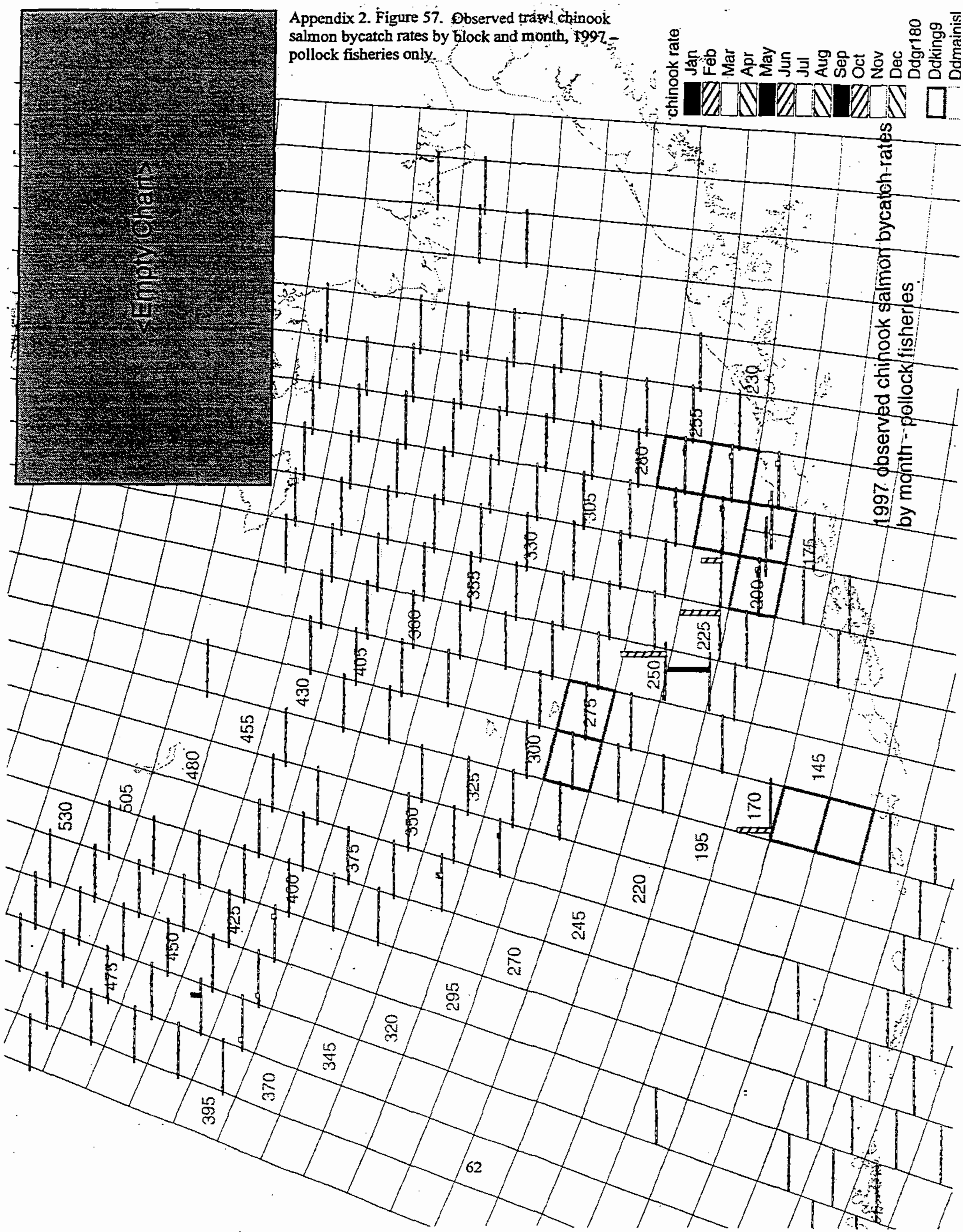
Appendix 2. Figure 55. Observed trawl groundfish catch by block and month, 1997 – pollock fisheries only.



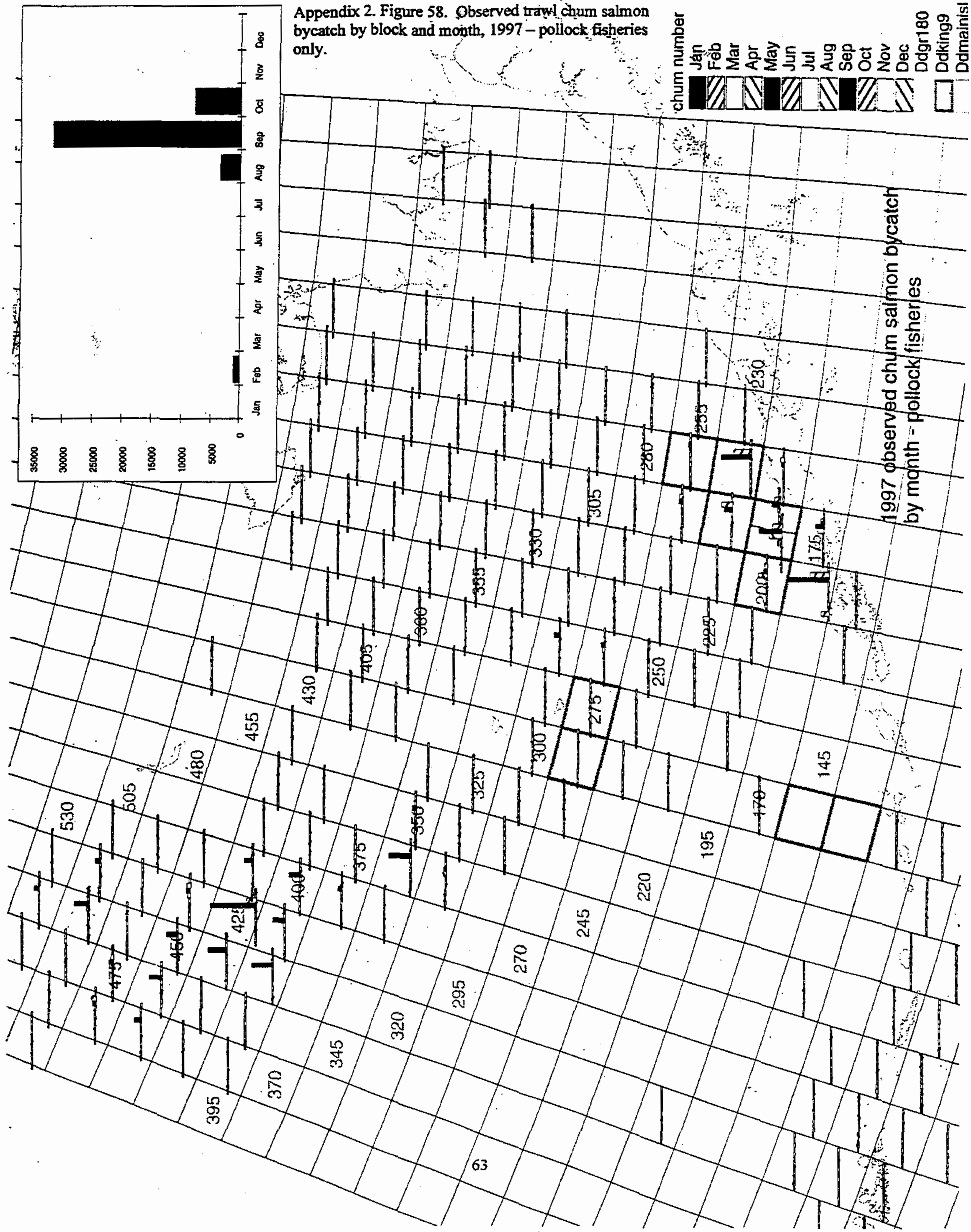
Appendix 2. Figure 56. Observed trawl chinook salmon bycatch by block and month, 1997 - pollock fisheries only.



