AGENDA D-2
JULY 1983

MEMORANDUM

TO: Council, SSC and AP Members

FROM: Jim H. Branson
Executive Director

DATE: July 19, 1983

SUBJECT: Herring FMP

ACTION REQUIRED

(1) Final approval of FMP and associated documents (in supplemental file)
(2) 1983 season update under Agenda B-2
(3) Report by Vidar Wespestad and Steve Fried

BACKGROUND

The Council has received three drafts of the Bering/Chukchi Sea Herring FMP in the last few months. The first of these (May 1983) was basically an update draft of the 1982 version and included the management measures and OY formula adopted by the Council last year. The SSC recommended some wording changes and clarifications which were incorporated into a July draft which was mailed to you in June. These changes included (1) combining and expanding the management objectives; (2) modifying the procedure for determining the winter apportionment of OY; (3) clarification of the procedures for determining and releasing the apportionments; and (4) general cleanup and clarification throughout the draft. All changes from the May draft are underlined.

The second July draft contains the Prohibited Species Catch (PSC) provisions for foreign vessels as suggested by NMFS. This draft is based on the earlier July draft and the changes from that July draft are the only ones underlined. The PSC draft includes the following provisions that differ from earlier drafts: (1) no directed or incidental catch retention is allowed; (2) clarification that foreign vessels may buy and retain joint venture herring (directed and incidental); (3) AIC is included in OY; (4) major amendment of the BS/AI Groundfish FMP is no longer needed; and (5) minor cleanup/clarification of earlier July draft.

The Council has been provided copies of a Regulatory Issues Paper which will be the primary basis for the RIR/RFA when the Council makes its final decision.

The FEIS has been modified to include the recent alternatives considered by the Council. Final work on these two documents will be completed by the September meeting.

The draft proposed regulations for the PSC version have been prepared by NOAA General Counsel. Portions of the regulation package are still being drafted, but the substantive management measures are ready for your review and approval.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 1668
Juneau, Alaska 99802

APR 19 1983

April 15, 1983

To: Members of the North Pacific Fishery Management Council

Feeling that we had not provided adequate background for my motion at the last Council meeting regarding conversion of the Bering Sea herring allowable incidental catch (AIC) to a prohibitive species catch (PSC), I would like to provide some further information:

(1) Presently, incidental catches of herring taken by foreign fishing vessels in the Bering Sea cannot be retained for future sale because herring are a prohibited species as a result of the court case Napoleon vs. Klutznick, 1980. Retention of herring on foreign vessels is clearly a violation.

(2) In recent years, U.S. processors have relayed to the Council and NMFS allegations from reportedly reliable Japanese sources that substantial quantities of illegally taken Bering Sea herring are being marketed in Japan. In 1981, the amount cited was 30 thousand mt; in 1982, 50 thousand mt. We have just completed an analysis of foreign vessel check-in check-out data and other information which suggests these figures are too high. We do accept, however, the probability that some herring are illicitly taken and retained in the FCZ. Indeed, the Japanese Fishery Agency, which rarely inspects landings, has reported finding herring aboard three trawlers that were offloading their catch in Japan.

(3) For other species of great interest to domestic fisheries, i.e., salmon, halibut, and crab, we are in the process of setting a specific PSC under Amendment No. 3 to the Bering Sea/Aleutian Islands Groundfish FMP. Due to high domestic interest in Bering Sea herring, it appears appropriate to treat the incidental catch of herring in the same manner.

(4) Should we continue to view the herring incidental catch only as an "allowable" catch (AIC), we will be authorizing retention by foreign trawlers and subsequent marketing of this catch. This seems incongruous when our FMP denies domestic trawlers an offshore fishery unless a surplus exists following the inshore fishery.

(5) Our Enforcement staff argues forcefully that not specifying herring as a PSC will deny them an essential tool in their efforts to assure that herring remain only an incidental and not a targeted catch. Allowing retention will free foreign trawlers to capitalize

on catch opportunities that may develop at times when U.S. observers or enforcement activities are not present. Such continuous monitoring will always be especially difficult during the winter period in the central and northern Bering Sea when herring are most available. If retention is legal, the finding of processed herring during a Coast Guard boarding obviously would not be a violation. The possibility of encountering a "rotating" allowable incidental catch quantity, with herring regularly offloaded onto cargo vessels, is a serious concern.

We consider this issue so important I will seek to touch base with Council members before the next meeting to answer any questions you might have regarding it. If appropriate, I will again move at the May meeting that the herring incidental catch be specified as a PSC. This is a motion that failed for a lack of a second at our last meeting and, as before, I would not be proposing that it apply to U.S. fishermen.

Sincerely yours,

Bob

Robert W. McVey
Director, Alaska Region

AGENDA ITEM D (2)

PRODUCTIVITY OF PACIFIC HERRING (*Clupea harengus pallasi*) IN THE EASTERN BERING SEA UNDER VARIOUS PATTERNS OF EXPLOITATION

A REPORT TO THE NORTH PACIFIC FISHERIES MANAGEMENT COUNCIL

JULY 1983

PREPARED BY:

STEPHEN M. FRIED, ADF&G, AND

VIDAR G. WESPESTAD, NMFS

This report is based on an invited paper presented at the International Herring Symposium held in honor of the 75th anniversary of the Pacific Biological Station, Nanaimo, British Columbia, Canada, 20-22 June 1983. Results and conclusions contained herein are preliminary and have not yet been critically reviewed by other authorities. A revised draft of this paper will be sent to Dr. J. R. Brett, Special Editor of the Symposium, by 1 September 1983 for review and possible inclusion within a Special Edition of the Canadian Journal of Fisheries and Aquatic Sciences to be published in 1984.

Productivity of Pacific Herring (Clupea harengus pallasi) in the Eastern Bering Sea under Various Patterns of Exploitation

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Pacific herring (Clupea harengus pallasi) is a major food source for western Alaska native people and has been commercially exploited in the eastern Bering Sea since the early 1900's. Commercial harvest were small and localized in coastal waters until foreign factory fleets located and developed a fishery on wintering herring concentrations in the early 1960's. Harvests peaked near 150,000 t in the early 1970's and then declined along with catch per unit effort. Foreign harvests were eliminated following establishment of the US 200 mile Fishery Conservation Zone. In recent years a fishery has developed in State of Alaska coastal waters which harvests herring for sac roe (egg skeins) during the spring spawning period. Proposals have been put forth by trawl fishermen to re-establish a food and bait fishery within Federal waters. Development of offshore mixed stock fisheries has been opposed by inshore commercial and subsistence users who fear that stocks will be overexploited. While both State and Federal managers have agreed to give subsistence users and inshore domestic commercial fishermen top priority, they

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have been unable to agree upon plans for dealing with potential offshore commercial harvests. In this paper we present results of a computer model which we developed to examine effects of various fishing patterns upon herring productivity and yield. Within our model MSY is achieved at an exploitation rate (E) of 0.3 (i.e. harvest of 30% of total spawning biomass). However, since stocks still appear to be below MSY biomass and since productivity and yield drop sharply at E values greater than 0.3, we suggest that an E of 0.2 be maintained under current conditions. This will result in a potential loss in yield of only 7% from an E of 0.3, but will allow a 52% increase in spawning biomass. Four fishing patterns in which both discrete and mixed stock fishery removals were allowed to occur were also examined. During years in which inshore fisheries fail to harvest 20% of available spawning biomass, an offshore allocation of up to 10,000 t could be permitted with minimal risk to damaging the reproductive potential of small spawning. However, results indicated that mixed stock fisheries should be restricted to lower levels than would be appropriate for fisheries targeting on discrete stocks to avoid risks of overharvesting some stocks.

Key words: Pacific herring, Clupea harengus pallasi; stocks; production and yield; population dynamics; computer model; eastern Bering Sea fisheries

Although Pacific herring, Clupea harengus pallasi, have been harvested for food by people living in eastern Bering Sea coastal villages since at least 500 BC (Hemming et al. 1978), development of large scale commercial fisheries did not begin until the twentieth century. The first commercial fisheries occurred in Norton Sound (1909) and off Unalaska Island (1928) (Rounsefell 1929). Lack of demand kept total annual harvests low (3 - 2,700 t), and these fisheries disappeared by the 1940's (Wespestad and Barton 1981). Beginning in 1959, Soviet trawl vessels, joined in later years by Japanese trawl and gillnet vessels, began to harvest large quantitites of herring in eastern Bering Sea offshore waters. Annual harvests reached a peak of 146,000 in 1970 and then declined along with catch per unit of effort. Offshore herring fishing was eliminated in 1980 when herring was made a prohibited species within the Fishery Conservation Zone. As foreign offshore herring harvests declined, inshore domestic harvests rose from an annual mean of less than 100 t during 1967-1976 to 15,000 t during 1977-1982. Most of the domestic harvest has been taken for sac roe (egg skeins) (25,355 t in 1982) during the spring spawning migration of herring; some has been taken for other food uses and bait (3,243 t in 1982) during the summer. Additionally, a herring spawn on kelp harvest (rockweed kelp, Fucus sp) has developed along with sac roe fisheries (141 t in 1982). Total value of these harvests to U.S. fishermen has risen from less than $1 million in 1977 to over $9 million in 1982.

Due to the limited information available on population biology of eastern Bering Sea herring, and in view of stock collapses which have commonly plagued herring fisheries in other parts of the world (see e.g. Cushing 1975; Blaxter and Hunter 1982 and references therein), much controversy surrounds management practices. Inshore fisheries, regulated by the State of Alaska, have been limited to a maximum exploitation rate of 20% of available spawning biomass for sac roe harvests, while quotas have been established for summer food and bait harvests (3,200 t) and spring spawn on kelp harvests (10% of available kelp standing crop). Offshore herring fisheries, pending development of a management plan by the U.S. Federal Government, have been prohibited, although about 2,000 t of herring are taken incidentally during groundfish trawl fisheries. Opponents of offshore fisheries contend that eastern Bering Sea herring stocks are already fully utilized by inshore commercial and subsistence users and that offshore fisheries present the added risk of fishing upon unknown mixtures of spawning stocks. Proponents of offshore fisheries counter that assessment techniques and exploitation rates used for inshore fisheries are overly conservative (i.e. herring stocks are not being fully utilized) and too much of the harvest is allocated to the sac roe fishery (i.e. markets for other herring products need to be developed).

The purpose of this study was to determine effects of various exploitation rates on biomass and yield of eastern Bering Sea herring stocks and to examine consequences of mixed stock fisheries. Specific objectives were: to present results obtained from a stochastic simulation model; to determine whether the model's behavior was consistent with available information; to evaluate current and proposed management strategies within the context of these results. No attempt was made to simulate density dependent or environmental effects upon growth and natural mortality rates or sexual maturity schedule within the model. Previously, Wespestad and Francis (1980) used a deterministic model, in which complete randomness was assumed for stock distribution and fishery removals, to examine effects of mixed stock harvests on eastern Bering Sea herring. They concluded that exploitation rates would be proportional to individual stock abundance.

Infomation Used in Developing the Model

STOCK COMPOSITION AND DISTRIBUTION

Six spawning groups of herring have been recognized for management purposes by the State of Alaska; Togiak, Security Cove, Goodnews Bay, Nelson Island, Cape Romanzof and Norton Sound (Fig. 1). Aerial survey assessments of these spawning groups during 1978-1982 indicated that Togiak comprised the largest group of spawners each year, averaging 82% of total estimated spawning biomass (Fried et al. 1982a). Security Cove, Goodnews Bay, Nelson Island, Cape Romanzof and Norton Sound averaged 3%, 2%, 3%, 2% and 8%, respectively. Although electrophoretic studies failed to demonstrate significant genetic differences among these spawning groups (Grant 1981), consistent differences in growth patterns among these groups have been found (Walker and Schnepf 1982; Rowell 1981; Barton and Steinhoff 1980; also see Age and Growth section below). Therefore, each of the six spawning groups were assumed to be valid stocks for the purposes of the present study. Other spawning groups of herring do occur along the Alaska Peninsula and Aleutian Islands (Warner and Shafford 1977; Wespestad and Barton 1981). However, their current status has not been well documented, and they were excluded from consideration within the present study.

Winter concentrations of herring occur northwest of the Pribilof Islands, between 57-59 N. lat., and 170-175 E. long. (Shaboneev 1965) (Fig. 1). Spawning stock affinities of herring on the winter grounds have not been determined. It is possible that at least some herring which spawn in Norton Sound may remain inshore throughout the year, since herring have been caught through the ice and have been found in seal stomachs in that area during winter (Barton 1978). Herring leave the winter grounds in late March to travel inshore to spawning grounds (Shaboneev 1965; Dudnik and Usoltsev 1964). Spawning occurs along the coast from mid-April until early July (Wespestad and Barton 1981). After spawning, herring remain within coastal waters to feed (Rumyantsev and Darda 1970). By August concentrations of herring occur off Nunivak Island, in the north, and Unimak to Unalaska Island, in the south (Dudnik and Usoltsev 1964; Rumyantsev and Darda 1970). (Fig. 1). Recent studies, using scale pattern analysis techniques, have shown that herring harvested in the Unalaska Island area during late summer probably belong to spawning stocks from Togiak, Security Cove, Goodnews Bay and Nelson Island, as well as Port Moller (Walker and Schnepf 1982). Herring from Cape Romanzof and Norton Sound were either not present, or present in low numbers. Spawning stock affinities of herring moving past Nunivak Island on their way to the winter grounds are not known.

AGE AND GROWTH

Herring usually first enter eastern Bering Sea commercial catches between the ages of three to five years (Wespestad and Barton 1981; Fried et al. 1982b and c). Herring older than nine or 10 years are uncommon in commercial and survey catches, although some may reach a maximum age of at least 15 years. Within our model herring reached a maximum age of 10 years.

Mean size at each age decreases for eastern Bering Sea herring spawning stocks located progressively northward from Togiak (Barton and Steinhoff 1980; Fried et al. 1982b and c). However, comparisons of von Bertalanffy age-length growth curves (Ricker 1975) for these six stocks, using the least squares technique of Kappenman (1981), revealed that only two different curves could be used: one for the southern stocks (Togiak, Security Cove and Goodnews Bay) and another for the northern stocks (Nelson Island, Cape Romanzof and Norton Sound) (Fig. 2). Age specific lengths computed from the two von Bertalanffy curves were converted to weights using a weight-length regression (Ricker 1975). A single weight-length equation was calculated for all spawning groups, since geographic trends were not evident (Fig. 3). Seasonal changes in growth rate were not simulated in our model, since most commercial harvests under present and proposed management regimes would occur when herring were at or near maximum age specific weights (i.e. spring sac roe and winter trawl harvest periods). Growth was increased uniformly in quarterly incrments each year so that herring reached maximum age specific weight in the spring of each year, prior to spawning (Fig. 4).

NATURAL MORTALITY

Little information on natural mortality rates is available for eastern Bering Sea herring. Wespestad (1982), using the Alverson and Carney (1975) procedure, estimated average instantaneous natural mortality (M) for Bering Sea herring to be 0.39, only slightly higher than the 0.36 M value obtained for British Columbia herring by Schweigert and Hourston (1980). However, age specific M values calculated from catch data (e.g. 0.15 for age 4 to 0.36 for age 9) (Fig. 4) were lower than those available for either Brtish Columbia (e.g. 0.43 for age 4 to 1.18 for age 9) (Tester 1955; Taylor 1964) or Gulf of Alaska (e.g. 0.20 for age 4 to 0.85 for age 9) (Skud 1963) herring. For most of our simulations Wespestad's (1982) age specific M values were used for all spawning stocks (Fig. 4). However, to test sensitivity of the model's behavior to changes in M, some simulations were done with a constant M of either 0.30 (slightly higher than the mean age specific rate of 0.27) or 0.39 (the highest estimated M value for these stocks).

SEXUAL MATURITY

Sexual maturity of eastern Bering Sea herrng coincides with recruitment into sac roe fisheries. Although some herring reach maturity by two years of age, most do not mature until they are three to five years old (Naumenko 1979; Wespestad 1982). Data from 1959-1977 offshore herring harvests indicate that recruitment into that fishery also coincided with sexual maturity since few age one and two year old herring were caught. The mean maturity schedule observed during 1959-1977 was used for all spawning stocks within our model (Fig. 4).

STOCK-RECRUITMENT RELATIONSHIP

Data from cohort analysis (Wespestad 1982) did not show a significant relationship between spawning stock and recruitment when fit by a Ricker (1975) curve (ANOVA, P>0.05). We assumed that this was due to the overwhelming importance of environmental factors in determining year class strength, as has been found in studies of other Pacific (Skud 1959; Taylor 1964) and Atlantic (Illes and Sinclair 1982) herring, C. harengus harengus, populations.

Recruitment was generated in our model using stochastic procedures to simulate environmental effects. The lowest estimated total spawning biomass obtained from cohort analysis (80,000 t) (Wespestad 1982) was used as a threshold level: below this point recruitment was set equal to spawning stock size; above this point recruitment was equal to total mean recruitment (79,600 t). Threshold levels and mean recruitment values for each of the six spawning stocks were calculated by apportioning total estimated values from cohort analysis (Wespestad 1982) according to mean stock abundance (Table 1). A covariance matrix, representing recruitment association among stocks, and random normal deviates were used to generate stochastic recruitment values. The covariance matrix (computed from specified values of mean recruitment; the coefficient of variation of mean recruitment, 1.78; and correlation coefficients representing year class strength relationships between stocks) and random normal deviates were calculated using the procedure of Naylor (1966).

FISHERY SIMULATION CHARACTERISTICS

During sac roe and subsistence fishery simulations, catchability was assumed to be equal for all sexually mature herring. Harvests were taken prior to spawning, were considered to be instantaneous and preceded natural mortality for the spring quarter. All stocks except Nelson Island were subjected to sac roe fisheries. Nelson Island spawning herring were only subjected to a subsistence fishery.

During winter trawl fishery simulations, only sexually mature herring four years of age and older were made available for harvest. All stocks were assumed to be present on the winter grounds. Herring were placed into schools, consisting of individuals of the same age and stock, according to a gamma distribution (mean school size 100 t, minimum size 10 t). Each school was randomly assigned to one of 100 locations within a matrix according to a univariate normal distribution, since catch data shows biomass to be normally distributed on the winter grounds (Wespestad 1978). Fishing was started within the location containing the greatest herring biomass. One school was randomly selected and 20% of its biomass harvested. This procedure continued until the specified harvest was taken or 90% of the total biomass within each location was removed. Although simulated catch per unit of effort (mean approximately 20 t per trawl haul) was higher than that achieved historically by Soviet and Japanese vessels (3.5-8.5 t per trawl haul) (Shaboneev 1965; fishery observer data, Northwest and Alaska Fishery Center, NMFS), we felt these values were reasonable with presently available fishing gear and electronics.

Management Strategies Examined

Management of Alaska roe fisheries is based on applying exploitation rates (E) of 0.10 to 0.20 on discrete stocks. However, the rational for using this range of E values has not been investigated quantitatively. We used our model to examine effects of E values ranging from 0.00 to 0.60 on total yield and spawning biomass of eastern Bering Sea herring. Each experiment consisted of 20 replicatd 100 year simulations at a constant level of E. For each experiment E was incrementd by 0.10 for each stock except Nelson Island. This stock was harvested at an E of only 0.03 during all experiments to simulate subsistence removals. To begin each simulation the total population was set equal to that estimated by cohort analysis for 1978 (Wespestad 1982): total biomass 255,000 t; (one to three year old herring 40% of total population); spawning population 171,000 t.

Federal draft plans for an offshore mixed stock herring fishery (North Pacific Fishery Management Council 1983) base harvest levels upon performance of established inshore fisheries managed by the State of Alaska. Offshore harvests would only be considered when inshore fisheries fail to harvest available surplus herring. This amount is based upon a variable E calculated by the following equation:

$E = E_{MSY} [B/B_{MSY}]$, where

E_{MSY} = exploitation rate that achieves MSY,

B_{MSY} = spawning biomass that produces MSY, and

B = current estimated spawning biomass.

Values presently used for E_{MSY} and B_{MSY} are 0.20 (the maximum E allowed for inshore fisheries) and 244,000 t (based upon past offshore harvests), respectively. We examined effects of using a variable E on yield and spawning biomass in the same manner used for constant E: 20 replicated 100 year simulations for each case investigated, and initial population size and age structure set at the 1978 level. Three different cases were tested by substituting three pairs of E_{MSY} (0.20, 0.30 and 0.40) and B_{MSY} (obtained from simulations in which constant E values of 0.20, 0.30 and 0.40 were used) values into the above equation.

To investigate efforts of offshore mixed stock harvests on inshore catches and spawning biomass we assumed that all stocks were available to the winter trawl fishery and that the five smallest stocks (18% of total biomass) were always exploited at the presently accepted maximum rate of 0.20 during inshore sac roe fisheries. Surplus for harvest offshore was provided by decreasing sac roe exploitation rate on the Togiak stock to either 0.00 or 0.15. This provides a potential offshore allocation equal either to 20% or 5% of the Togiak spawning biomass. Four patterns of fishing were examined by replicating 100 years simulations 20 times for each pattern: 1) Togiak sac roe E= 0.00, offshore harvest = maximum of 10,000 t; 2) Togiak sac roe E = 0.15, offshore harvest = maximum of 10,000 t; 3) Togiak sac roe E = 0.00, offshore harvest = 20% Togiak spawning biomass 4) Togiak sac roe E = 0.15, offshore harvest = 5% Togiak spawning biomass. To begin each simulation the total population was set equal to that estimated for 1959: total biomass 1,446,000 t (one to three year old herring 89% of total population); spawning biomass 255,000 t.

Results and Discussion

BEHAVIOR OF THE MODEL

Without commercial removals mean total spawning biomass for the model was 791,041 t (sd. dev. 131,279 t) (Table 2, Figs. 7 and 8). Maximum yield was reached with a constant E of 0.30 where mean total spawning biomass was 248,812 t (sd. dev. 29,280 t) and mean total sac roe harvest was 95,716 t (sd. dev. 11,253 t). Both mean total spawning biomass and harvest declined sharply when E values exceeded 0.30. Similar results were obtained using a variable E calculated from specified values of E_{MSY} and B_{MSY}. Maximum yield occurred when E_{MSY} was set at 0.30. No significant differences (t-test, P>0.05) in mean yield were found between variable and constant exploitation schemes.

Simulations in which constant M values (greater than the mean of age specific M values) were used achieved maximum yield with a constant E of 0.20 (Table 3). Mean total sac roe yield at both constant M values tested was less than that achieved at similar E values when age specific M values were used.

Model results conform to historical trends of spawning biomass and exploitation rates for the fishery (Table 4). Estimated mean total spawning biomass during a period of low exploitation (1960-1966) was 1,166,000 t (sd. dev. 291,430t). Although this is about 1.5 times greater than the mean value from our model results from cohort analysis (Wespestad 1982) indicate that population structure was unusual during 1960-1966 due to presence of the extremely abundant 1957 year class. This year class was eight times greater than estimated mean annual recruitment of age one year herring, (mean 1.3 x 10^9 individuals; 1957 year class, 10.6 x 10^9. No other year class has since approached this abundance (Figure 9).

