FRI-UW-7620
December 1976

FISHERIES RESEARCH INSTITUTE
College of Fisheries
University of Washington
Seattle, Washington 98195

DETERMINATION AND DESCRIPTION OF THE STATUS OF KNOWLEDGE OF THE DISTRIBUTION, ABUNDANCE, AND MIGRATIONS OF SALMONIDS IN THE GULF OF ALASKA AND BERING SEA

Third and Final Report Covering Prince William Sound, Copper River, Bering River, Yakutat, and Offshore Waters of the Northern Gulf of Alaska

by

Loren J. Stern
Project Leader

Allan C. Hartt
Donald E. Rogers
Principal Investigators

A contribution to biological information needed by OCSEAP in making decisions with respect to offshore oil leases. Work performed under proposal RU 353-76 RFP Tasks A-7 and A-11.

Submitted 29 December 1976

Approved:

[signature]
Director

TABLE OF CONTENTS

DETERMINATION AND DESCRIPTION OF THE STATUS OF KNOWLEDGE OF THE DISTRIBUTION, ABUNDANCE, AND MIGRATIONS OF SALMONIDS IN THE GULF OF ALASKA AND BERING SEA

Third and Final Report Covering Prince William Sound, Copper River, Bering River, Yakutat, and Offshore Waters of the Northern Gulf of Alaska

INTRODUCTION

This is the third and final report from the salmonid literature survey. It completes a summary of existing knowledge on the distribution, abundance, and migrations of salmonids in potential oil producing areas in the Gulf of Alaska and Bering Sea. The geographic area covered by this report is shown in Fig. 1 together with the geographic areas covered in the first report (Kodiak region) and the second report (St. George Basin region). The geographic coverage of the three reports is such that all three reports are needed for a description of knowledge of salmonid dynamics throughout the entire area. Because of the migratory nature of salmonids and in order that each report be complete within itself, there was necessarily some overlap of information in each report.

Like the first two reports, this report focuses on five species of Pacific salmon and covers steelhead and sea-run cutthroat trout and char secondarily. This is not to say these latter species are not important, but data on their marine life is much scarcer because of their minor importance in the commercial fishery. In fact, these species should be of particular concern because of their long residence in nearshore waters as compared to salmon which usually migrate far offshore (Figs. 2-9).

ADULT SALMONIDS IN NEARSHORE WATERS

This report, like the first two, begins with mature adult salmonids as they enter nearshore waters enroute to natal streams. Next juvenile salmonids (age .0)[1] are discussed from their entry into estuarine waters until they have moved to offshore feeding grounds. Lastly, the offshore phase of salmonid life history is discussed.

Distribution and Abundance

Estimates of annual abundance in coastal production areas were based on catch data supplemented by estimates of escapement. Escapement was estimated to be 30 percent of the total run (i.e. 0.43 times catch). Although the relationship between catch and escapement varies substantially between species, locations and years, both due to natural fluctuations and to management quotas established for optimum production, the total run figures provide satisfactory estimates for the purposes herein.

Catch

An intensive nearshore commercial fishery catches the largest proportion of salmon although sport and subsistence fisheries are also important in the case of chum, coho, and chinook salmon. The Japanese mothership fishery which operates west of 175°W catches only small numbers of sockeye and chum salmon bound for streams in the area covered by this report (Fredin and Worlund 1974; Shepard et al. 1968). Pink and coho salmon from the study area are not known to occur west of 175°W (Neave et al. 1967; Godfrey et al. 1973). Indirect evidence indicates that small numbers of chinook salmon and steelhead trout from the study area are probably caught by the mothership fishery (Sutherland 1973; Hartt 1962).

[1] Age designation proposed by Koo (1962) in which the number of ocean winter annuli on the scale is preceded by a decimal point and the number of freshwater winter annuli precedes the decimal point.

In short, the oceanic distributions of salmonids bound for natal streams within the study area are such that relatively few are intercepted by high seas fisheries. Consequently, abundance estimates based upon nearshore catch data should not be greatly biased by high seas removals.

Salmon catch statistics are compiled by general districts (Fig. 10) and by detailed areas (Fig. 11). Catch statistics for the districts covered by this report (Prince William Sound, Copper River, Bering River, and Yakutat) for 1925-75 (Fig. 12, Table 1) show that pink salmon are the most abundant species on a region-wide basis. Runs of chum salmon to Prince William Sound and sockeye to the Copper River are also very important.