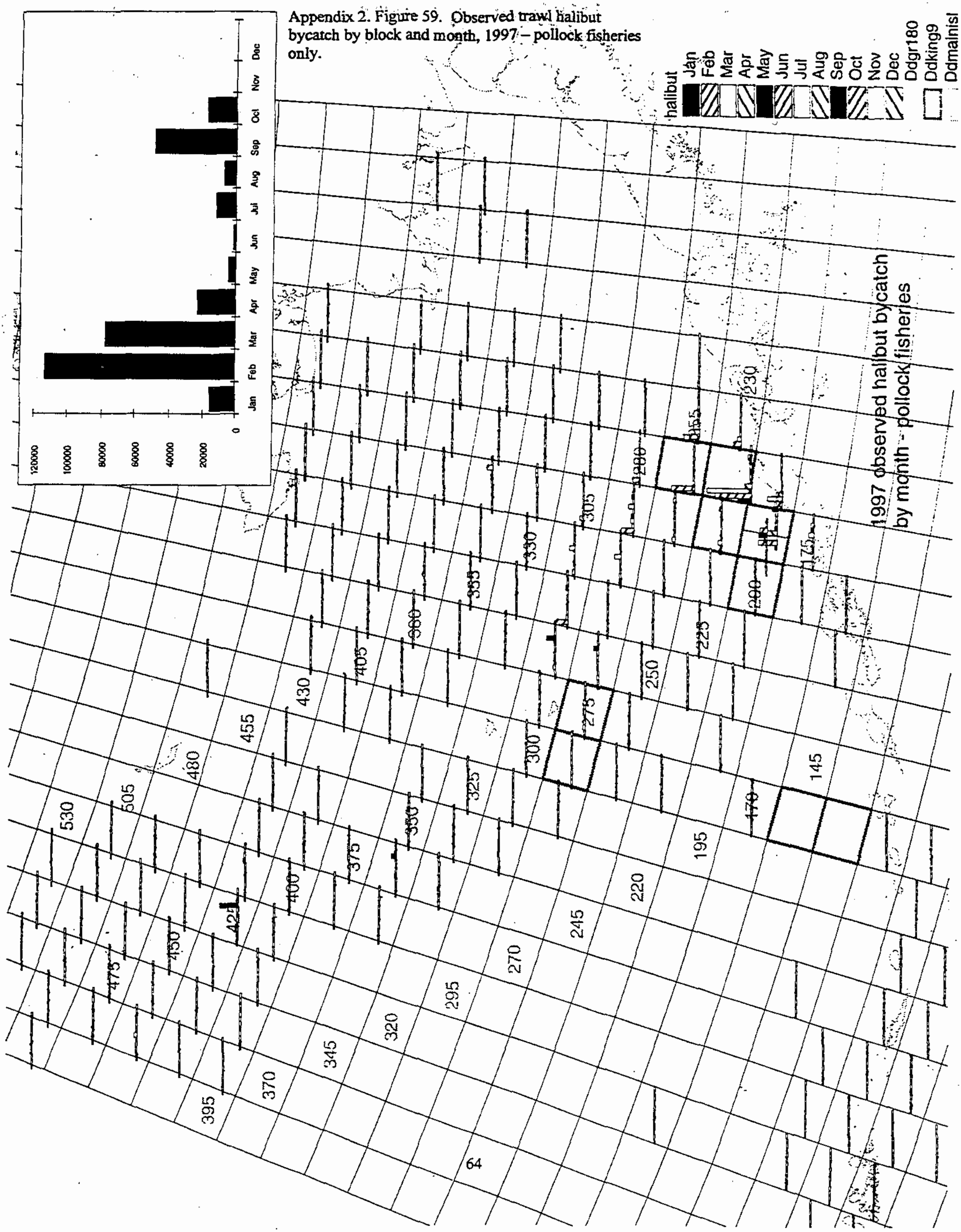
Appendix 2. Figure 57. Observed trawl chinook salmon bycatch rates by block and month, 1997 – pollock fisheries only.



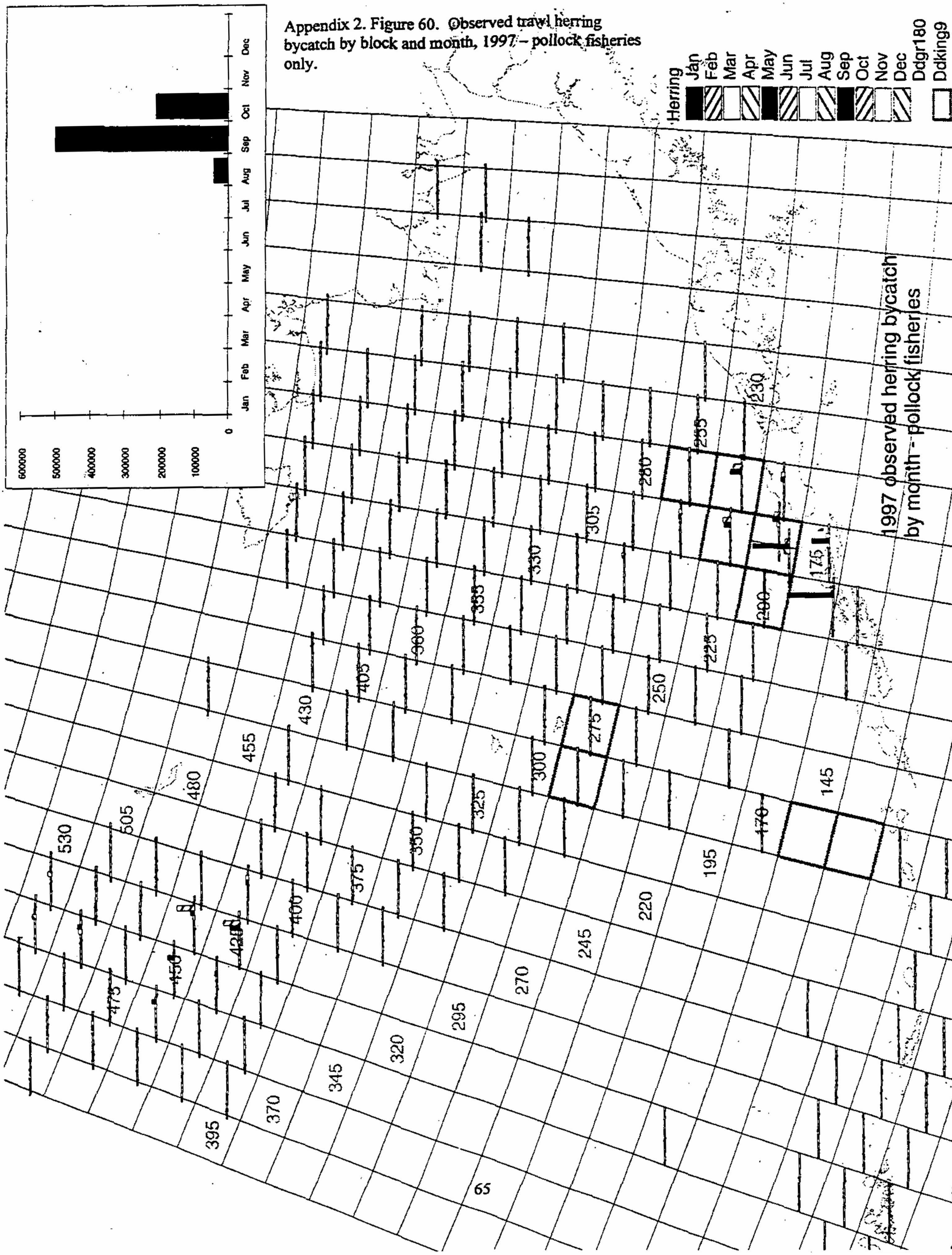
Appendix 2. Figure 58. Observed trawl chum salmon bycatch by block and month, 1997 – pollock fisheries only.