During the most intensive period of offshore exploitation (1968-1977) mean E was 0.33, but reached a maximum of 0.68 one year. Mean spawning biomass and harvest declined during this period as occurred during simulations with the model at E values greater than 0.30 (Tables 2 and 4). In more recent years (1978-1982) E has been below 0.3, and often below 0.2. However, populations have probably not yet recovered from previous high exploitation rates. Estimated mean total spawning biomass during 1968-1982 has been about 160,000 t.

EFFECTS OF MIXED STOCK HARVEST

To simulate effects of mixed stock harvests on individual spawning stocks and inshore harvest levels, we examined four combinations of inshore and offshore fishing patterns (Table 5, Figs. 10-13). Inshore sac roe and subsistence harvests were taken from discrete spawning stocks; the offshore food/bait harvest was taken from mixed stocks of mature herring. Probability of overharvesting individual spawning stocks (where overharvest is defined as E>0.3) was generally less than 0.06 when offshore fishing was limited to a 10,000 t maximum harvest (patterns I and II) or an amount equal to 5% of the Togiak surplus (pattern IV). In these cases mean sac roe and subsistence harvests for stocks other than Togiak were similar to those obtained when E = 0.2 and no mixed stock fishery occurred (Figs. 14-16). However, when no inshore harvest was taken from the Togiak stock and an amount equal to 20% of this spawning biomass was allocated offshore (pattern IV), effects upon other (smaller) spawning stocks were dramatic (Table 5, Fig. 13). Probability of overharvesting (E>0.30) these smaller spawning stocks increased to 0.78 or more for all stocks except Nelson Island, which had a probability of overharvest of 0.11. A marked overall decline in inshore harvests from those obtained when E = 0.2 and no mixed stock fishery occurred was also shown for these groups (Figure 17). Effects of offshore mixed stock harvests were always greatest for the smallest spawning groups which were already harvested at a constant inshore E of 0.2

EVALUATION OF HARVEST STRATEGIES

Although the computer model gives our best estimate of long term consequences of different harvest strategies, simulation results must be used with caution. Pacific herring lack strong density dependent regulatory mechanisms and are subject to large abundance fluctuations due to biotic and abiotic factors (Cushing 1981; Blaxter and Hunter 1982). Fishing may intensify or increase the possibility of stock declines. Since the model cannot be used to forecast events for a given year, management procedures must remain flexible to react to unforeseen abundance fluctuations.

Currently estimates of spawning stock abundance are made using aerial survey techniques and, while they cannot provide statistically precise estimates, appear to be the only cost effective, practical means of obtaining annual abundance information (Fried 1983). Although such estimates may be conservative, current values have usually been well below those which produced maximum yield within the model (Tables 2 and 4). It seems that stocks are still recovering from heavy exploitation which occurred during the peak of the foreign offshore trawl fishery (1968-1977). Therefore, although maximum yield within the model was obtained at an E of 0.30, it would be prudent to maintain the current maximum E of 0.20. This may allow stocks to regain their former abundance more quickly and provide a measure of protection against overharvest, while only decreasing mean harvests by 7% and increasing mean spawning biomass by 52% from levels obtained at an E of 0.30.

During years in which the inshore fisheries fail to harvest the Togiak group at an E of 0.20, an offshore harvest of up to 10,000 t could be allowed with minimal risk to other spawning groups. While a somewhat higher offshore harvest could be taken during some years, it is necessary to restrict offshore (and inshore) mixed stock fisheries to lower levels than would be appropriate for fisheries targeting upon discrete stocks, since the risk of overharvesting individual stock components increases with size of harvest (Table 5) (also see Illes and Sinclair 1982).

ALVERSON, D.L., AND M.J. CARNEY. 1975. A graphic review of the growth and decay of population cohorts. J. Cons. Int. Explor. Mer 36:133-143.

BARTON, L.H. 1978. Finfish resource surveys in Norton Sound and Kotzebue Sound. Final Rep. Alaska Marine Environmental Assessment Project. Alaska Dep. Fish and Game, Anchorage, AK 202 p.

BARTON, L.H. AND D.L. STEINHOFF. 1980. Assessment of spawning herring (Clupea harengus pallasi) stocks at selected coastal areas in the eastern Bering Sea. Alaska Dep. Fish and Game Informational Leaflet No. 187. 60 p.

BLAXTER, H.H.S., AND J.R. HUNTER. 1982. The biology of clupeiod fishes. Adv. Mar. Biol. 20:1-223.

CUSHING, D.H. 1981. Fisheries biology: a study in population dynamics. Univ. Wisconsin Press, Madison, WI.

DUDNIK, YU. I., AND E.A. USOLTSEV. 1964. The herring of the eastern part of the Bering Sea, p. 225-229. In P.S. Moiseev [ed.] Soviet fisheries investigations in the northeast Pacific. Part II. (In Russian. Trans. 1968. Israel Prog. Sci. Tansl. Avail. U.S. Dep. Comm., Natl. Tech. Inf. Serv., Springfield, VA.)

FRIED, S.M.F. 1983. Stock assessment of Pacific herring, Clupea harengus pallasi, in western Alaska using aerial survey techniques, p. 61-66. In K. Buchanan [ed.] Proceedings of the fourth Pacific coast herring workshop, October 7-8, 1981. Can. Manuscr. Rep. Fish. Aquat. Sci. No. 1700. 151 p.

FRIED, S.M., C. WHITMORE, AND D. BERGSTROM. 1982a. Pacific herring stocks and fisheries in the eastern Bering Sea, Alaska, 1982. Rep. to Alaska Bd. Fish. Alaska Dep. Fish and Game. 21 p.

1982b. Age, sex, and size composition of Pacific herring, Clupea harengus pallasi, from eastern Bering Sea coastal spawning sites, Alaska, 1981. ADF&G Tech. Data Rep. No. 78. 40 p.

1982c. Age, sex, and size composition of Pacific herring, Clupea harengus pallasi, from eastern Bering Sea coastal spawning sites, Alaska, 1982. ADF&G Tech. Data Rep. No. 79. 32 p.

GRANT, S. 1981. Biochemical genetic variation, population structure and evolution of Atlantic and Pacific herring. Ph.D. Thesis. Univ. Wash., Seattle, WA.

HEMMING, J.E., G.S. HARRISON, AND S.R. BRAUND. 1978. The social and economic impacts of a commercial herring fishery on the coastal villages of the Arctic/Yukon/Kuskokwim area. North Pacific Fishery Management Council Doc. 3, Anchorage, AK. 186 p.

ILLES, T.D., AND M. SINCLAIR. 1982. Atlantic herring: stock discreetness and abundance. Sci. 215:627-633.

KAPPENMAN, R.F. 1980. A method for growth curve comparisons. Fish. Bull. 79:95-101.

NAUMENKO, N.I. 1979. The state of stocks of eastern Bering Sea herring. Pacific Res. Inst. Fish. Oceanogr. (TINRO), Vladivostok, USSR. 15 p. (Unpubl.)

NAYLOR, T.H. 1966. Computer simulation techniques. John Wiley and Sons, Inc. N.Y. 352 p.

NORTH PACIFIC FISHERY MANAGEMENT COUNCIL. 1983. Bering-Chukchi Sea herring. Fishery management plan and final environmental impact statement. (Unpubl.)

RICKER, W.E. 1975. computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191:382 p.

ROUNSEFELL, G.A. 1929. Contribution to the biology of Pacific herring, Clupea pallasi, and the condition of the fishery in Alaska. Bull. U.S. Bur. Fish. 45:227-320.

ROWELL, K.A. 1981. Feasibility of scale pattern analysis techniques for stock identification and growth of Pacific herring (Clupea harengus pallasi) from four spawning locations of the eastern Bering Sea. Alaska Dep. Fish and Game, Juenau. 59 p. (Unpubl.)

RUMYANTSEV, A.I., AND M.A. DARDA. 1970. Summer herring in the eastern Bering Sea, p. 409-441. In P.A. Moiseev [ed.] Soviet fisheries investigations in the northeastern Pacific. Part V. (In Russian. Transl. 1972. Israel Prog. Sci. Transl. Avail. US. Dep. Comm., Natl. Tech. Inf. Serv., Springfield, VA.)

SCHWEIGERT, J.F., AND A.S. HOURSTON. 1980. Cohort analysis and mortality rates of the Barkley sound herring stock, 1972-1979. Can. Tech. Rep. Fish. Aquat. Sci. No. 960. 37 p.

SHABONEEV, I.E. 1965. Biology and fishing of herring in the eastern part of the Bering Sea, p. 130-154. In P.A. Moiseev [ed.] Soviet fisheries investigations in the northeastern Pacific. Part IV. (In Russian. Transl. 1968. Israel Prog. Sci. Transl. Avail. U.S. Dep. Comm., Nsatl. Tech. Inf. Serv., Springfield, VA.)

SKUD, B.E. 1963. Herring tagging experiments in southeastern Alaska. U.S. Fish. Bull. 63:19-32.

TAYLOR, F.H.C. 1964. Life history and present status of British Columbia herring stocks. Fish. Res. Baord. Can. Bull. 143:81 p.

TESTER, A.L. 1955. Estimation of recruitment and natural mortality rate from age composition and catch data in British Columbia herring populations. J. Fish. Res. Board Can. 12:649-681.

WALKER, R.V., AND SCHNEPF. 1982. Scale pattern analysis to estimate the origin of herring in the Dutch Harbor fishery. Final Rep. Alaska Dep. Fish and Game. Univ. Washington FRI-UW-8219, Seattle, WA. 21 p.

WARNER, I.M., AND P. SHAFFORD. 1977. Forage fish spawning surveys--southern Bering Sea. Alaska Marine Environmental Assessment Project. Completion Rep. Alaska Dep. Fish and Game, Kodiak. 59 p.

WESPESTAD, V.G. 1978. A review of Pacific herring studies with special reference to the Bering Sea. (Status of Stocks Task) Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA, Seattle, WA. (Unpubl.)

1982. Cohort analysis of catch data on Pacific herring in the eastern Bering Sea, 1959-1981. NOAA Tech. Mem. NMFS F/NWC-24. 18 p.

WESPESTAD, V.G., AND R. FRANCIS. 1980. Probability of overexploitation of individual herring stocks in a winter mixed stock fishery in the central Bering Sea. Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA, Seattle, WA. 5 p.

WESPESTAD, V.G., AND L.H. BARTON. 1981. Distribution, migration and status of Pacific herring, p. 509-525. In D.W. Hood, and J.A. Calder [ed.] The eastern Bering Sea shelf: oceanography and resources. Vol. I. U.S. Gov. Print. Office, Washington, D.C.

Table 1. Values used in a model to generate recruitment vectors for eastern Bering Sea Pacific herring spawning groups.

	Togiak	Security Cove	Goodnews Bay	Nelson Island	Cape Romanzof	Norton Sound	Total
	Spawning Group						
Mean Recruitment: billions of age 1 herring (biomass, t)	1.050 (65,264)	0.038 (2,388)	0.026 (1,592)	0.038 (2,388)	0.026 (1,592)	0.102 (6,367)	1.281 (79,591)
Critical Biomass (t)	65,600	2,400	1,600	2,400	1,600	6,400	80,000
Correlation matrix: year class strength between spawning groups — Togiak	1.0	0.9	0.9	0.9	0.8	0.8	
S. Cove		1.0	0.9	0.9	0.8	0.8	
G. Bay			1.0	0.9	0.8	0.8	
N. Island				1.0	0.8	0.8	
C. Romanzof					1.0	0.9	
N. Sound						1.0	

Table 2. Eastern Bering Sea Pacific herring sac roe yield and spawning biomass from computer simulations using different levels of constant and variable exploitation. Data results of 20 replicated 100 year simulations for each change in E and E_{MSY} examined.

sac roe exploitation rate	Spawning biomass (t) remaining after sac roe harvest: Mean	Sd. dev.	Range	Sac roe harvest (t): Mean	Sd. dev.	Range
E (constant proportion of spawning biomass removed)						
0.0	791,041	131,279	247,631-1,023,287	531 a/	83 a/	183- 679 a/
0.1	547,264	82,960	221,272- 705,141	59,010	8,898	23,910- 76,122
0.2	377,870	51,767	180,854- 471,237	88,915	12,205	43,071-115,814
0.3	248,812	29,280	143,969- 321,450	95,716	11,253	55,679-124,009
0.4	127,832	22,980	83,071- 179,749	68,818	14,209	41,365- 98,066
0.5	41,740	22,902	17,969- 130,151	22,171	22,114	1,919-121,033
0.6	24,571	14,713	15,620- 106,656	9,720	21,789	503-145,204
E_{MSY} (Variable proportion of spawning biomass removed based on different E_{MSY} values)						
0.2	324,817	25,862	209,475- 374,350	96,792	17,966	28,995-140,673
0.3	194,791	9,417	155,910- 216,837	102,319	15,783	46,077-140,425
0.4	84,809	4,209	64,440- 95,025	51,749	15,828	28,995-187,603

a/ Nelson Island stock exploited at constant rate of 0.03 in all cases to simulate subsistence harvest.

Table 3. Eastern Bering Sea Pacific herring sac roe yield and spawning biomass from computer simulations using two different values of constant natural mortality (M) and several levels of constant exploitation (E). Results of 20 replicated 100 year simulations for each change in E examined.

Sac Roe Exploitation Rate (E)	Spawning Biomass (t) Remaining After Sac Roe Harvest Mean	Sd. Dev.	Range	Sac Roe Harvest (t) Mean	Sd. Dev.	Range
			M = 0.30			
0.1	391,090	174,288	50,237-1,254,038	42,113	18,838	5,319-135,221
0.2	265,337	128,778	28,944- 907,412	62,169	30,496	6,518-214,163
0.3	150,330	95,385	4,860- 539,818	56,768	37,607	854-211,320
0.4	53,810	52,835	1,028- 34,076	25,877	31,305	82-198,140
			M = 0.39			
0.1	235,925	116,192	24,841- 814,276	25,360	12,539	2,617- 87,708
0.2	130,286	88,098	2,739- 492,306	30,123	20,896	300-116,220
0.3	44,772	49,110	519- 313,526	15,464	19,495	44-122,263
0.4	19,398	26,874	445- 162,811	7,663	16,413	14- 93,998

Table 4. Eastern Bering Sea Pacific herring spawning biomass and commercial fishery exploitation rates during 1960-1982. Spawning biomass estimates obtained from cohort analysis (Wespestad 1982) unless otherwise indicated. Total and spawning biomass exploitation rates (E_T and E, respectively) were calculated from catches summarized by Wespestad (1980) unless otherwise indicated.

Period	Area of Catch	Spawning Biomass Mean	Spawning Biomass Sd. Dev.	E_T Mean	E_T Range	E Mean	E Range
1960-1966	Offshore a/	1,166,000	291,430	0.01	0.01-0.03	0.02	0.01-0.04
1968-1977	Offshore b/	189,400	134,638	0.21	0.09-0.44	0.33	0.12-0.68
1978-1981	Inshore c/	166,750	7,228	0.11	0.09-0.13	0.15	0.12-0.18
1978-1982 d/	Inshore	161,540	68,472	not available		0.14	0.04-0.29

a/ Entire harvest offshore except 18 t in 1964.

b/ Less than 1% of total harvest inshore except 1977 when 12% inshore.

c/ Transition to total inshore harvest: 1978 and 1979, 31 and 38%, respectively, inshore; 1980-1982 entire harvest inshore.

d/ Data from ADF&G aerial assessments and inshore sac roe harvests. (Fried et al. 1982a).

Table 5. Probability of achieving various total annual exploitation rates (E) for eastern Bering Sea Pacific herring stocks subjected to four different fishing patterns simulated with the computer model. Results of 20 replicated 100 years simulations for each pattern examined. Spawning stocks used in the model were: Togiak (TOG), Security Cove (SC), Goodnews Bay (GB), Nelson Island (NI), Cape Romanzof (RO) and Norton Sound (NS).

Annual exploitation rate or quota for each fishery				Probability of obtaining various ranges of total annual exploitation rates						
Sac roe (E_R)		Subsistence (E_S)	Food/bait (t)	Range	Spawning Stock					
TOG	All others	(NI only)	All Stocks offshore	of E	TOG	SC	GB	NI	RO	NS
				Fishing Pattern I						
0.00	0.20	0.03	10,000 max.	<0.10	0.996	0.000	0.000	0.919	0.000	0.000
				0.10-0.19	0.004	0.000	0.000	0.073	0.000	0.000
				0.20-0.29	0.000	0.960	0.947	0.004	0.922	0.983
				0.30-0.39	0.000	0.032	0.046	0.003	0.062	0.013
				>0.39	0.000	0.008	0.007	0.001	0.016	0.004
				Fishing Pattern II						
0.15	0.20	0.03	10,000 max.	<0.10	0.000	0.000	0.000	0.884	0.000	0.000
				0.10-0.19	0.940	0.000	0.000	0.110	0.000	0.000
				0.20-0.29	0.060	0.933	0.922	0.006	0.894	0.973
				0.30-0.39	0.000	0.057	0.065	0.000	0.081	0.023
				>0.39	0.000	0.010	0.013	0.000	0.025	0.004

Table 5. Continued

Annual exploitation rate or quota for each fishery				Probability of obtaining various ranges of total annual exploitation rates						
Sac roe (E_R)		Subsistence (E_S)	Food/bait (t)	Range	Spawning Group					
TOG	All others	(NI only)	All Stocks offshore	of E	TOG	SC	GB	NI	RO	NS
				Fishing Pattern III						
0.00	0.20	0.03	entire	<0.10	0.000	0.000	0.000	0.020	0.000	0.000
			surplus	0.10-0.19	0.998	0.000	0.000	0.287	0.000	0.000
				0.20-0.29	0.002	0.129	0.174	0.583	0.216	0.075
				0.30-0.39	0.000	0.591	0.525	0.097	0.452	0.711
				>0.39	0.000	0.320	0.301	0.013	0.332	0.214
				Fishing Pattern IV						
0.15	0.20	0.03	entire	<0.10	0.000	0.000	0.000	0.656	0.000	0.000
			surplus	0.10-0.19	0.969	0.000	0.000	0.340	0.000	0.000
				0.20-0.29	0.031	0.922	0.885	0.004	0.865	0.978
				0.30-0.39	0.000	0.077	0.106	0.000	0.127	0.021
				>0.39	0.000	0.001	0.009	0.000	0.008	0.001

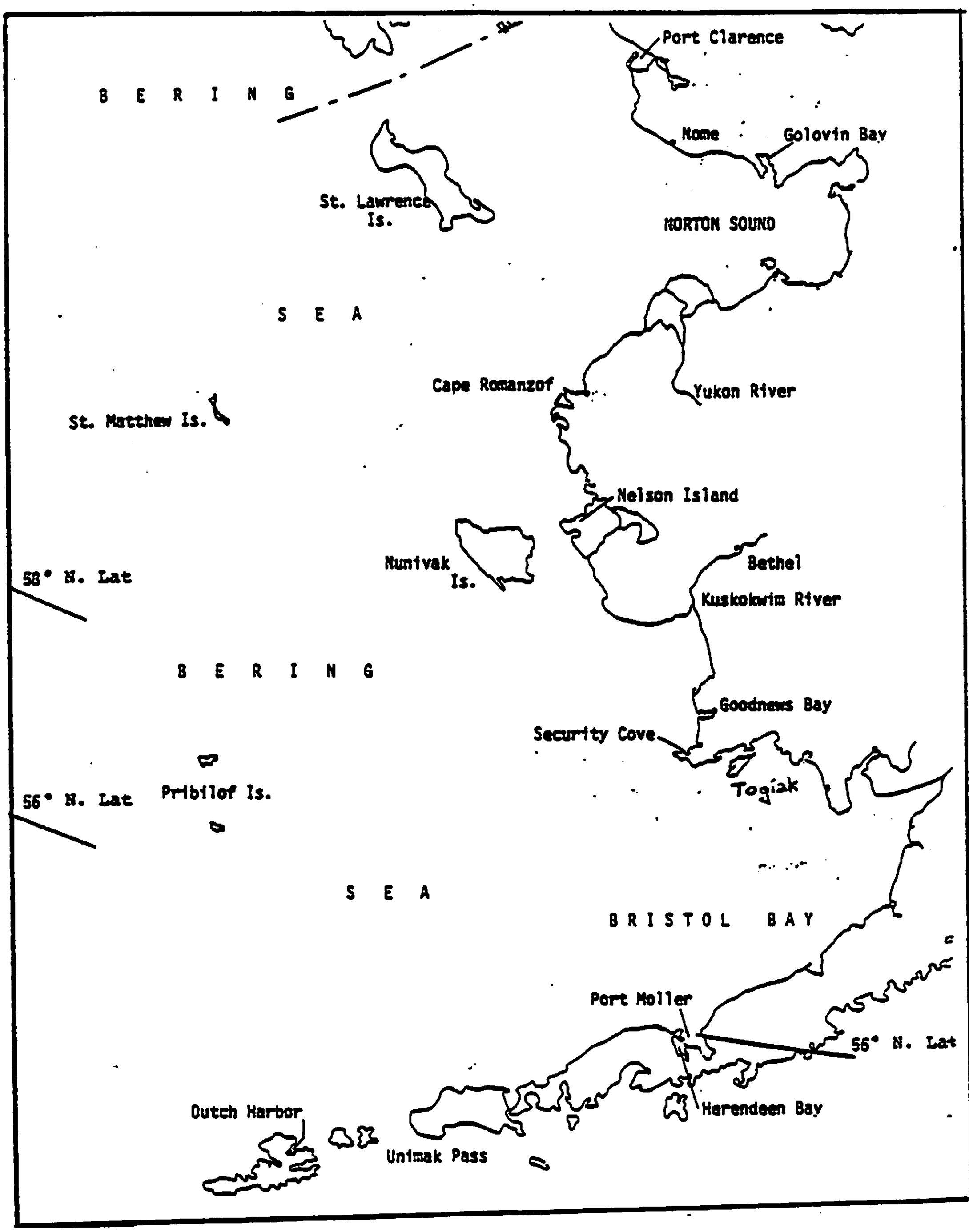


Fig. 1. Map of the eastern Bering Sea, Alaska, showing locations discussed in the text.