Sockeye (Fig. 12, Table 1) have historically been second only to pink salmon in abundance in this region. Catches of sockeye salmon averaged more than 0.9 million fish annually, and ranged from about 0.4 to 1.5 million fish.

Pink salmon catches declined from an average annual catch of 6.0 million fish for the period 1925-45 to slightly less than 3.0 million for the period 1946-75 (Fig. 12). The fishery is dominated by catches made in Prince William Sound (Table 1).

Chum salmon catches fluctuated greatly from a high of 1.7 million fish in 1945 to a low of only 0.02 million in 1954. Recent catches (1965-75) averaged approximately 0.3 million fish annually and like pink salmon are primarily from Prince William Sound.

Coho catches ranged from a high of 1.3 million fish in 1927 to a low of only 0.1 million in 1932. Recent catches are significantly lower than past catches primarily resulting from decreased levels of abundance in Prince William Sound. The Copper River and Yakutat districts currently provide most of the coho salmon catches.

Chinook salmon catches were significantly lower than those of other species. A peak catch of over 0.1 million fish occurred in 1930. Since then, catches ranged from about 0.01 to 0.03 million fish annually. During the past 6 years the catches were at or above the long-term average of about 0.03 million fish.

Although current levels of abundance are below historic levels, particularly in the case of pink salmon, the stocks in the study area are substantial. Levels of abundance in the future can be expected to fluctuate as during the past 20 years and perhaps to maintain the average observed during that period. Enhancement programs may ultimately increase runs of some species substantially.

Catch statistics for the 21-year period 1955-75 are summarized by detailed statistical area in Table 2. For this period the annual average catch is 6.1 million salmon and the potential catch[2] is 14.9 million.

Population Estimates

Total run estimates (Table 3) were made by summing the average annual catch and estimated escapement (assumed to be 30 percent of the total run or 0.43 times catch). On this basis, the average annual runs to rivers in the area covered by this report totalled 8.5 million salmon during the period 1955-75. The percentage composition of the data in Table 3 are shown in Table 4. Pink salmon were most abundant, comprising 71 percent of the total (even and odd years averaged) with the remainder divided as follows: sockeye (14 percent), chum (9 percent), coho (5 percent), and chinook (< 1 percent).

Prince William Sound. This is the most important district in the region, accounting for 82 percent of the total (Table 4). Total runs of all species to this district averaged 6.9 million fish with a potential of 17.8 million

---

[2] Potential catch refers to the sums of peak catches of individual species for the 21 year period, 1955-75, for each statistical area.

(Table 3). Pink salmon stocks are very important both on a district and region-wide basis constituting 86 and 71 percent, respectively, of the total average annual catch (even and odd years averaged) (Table 4). Chum salmon stocks are also important as they comprise 9 percent of the region's total catch.

Over 50 percent of the Prince William Sound district's total catch and over 40 percent of the region's catch comes from statistical areas 221 and 226 (Table 4 and Fig. 11). Statistical area 221 also produced nearly 40% of the district's catch of chum salmon (Tables 3 and 4).

Copper River District. This district was estimated to provide 12 percent of the region's total salmon stocks (Table 4). Total runs to this district averaged 1.1 million salmon with a potential of over 2.0 million (Table 3). Sockeye salmon are the most abundant species in this district as they constitute almost 80 percent of the district's average annual salmon catch (Table 4). Significant runs of coho salmon also occur in the Copper River district.

Bering River District. This district was estimated to provide only 1 percent of the region's total salmon stocks (Table 4). Total runs were estimated at only 0.1 million salmon with a potential of twice that number (Table 3). Coho and sockeye salmon are the most abundant, constituting 63 and 35 percent of the total district catch, respectively.

Yakutat District. Runs to this district constitute only 5 percent of the region's total catch. Total runs to the Yakutat district were estimated at 0.4 million salmon with a potential of 1.3 million (Table 3). Sockeye and coho salmon are the most abundant species, consitituting 43 and 36 percent, respectively, of the total average catch (Table 4). Within the Yakutat district, statistical areas 182 and 185 are the most important salmon producing areas (Table 4, Fig. 11).

Timing of Migrations

The timing of salmonid migrations, both mature and immature in nearshore waters is of major importance in considering possible impacts by the petroleum industry.