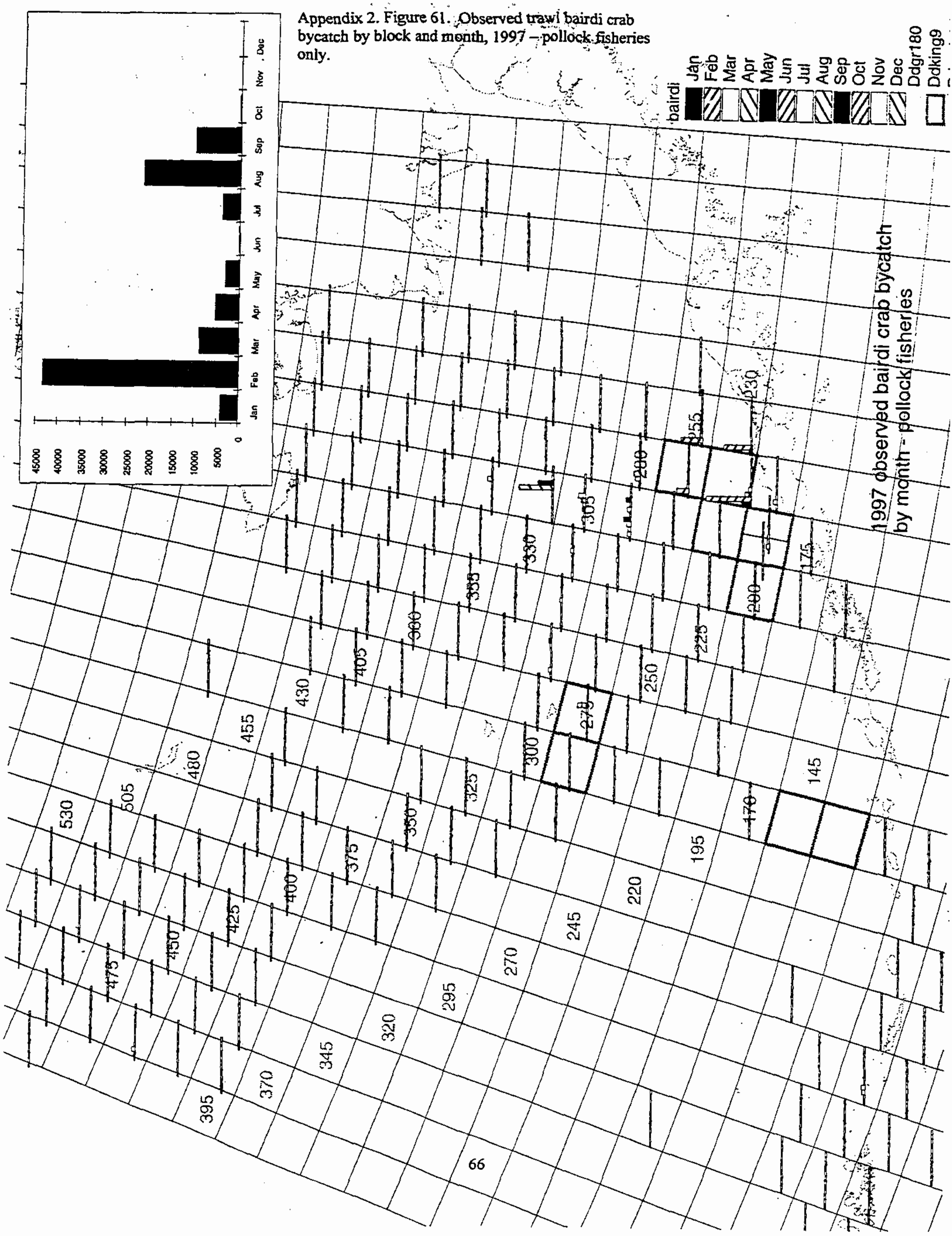
Appendix 2. Figure 59. Observed trawl halibut bycatch by block and month, 1997 – pollock fisheries only.



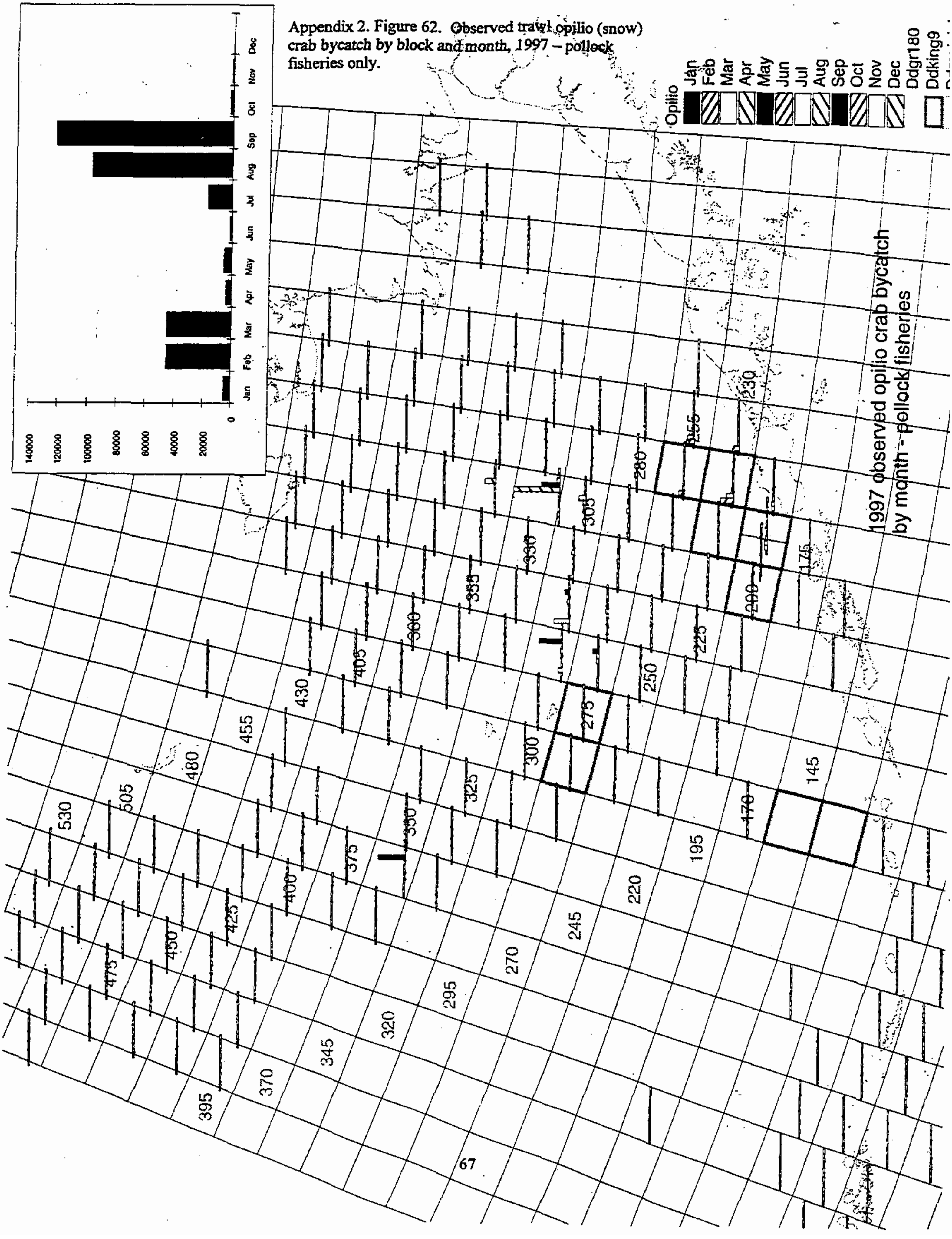
Appendix 2. Figure 60. Observed trawl herring bycatch by block and month, 1997 – pollock fisheries only.