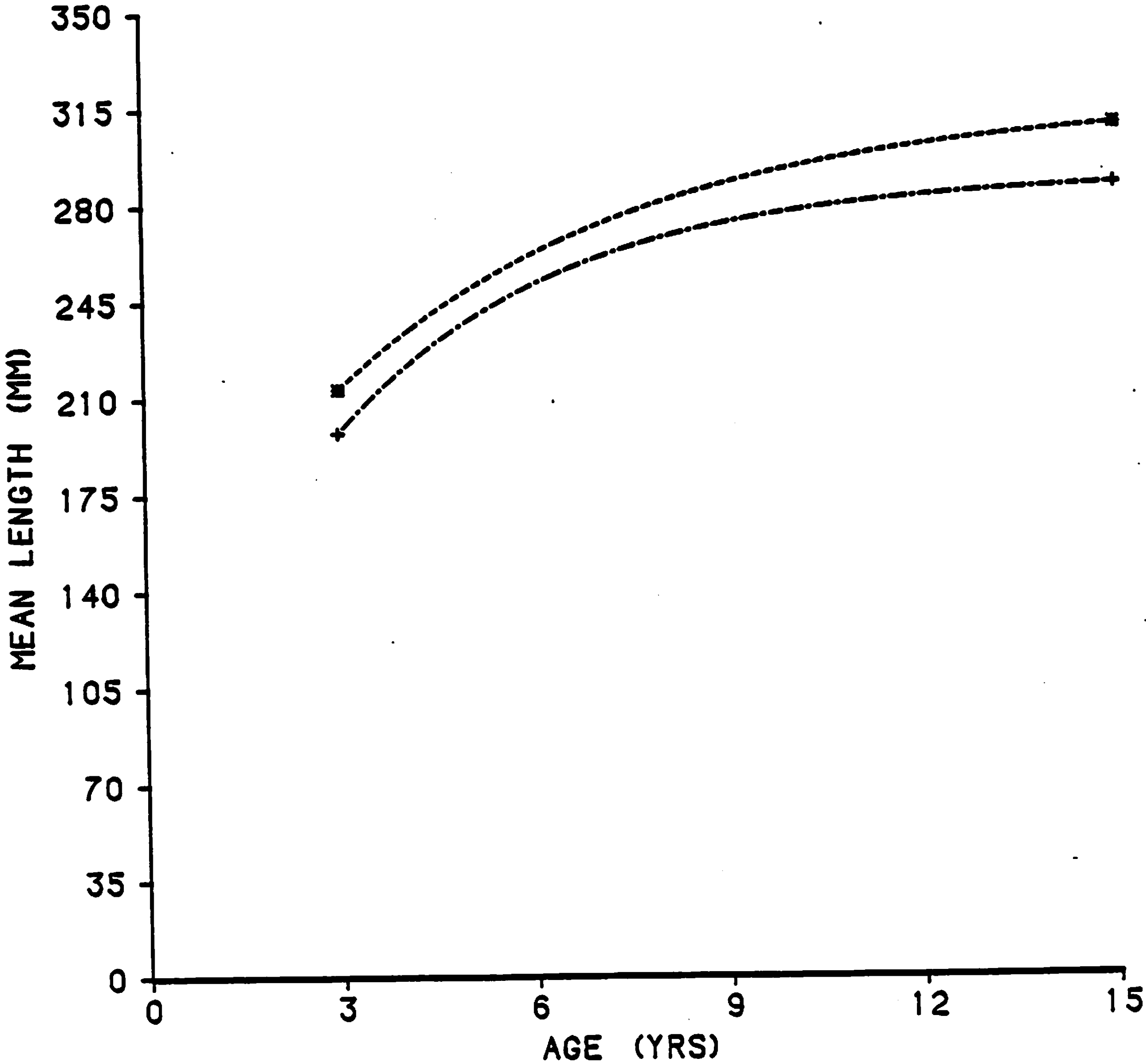


Fig. 2. Age specific growth curves for southern (upper curve: Togiak, Security Cove and Goodnews Bay) and northern (lower curve: Nelson Island, Cape Romanzof and Norton Sound) populations of Pacific herring in the eastern Bering Sea, 1978-1982, Alaska.

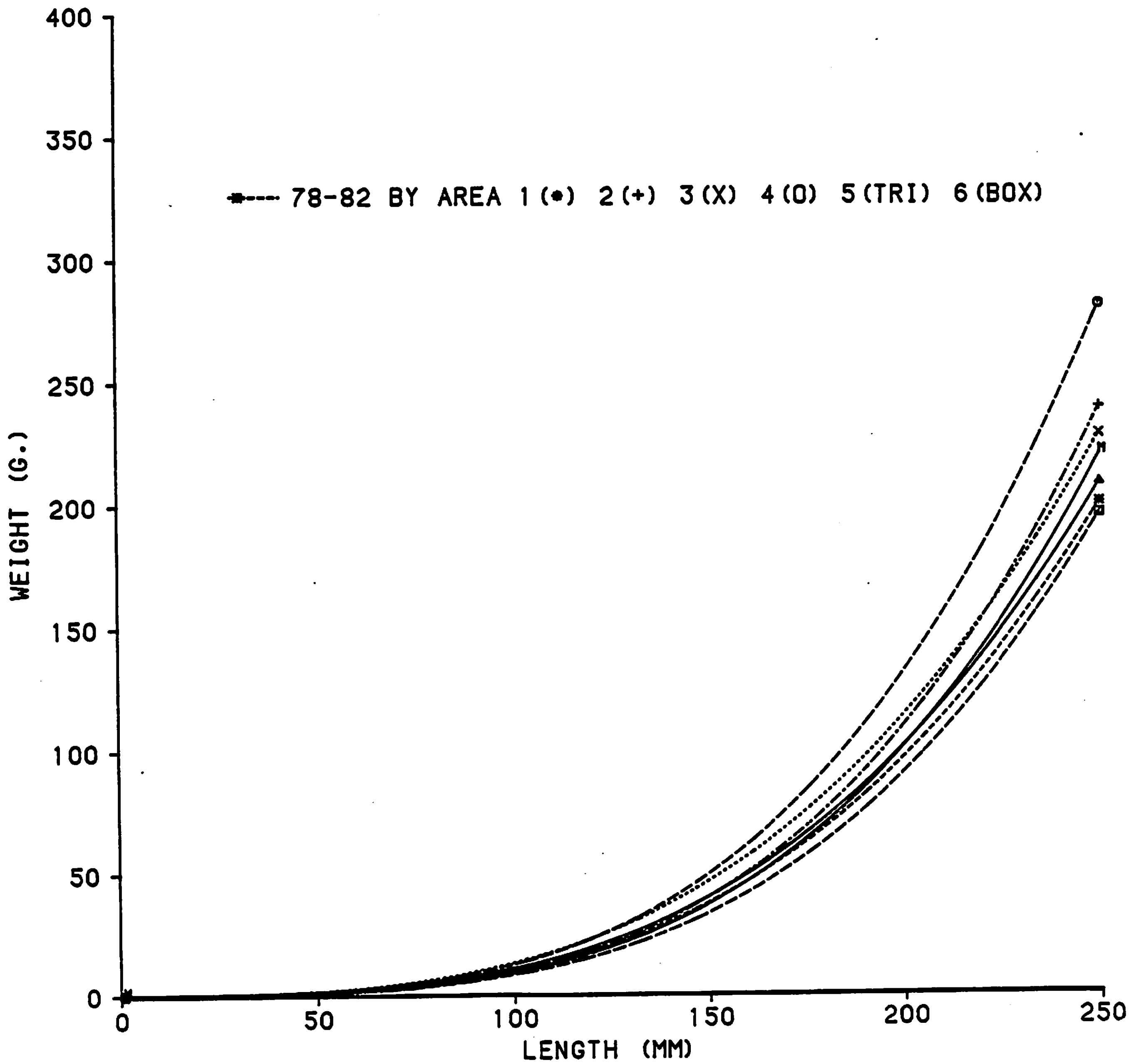


Fig. 3. Weight-length relationship for six spawning groups of eastern Bering Sea Pacific herring (1 = Togiak, 2 = Security Cove, 3 = Goodnews Bay, 4 = Nelson Island, 5 = Cape Romanzof, 6 = Norton Sound), 1978-1982, Alaska. The general curve for all groups combinded is indicated by an M.

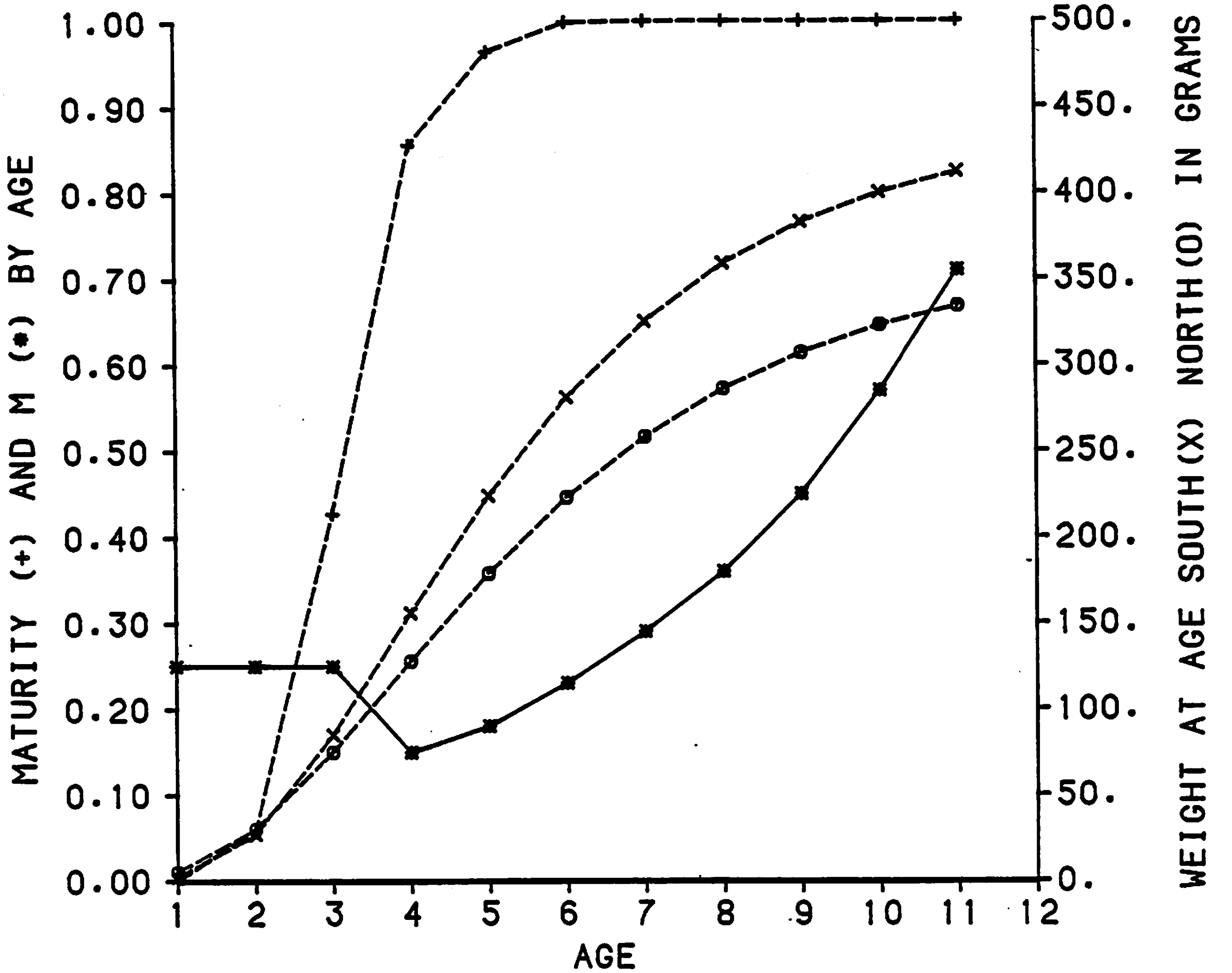


Fig. 4. Population parameters used in the herring model to simulate responses of eastern Bering Sea Pacific herring populations to various patterns of exploitation. Maturity and instantaneous natural mortality schedules from Wespestad (1982).

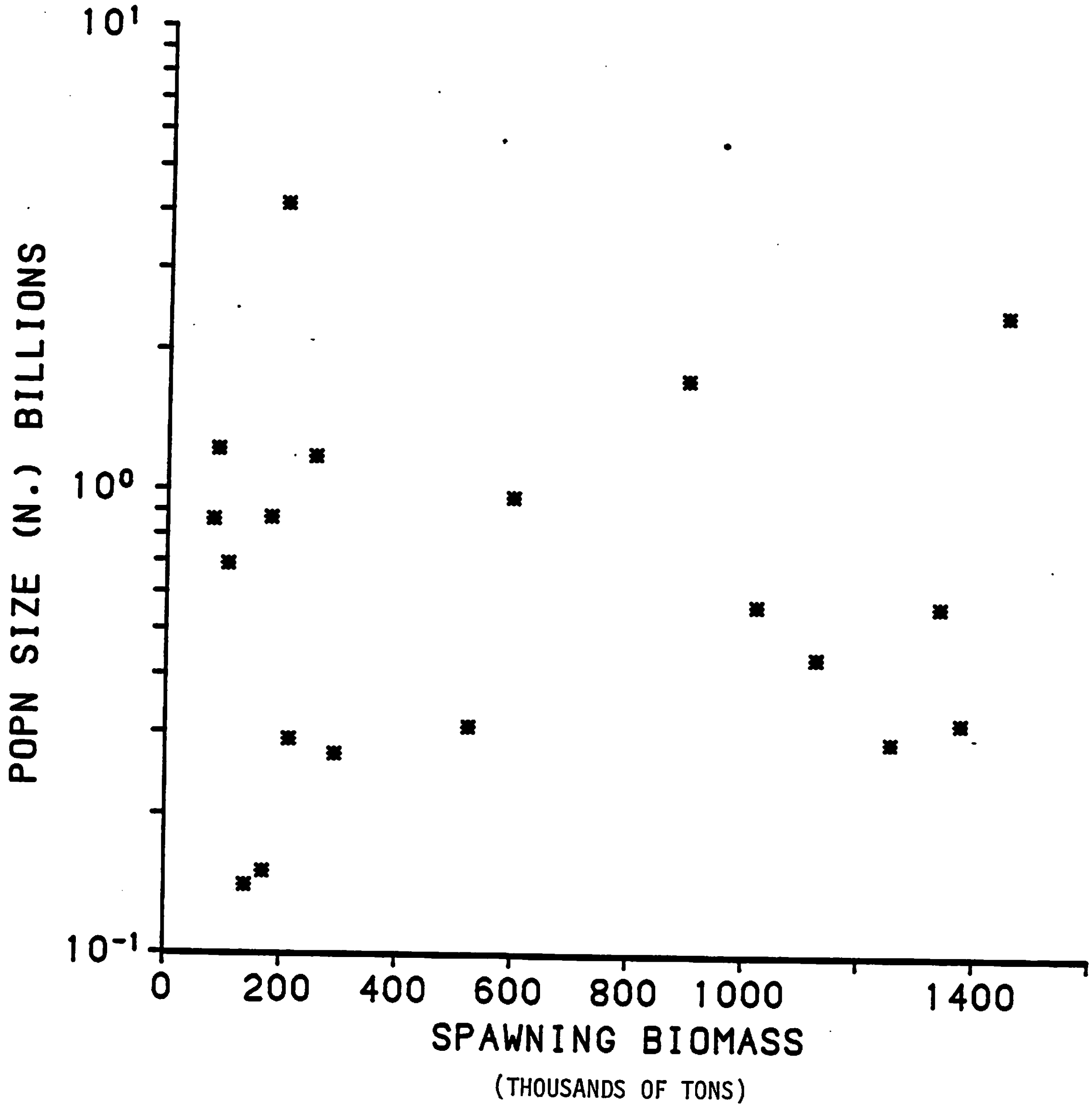


Fig. 5. Plot of number of age one recruits and the spawning biomass of the parental stock for eastern Bering Sea Pacific herring. Data obtained from cohort analysis (Wespestad 1982).

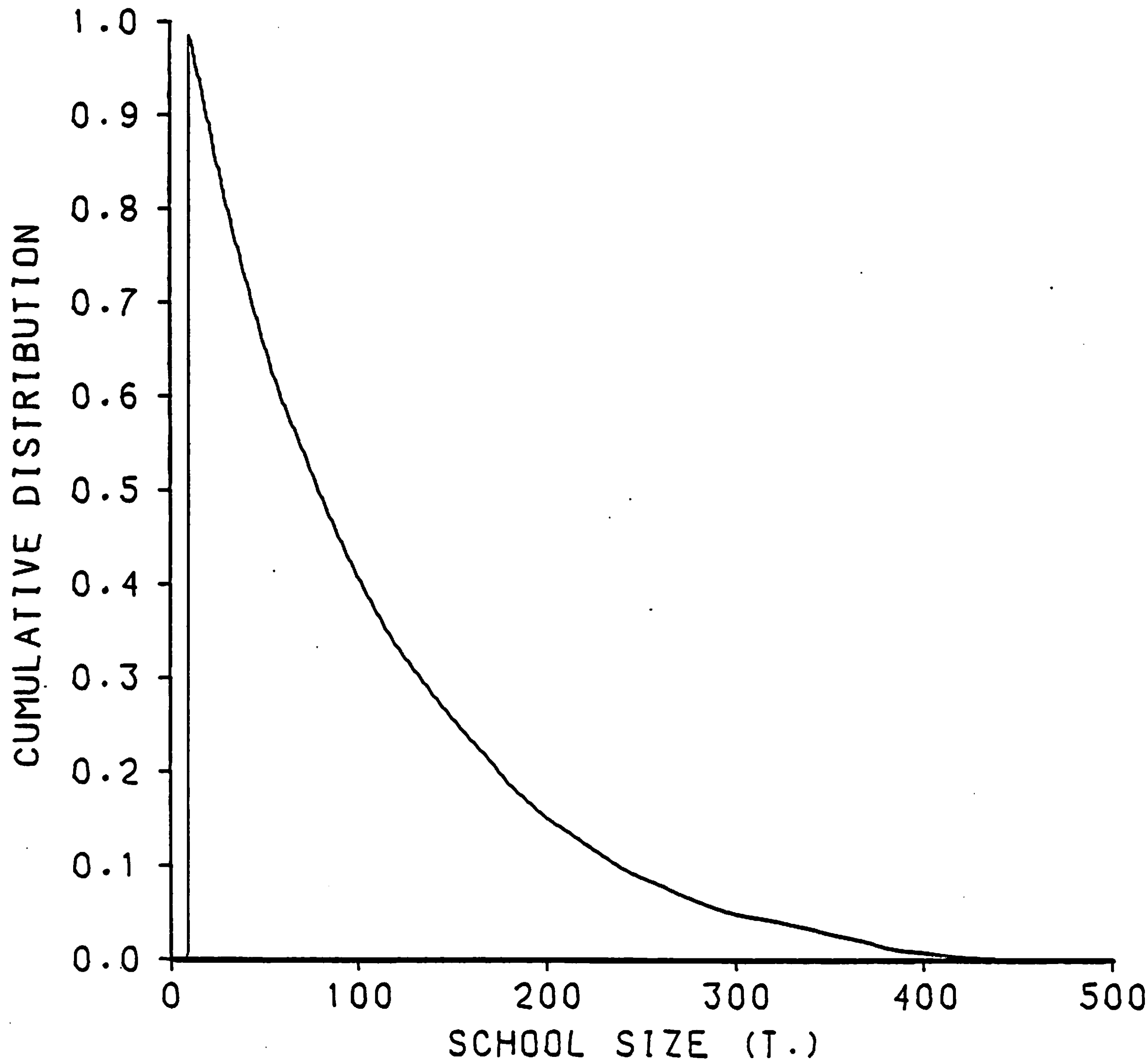


Fig. 6. Cummulative frequency distribution of school sizes used in the computer model to simulate distribution of eastern Bering Sea Pacific herring available to mixed stock fisheries. School size was distributed according to a gamma function. Each school consisted of herring of the same age and spawning group.

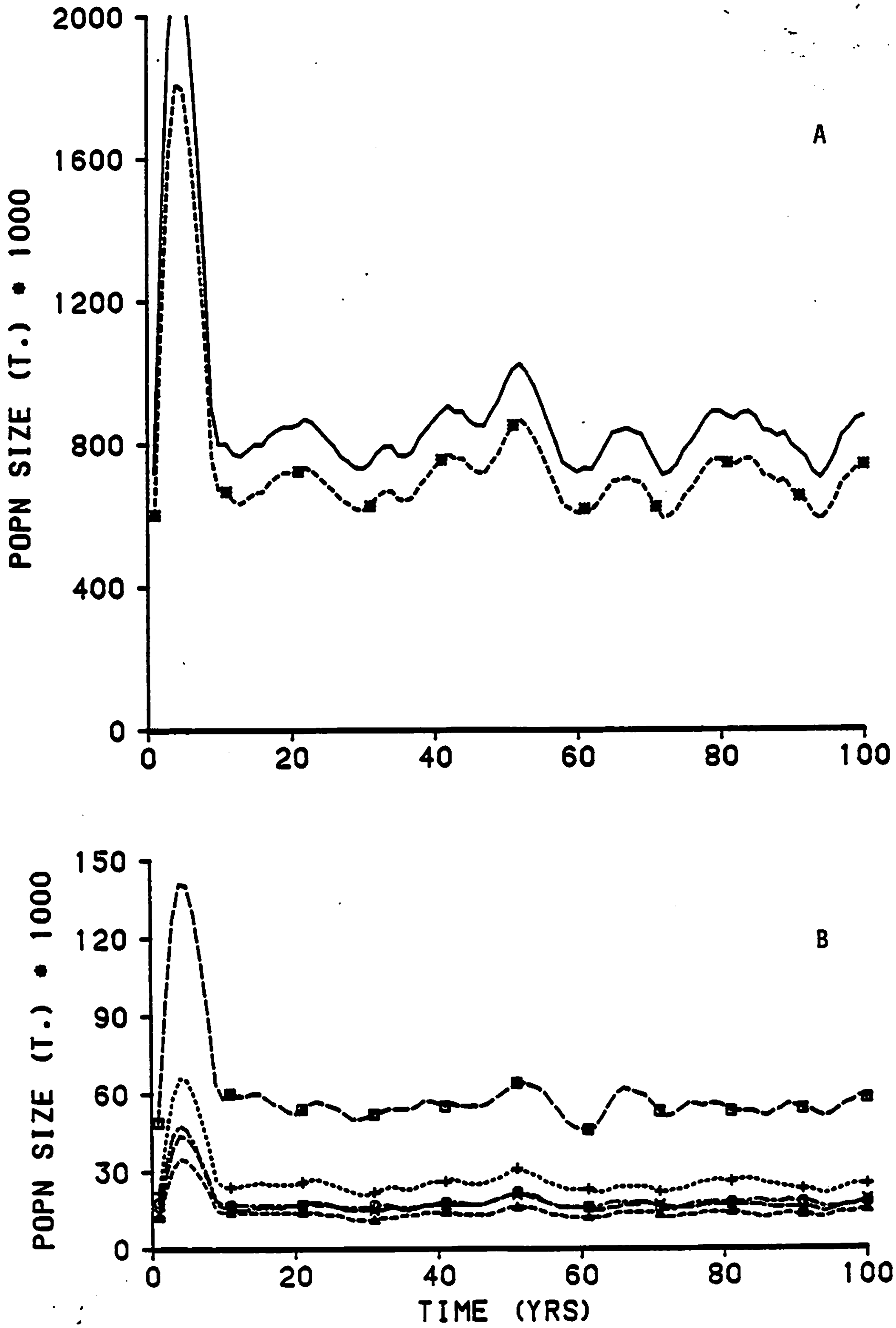


Fig. 7. Output from herring model showing yearly fluctuations in biomass for unfished eastern Bering Sea Pacific herring spawning groups. Graph A shows all groups combined (solid line) and Togiak (dotted line). Graph B shows Security Cove (+), Goodnews Bay (X), Nelson Island (O), Cape Romanzof (Δ) and Norton Sound (▭).