Weekly catch statistics by district and species for the ten year period, 1963-72, were used to describe the timing of mature salmon migrations in nearshore waters. Catch statistics provide a satisfactory profile of the timing of salmon runs but are influenced to a degree by necessary regulation of fishing periods by management agencies. Consequently, escapement data where available were used to supplement the use of catch statistics.

Prince William Sound (Fig. 13). The fishery is such that fish are first intercepted in the outer areas (i.e., statistical areas 226, 227, and 228; Fig. 11) and then fished at various locations on their migration to natal streams. As a result, the timing curves shown represent a broad picture of the migration timing rather than what would be seen at a particular location within Prince William Sound.

Sockeye catches begin in mid-June, peak bimodally in early July (largest peak) and early August, and continue through late August. Pink salmon catches begin in early July, peak in early August, and continue through late August. Analyses of escapement data indicate that intertidal spawning continues through September (Helle et al. 1964) and that odd year pinks generally return earlier than even year runs (Noerenberg 1963). Chum salmon catches begin in late June, peak bimodally in late July and early August, and continue through the end of August. Sport catches of coho in Prince William Sound suggest that few coho remain after the first week of September (Williams 1972). Chinook catches begin in mid-June, peak bimodally in early July and early August, and continue through late August.

Copper River District (Fig. 14). Sockeye catches in this district begin in early June, peak soon thereafter, and continue into early August. Pink salmon catches begin almost 3 weeks later, peak bimodally in mid-July and early August, and end in late August. Chum catches like sockeye begin in early June and remain relatively constant through late August. Coho catches begin latest (in early August), peak in early September, and continue through the end of the month. Chinook catches begin in early June, peak in late June, and end in late July.

Bering River District (Fig. 15). Sockeye catches begin in early June, peak in early July, and continue through mid-August. Coho catches begin in mid-August, peak two weeks later, and end in late September. Chinook catches begin in mid-June peak in late June, and end by mid-July.

Yakutat District (Fig. 16). Sockeye catches begin in mid-June, peak in early July, and continue into September. Pink salmon catches begin almost a month later than sockeye, peak in late August, and end in mid-September. Chum catches begin in early August, peak in mid-September, and continue into early October. Coho catches begin in mid-July, peak in early September, and continue into October. Chinook catches begin in the spring and continue into late September. Weir count data in southeastern Alaska streams south of this district support the timing as shown from weekly catches and add information on char, sea-run cutthroat and steelhead trout timing (Table 5).

Migratory Routes

As discussed in the first two reports, maturing salmon approach natal streams over a broad front from high seas feeding areas, and as a result, often make extensive migrations along the coast. Thus, nearshore movements in opposite directions, characterized as "wandering," are quite common (Neave 1964; Verhoeven 1947). In addition, interspecific differences in migratory behavior have also been reported (Milne 1957; Prakash 1962).

Tagging studies in Prince William Sound have shown that a significant number of salmon caught in the outer waters are bound for Cook Inlet[2] (Noerenberg and Sevoie 1963). Also indicated are two main migration routes into Prince William Sound; fish bound for streams on the eastern shore generally migrate through the Hinchinbrook pass whereas fish bound for streams on the west shore move through passes near Knight Island (Thompson 1931; Noerenberg and Sevoie 1963). Superimposed on these routes are "to and fro" movements. Tagging only slightly offshore near the Copper River and Yakutat have yielded returns from southeastern Alaska (French et al. 1975). Thus, salmon approaching the coast in the northeast part of the Gulf of Alaska are a mixture of many stocks some of which are bound for areas other than those covered by this report.

JUVENILE SALMONIDS IN NEARSHORE WATERS

Distribution and Abundance

The abundance and species composition of young salmon upon their entry into marine waters are logically a function of the numbers of adults spawning

[3]Tyler, Richard W. and Wallace H. Noerenberg. 1959 MS. Salmon tagging in Cook Inlet and Prince William Sound, Fish. Res. Inst., Univ. Washington, Seattle, WA, unpublished manuscript.

in streams within the area. Data summarized by Atkinson et al. (1967), which presents detailed figures by species for individual stream, show that juvenile salmon enter the marine environment throughout nearshore waters covered by this report. The major contributing streams are presented in Figs. 17-21. The approximate numbers of spawners were presented in the foregoing section. Literature reports (Clemens and Wilby 1961) show that steelhead trout, char, and sea-run cutthroat trout also commonly occur in the nearshore waters of the area.