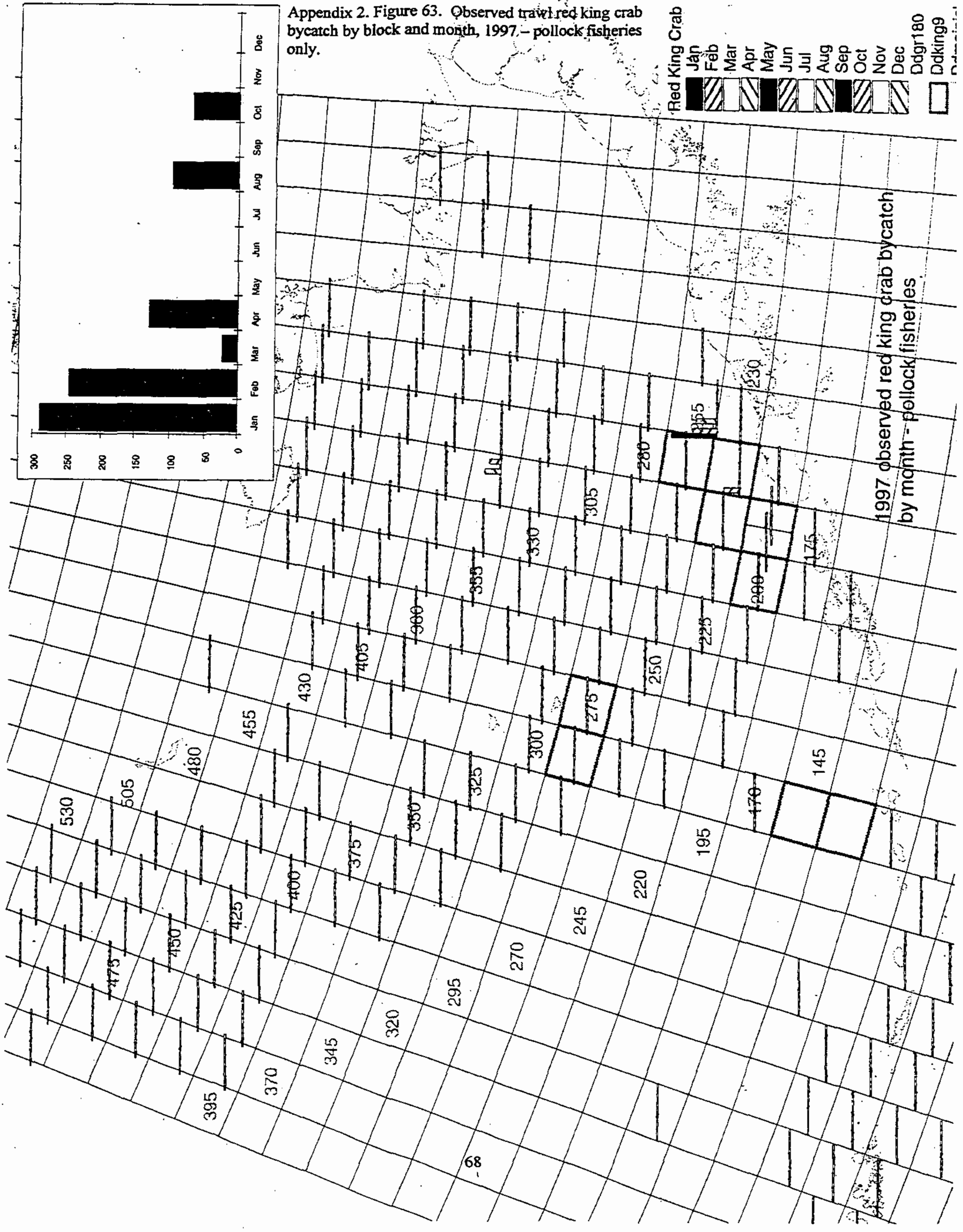
Appendix 2. Figure 61. Observed trawl bairdi crab bycatch by block and month, 1997 – pollock fisheries only.



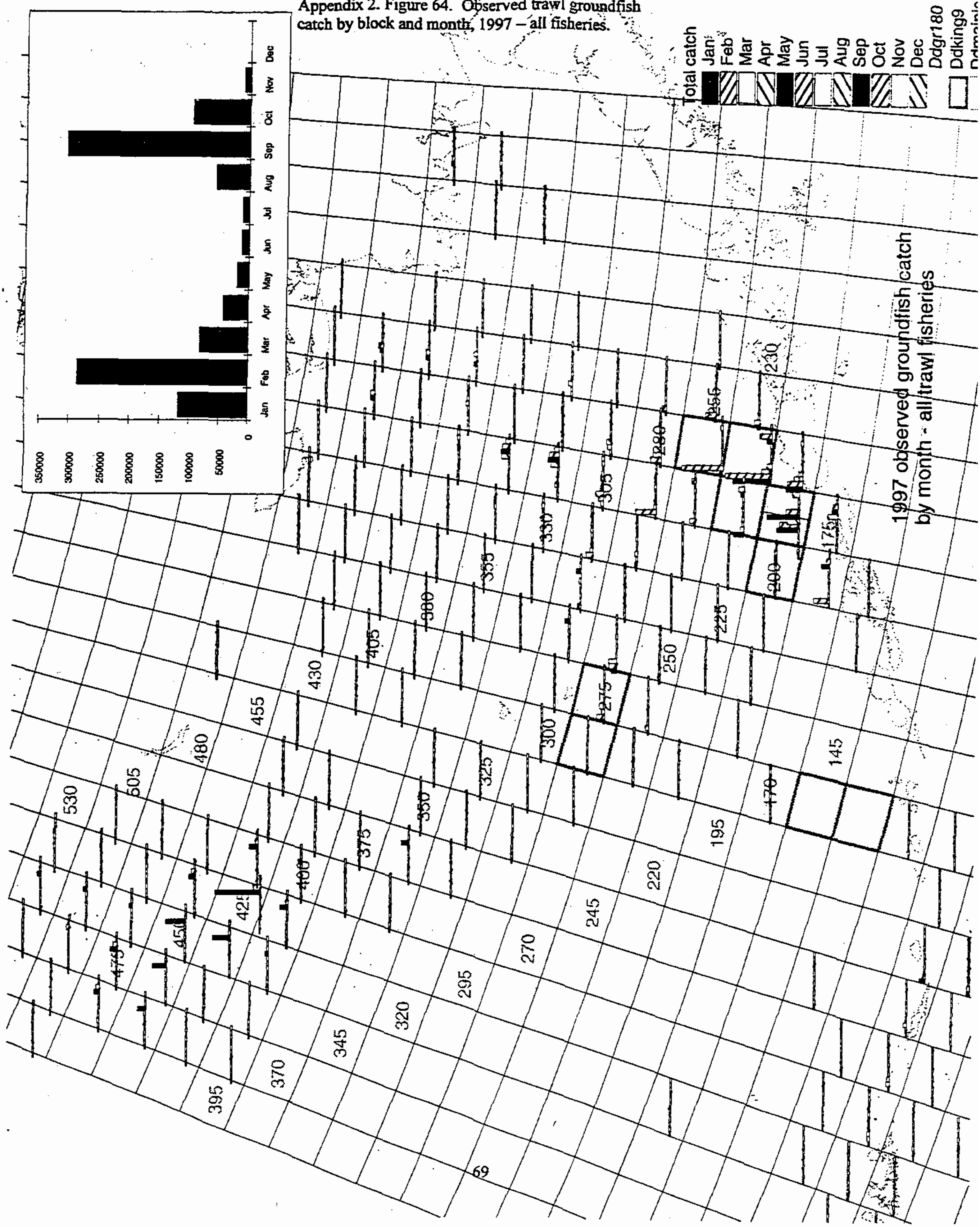
Appendix 2. Figure 62. Observed trawl opilio (snow) crab bycatch by block and month, 1997 – pollock fisheries only.