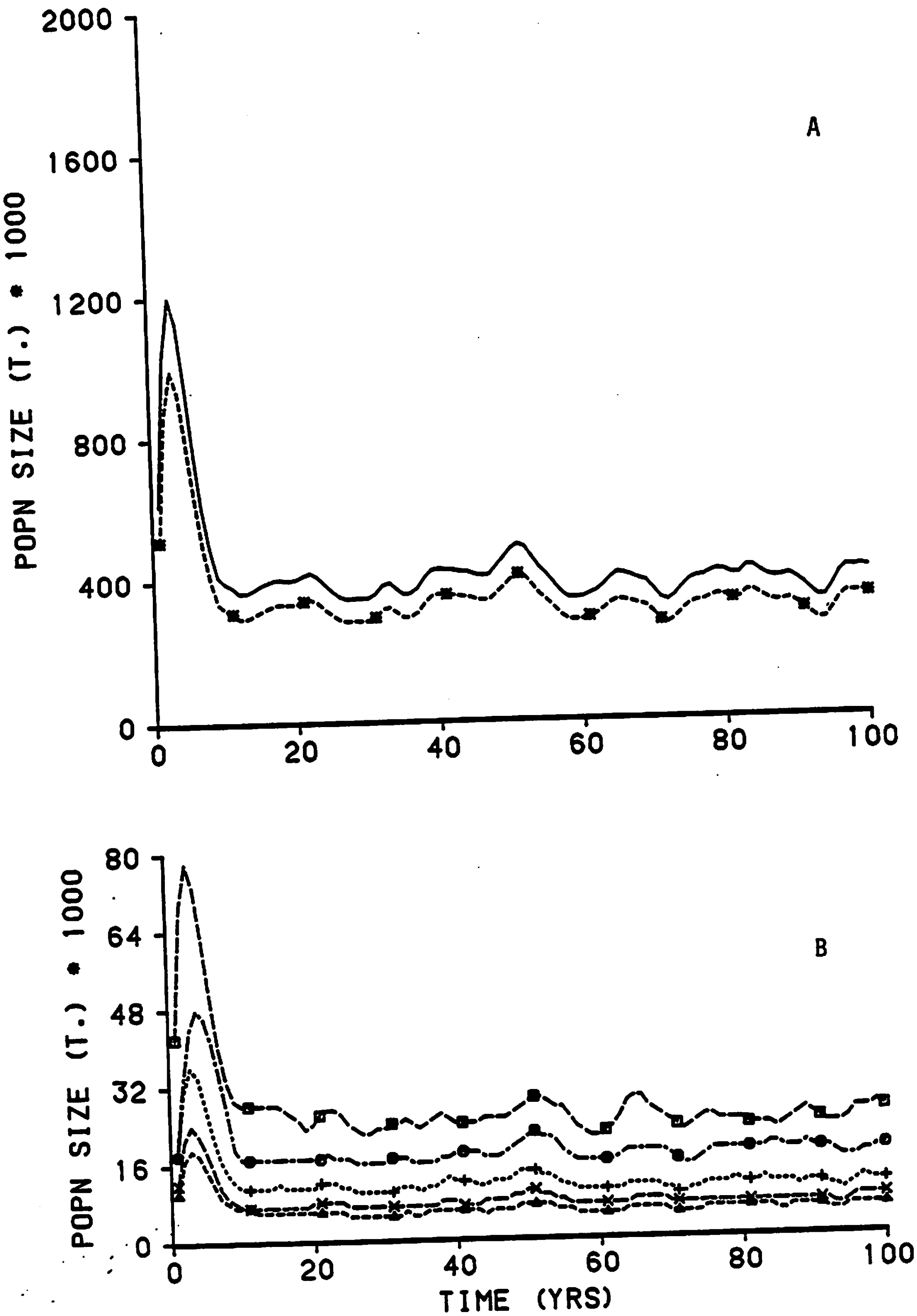


Fig. 8. Output from herring model showing yearly fluctuations in biomass in eastern Bering Sea Pacific herring spawning groups subjected to inshore sac roe removals (E = 0.2 for all groups except Nelson Island) and subsistence removals (E = 0.03 for Nelson Island only). Symbols same as in Fig. 7.

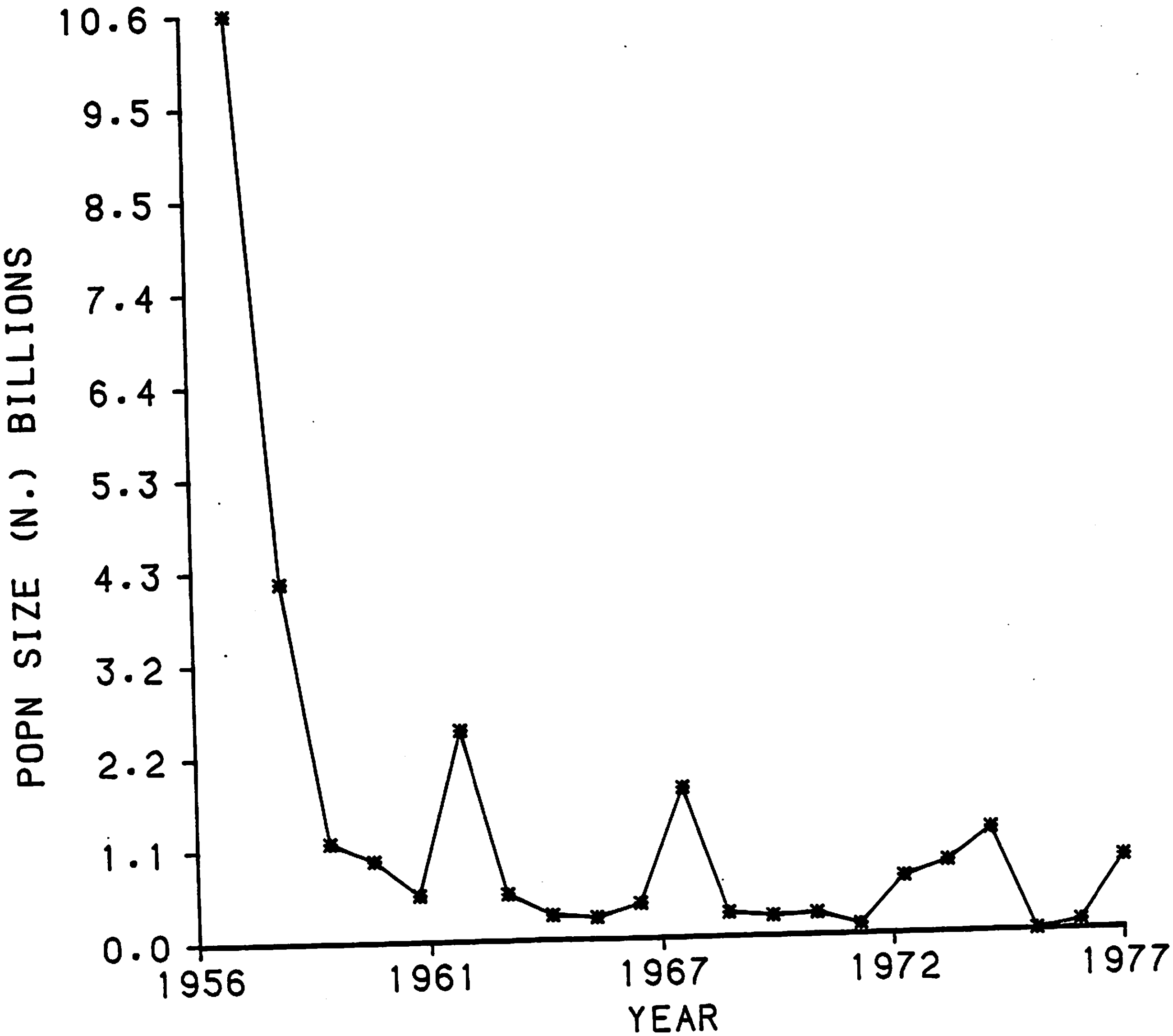


Fig. 9. Annual fluctuations in the population size of eastern Bering Sea age one Pacific herring, 1957-1977 year classes.

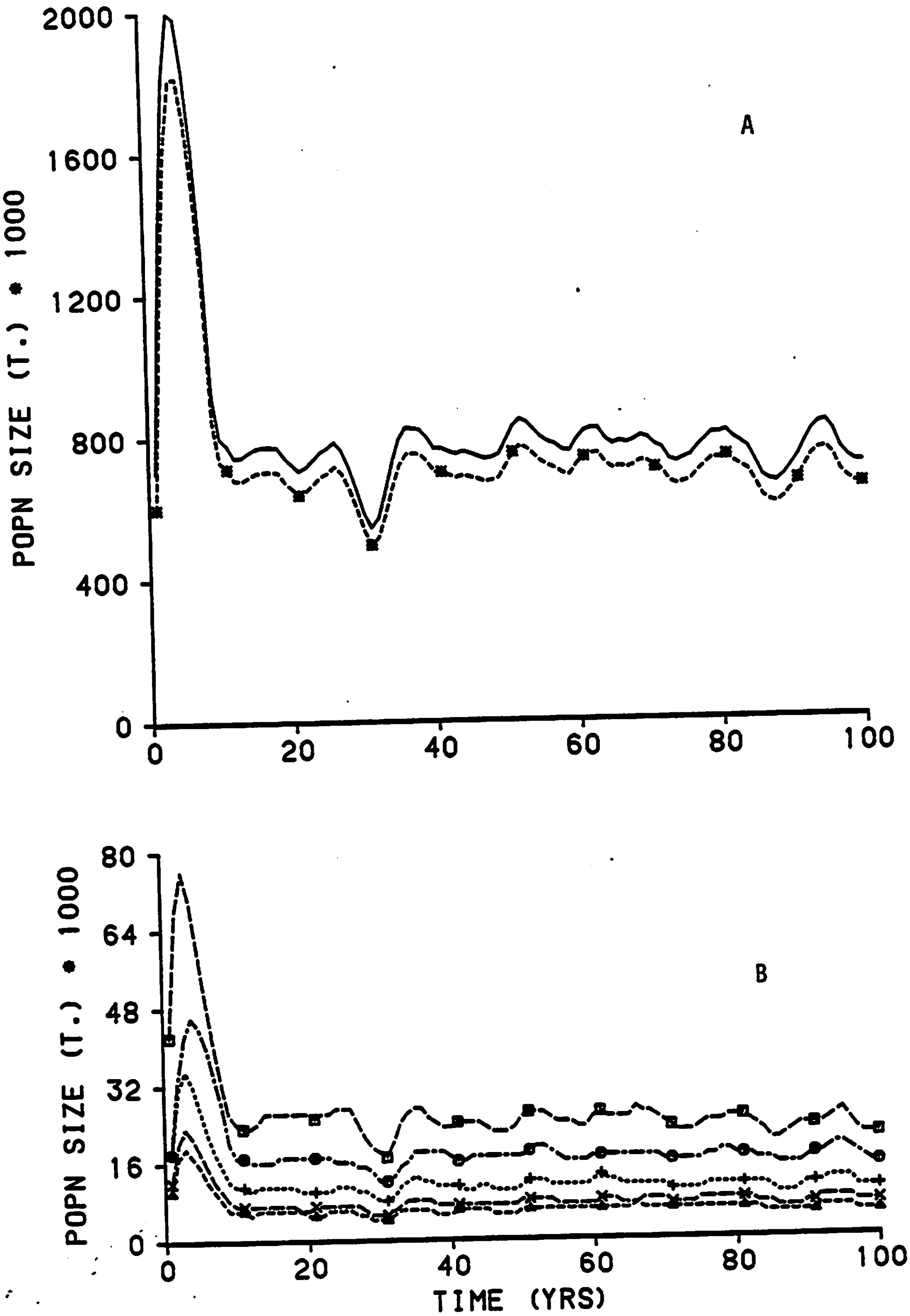
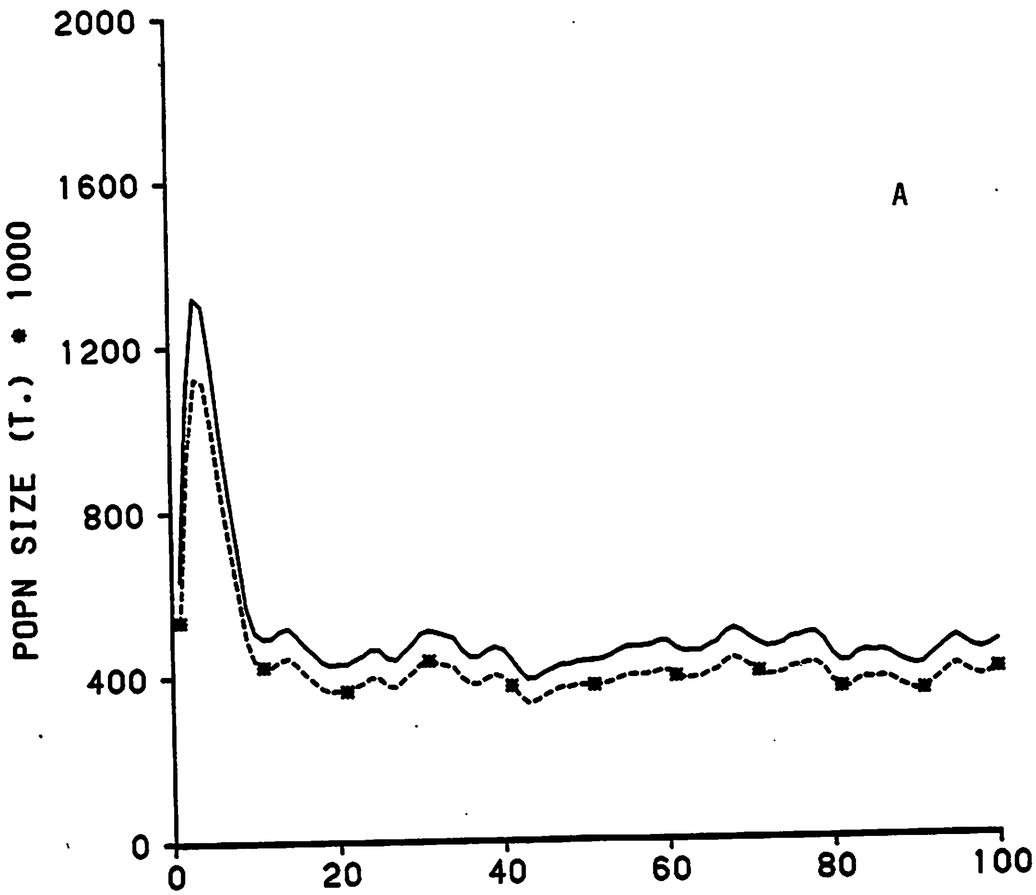


Fig. 10. Output from herring model showing yearly fluctuations in biomass in eastern Bering Sea spawning groups subjected both discrete and mixed stock fishery removals. Fishery removals correspond to pattern I in Table 4. Symbols same as in Fig. 7.



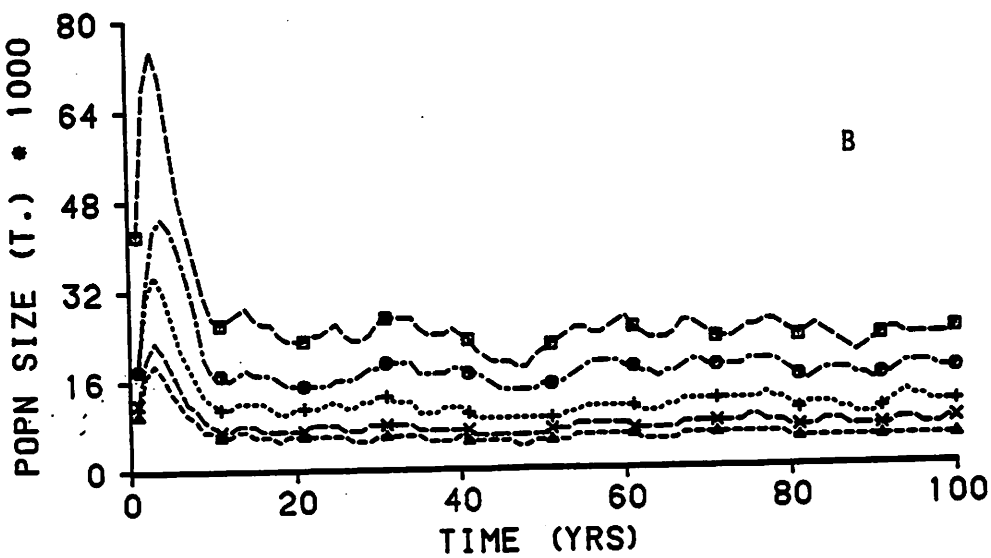


Fig. 11. Output from herring model showing yearly fluctuations in biomass in eastern Bering Sea spawning groups subjected to both discrete and mixed stock fishery removals. Fishery removals correspond to pattern II in Table 4. Symbols same as in Fig. 7.

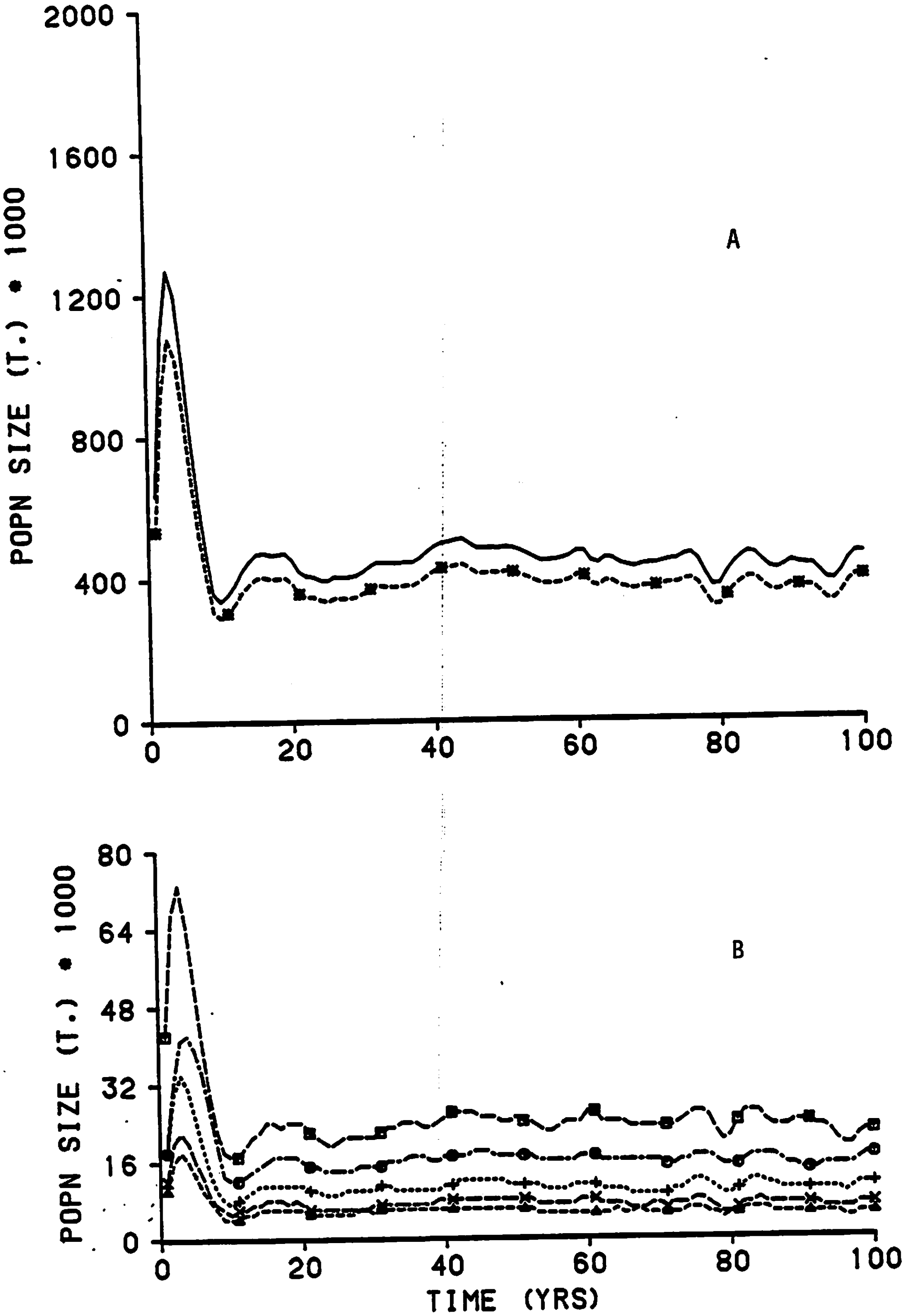


Fig. 12. Output from herring model showing yearly fluctuations in biomass in eastern Bering Sea spawning groups subjected to both discrete and mixed stock fishery removals. Fishery removals correspond to pattern III in Table 4. Symbols same as in Fig. 7.