Population Estimate

Estimates of juvenile salmon abundance were based on parent spawning stock size and calculated using a 50/50 sex ratio, and average fecundity and survival (egg to downstream migrant) values. Average fecundities of 2,000 eggs for pink salmon, 3,000 eggs for chum, 3,500 eggs for sockeye and coho, and 4,000 eggs per female for chinook were used (Bailey 1969). Average survival rates to seaward migrant stage of 2% for sockeye, coho, and chinook and 10% for pink and chum salmon were used (Donaldson 1963; MacKinnon 1970). Even though fecundity and survival vary greatly in the natural environment, the use of average values provide a reasonably accurate picture of abundance.

Using the above rationale, over 231 million juvenile salmon were estimated to enter marine waters of this region in an average year and nearly 600 million in a peak year (Table 6). This does not include juvenile steelhead trout, Pacific char, and sea-run cutthroat trout for which there are no bases for abundance estimations.

Timing of Migrations

Juvenile salmon enter estuarine waters in the spring and summer, the precise timing depending on genetic and environmental factors (Hartman et al. 1967). Subsequent movements through the estuaries and protected bays and channels are a progression of actions related to the time of entry into the estuary. It is possible that salmon from adjacent rivers may enter Prince William Sound as part of their early marine migrations. Although most smolts reach estuarine waters in May small numbers continue through at least August (Table 7).

Migratory Routes

Juvenile salmon that enter protected estuarine waters generally remain near the surface, and gradually move offshore as the summer progresses (Healey 1969; Lagler and Wright 1962; Sakagawa 1972). Salmon smolts that enter the estuary along unprotected shores apparently move directly offshore.[4]

JUVENILE SALMONIDS OFFSHORE

Distribution and Abundance

Information on the distribution and abundance of juvenile salmon in offshore coastal waters was based primarily on the results of purse seine sampling which was done by the Fisheries Research Institute for the purposes of the International North Pacific Fisheries Commission. Analysis of these data indicates that juvenile salmonids are concentrated close to shore in a belt extending about 37 km offshore and apparently directly related to the width of the continental shelf[5] (Royce et al. 1968). Fig. 22 illustrates

---

[4]Tyler, Richard W. MS 1976. Forecasts of pink salmon (*Oncorhynchus gorbuscha*) runs to the Kodiak Island area based on estuarine abundance of juveniles. Fish. Res. Inst., Univ. Washington, Seattle, WA, unpublished manuscript.

[5]Hartt, Allan C. and Michael B. Dell. MS 1976. Life history of Pacific salmon and steelhead trout during their first summer in the open sea. Fish. Res. Inst., Univ. Washington, Seattle, WA, unpublished manuscript.

the catches of juvenile salmonids by time periods and by 2° x 5° statistical areas. The general tendency for juvenile salmon to be concentrated nearshore during the summer is illustrated, but the scale of the figure is inadequate to show the actual narrow width of salmon distribution along the coast.

Timing of Migrations

Relatively small purse seine catches in April-June indicate that most age .0 fish have not migrated from nearshore protected waters. This is not the case in July and August when high CPUE's for all species indicate that movement from protected waters is underway. Catches in September-October indicate that relatively large numbers of juvenile pink and chum salmon and lesser numbers of the other species still occur in a narrow belt along the coast.

Migratory Routes

Information on the migration routes of age .0 salmon after departing the protection of nearshore waters were based on directional data from purse seine fishing, sizes of fish, and tag returns. These data indicate that age .0 salmonids move in a narrow band close to shore in a counterclockwise direction along the Pacific coast (Royce et al. 1968; Sakagawa 1972). The width of this band appears related to that of the continental shelf and averages approximately 37 km in width along the British Columbia and Southeast Alaska coasts and slightly wider along the northern Gulf of Alaska coast where the continental shelf is wider. Thus, the area along the coast of the northeastern part of the Gulf of Alaska is an area through which juvenile salmonids from as far south as California pass. All species are included, but sockeye, chum, and pink salmon far outnumber the other species and these originate as far south as Puget Sound. Thus, the actual population of juvenile salmonids is much larger than would be expected based upon the outmigration from rivers of the northeastern Gulf of Alaska.