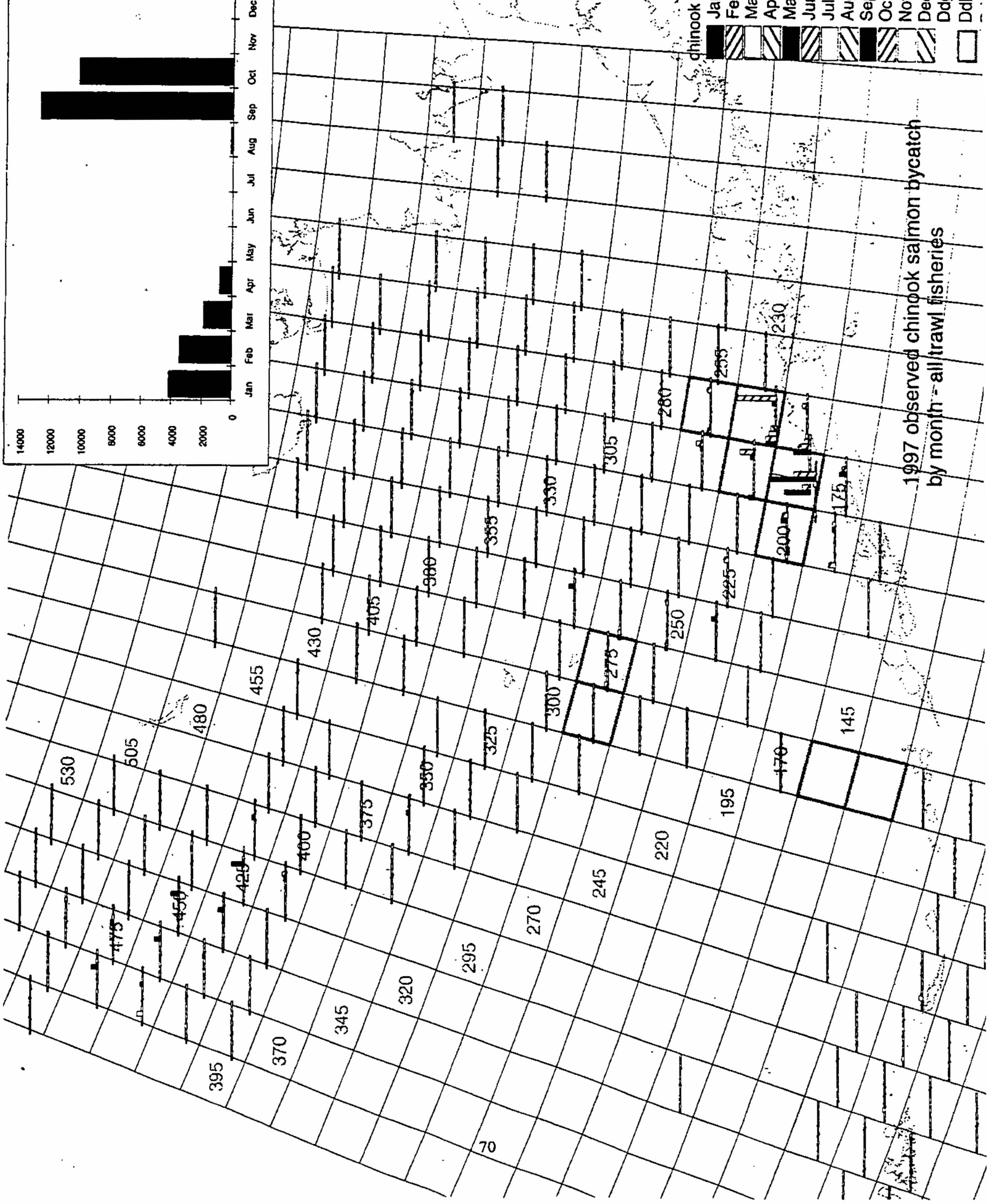
Appendix 2. Figure 63. Observed trawl red king crab bycatch by block and month, 1997 – pollock fisheries only.