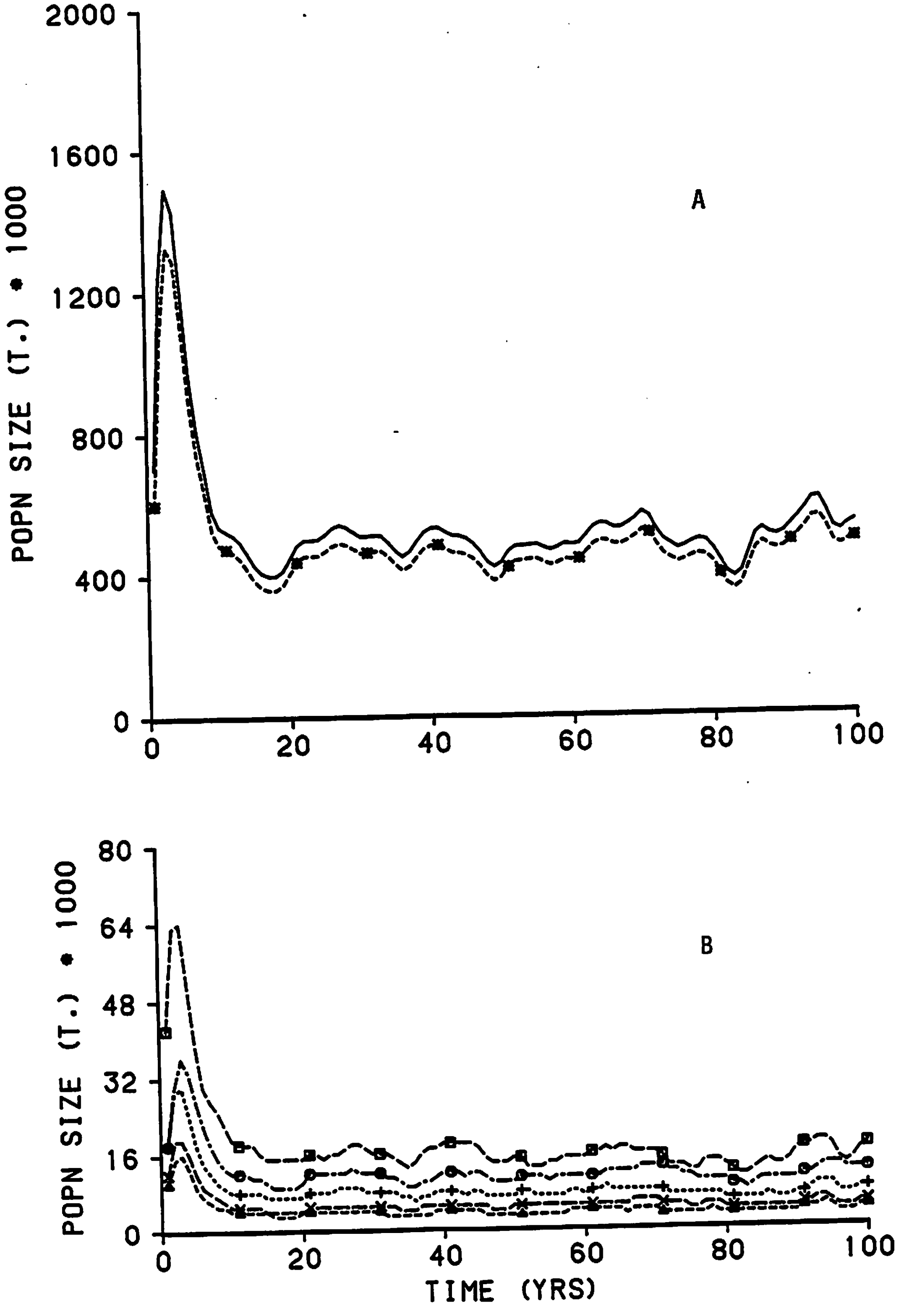


Fig. 13. Output from herring model showing yearly fluctuations in biomass in eastern Bering Sea spawning groups subjected to both discrete and mixed stock fishery removals. Fishery removals correspond to pattern IV in Table 4. Symbols same as in Fig. 7.

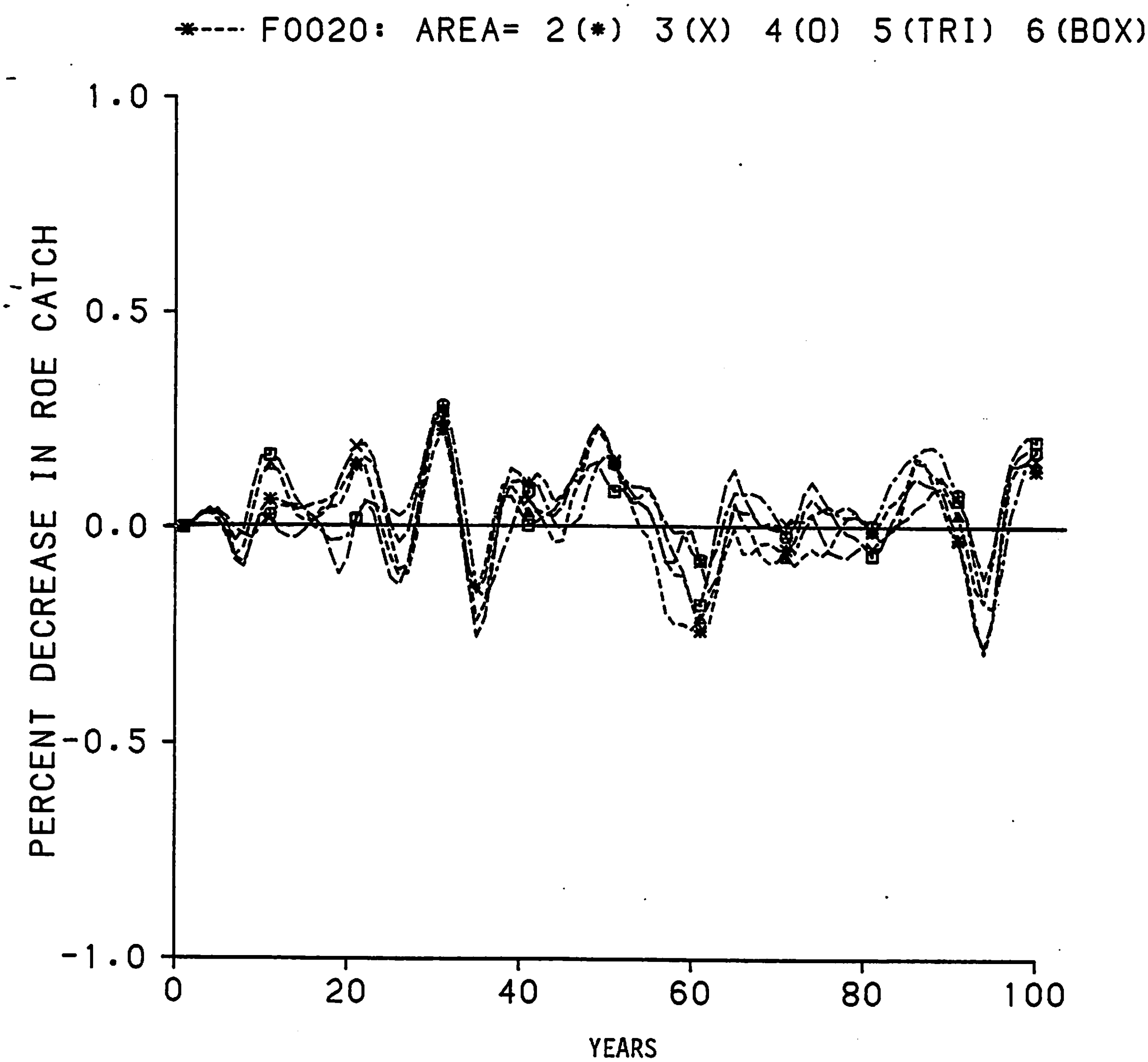


Fig. 14. Output from herring model showing yearly departures from expected sac roe (Security Cove, *; Goodnews Bay, X; Cape Romanzof, Δ; Norton Sound □) and subsistence (Nelson Island, O) harvests when both discrete and mixed stock fishery removals occur. Fishery removals correspond to Pattern I in Table 4. Mean expected sac roe and subsistence harvests based upon exploitation ratios of 0.2 and 0.03, respectively.

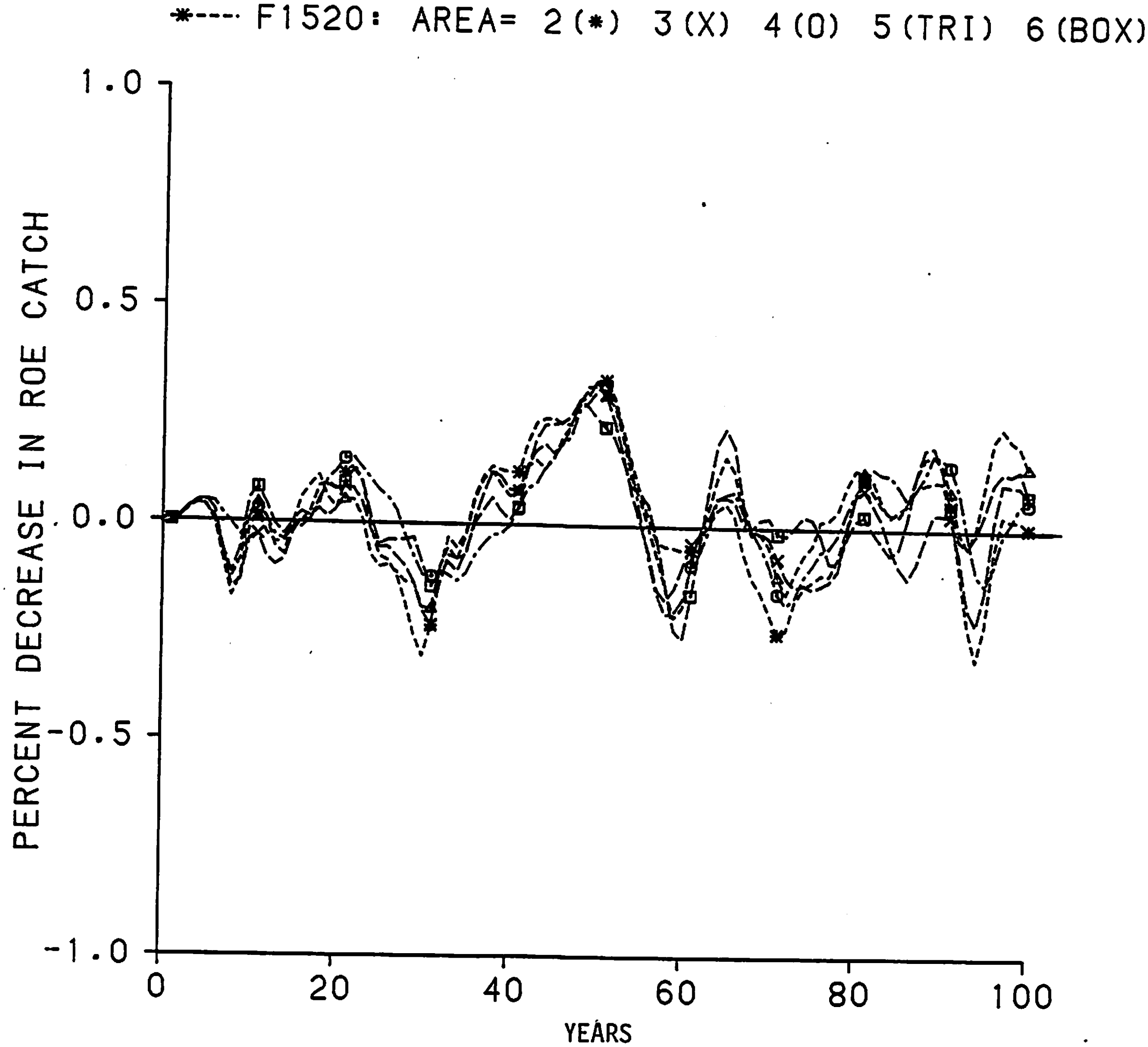


Fig. 15. Output from herring model showing yearly departures from expected sac roe and subsistence harvests when both discrete and mixed stock fishery removals occur. Fishery removals correspond to Pattern II in Table 4. Mean expected sac roe and subsistence harvests based upon exploitation ratios of 0.2 and 0.03, respectively. Symbols same as Fig. 14.

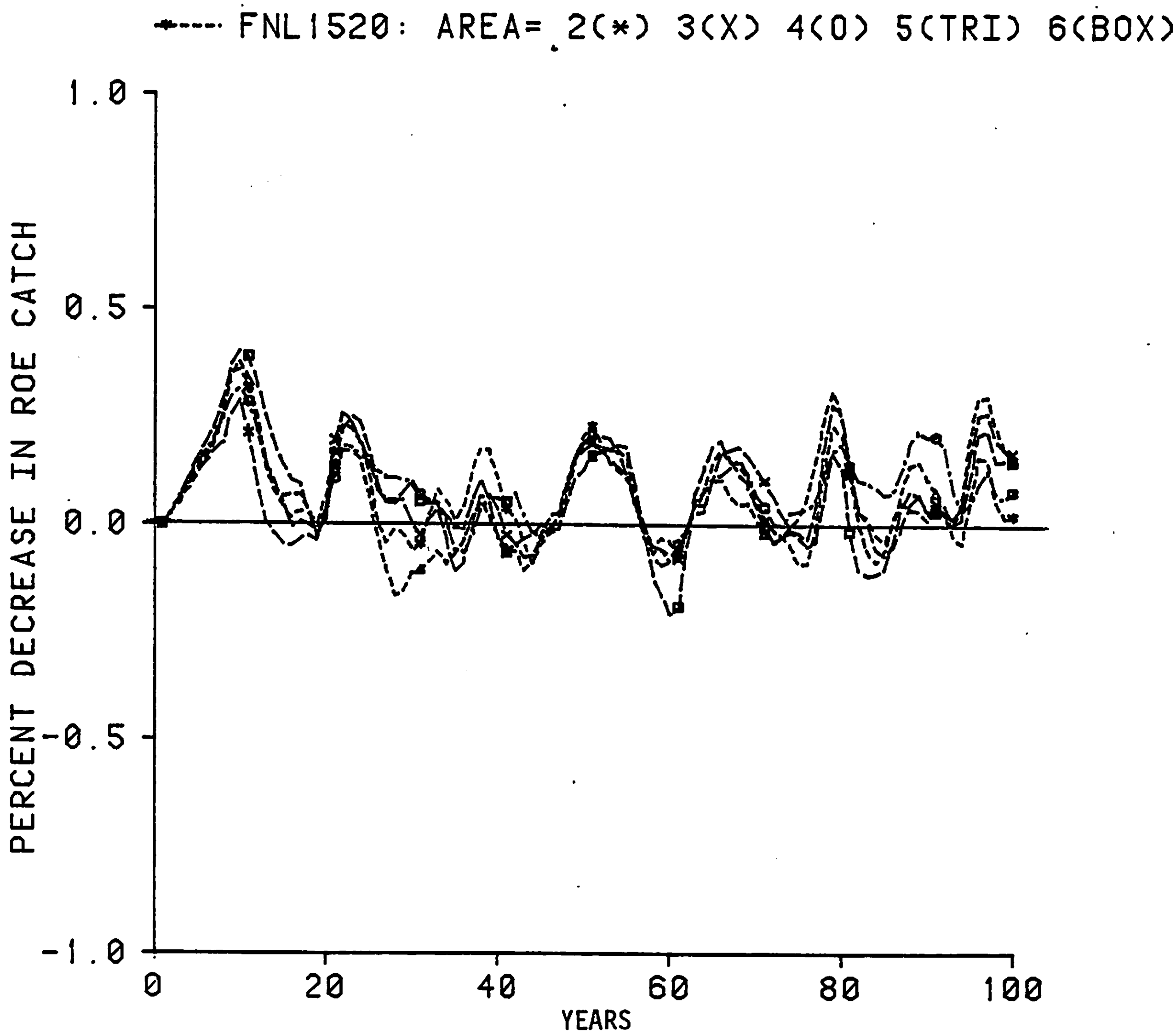


Fig. 16. Output from herring model showing yearly departures from expected sac roe and subsistence harvests when both discrete and mixed stock fishery removals occur. Fishery removals correspond to Pattern IV in Table 4. Mean expected sac roe and subsistence harvests based upon exploitation ratios of 0.2 and 0.03, respectively. Symbols same as Fig. 14.

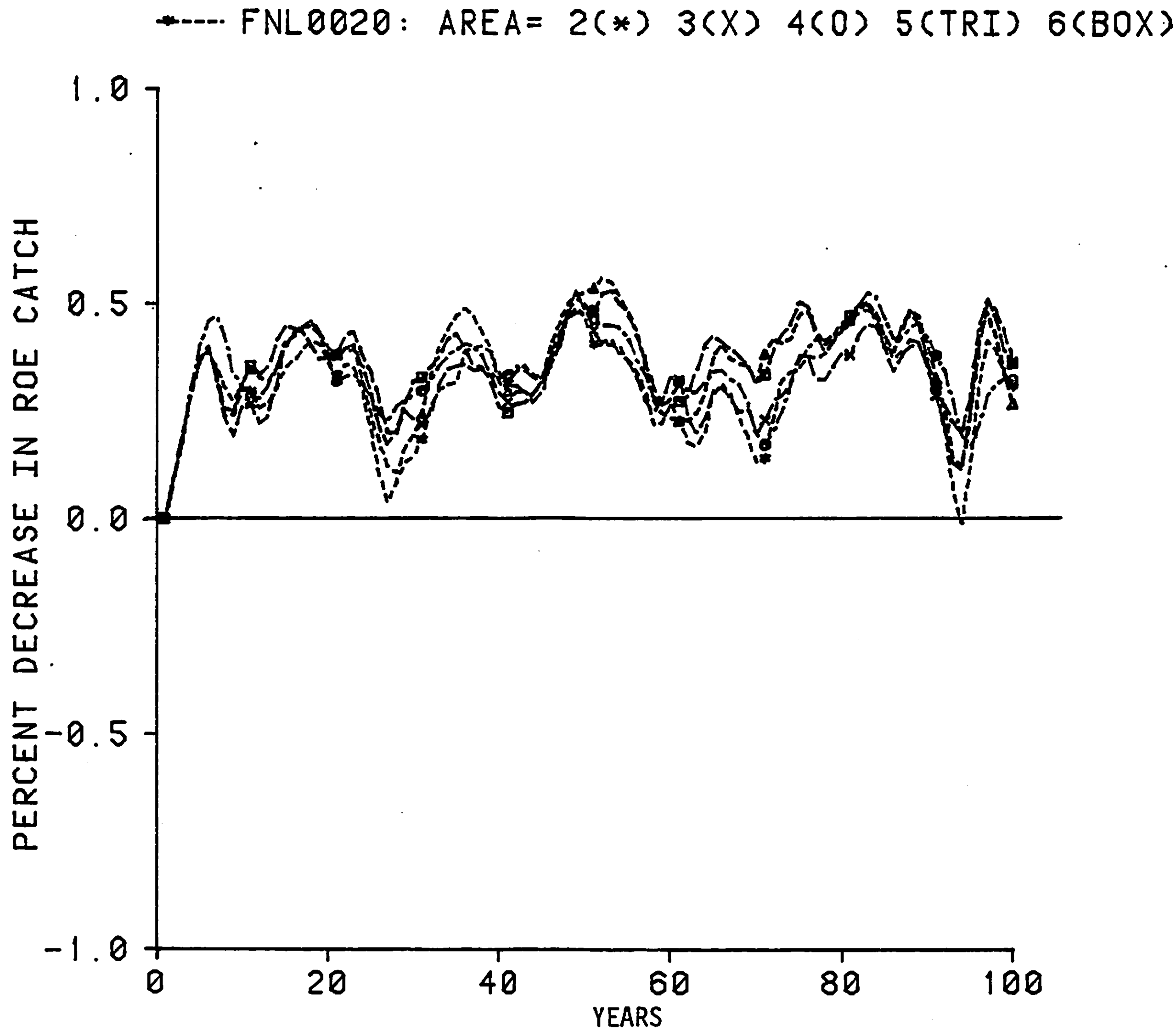


Fig. 17. Output from herring model showing yearly departures from expected sac roe and subsistence harvests when both discrete and mixed stock fishery removals occur. Fishery removals correspond to Pattern III in Table 4. Mean expected sac roe and subsistence harvests based upon exploitation ratios of 0.2 and 0.03, respectively. Symbols same as Fig. 14.

PART 676 -- BERING-CHUCKCHI SEA HERRING

Subpart A -- General

Subpart B -- Management Measures

Subpart A -- General

§676.1 Purpose and scope

(a) Regulations in this Part govern fishing for herring by vessels of the United States within the fishery conservation zone in (1) the Chuckchi Sea lying south of Point Hope, (2) the Bering Sea, and (3) the North Pacific Ocean adjacent to the Aleutian Islands and west of 170° W. longitude, hereinafter referred to as the "management area". (See Figure 1)

(b) For regulations governing fishing for herring within the Bering-Chuckchi Sea management area by fishing vessels other than vessels of the United States, see 50 CFR §611.95.

(c) These regulations implement the Bering-Chuckchi Sea herring fishery management plan developed by the North Pacific Fishery Management Council.

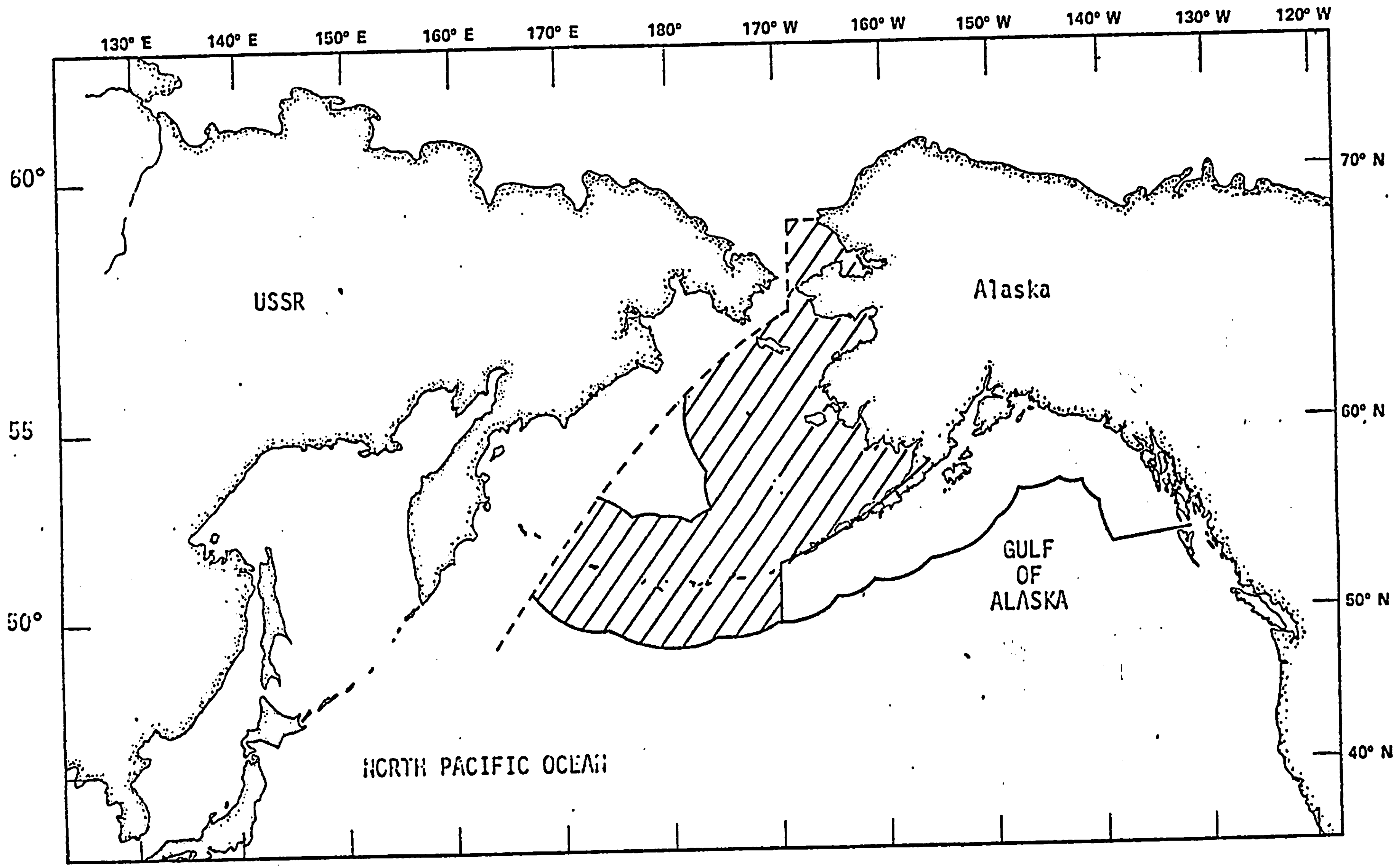


Figure 1. Area (diagonal lines) over which this Fishery Management Plan applies.