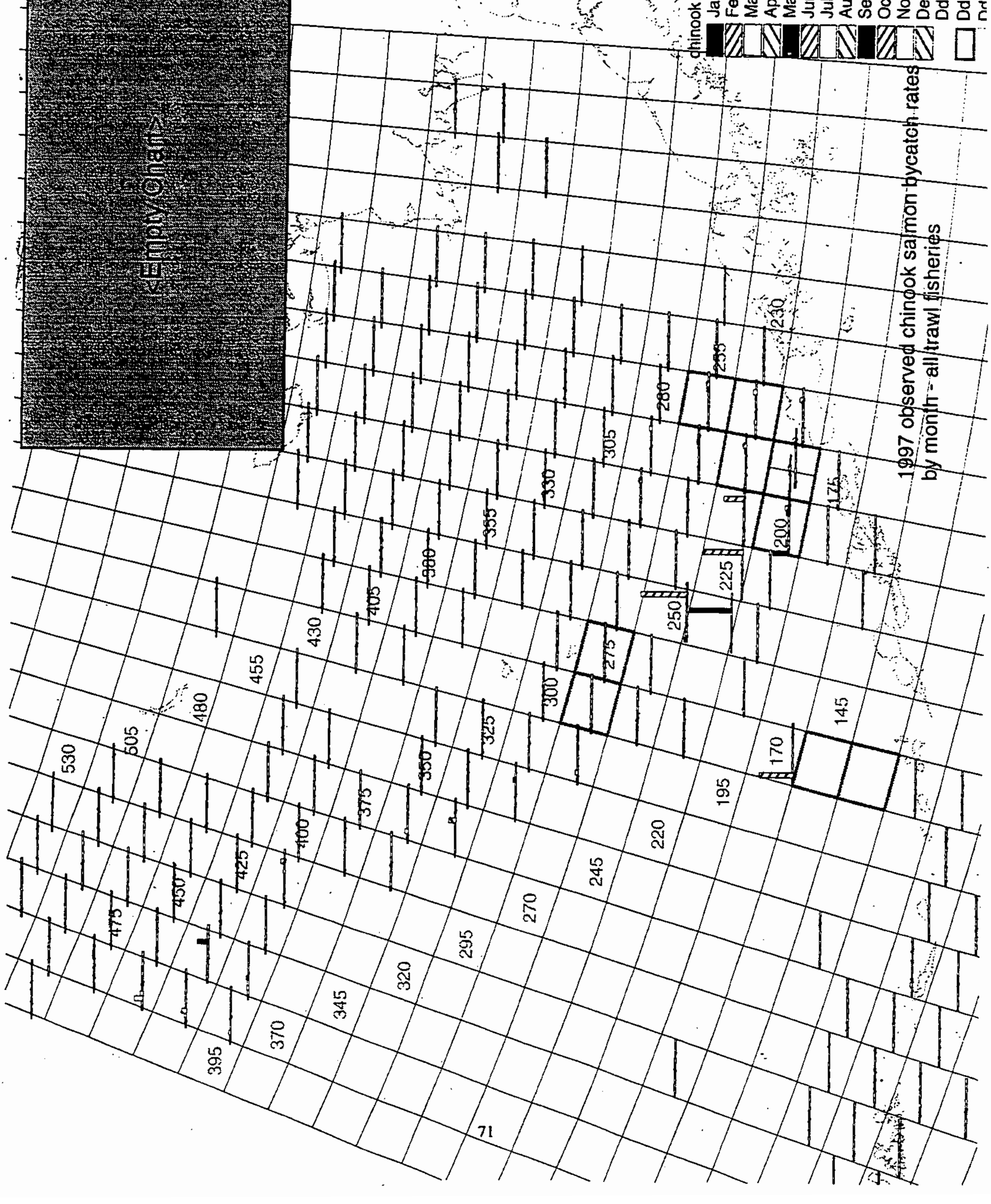
Appendix 2. Figure 64. Observed trawl groundfish catch by block and month, 1997 – all fisheries.



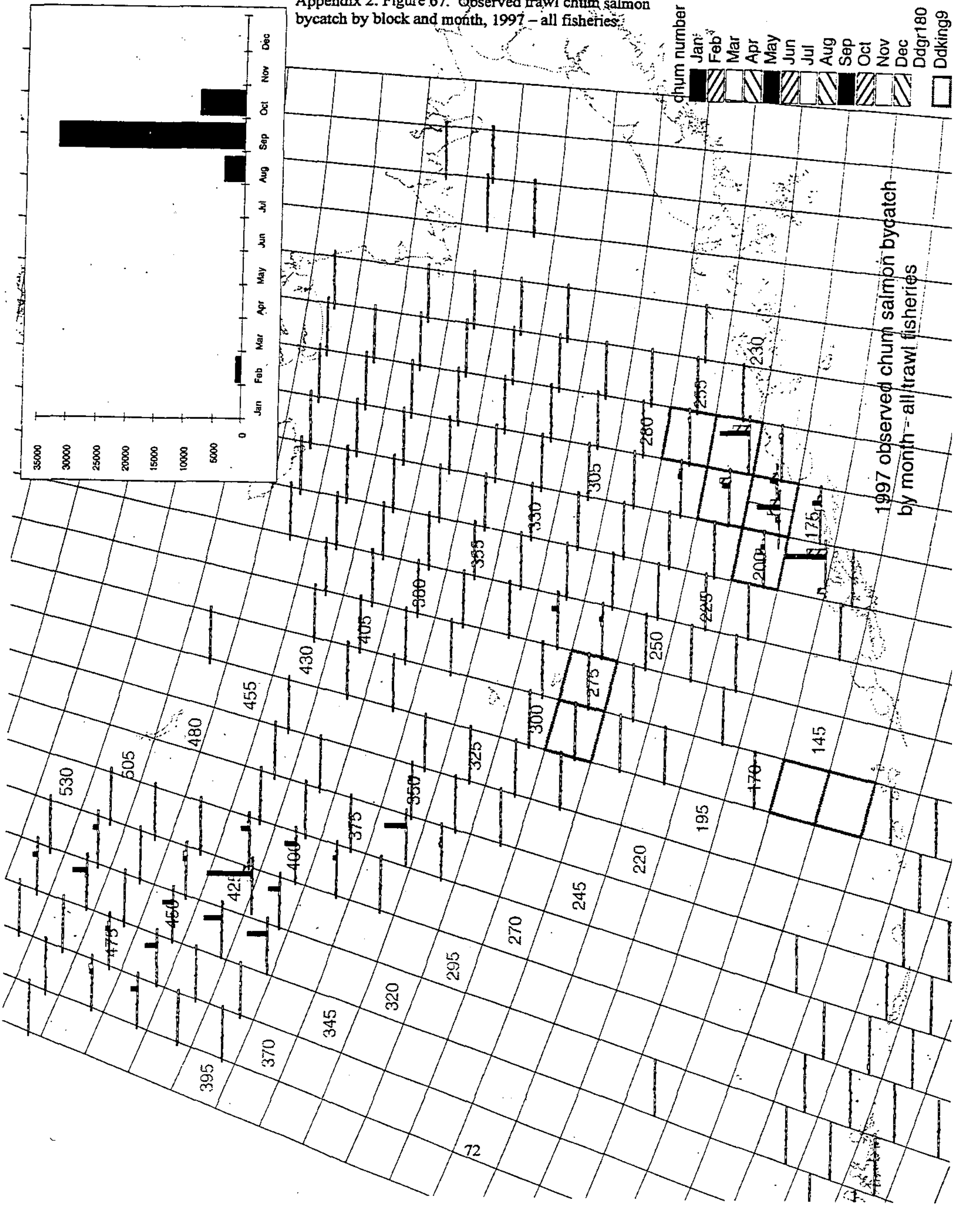
Appendix 2. Figure 65. Observed trawl chinook salmon bycatch by block and month, 1997 – all fisheries.



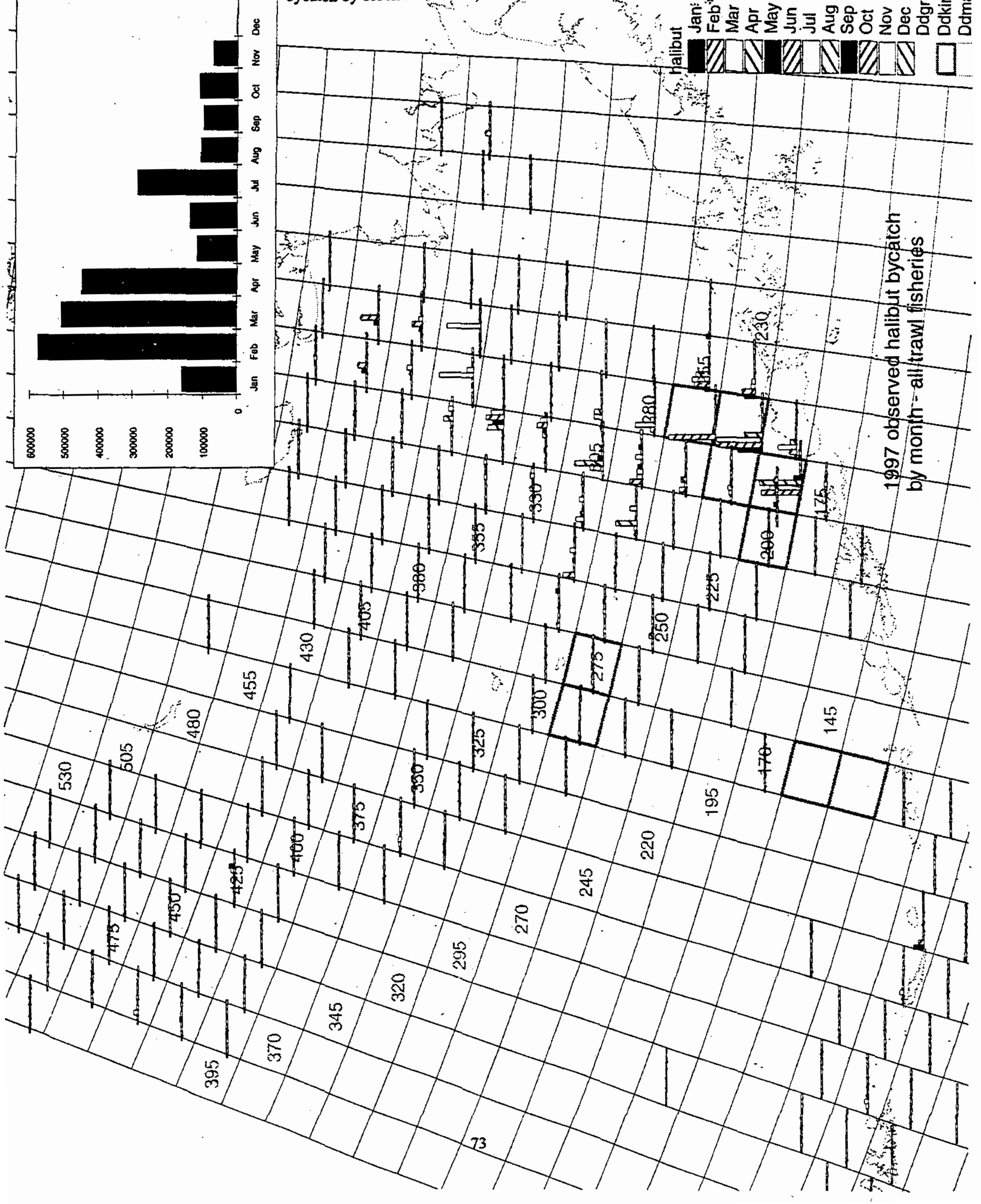
Appendix 2. Figure 66. Observed trawl chinook salmon bycatch rates by block and month, 1997 – all fisheries.



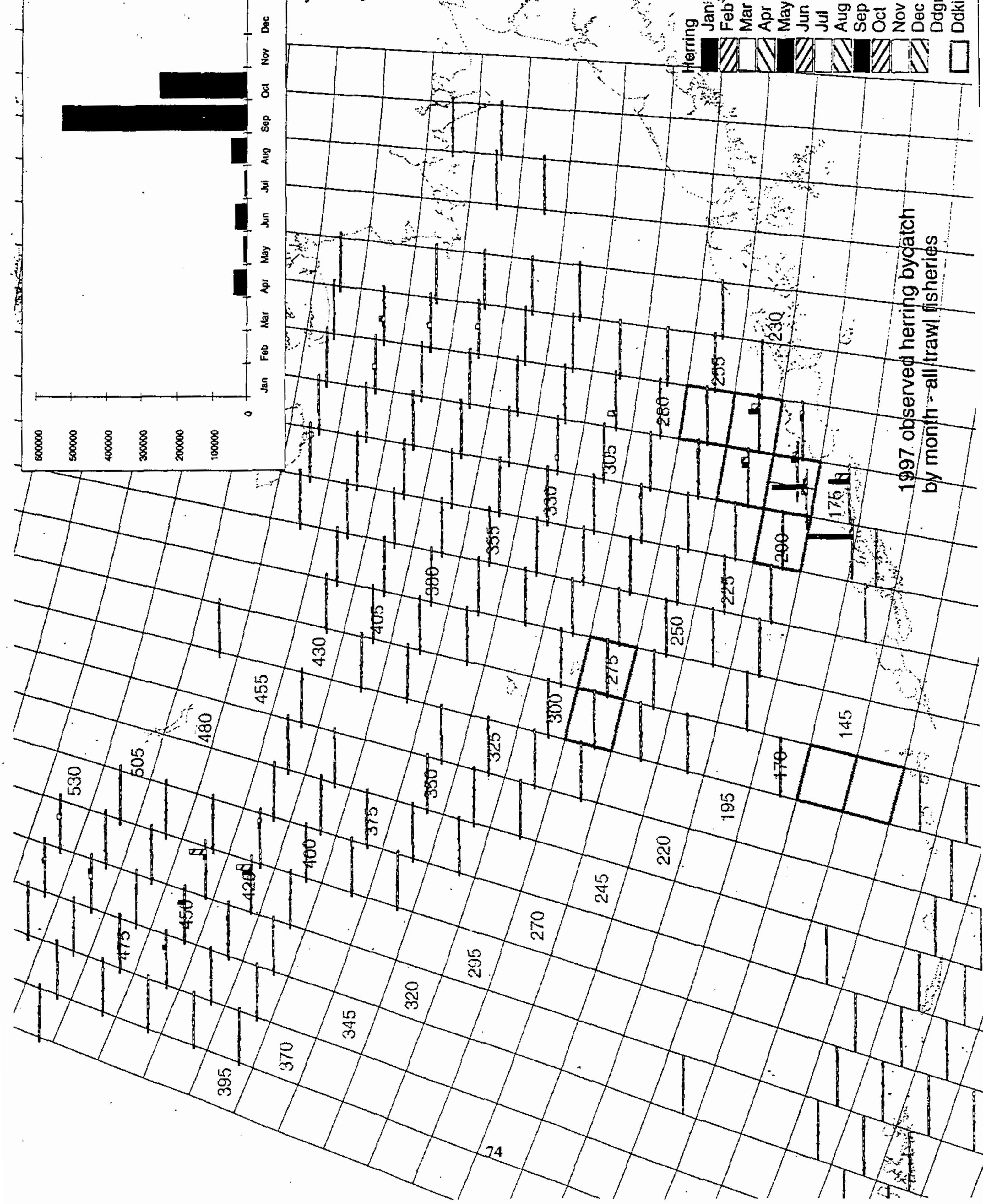
Appendix 2. Figure 67. Observed trawl chum salmon bycatch by block and month, 1997 – all fisheries.