§676.2 Definitions

In addition to the definitions in the Act, and unless the context requires otherise, the terms used in this Part shall have the following meanings (some definitions in the Act have been repeated here to aid understanding of the regulations):

Act means the Magnuson Fishery Conservation and Management Act, Pub. L. 94-265, as amended, 16 U.S.C §§1801 et seq.

Acceptable biological catch (ABC) means a seasonally determined catch based primarily on the ratio of the annual biomass estimate to the MSY biomass level. ABC may be less than, equal to, or greater than MSY, depending on resource conditions. ABC applies to the combined state and federal management areas.

ADF&G means the Alaska Department of Fish and Game.

Allowable incidental catch (AIC) means that amount of herring allocated to be taken incidentally to the United States groundfish fishery. It is a part of the optimum yield (OY) for the fishery regulated by this Part, and is accounted for in the determination of the winter apportionment of OY.

Assistant Administrator means the Assistant Administrator for Fisheries, National Oceanic and Atmospheric Administration, United States Department of Commerce, or an individual to whom the Assistant Administrator for Fisheries has delegated the appropriate authority.

Authorized Officer means:

(a) Any commissioned, warrant, or petty officer of the United States Coast Guard;

(b) Any certified enforcement or special agent of the National

Marine Fisheries Service;

(c) Any officer designated by the head of any Federal or State agency which has entered into an agreement with the Secretary and the Commandant of the Coast Guard to enforce the provisions of the Act; or

(d) Any Coast Guard personnel accompanying and acting under the direction of any person described in paragraph (a) of this definition.

Fishery Conservation Zone (FCZ) means that area adjacent to the United States which, except where modified to accommadate international boundaries, encompasses all waters from the seaward boundary of each of the coastal States to a line on which each point is 200 nautical miles from the baseline from which the territorial sea of the United States is measured.

Fishing means any activity, other than scientific research activity conducted by a scientific research vessel, which involves:

(a) The catching, taking, or harvesting of fish;

(b) The attempted catching, taking or harvesting of fish;

(c) Any other activity which can reasonably be expected to result in the catching, taking or harvesting of fish; or

(d) Any operations at sea in support of, or in preparation for, any activity described in paragraphs (a), (b), or (c) of this definition.

Fishing vessel means any vessel, boat, ship, or other craft which is used for, equipped to be used for, or of a type which is normally used for: (a) fishing; or (b) aiding or assisting one or more vessels at sea in the performance of any activity relating to fishing, including, but not limited to, preparation, supply, storage, refrigeration, transportation, or processing.

Fishing year means April 1 to March 31.

Herring means Clupea harengus palassi.

Groundfish means groundfish as defined in Part 675 of this title.

Herring savings area means the portion of the management area bounded by rhumb lines connecting the following points in the order listed:

North Latitude	West Longitude
59° 30'	179° 00'
59° 30'	171° 00'
57° 00'	171° 00'
57° 00'	175° 00'
57° 30'	175° 00'
57° 30'	176° 00'
58° 00'	176° 00'
58° 00'	177° 00'
58° 30'	177° 00'
58° 30'	179° 00'
59° 30'	179° 00'

Land means to offload fish on a facility located on the land or within the baseline from which the terrirorial sea of the United States is measured.

Management area means the FCZ in the Chuckchi Sea south of Point Hope, the Bering Sea, and the North Pacific Ocean adjacent to the Aleutian Islands and west of 170° 00' W. longitude.

Maximum sustainable yield (MSY) means an average, over a reasonable length of time, of the largest catch which can be taken continuously from a stock under current environmental conditions.

Operator, with respect to any vessel, means the master or other individual on board and in charge of that vessel.

Optimum yield (OY) means that amount of the herring biomass which is available for harvest in the FCZ.

Owner, with respect to any vessel, means:

(a) Any person who owns that vessel in whole or in part;

(b) Any charterer of the vessel, whether bareboat, time, or voyage;

(c) Any person who acts in the capacity of a charterer, including but not limited to parties to a management agreement, operating agreement, or any similar agreement that bestows control over the destination, function or operation of the vessel; or

(d) Any agent designated as such by any person in paragraphs (a), (b), or (c) of this definition.

Person means any individual (whether or not a citizen or national of the United States), corporation, partnership, association, or other entity (whether or not organized or existing under the laws of any State), and any Federal, State, local, or foreign government or any entity of such government.

Prohibited species catch limit (PSC) means the maximum amount of herring mortality which fishing vessels of foreign nations may cause incidental to their trawl fisheries in the management area, before the herring savings area is closed to trawling by such vessels.

Regional Director means the Director, Alaska Region, National Marine Fisheries Service, P.O. Box 1668, Juneau, Alaska 99802, or an individual to whom the Regional Director has delegated appropriate authority.

Secretary means the Secretary of Commerce, or his or her designee.

Trawling means fishing by use of a bag-shaped net dragged through the water to capture fish.

Vessel of the United States means:

(a) Any vessel documented under the laws of the United States;

(b) Any vessel numbered in accordance with the Federal Boat Safety Act of 1971 (46 U.S.C.§§ 1400 et seq.) and measuring less than 5 net tons; or

(c) Any vessel numbered under the Federal Boat Safety Act of 1971 (46 U.S.C. §§1400 et seq.) and used exclusively for pleasure.

United States fish processors means facilities located within the United States for, and vessels of the United States used or equipped for, the processing of fish for commercial use or consumption.

United States-harvested fish means fish caught, taken, or harvested by vessels of the United States within any fishery regulated by a fishery management plan or preliminary fishery management plan implemented under the Act.

§676.3 Relation to other laws

(a) Federal law. For regulations concerning fishing for groundfish in the Bering Sea and Aleutian Islands portion of the management area, see 50 CFR Part 675; for regulations concerning fishing for groundfish in the Gulf of Alaska, see 50 CFR Part 672; for regulations concerning fishing for Tanner Crab, see 50 CFR Part 671; for regulations governing permits and certificates of inclusion for the taking of marine mammals, see 50 CFR §216.24.

(b) State law. This Part will be administered in close coordination with ADF&G's administration of the regulations of the State of Alaska governing the subsistence and roe fisheries for herring in the territorial sea and internal waters off Alaska. Certain responsibilities relating to data collection and enforcement may be performed by employees of the State of Alaska.

§676.4 Permits

(a) General. No vessel of the United States may fish for herring in the management area without first obtaining a permit under this Part. Such permits shall be issued without charge.

(b) Application. A fishing vessel owner may obtain a permit required under the preceding subsection by submitting to the Regional Director a written application containing the following information:

(1) The applicant's name, mailing address, and telephone number;

(2) The name of the vessel;

(3) The vessel's U.S. Coast Guard documentation number or state registration number;

(4) The home port of the vessel;

(5) The length of the vessel;

(6) The type of fishing gear to be used;

(7) The signature of the applicant.

The Regional Director may accept a completed State of Alaska commercial fishing license application in satisfaction of the requirements of this paragraph.

(c) Issuance.

(1) Upon receipt of a properly completed application, the Regional Director shall issue a permit required by paragraph (a) of this section, except as otherwise required under paragraph (i) of this section.

(2) Upon receipt of an improperly completed application, the Regional Director shall notify the applicant of the deficiency in the application. If the applicant fails to correct the deficiency within 30 days following the date of notification, the application shall be considered abandoned.

(d) Notification of change. Any person who has applied for and received a permit under this section shall give written notification of any change in the information provided under paragraph (b) of this section to the Regional Director within 30 days of that change.

(e) Duration. A permit issued under this section shall authorize the permitted vessel to fish for herring in the management area during a single specified year, and shall continue in full force and effect therough December 31 of the year for which it was issued, or until it is revoked, suspended, or modified pursuant to 50 CFR Part 621.

(f) Alteration. No person shall alter, erase, or mutilate any permit issued under this section. Any such permit that has been intentionally altered, erased, or mutilated shall be invalid.

(g) Transfer. Permits issued under this section are not transferable or assignable. Each such permit shall be valid only for the fishing vessel for which it is issued. The Regional Director must be notified of a change in ownership, pursuant to paragraph (d) of this section.

(h) Inspection. Any permit issued under this section must be carried aboard the permitted vessel whenever the vessel is fishing in the management area. The permit shall be presented for inspection upon request by any authorized officer.

(h) Inspection. Any permit issued under this section must be carried aboard the permitted vessel whenever the vessel is fishing for groundfish or herring in the management area. The permit shall be presented for inspection upon request of any authorized officer.

(i) Sanctions. Subpart D of 50 CFR Part 621 shall govern the imposition of permit sanctions against a permit issued under this section. As specified in that subpart D, a permit may be revoked, modified, or suspended with or without prejudice to the issuance of future permits, if the permitted vessel is used in the commission of an offense prohibited by the Act or these regulations; and such a permit shall be revoked if a civil penalty or criminal fine imposed under the Act and pertaining to a permitted vessel is not paid.

§676.5 Reporting requirements.

(a) Fishing vessel reporting requirements.

(1) Port of landing outside Alaska. The operator of any fishing vessel that harvests and retains herring under this Part, and lands such herring at a port outside the State of Alaska shall report that harvest to ADF&G on a completed State of Alaska fish ticket, or an equivalent document containing all of the information required on an Alaska fish ticket, within one week after that herring is landed. The address to which these documents must be sent is: Director, Division of Commercial Fisheries, Alaska Department of Fish and Game, P.O. Box 33-2000, Juneau, Alaska 99802.

(2) Sale, delivery, or consumption at sea.

(A) For each consumption or sale or delivery to a United States fish processor of herring harvested and retained under this Part, the operator of the fishing vessel performing that consumption, sale or delivery shall submit the following information to ADF&G:

(i) a completed State of Alaska fish ticket, or an equivalent document containing all of the information required on an Alaska fish ticket; and

(ii) a statement indicating whether or not the vessel to which any sale or delivery was made was a vessel of the United States.

(B) The information required by paragraph (a)(2)(A) of this section shall be submitted to ADF&G within one week of the first return of the vessel that harvested the herring to port following such sale, delivery, or consumption. Such information may be submitted by the United States fish processor to which the sale or delivery at sea was made, acting as the agent of the fishing vessel operator, but the fishing vessel operator shall remain ultimately responsible for submission of the information.

(b) Processor reporting requirements. When requested by the Regional Director, but not more than four times a year, each United States fish processor who intends to process United States harvested herring taken in the management unit shall complete a written survey received from the Regional Director, to include the following information:

(1) the quantity of herring that the processor has the capacity to process during a designated period; and

(2) the quantity of herring that the processor expects to process from any areas of the management area at any time during the fishing year.

(c) Joint venture reporting requirements. When requested by the Regional Director, but not more than four times a year, each joint venture representative whose company or association intends to deliver herring harvested by United States fishermen from the management area to foreign processors shall complete a written survey received from the Regional Director. This survey shall state the quantity of United States - harvested herring that the joint venture operator expects to deliver to foreign processors from any areas of the management unit at any times during the fishing year.

§676.6 General prohibitions

It shall be unlawful for any person to:

(a) Fish for herring in the management area with a vessel of the United States which does not have aboard a valid permit issued pursuant to this Part;

(b) Possess, have custody or control of, ship, transport, import, export, offer for sale, sell, or purchase any fish taken or retained in violation of the Act, this Part, or any other regulation or permit issued under the Act;

(c) Refuse to permit an authorized officer to board a fishing vessel subject to such person's control for purposes of conduction any search or inspection in connection with the enforcement of the Act, this Part, or any other regulation or permit issued under the Act;

(d) Forcibly assault, resist, oppose, impede, intimidate, or interfere with any authorized officer in the conduct of any search or inspection described in paragraph (c) of this section;

(e) Resist a lawful arrest for any act prohibited by this Part;

(f) Interfere with, delay, or prevent, by any means, the apprehension or arrest of another person knowing that such person has committed any act prohibited by this Part;

(g) Forcibly assault, resist, impede, intimidate or interfere with an observer placed aboard a fishing vessel pursuant to this Part;

(h) Violate any other provision of this Part, the Act, or any other regulation or permit issued under the Act.

§676.7 Enforcement

(a) General. The owner or operator of any fishing vessel regulated under this Part shall immediately comply with instructions issued by an authorized officer to facilitate safe boarding and inspection of the fishing vessel, its gear, equipment, and catch for the purposes of enforcing the Act and this Part.

(b) Signals. Upon being approached by a Coast Guard cutter or aircraft, or other vessel or aircraft authorized to enforce the Act, the operator of a fishing vessel shall be alert for signals conveying enforcement instructions. The vessel may guard Channel 16, VHF-FM, or 2182 KH2, if equipped with suitable radios, to receive verbal instructions. The following visual signals extracted from the International Code of Signals are among those which may be used:

(1) "L", meaning "You should stop your vessel instantly,"

(2) "SQ3", meaning "You should stop or heave to; I am going to board you,"

(3) "RY CY", meaning "You should proceed at slow speed, a boat is coming to you," and

(4) "AA AA AA etc." is the call to an unknown station.

(c) Boarding. A vessel signaled to stop or heave to for boarding shall:

(1) Stop immediately and lay to or maneuver in such a way as to permit the authorized officer and his or her party to come aboard;

(2) If requested, provide a safe ladder for the authorized officer and his or her party;

(3) When necessary to facilitate the boarding, provide a man rope, safety line, and illumination for any ladder; and

(4) Take such other actions as necessary to ensure the safety of the authorized officer and his or her party and to facilitate the boarding.

§676.8 Penalties.

Any person or fishing vessel found to be in violation of this Part shall be subject to the civil and criminal penalty provisions and forfeiture provisions prescribed in the Act, in 50 CFR Parts 620 (Citations) and 621 (Civil Procedures), and in other applicable law.

Subpart B -- Management Measures

§676.20 Optimum Yield.

(a) Determination. The optimum yield (OY) for the fishery governed by this Part shall be the sum of three components: an allowable incidental catch (AIC), a summer apportionment, and a winter apportionment. These components shall be calculated as follows:

(1) Allowable incidental catch (AIC). AIC shall be 0.10 per cent of the domestic annual harvest (DAH) for target and other species in the groundfish fishery of the Bering Sea and Aleutian Islands area, as determined under 50 CFR §675.20.

(2) Summer apportionment. Subject to reduction as specified below, the summer apportionment of OY shall be 2,000 metric tons (mt). The Regional Director, after consultation with the Council and the State of Alaska, may by field order issued pursuant to §676.21(d) and (e) reduce the summer apportionment as necessitated by any of the following factors:

(A) The extent to which the subsistence and inshore commercial fisheries have harvested or exceeded the ABC;

(B) The condition of the spawning stocks of herring, with special focus on the subsistence stocks;

(C) The abundance of spawning herring and their spawning success;

(D) The age composition of the spawning hering;

(E) Recruitment to the spawning stocks of herring;

(F) Variation in exploitation rates between the spawning stocks; and

(G) Changes in the management of the inshore commercial fishery by the State of Alaska.

(3) Winter apportionment. The winter apportionment of OY shall be determined according to the following formula:

$$\text{Winter apportionment} = \frac{\text{ABC} - \text{Inshore Commercial Harvest} - \text{Subsistence Adjustment} - (\text{AIC} + \text{PSC})}{2},$$

where

(A) ABC is the acceptable biological catch calculated under Appendix I to this Part;

(B) Inshore commercial harvest is equal to the total harvest taken from State waters adjacent to the management area between April 1 and September 30, plus the harvest in that portion of the management area south of 55°47' N. latitude between April 1 and September 30;

(C) Subsistence adjustment equals 500 mt;

(D) AIC equals 0.10 per cent of the DAH for target and other species in the groundfish fishery of the Bering Sea and Aleutian Islands area, as determined under 50 CFR §675.20; and

(E) PSC is a Prohibited Species Catch calculated as 0.10 per cent of the Total Allowable Level of Foreign Fishing (TALFF) for target and other species in the groundfish fishery of the Bering Sea and Aleutian Islands Area, as determined under 50 CFR § 675.20.

In the event that the winter apportionment as so calculated is less than zero, the winter apportionment shall be equal to zero. Further limitations on the winter apportionment are as follows:

(A) If the amount so calculated is less than 2,000 mt, the winter apportionment shall be zero.

(B) If the amount so calculated is greater than 10,000 mt, the winter apportionment shall be 10,000 mt.

(C) If the current herring spawning biomass is less than one-half of the MSY biomass as specified in Appendix I to this Part, the winter apportionment shall be zero.

The Regional Director, after consultation with the Council and the State of Alaska, may by field order issued pursuant to §676.21(d) and (e) further reduce the winter apportionment as necessitated by any of the following factors:

(A) The extent to which the subsistence and inshore commercial fisheries have harvested or exceeded the ABC;

(B) The condition of the spawning stocks of herring, with special focus on the subsistence stocks;

(C) The abundance of spawning herring and their spawning success;

(D) The age composition of the spawning herring;

(E) Recruitment to the spawning stocks of herring; and

(F) Variation in exploitation rates among the spawning stocks.

(b) Procedures and availability. The three components of opimum yield shall be determined and made available for harvest as follows:

(1) Allowable incidental catch (AIC).

(A) Procedure. Prior to January 1 the Regional Director shall by rule-related notice determine the initial value of AIC for the new calendar year as defined in paragraph (a)(1) of this section, based upon the initial DAH for that year of target and other species in the groundfish fishery of the Bering Sea and Aleutian Islands area. The determination of initial AIC and the publication of the value determined shall follow the procedure and schedule set forth at 50 CFR §675.20(a). Increases in AIC to accommodate apportionment of groundfish reserves to DAH shall be calculated as 0.10 per cent of each such apportionment. Determination and publication of such increases shall follow the procedure and schedule set forth at 50 CFR §675.20(b).

(B) Availability. AIC may be harvested and retained only by vessels of the United States, and only incidentally to the participation of those vessels in the groundfish trawl fishery within the management area. Foreign vessels permitted to purchase groundfish from vessels of the United States under regulations set forth at 50 CFR Part 611 may purchase, process, and retain such herring.

AIC shall be available for incidental harvest beginning January 1, unless the Herring Savings Area described in Appendix II to this Part has been closed after April 1 of the previous calendar year under §676.21 of this Part. If the Herring Savings Area has been so closed, herring shall remain a species prohibited to vessels of the United States until April 1 of the new calendar year, at which time the AIC shall become available for incidental harvest. When AIC is harvested within the calendar year for which it has been prescribed, all or a portion of the Herring Savings Area shall be closed to trawling for groundfish by vessels of the United States until April 1 of the following year, subject to the provisions at 50 CFR §676.21(d) and (e).

AIC shall be available for harvest in any part of the management area where another component of OY is not available for harvest.

All herring caught in areas closed to directed herring fishing shall be treated as AIC. All herring caught in areas open to directed herring fishing shall be considered to have been harvested under the summer or winter apportionment.

(2) Summer apportionment.

(A) Procedure. The summer apportionment shall be 2,000 mt unless the Regional Director determines that one or more of the factors set out at §676.20(a)(2) requires a reduction. Any such reduction shall be by field order, under the provisions of §§676.20(a)(2) and 676.21(e).

(B) Availability. The summer apportionment shall be available for harvest by vessels of the United States in that portion of the management area lying south of 55°47' N. latitude from July 1 (or the date on which a field order reducing the summer apportionment is filed with the FEDERAL REGISTER, whichever comes later) through September 30. Herring harvested in the territorial sea adjacent to the management area and south of 55°47' N. latitude between July 1 and September 30 shall also be considered to have been harvested under the summer apportionment. When the summer apportionment has been harvested, that portion of the management area south of 55°47' N. latitude shall be closed to directed fishing for herring by notice published in the FEDERAL REGISTER. This closure shall remain in effect until July 1 of the following year, or until a winter apportionment is finally determined, whichever comes earlier.

(3) Winter apportionment

(A) Procedure. Annually by July 1 the Regional Director shall by rule-related notice publish in the FEDERAL REGISTER estimate ABC in accordance with the formula set out in Appendix I to this Part.

In the same notice, he shall estimate the winter apportionment for the current fishing year.

Public comment shall be accepted on the values estimated for a period of at at least 45 days after the rule-related notice is published in the FEDERAL REGESTER. Any timely comments submitted in accordance with this paragraph shall be considered in reviewing those estimates and in establishing final values for ABC and the winter apportionment. Comments provided for in this paragraph shall be addressed to the Director, Alaska Region, National Marine Fisheries Service, P.O. Box 1668, Juneau, Alaska 99802. The Regional Director shall make available to the public during business hours the aggregate data upon which any estimated or final values for ABC and the winter apportionment are based at the National Marine Fisheries Service Alaska Regional Office, Federal Building, Room 453, 907 West Ninth Street, Juneau, Alaska. These data shall be available for a sufficient period to facilitate informed comment by interested persons.

Annually by October 1 or as soon thereafter as is practicable, the Regional Director shall by rule-related notice determine final values for ABC and for the winter apportionment under §676.20(a)(3) and Appendix I to this Part.

(B) Availability. The winter apportionment shall be available for directed harvest only by vessels of the United States throughout the management unit from October 1, or the date on which the final determination of the winter apportionment is filed with the FEDERAL REGISTER, whichever comes later, until March 31, the end of the fishing year. In the event that the winter apportionment is zero, the entire management area shall be closed to directed fishing for herring until March 31 of the following year.

The Regional Director shall by notice published in the FEDERAL REGISTER close all or part of the Herring Savings Area described in Appendix II to this Part to vessels of the United States if:

(i) OY (including AIC) has been harvested; or

(ii) the amount of AIC remaining is likely to be harvested within one reporting period (one week).

This notice shall take effect upon its filing with the Office of the FEDERAL REGISTER.

(c) Prohibited species.

(1) Prohibited species, for purposes of this Part, means any species of fish caught while fishing for herring in the management area, the retention of which is prohibited by other applicable federal law; and herring whenever there is no OY available for harvest and retention under this Part.

(2) The operator of each vessel of the United States participating in the fishery regulated under this Part, or participating in any fishery in the management area when there is no OY available for harvest and retention under this Part, shall minimize that vessel's catch of prohibited species. Each such operator shall sort the catch of the vessel as soon as possible after retrieval of the catch and, after allowing for sampling by an observer (if any), shall return any catch of prohibited species or parts thereof to the sea immediately with a minimum of injury regardless of its condition.