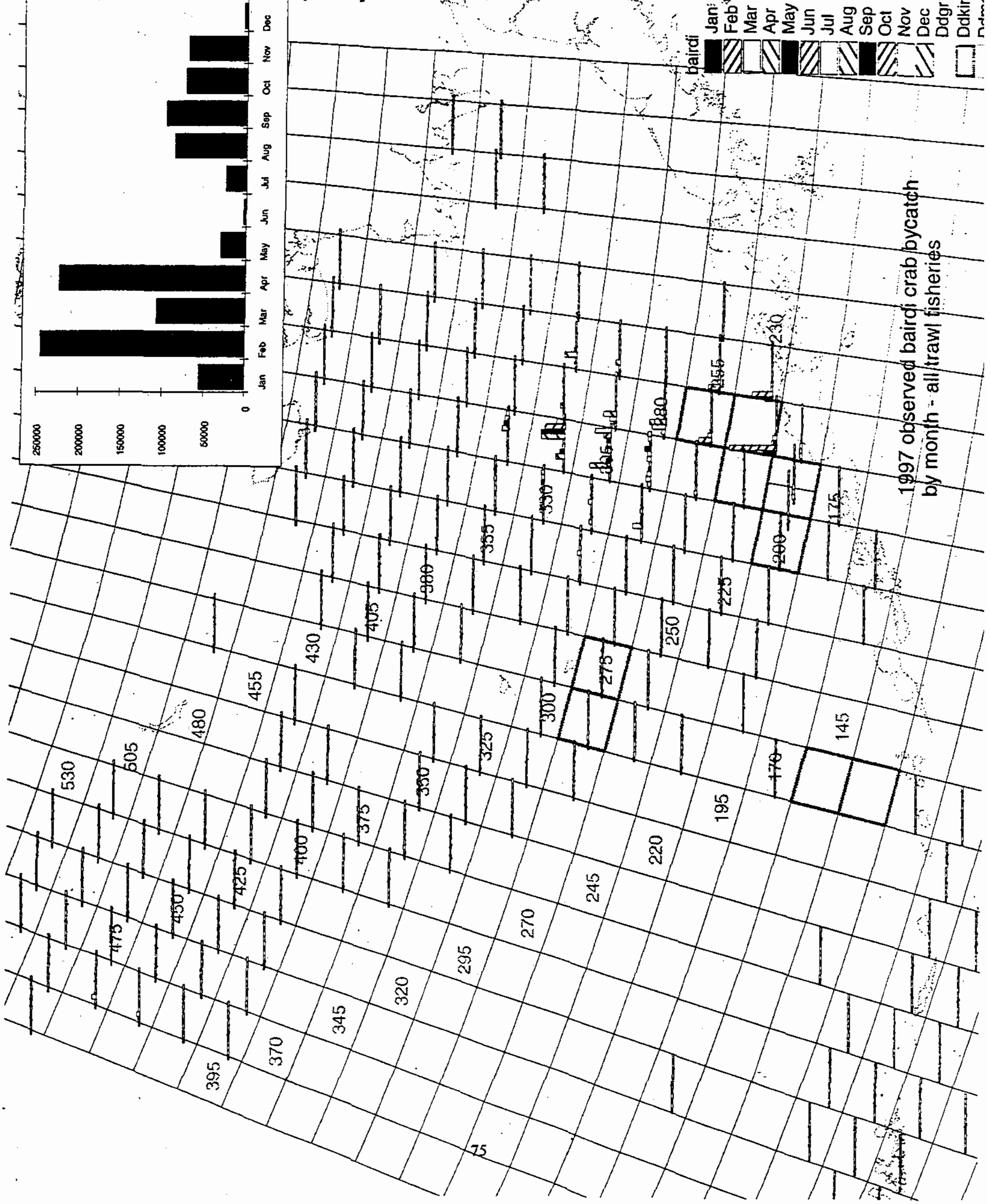
Appendix 2. Figure 68. Observed trawl halibut bycatch by block and month, 1997 – all fisheries.



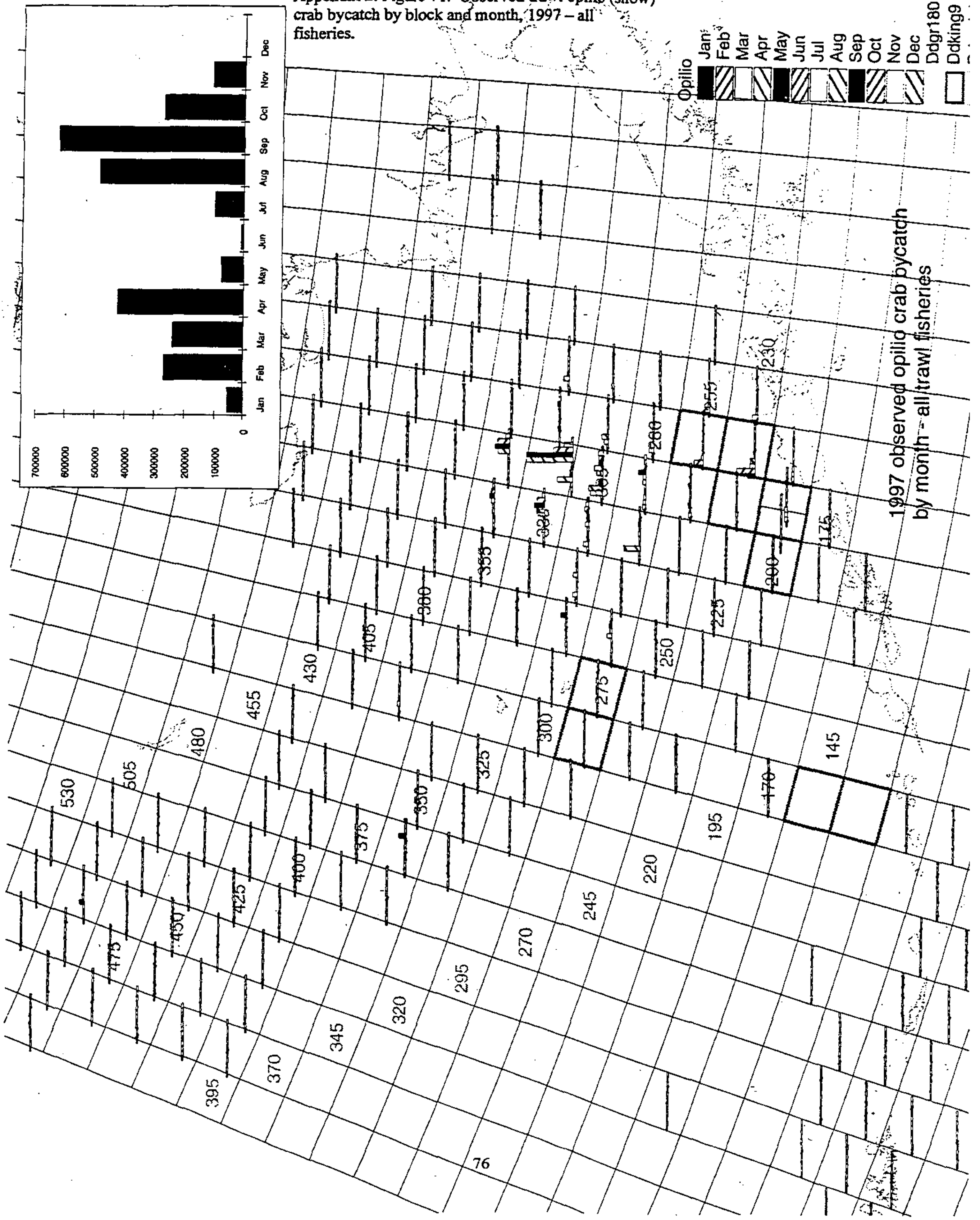
Appendix 2. Figure 69. Observed trawl herring bycatch by block and month, 1997 – all fisheries.



Appendix 2. Figure 70. Observed trawl bairdi crab bycatch by block and month, 1997 -- all fisheries.



Appendix 2. Figure 71. Observed trawl opilio (snow) crab bycatch by block and month, 1997 – all fisheries.



Appendix 2. Figure 72. Observed trawl red king crab bycatch by block and month, 1997 – all fisheries.