(3) It shall be a rebuttable presumption than any prohibited species found onboard a fishing vessel participating in the fishery regulated under this Part, or in any fishery in the management area

when there is no OY available for harvest and retention under this Part, was caught and retained in violation of this subsection.

§676.21 Time and area limitations.

(a) Fishing year. The fishing year shall be April 1 through March 31.

(b) Management area.

(1) That portion of the management area north of 55°47' N. latitude shall be closed to directed fishing for herring by vessels of the United States between April 1 and either September 30 or the date on which the final determination of the winter apportionment is filed with the FEDERAL REGISTER, whichever is later. In the event that the winter apportionment is zero, this portion of the management area shall remain closed to directed fishing for herring through March 31.

(2) That portion of the management area south of 55°47' N. latitude shall be closed to directed fishing for herring from April 1 through June 30. In the event that the summer apportionment of OY is zero, this portion of the management unit shall remain closed to directed fishing for herring through March 31 or until the date on which the final determination of the winter apportionment is filed with the FEDERAL REGISTER, whichever is earier.

(c) Herring savings area.

(1) The Regional Director shall by notice published in the FEDERAL REGISTER close all or part of the Herring Savings Area described in Appendix II to this Part to trawling by vessels of the United States for the rest of the current fishing year if:

(A) OY (including AIC) has been harvested; or

(B) the amount of remaining AIC is likely to be harvested within one reporting period (one week).

This notice shall take effect upon its filing with the Office of the FEDERAL REGISTER.

(2) For the purposes of this Part all herring caught in a portion of the management area open to directed fishing for herring shall be considered to have been harvested under the summer or winter apportionment. All herring harvested in portions of the management area closed to directed fishing for herring shall be treated as AIC, if any AIC is available for incidental harvest. All herring harvested in the management area subsequent to the harvest of OY (including AIC) shall be treated as prohibited species.

(d) Modifications of time and area limitations, and of summer apportionment. The Regional Director may modify the time and area closures prescribed in this section, may open and close fishing areas or parts thereof, and may reduce the summer apportionment as provided by §676.20 of this Part, by issuing a field order in accordance with paragraph (e) of this section. Field orders shall be based on the best available scientific information, and upon any of the following considerations:

(1) the effect of overall fishing effort;

(2) the catch per unit of effort and rate of harvest;

(3) the relative abundance of herring in comparison with pre-season expectations;

(4) the performance of the subsistence and commercial roe fisheries;

(5) the proportion of immature or spawned-out herring and the age structure of the population;

(6) general information on the condition of herring;

(7) information pertaining to the optimum yield for herring;

(8) timeliness and accuracy of catch reporting by buyers to the extent that such timeliness or accuracy may reasonably be expected to affect proper management;

(9) the magnitude and distribution of incidental catch of herring in the groundfish trawl fisheries;

(10) any other information on herring distribution in the management unit; and

(11) any other factors necessary for the conservation and management of the herring resource.

Field orders reducing the summer apportionment shall be based on the best available scientific information and upon any of the factors set forth in §676.20(a)(2) of this Part.

(e) Field orders.

(1) Any field order issued by the Regional Director under this Part shall include the following:

(A) the reasons for the field order, as set out in paragraphs (c) and (d) of this section, and paragraphs (a) and (b) of §676.20 of this part.

(B) a description and order of the modification; and

(C) the effective dates of the modification.

(2) No field order issued under this section may take effect until:

(A) it has been filed for publication with the Federal Register;

(B) the foreign nations concerned and the designated representatives for affected foreign fishing vessels, if any, are notified. If practicable, notification shall be given at least 48 hours before the field order is to be effective;

(C) it has been broadcast at those time intervals, channels and frequencies customarily used by ADF&G to broadcast similar notices of closure, for 48 hours prior to its effective date; and

(D) the public has been offered the opportunity to comment upon the proposed field order for a period of at least thirty (30) days, unless the Regional Director finds that such prior opportunity for public comment would adversely affect the conservation and management of herring.

(3) If the Regional Director finds that prior opportunity for public comment on the field order would adversely affect the conservation and management of herring, he shall receive public comment on the field order for thirty (30) days after its effective date, making available to the public during business hours the aggregate data on which it was based. After considering the comments received, the Regional Director shall determine whether the field order should be changed.

(4) Any modification prescribed by a field order issued under this section shall remain in effect in accordance with the terms of the field order, or of any subsequent field order, rule-related notice, or regulation.

(f) Other regulations. Time and area closures imposed by or under Part 675 of this Title shall also apply to all fishing for herring in the Bering Sea and Aleutian Islands portion of the management area, described at 50 CFR §675.1(d).

§676.22 Reporting requirements.

(a) Fishing vessel reporting requirements.

(1) Port of landing outside Alaska. The operator of any fishing vessel that harvests and retains herring under this Part, and lands such herring at a port outside the State of Alaska shall report that harvest to ADF&G on a completed State of Alaska fish ticket, or an equivalent document containing all of the information required on an Alaska fish ticket, within one week after that herring is landed. The address to which these documents must be sent is: Director, Division of Commercial Fisheries, Alaska Department of Fish and Game, P.O. Box 33-2000, Juneau, Alaska 99802.

(2) Sale, delivery, or consumption at sea.

(A) For each consumption or sale or delivery to a United States fish processor of herring harvested and retained under this Part, the operator of the fishing vessel performing that consumption, sale or delivery shall submit the following information to ADF&G:

(i) a completed State of Alaska fish ticket, or an equivalent document containing all of the information required on an Alaska fish ticket; and

(ii) a statement indicating whether or not the vessel to which any sale or delivery was made was a vessel of the United States.

(B) The information required by paragraph (a)(2)(A) of this section shall be submitted to ADF&G within one week of the first return of the vessel that harvested the herring to port following such sale, delivery, or consumption. Such information may be submitted by the United States fish processor to which the sale or delivery at sea was made, acting as the agent of the fishing vessel operator, but the fishing vessel operator shall remain ultimately responsible for submission of the information.

(b) Processor reporting requirements. When requested by the Regional Director, but not more than four times a year, each United States fish processor who intends to process United States harvested herring taken in the management unit shall complete a written survey received from the Regional Director, to include the following information:

(1) the quantity of herring that the processor has the capacity to process during a designated period; and

(2) the quantity of herring that the processor expects to process from any areas of the management area at any time during the fishing year.

(c) Joint venture reporting requirements. When requested by the Regional Director, but not more than four times a year, each joint venture representative whose company or association intends to deliver herring harvested by United States fishermen from the management area to foreign processors shall complete a written survey received from the Regional Director. This survey shall state the quantity of United States - harvested herring that the joint venture operator expects to deliver to foreign processors from any areas of the management unit at any times during the fishing year.

§611.95 Bering Sea and Aleutian Islands Herring Fishery

(a) Purpose.

(1) This section regulates foreign fishing for herring within those portions of the fishery conservation zone located in (1) the Chuckchi Sea lying south of Point Hope, (2) the Bering Sea, and (3) the North Pacific Ocean adjacent to the Aleutian Islands and west of 170°00' W. longitude, over which the United States exercises exclusive fishery management authority (hereafter referred to in this section as the "management area").

(2) For regulations governing fishing for herring within the management area by vessels of the United States, see 50 CFR Part 676.

(3) These regulations implement the Bering-Chuckchi Sea herring fishery management plan developed by the North Pacific Fishery Management Council.

(b) Authorized fishery. Directed foreign fishing for herring or retention of herring incidentally harvested by foreign vessels is prohibited. Herring shall be treated as a prohibited species in accordance with §611.13 of this Part.

(c) Prohibited species catch limit (PSC).

(1) Determination. The prohibited species catch limit (PSC) shall be 0.10 per cent of the total allowable level of foreign fishing (TALFF) for target and other species in the groundfish fishery of the Bering Sea and Aleutian Islands area, as determined under 50 CFR §675.20.

(2) Procedure. Prior to January 1 the Regional Director shall by rule-related notice determine the initial value of PSC, as defined

in paragraph (c)(1) of this section, for the new calendar year. The determination of initial PSC and the publication of the value determined shall follow the procedures and schedule set forth at 50 CFR §675.20(a). Increases in PSC to accommodate apportionment of groundfish reserves to TALFF shall be calculated as 0.10 per cent of each such apportionment. Determination and publication of these values shall follow the procedures and schedule set forth at 50 CFR §675.20(b). PSC shall be assigned to foreign nations in proportion to their allocations of the TALFF for groundfish and other species in the groundfish fishery of the Bering Sea and Aleutian Islands area.

(3) Availability. PSC shall apply to the incidental harvest of herring by foreign vessels trawling for groundfish in the management area beginning January 1, unless the Herring Savings Area provided for by paragraph (d) of this section has been closed to trawl vessels of a nation after April 1 of the previous calendar year. If the Herring Savings Area has been closed to groundfish trawling by a nation after April 1 of the previous calendar year, it shall remain closed to trawling by that nation until April 1 of the new calendar year, at which time the PSC shall come into effect for the remainder of the new calendar year.

(d) Herring Savings Area.

(1) Description. The Herring Savings Area is described in Appendix II, to 50 CFR Part 676.

(2) Closure. When a nation harvests its share of the PSC for herring, or when the amount of its PSC remaining can be harvested within one reporting period (one week), the Regional Director shall by notice of closure published in accordance with §611.15(c) close

all or part of the Herring Savings Area to trawling by vessels of that nation until April 1 of the following calendar year. Any portion of a nation's PSC which is not harvested during a given calendar year shall not be reassigned or carried over to the following year.

(3) Field orders. The Regional Director may modify the time and area closures imposed upon the Herring Savings Area by field order in accordance with the procedures and criteria set forth at 50 CFR §676.21(d) and (e).

APPENDIX I

7.6.1 Maximum sustainable yield

Herring populations are subject to significant changes in abundance over relatively short periods of time. It appears that these changes may result from changing environmental conditions and/or be related to fishing pressure. Because of this aspect of herring population dynamics, the maximum sustainable yield (MSY) concept does not provide a good indicator of the level of harvest that should be allowed in a given fishing year. MSY is a measure of the average maximum annual yield of the fishery over a long period of time. An estimate of the MSY for eastern Bering Sea herring can be calculated by first estimating the average size of the virgin resource. Two methods have been used to do this: (1) estimates based on early Russian hydroacoustic trawl surveys and (2) ecosystem modeling. Each method has its limitations and at present, it is difficult to determine the accuracy of either. The following is a description of each method.

In 1963, three years after the fishery began, the eastern Bering Sea herring biomass was estimated to be 2.16 million mt based on a Soviet hydroacoustic survey of the wintering grounds (Shaboneev 1965). Using the same data, a recent paper by Kachina (1978) reduced this earlier estimate to 0.374 million mt by using a lower mean school density of 0.5 fish/m^3 compared to 3.38 fish/m^3 used for the original estimate.

According to Shaboneev, schools were surveyed at night and the area and height of schools were charted acoustically. School composition and age distribution were determined by trawling. The original density (3.38 fish/m^3) was determined by comparing acoustic echograms from the eastern Bering Sea to echograms of schools sampled by purse seines in western Bering Sea coastal waters. The revised density estimate of 0.5 fish/m^3 is based on observations from subsequent surveys of herring concentrations on the winter grounds northwest of the Pribilofs during 1969-71 (Fadeev, personal communication).[1/]

The densities derived are questionable but cannot be fully evaluated because few specific details regarding Soviet survey methods and accuracy are available. However, data reported in the literature and from individuals involved with herring hydroacoustic surveys indicate that the range of densities used by the Soviets may be extreme and an intermediate value may be more realistic.

There are also other sources of potential error in these estimates. The smaller herring stocks in northern areas may not have been included in the Soviet hydroacoustic survey and the age distribution data reported by Shaboneev indicate that age-1 fish were not included and age-2 fish only partially included in the survey. These factors would tend to bias the biomass estimate downward.

A numerical ecosystem model was applied to estimate biomass of eastern Bering Sea herring (Laevastu and Favorite 1978). This model simulated herring abundance based on the amount of herring needed to sustain the diet of herring predators at reported rates of consumption. Although the accuracy of

1/ Fadeev, N. Pacific Institute of Fisheries and Oceanography (TINRO), Vladivostok, USSR. Information presented at US - USSR Scientific meetings, Seattle, WA, June 5-8, 1979.

input parameters, such as size of predator populations and consumption rates, has not yet been sufficiently evaluated, this model estimated that a stock size of 2.75 million mt of herring is réquired to maintain components of the ecosystem including predators at a level observed in the mid-1960's prior to the start of intensive fishing.

Calculation of MSY from each estimate of virgin biomass can be accomplished by applying a method developed by Alverson and Pereyra (1967) for obtaining first approximation of yield from an unexploited biomass (MSY = 0.5 MB, where B = virgin biomass and M = natural mortality of 0.47). The resultant MSY values are provided in Table 7-6.

A third estimate of MSY can be derived by average annual catch data for the foreign fishery over the long term. The average long term catch is 48,712 mt. This figure was calculated using the total catches from 1962 after the fishery developed up to 1976, after which date the fishery was curtailed, and excluding 1967 when data were unavailable (Table 3-7). Data from 1977-79 were not used in this calculation because foreign fisheries were limited by low quotas established in the PMP. Assuming an exploitation rate of 0.2 (see Section 7.6.2.2) the estimated biomass would be 243,560 mt.

Table 7-6. Estimation of biomass and MSY

Estimated Biomass (million mt)	Estimated MSY (mt)	Biomass Data Source
2.750	194,000[1]	Ecosystem Model (Laevastu and Favorite 1978)
0.374 - 2.16	88,000-507,000	Hydroacoustic Survey (Shaboneev 1965, Kachina 1978)
new entry → 0.243[2]	47,812	Average Catch 1962-76

1/ Assumes 30% of biomass is available for exploitation.
2/ Assumes a 20% exploitation rate.

The actual performance of the foreign fishery from 1962-76 indicates that MSY estimates in excess of 100,000 mt may be too high. The overall abundance of herring decreased during this period. Some of the decrease may have been due to environmental conditions, but the period over which the catch was averaged is relatively long (14 years), so that positive and negative environmental factors should have balanced to some degree.

It is difficult to determine which estimate of MSY is the best, since each method is based on different sets of assumptions which may or may not be valid. It is evident from all indices of stock abundance that herring stocks declined in the early 1970's and are now increasing. Choosing the appropriate level of MSY depends on whether declines were due to excessive fishing mortality or environmental factors causing poor survival. If the declines were due to overfishing then MSY is likely near the average catch. However, if declines were due to poor recruitment, then MSY may be greater than the average catch level but is dependent on the magnitude and frequency of population fluctuations.

Given the lack of definitive biomass data, it appears reasonable to use the long term average catch of 48,712 mt as an estimate of MSY. This figure is considered the best available and will apply until better data are available. It may be revised as additional research information and catch statistics become available.

7.6.2 Acceptable biological catch

Because the herring population of the Bering Sea fluctuates significantly, the Acceptable Biological Catch (ABC) in any given year must reflect current stock conditions to the maximum extent possible. Therefore, ABC shall be determined annually and may be adjusted during the year as new information becomes available. The ABC determined under this plan applies to the combined state and federal management areas. The method of determination is as follows:

7.6.2.1 Spawning biomass estimation

Since 1977, ADF&G has performed aerial surveys along the western Alaska coast during the spawning period. The purpose of these surveys is to count schools of herring which are then recorded according to total surface area. Estimates of the spawning biomass are then obtained by applying a density factor to the total surface area of all schools recorded on the peak day in each spawning area. Using this technique, the spawning biomass in 1978 from Bristol Bay to Norton Sound was estimated to be 187,210-334,723 mt and estimates for 1979 were 258,079-637,583 mt (Barton and Steinhoff 1980). The estimate generated by ADF&G in 1982 (excluding Nelson Island) was 116,000 mt (Table 7-7).

The spawning biomass estimate does not include any data from the Aleutian Islands/Alaska Peninsula area or from the Port Clarence/Kotzebue Sound region. Reliable spawning biomass estimates do not presently exist for either of these areas. When spawning biomass estimates are available they will be included in the spawning biomass estimation used to determine ABC.

Despite the problems with the method, the spawning biomass estimates developed by aerial surveys are the best available. Until additional data become available through hydroacoustic surveys, spawn deposition surveys, or other sources, the aerial surveys shall be the basis for determining annual spawning biomass.

In the past, there have been times when ice and weather conditions have been such that aerial surveys could not be conducted to accurately assess spawning biomass. When spawning surveys are limited by these or other factors, the primary stock assessment tool will be virtual population analysis (VPA or cohort analysis). VPA is based on data generated from previous years' inshore and offshore surveys. The biomass of each year-class of herring is computed and subjected to an estimated annual mortality (a combination of natural and fishing mortality). An estimate of recruitment into the fishery is also computed. The current biomass estimate is then the sum of the computed biomass estimates for each year-class and the predicted recruit biomass.

If it is not possible to determine herring abundance by using aerial surveys or VPA, stock condition will be assessed by using commercial catch rates, the percentage of roe recovery, ratios of pre to post spawners from test net and commercial catches (both inshore and offshore), spawn deposition observations and any other available information.

When virtual population analysis or other methods are used to provide biomass estimates, those estimates must be reduced to a spawning biomass estimate before they may be used to determine ABC.

Table 7-7. Estimated biomass and commercial harvest of Pacific herring in eastern Bering Sea fishing Districts, Alaska, 1978-1982.

District		Biomass (m.t.)	Harvest (m.t.)	Roe %	Estimated Value (dollars)	% Biomass Harvested
1982						
	Togiak	88,800	19,556	8.8	6,174,300	22.0
	Security Cove	4,600	737	9.3	271,000	16.0
	Goodnews Bay	2,400	441	9.5	187,900	18.4
	Cape Romanzof	4,400	596	9.3	221,700	13.6
	Norton Sound	15,800	3,567	8.8	1,046,200	22.6
	Total	116,000	24,897	8.9	7,630,100	21.5
1981						
	Togiak	143,900	11,374	9.1	3,988,000	7.9
	Security Cove	7,500	1,064	8.1	347,070	14.2
	Goodnews Bay	3,900	596	7.7	196,170	15.3
	Cape Romanzof	4,400	653	8.0	211,260	15.0
	Norton Sound	22,800	3,965	8.8	1,500,000	17.3
	Total	182,500	17,652	8.9	6,242,500	9.7
1980						
	Togiak	62,300	17,774 1/	9.2	3,205,000	28.5
	Security Cove	1,100	632	8.2	151,000	57.4
	Goodnews Bay	1,100	406	9.5	97,000	36.9
	Cape Romanzof	2,700	554	9.8	132,000	20.5
	Norton Sound	7,600	2,224	8.1	500,500	29.3
	Total	74,800	21,590	8.8	4,085,500	28.9
1979						
	Togiak	216,800	10,115	8.6	6,700,000	4.7
	Security Cove	19,500	385	8.5	327,000	2.0
	Goodnews Bay	6,700	82	4.7	38,500	1.2
	Cape Romanzof	2,700	0	-	-	0.0
	Norton Sound	7,000	1,172	7.0	628,200	16.7
	Total	252,700	12,406	8.0	7,694,000	4.9
1978						
	Togiak	172,600	7,033	8.2	2,300,000	4.1
	Security Cove	1,200	259	-	-	21.6
	Goodnews Bay	400	0	-	-	0.0
	Cape Romanzof	2,700	0	-	-	0.0
	Norton Sound	4,800	13	-	-	0.3
	Totals	181,700	7,305	8.2	2,300,000	4.0

1/ Does not include an estimated 5,200 m.t. of waste.

7.6.2.2 Exploitation rates

Once an estimate of the spawning biomass has been established, the level at which ABC is set will depend on the exploitation rate that is applied. In other herring fisheries, several methods of determining an appropriate exploitation rate have been used. These are briefly summarized below.

In the northeastern Pacific, herring are generally managed for escapement (egg deposition). The rate of exploitation is set in the range of 10-30%. In British Columbia, escapement is set at a level that historically produced the greatest recruitment; herring that are surplus to escapement requirements are harvested. Using this method, Canadian biologists estimate that the rate of exploitation has averaged 20-30%. In Southeastern Alaska, optimum escapement is unknown but stock abundance is known to be low and only 10 percent of the estimated biomass is harvested in order to increase abundance. When a stock is below a determined minimum biomass, no fishing occurs, and if strong year classes are present, 20% of the biomass may be harvested.

In Washington, the herring exploitation rate has been determined to be 20 percent based on the assumption that at this rate, fishing mortality approximately equals the rate of natural mortality (Trumble, pers. comm.)[1/] Also it is assumed that at this level the stock will be protected from sharp reductions due to recruitment failures and that herring are maintained at a level that provides adequate forage for predators (i.e., salmon).

Exploitation of many Atlantic herring stocks is based on yield-per-recruit analysis (Beverton and Holt 1957). The yield-per-recruit model defines a point of maximum yield-per-recruit for a given age of entry into the fishery and rate of fishing mortality. However, herring do not generally have a maximum, but rather yield increases with increasing fishing mortality (Figure 7-12). Since the yield-per-recruit/F curve is rather flat, fishing mortality can be reduced from maximum without much loss in yield. At a lower than maximum rate of fishing mortality a larger stock size is maintained and

1/ Robert Trumble, Washington Dept. of Fisheries, Seattle, WA.

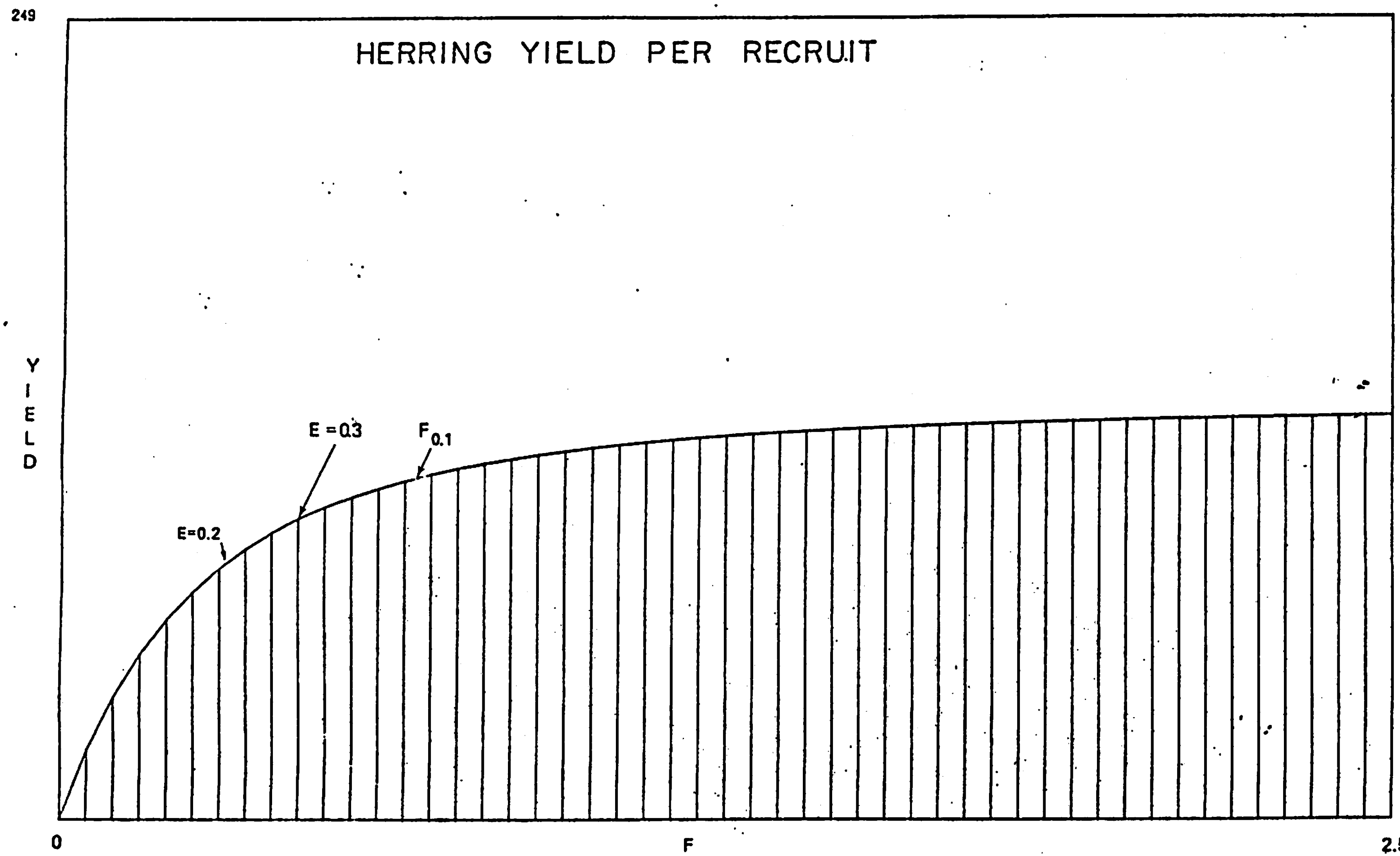


Figure 7-12. Herring yield per recruit at various levels of fishing mortality (F) (in 0.05 increments) and yield at 3 levels of exploitation (E). A & F 0.1 th E value = 0.39.

the fishery is more stable since more ages are in the fishery. The conventional lower rate of fishing mortality used is the $F_{0.1}$ level, which is the level at which the increase in yield-per-recruit from an additional unit of fishing mortality is 10% of what the yield would have been for a unit of fishing mortality on the virgin stock (ICNAF 1976). The $F_{0.1}$ rate for eastern Bering Sea herring occurs when F = 0.675 and the exploitation rate corresponding to this level of fishing mortality is 39%.

Thus, the range of exploitation rates which could be considered for the eastern Bering Sea herring fishery is 10-39%. There are a number of factors which indicate that a conservative rate within this range should be selected:

(1) The fishery in its present form has a very short history so that there is not a lengthy data base to analyze;
(2) the accuracy of biomass estimates is unknown;and
(3) biological relationships are little known.

Together, these factors indicate that under average conditions an exploitation rate of 20% would be appropriate in view of currently available data. If abundance indices were low, or if future recruitment was anticipated to be poor, then a rate less than 20% should be applied.

A method of determining the appropriate level of exploitation is to assume that MSY is obtained at an exploitation rate of 0.2 (E_{msy}). This means that the biomass level (B_{msy}) that produces MSY is equal to MSY/.2 or 48,712/.2 = 243,560 mt.

When stocks are at a level that will produce MSY, the exploitation rate is equal to .20. However, biomass will not always remain at MSY; rather, it will fluctuate around MSY in response to growth, recruitment and mortality. To adjust exploitation when the current biomass estimate is below the MSY biomass, the exploitation rate will be adjusted by the ratio of current biomass to MSY biomass, or:

$$E_t = \frac{B_t}{B_{msy}} \times E_{msy}$$

for example, if B_t = 200,000 mt, then

$$E_t = \frac{200,000}{243,560} \times .20 = .16$$

Until a better estimate of the current biomass becomes available the spawning biomass estimate (Section 7.6.2.1) will be used.

Because of the uncertainty in the determination of MSY it has been determined that the exploitation rate shall not exceed 20%. This limitation shall be reviewed when better data are available to determine MSY.

7.6.2.3 Determination of ABC

Annually by July 1, ABC shall be estimated by the Regional Director of the NMFS according to the procedure described below. This estimate shall be reviewed by the Council and its advisory groups. The Council shall provide for public comment on the estimated values and procedures.

The Council shall on October 1 recommend a final value of ABC to the Assistant Administrator or the Alaska Regional Director, NMFS, who will specify the final values. The ABC so specified will be for the current fishing year.

$$ABC = Et \times B_t$$

$$= \frac{\text{spawning biomass estimate}}{\text{MSY biomass}} \times 0.2 \times \text{spawning biomass estimate}$$

7.6.2.3.1 Spawning biomass estimate

Spawning biomass estimates will be determined in accordance with Section 7.6.2.1. The most current data available at the time of determination of ABC shall be used.

Spawning biomass estimates for Nelson Island will be excluded from the spawning biomass estimate. This exclusion is intended to provide an additional degree of protection for the subsistence fishery in this area.

7.6.2.3.2 MSY biomass

In accordance with Section 7.6.1 the best available estimate of MSY biomass is 243,560 mt.

7.6.2.3.3. Limitations on exploitation rate

In accordance with Section 7.6.2.2. the exploitation rate may not exceed 20 percent. If the spawning biomass estimate divided by the MSY biomass is greater than 1, then the exploitation rate (E_t) is set equal to 0.2.

APPENDIX II

8.3.2 Herring Savings Area

As was noted above, prior to 1982 the majority of trawl-caught herring was taken in U.S. Statistical Area II and only a small amount was taken in other areas of the eastern Bering Sea. The Council compared four options in determining which areas should be closed to protect herring. The four options are shown in Figure 8-1, and relative area comparisons are shown in Figure 8-2.

To compare the effectiveness of each closure for herring protection, data supplied to the U.S. by Japan were used. The Japanese data cover the years 1968 through 1978 and contain catches by species, month, 1° longitude by ½° latitude, and vessel class. Comparable data are not available from the Soviet fishery; therefore, it must be assumed that they operated in the same areas as the Japanese. U.S. surveillance reports indicate that the Japanese and Soviet herring fisheries did operate in the same general area, (see Tables 8-1, 8-2 & 8-3).

Area selection was based on the years 1968 and 1972. These years were selected because catches were high and most herring were taken as the target species. Also during these years, there were no catch quotas or regulations that would have influenced fishing. In subsequent years, catches have been low, influenced by declining stocks or quotas and regulations. The boundaries

8.3.1.3 Accounting for AIC

To simplify the accounting of herring harvested as DAH or AIC, all herring caught in an area open to directed herring fishing will be charged against DAH. All herring harvested in an area closed to directed herring fishing will be charged against AIC.

8.3.1.4 Exemptions

The Herring Savings Area applies to trawl gear only. Longline, pot or other gear which are not utilized to fish for herring or catch herring above trace amounts (less than 0.001% of total catch) are exempt from this time/area restriction.

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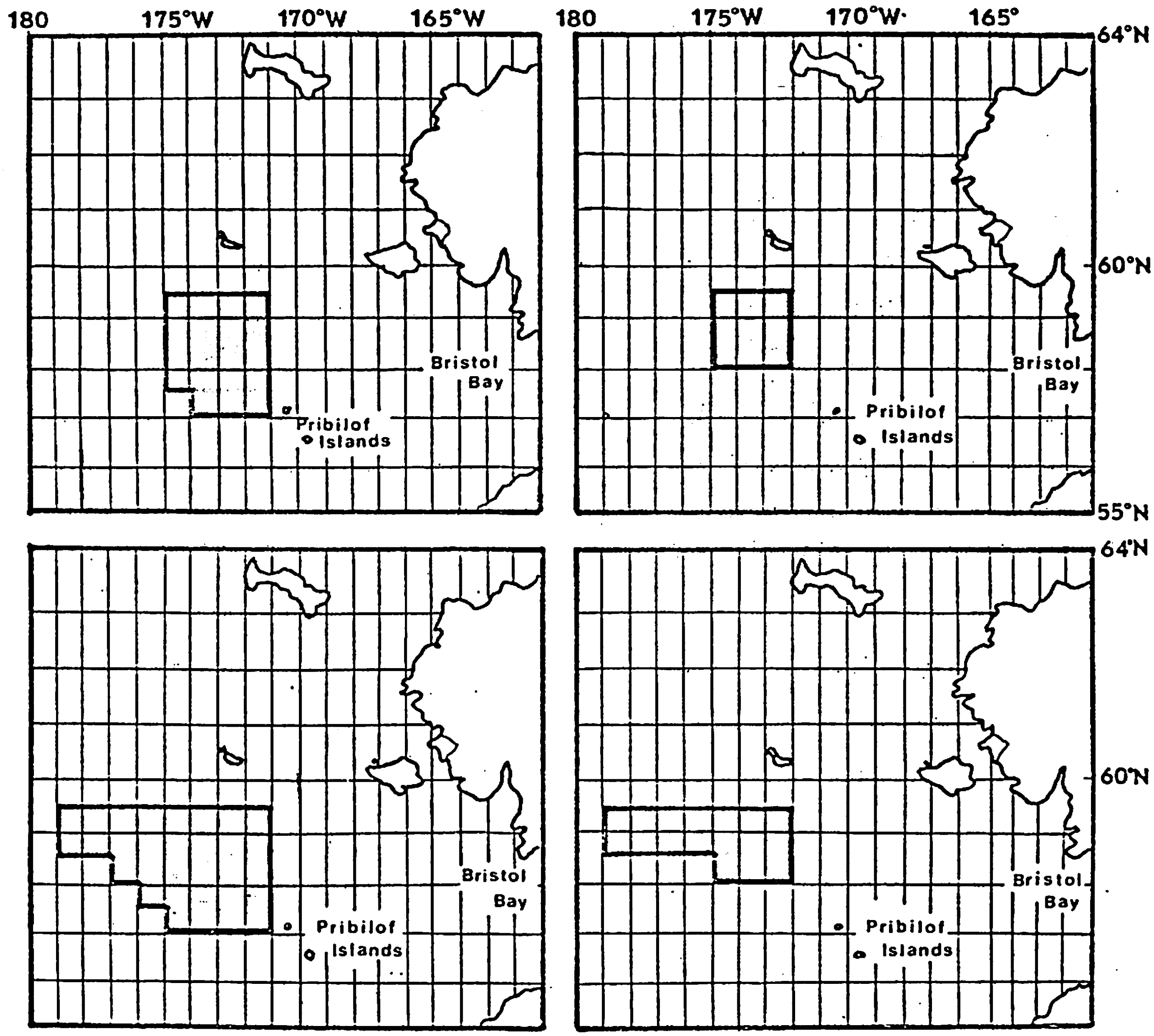

Figure 8-1. Options considered for the Herring Savings Area. Area C provides the maximum protection to the wintering herring populations.

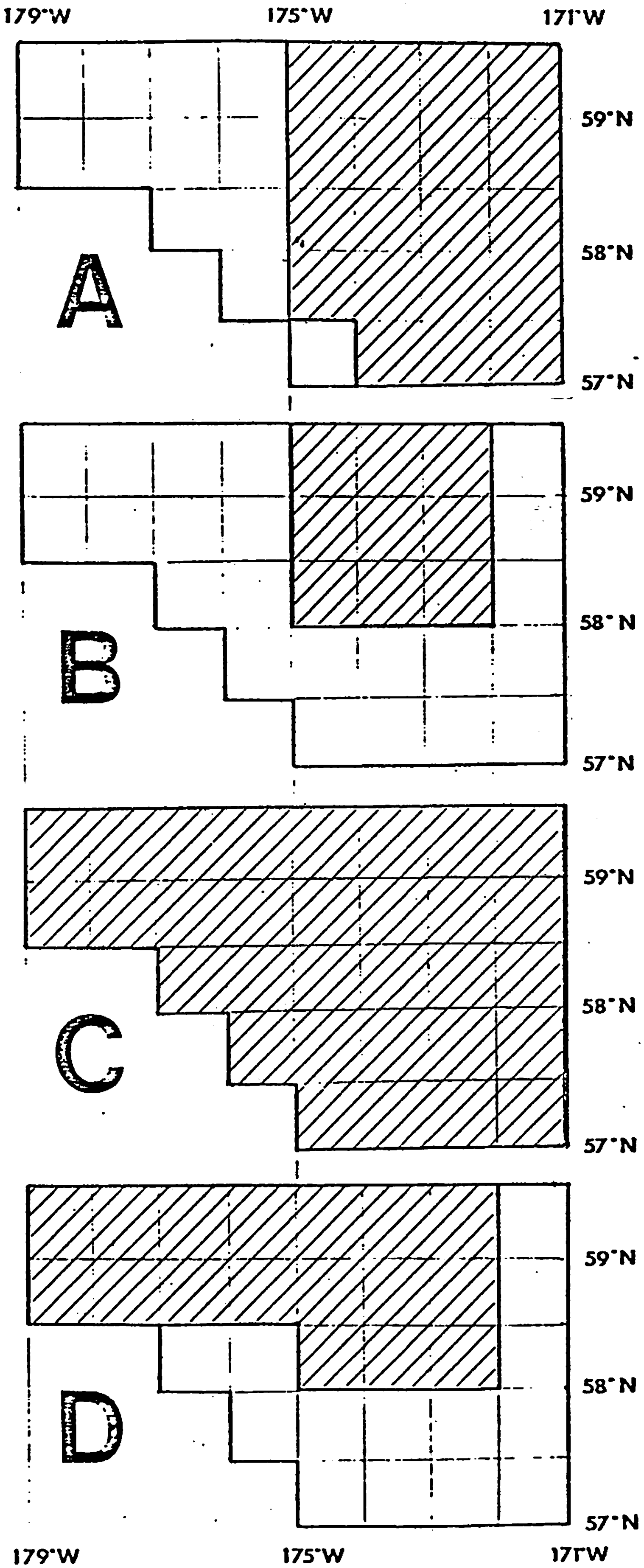

Figure 8-2. Herring savings area options = Relative area comparisons.

of the potential closure areas follow lines of latitude and longitude as much as possible to minimize future enforcement efforts, although, by doing so, some blocks are included in which herring have not been caught.

Table 8-4 contains the catch of herring within each area for the November-March period that the closures would be in effect, total Bering Sea herring catch for gear other than gillnet for the November-March period, and the annual herring catch for the year 1968-1969 and 1977-1978. Mean catches were computed for the entire data series and for the year 1968-1969 to 1971-1972. The latter series is believed to be more indicative of the amount of protection to herring stocks by each time-area closure, because in these years stocks were high, regulations did not exist, and herring was a target species to a greater degree than in later years.

The 1968-1969 to 1971-1972 data show that 90% of the Bering Sea herring catch occurs from November-March and that 88-95% of this catch is taken within the proposed herring time-area closure. Area C (the largest area) provides the greatest protection, accounting for 95% of the average November-March catch and 85% of the average annual catch. Area B (the smallest area) provides the least protection, accounting for 88% of the November-March catch and 79% of the average annual catch. The other two areas (A and D) are intermediate to B and C and account for 93% and 94% of the average November-March catch and 83% of the average annual catch, respectively.

The difference in herring protection afforded by the four areas is nonsignificant because of the variability in distribution of herring over the past years (1968 to 1978). Historically, the greatest proportion of herring harvest has been in Area B, the smallest area. However, there are significant differences in relation to the proportion of total groundfish catch and pollock in particular taken in these areas.

Table 8-5 shows that the November-March Bering Sea groundfish harvest averaged 16.5% of the annual harvest. The proportion of the winter harvest taken in the proposed time-area closures ranges from 24.3% in Area C to 6.3% in Area B. In relation to the Bering Sea annual harvest, the proportion harvested in the time-area closure ranges from 1% to 4%.

Table 8-4. Japanese herring catch in the proposed November-March time-area closures and the eastern Bering Sea and the mean catch and mean percentage of the Bering Sea : annual and November-March catch for the years 1968-69 to 1971-72 and 1968-69 to 1977-78.

	Herring Catch (mt) by Area				Bering Sea	
	A	B	C	D	Nov.-March	Annual (Jul.-June)
1968-69	40316	40273	40479	40436	41875	50857
69-70	20925	17045	21085	17165	22274	23901
70-71	19415	19298	22978	22737	23717	24236
71-72	12301	11748	12534	11978	12889	13143
72-73	18	18	18	18	435	346
73-74	21	14	94	91	620	219
74-75	17	16	124	115	1569	2663
75-76	5	0	296	291	612	3119
76-77	4929	4858	8428	7873	12127	13413
77-78	4	5	431	375	1257	2703
Mean Catch:						
1968-69 to 71-72	23240	22091	24269	23581	25118	28034
1968-69 to 77-78	9795	9327	10647	10109	11737	13460
Mean(%) of Bering Sea November-March Catch:						
1968-72	93	88	97	94		
1968-78	84	80	91	86		
Mean(%) of Bering Sea Annual Catch:						
1968-72	83	79	86	84	90	
1968-78	73	69	79	75	87	

Table 8-5. Japanese total groundfish (including herring) catch in the proposed November-March time-area closures and the eastern Bering Sea and the mean catch and percentage of the Bering Sea annual and November-March catch for 1968-69 to 1977-78.

	Groundfish Catch (1000 mt) by Area					
					Bering Sea	
	A	B	C	D	Nov.-March	Annual
1968-69	44.5	44.4	44.7	44.6	160.0	878
69-70	31.3	20.7	32.5	20.9	180.4	1036
70-71	38.1	24.5	42.8	28.6	264.1	1447
71-72	34.2	16.7	53.6	34.2	305.3	1782
72-73	14.9	6.6	44.1	29.2	257.7	1844
73-74	6.6	6.7	109.1	95.2	245.0	1726
74-75	21.2	4.9	62.0	37.4	191.7	1487
75-76	14.0	0.8	32.2	13.2	297.1	1278
76-77	18.9	13.3	52.0	41.6	157.8	1062
77-78	2.7	1.2	69.4	57.2	174.1	957
Mean Catch:	22.6	14.0	54.2	40.2	223.3	1350
Mean (%) of Bering Sea November-March Catch:						
	10.1	6.3	24.3	18.0		
Mean (%) of Bering Sea Annual Catch:						
	1.7	1.0	4.0	3.0	16.5	

The pollock catch record is more meaningful than the total groundfish harvest, because it is the principle target species in the area proposed. Pollock comprised 77% of the average November-March Bering Sea catch, and pollock and herring combined averaged 83% of the Bering Sea winter groundfish harvest from 1968-1969 to 1977-1978.

The relationship of harvest between areas is the same for pollock as for groundfish, but the percentage of catch drops sharply in Areas A and B, primarily because herring, included in the total grounfish catch, was the major species, along with pollock, harvested in these areas. If a time-area closure is instituted, the greatest impact to existing fisheries would be in Area C which averaged 21.4% of the November-March catch during the period of record (Table 8-6). Area B would have the least impact with 1.8% of the November-March average pollock harvest, and Areas A and D are intermediate with averages of 5.7% and 15.7%, respectively. On an annual basis institution of an Area A closure would result in an average of a 0.8% reduction of the Japanese pollock harvest, 0.3% with Area B, 3.2% with area C, and 2.3% with Area D.

This analysis is based on Japanese data, and measures impact to Japanese fisheries only. The U.S.S.R. has also conducted a major fishery in the Areas analyzed. U.S. observer data and historical catch data show that much of the Soviet effort in these areas has been directed toward herring and that the ratio of herring to pollock and groundfish is much higher than for Japan. Therefore, if U.S.S.R. data had been available, the amount of herring protection would have been greater in each area and the overall impact to other fisheries would have been less.

Historically, Area B has contained the bulk of the herring found on the winter grounds. However, in the late 1970s, in response to different hydrological conditions, herring winter distribution shifted to the northwest corner of Area C. Since herring are known to winter in different locales over a large range and since it may be difficult to determine the specific area, it is prudent to select Area C, which covers most of the winter range, as the primary area closure for the November-March period.

Table 8-6. Japanese pollock catch in the proposed November-March time-area closures and the Eastern Bering Sea and the mean catch and percentage of the Bering Sea annual and November-March catch for 1968-69 to 1977-78.

	Pollock Catch (mt) by Area				Bering Sea	
	A	B	C	D	Nov.-March (1000 mt)	Annual (1000 mt)
1968-69	3317	3270	3364	3317	97.9	701
69-70	2416	592	2471	591	122.2	830
70-71	11601	1322	11655	1337	187.2	1231
71-72	18417	4598	35505	20348	242.6	1513
72-73	12820	5715	40089	26988	214.2	1651
73-74	5889	5191	102438	90713	201.7	1476
74-75	18923	4468	46942	34768	157.4	1253
75-76	11106	660	26103	11104	246.4	1137
76-77	10258	1156	37102	28586	113.9	913
77-78	2478	3483	60495	51011	125.1	869
Mean Catch:	9723	3046	36616	26876	170.9	1158
Mean (%) of Bering Sea November-March Catch:	5.7	1.8	21.4	15.7		
Mean (%) of Bering Sea Annual Catch:	0.8	0.3	3.2	2.3	14.8	

At the time AIC is attained the Regional Director will, using field order authority close the entire area or only the portion of Area C necessary to protect herring in a particular season using criteria specified under Section 12.5. If it occurs that AIC is exceeded prior to November or the amount of AIC remaining is so small that it could be exceeded within one reporting period (one week) prior to November and the specific wintering location of the herring population in that season cannot yet be determined, then that portion of Area C corresponding to Area A should be closed until November arrives. In November the Regional Director should reevaluate the closure and adjust as necessary to protect herring. This closure under the above set of conditions was selected because it provides the greatest savings of herring and the least impact to the pollock fishery based on the available data.

Since the primary purpose of the Herring Savings Area is to protect herring on the winter range, once closed to a nation, the Herring Savings Area should remain closed until April 1. At any time the Regional Director may reevaluate the closure using the criteria specified under Section 12.5.

8.4 Limited Entry

The Bristol Bay herring roe fishery is the only major herring fishery in Alaska which is not covered by a limited entry system. As the fishery develops and effort increases, management problems may arise and create a need for imposing limited entry. Once a need is perceived, entry into the inshore roe fishery will be regulated by the Alaska Commmerical Fisheries Entry Commission.

If an intensive high seas domestic herring fishery eventually develops, entry to this fishery could be regulated through an amendment to this FMP.

8.5 Offshore Petroleum Production

Most of the Bering and Chukchi Seas are scheduled for sale under the current five-year Outer Continental Shelf (OCS) Oil and Gas Leasing Schedule (Figure 8-3). Both the St. George Basin sale and the Norton Basin sale have already taken place but are being delayed by court actions. Further sales in