ADULT SALMONIDS IN OFFSHORE WATERS

Abundance, Distribution, and Timing of Migrations

Gillnet (Fig. 23) and longline (Fig. 24) catches were used to describe the seasonal distribution and abundance of salmon in offshore waters adjacent to the study area. Fukuhara (1971) noted that the amount of sampling was less than that required to adequately reflect true abundance at sampling sites. Consequently, the figures may be viewed as showing only the general distributional pattern together with their seasonal migrations toward coastal waters of origin. Some older age immature fish are also included in the catches, thus accounting for chum salmon occurring far offshore in September.

Experimental fishing results in winter (Fig. 23, 24) suffer from small sample size but show that considerable numbers of sockeye and lesser numbers of pink and chum salmon overwinter in the offshore waters of the region covered by this report. Analysis of gillnet catches indicate that sockeye are most abundant in the western waters of the region. Seasonal changes in the availability of the salmon to the gear probably caused bias, particularly in winter sampling (Hartt 1962).

Results of fishing in spring (Fig. 23,24) demonstrate that larger numbers of sockeye, pink, and chum salmon have entered the study area than were present in winter or that they have become more vulnerable to the gear by changes in depth and/or feeding activity. Sockeye and chum salmon are distributed throughout the region. Pinks are most abundant in the eastern part of the study area. By June significantly more pink and chum salmon occurred in the catches whereas the CPUE's for sockeye were not changed significantly. As in spring sockeye and chum salmon are distributed throughout the study area, while pinks are most abundant in the eastern portion, probably indicative of inshore migrations for spawning. A high abundance of sockeye occurred in the north-central Gulf (Fig. 23), probably evidence of inshore migration of sockeye in this area.

Lower CPUE's for sockeye in July reflect the departure of Bristol Bay and other stocks from the sampling area. Increased CPUE's of sockeye in the coastal areas (Fig. 23) indicate migration toward spawning grounds in this vicinity. Increased CPUE's for chum salmon show that more fish of this species entered the study area or became more available to the gear. Pinks were still most abundant in the eastern portion of the study area although large numbers (probably reflecting Kodiak I. stocks) also occurred in the northwest portion. The large catches of sockeye in the southwest portion probably include mainly immature fish of age .2 and older.

The decrease in CPUE for sockeye continued into August and was evident for pink and chum as well. Gillnet data indicate that sockeye were most abundant in the south-central and southwest portion of the study area and chum were distributed evenly throughout the area.

A similar picture to that of August was seen in September. Again, the presence of immature age .2 fish probably distorted the picture of the distribution of maturing stocks in August and September.

Migratory Routes

The migratory routes of salmonids in offshore waters have been described from results of experimental fishing and tagging as follows: pinks - Royce et al. 1968, Takagi et al. (in press), sockeye - Royce et al. (1968), French and Bakhala (1974), French et al. (in press), chum - Neave et al. (in press), coho - Godfrey et al. 1973, chinook - Major et al. (in press), steelhead trout - Sutherland 1973.

After departing the coastal belt, juvenile salmonids move south probably in response to temperature, where they mix with older age classes. The juvenile salmon from the study area in the northwestern Gulf of Alaska apparently depart the coastal belt along the broad front extending from at least Yakutat to Unimak Island and the period of their departure probably continues from late summer through late fall. Sampling south of the eastern Aleutian Islands suggest that most of the juvenile sockeye, chum and pink salmon have moved offshore prior to reaching that far west. Pink salmon which spend only one winter at sea are more easily described and their general spring and summer migratory pattern is outlined in Fig. 25. The actual migrations and distribution and timing of their southward movement is known only from extrapolated data derived from late fall observations compared with early spring operations the following year. Pink salmon, however, migrate southward to at least 42° or 43° N. where they are found dispersed widely during the spring. They then migrate northward during spring and summer across a broad east - west front as diagrammed in Fig. 25. They then approach their coastal destinations via various approaches and perform the inshore migrations that were described in the earlier section of this paper. An important observation was made by Neave (1964) showing that frequently the late run fish tend to migrate well north of their final destination and then shift southward again along the coast toward their final purpose of origin in late summer or early fall.

Sockeye (Fig. 26) and chum salmon follow the same general pattern except that most individuals of these species remain two or three winters at sea before maturing and returning. Thus, they have opportunity to disperse much farther seaward than do the pink salmon. Some sockeye and chum salmon from the study area in the northeastern Gulf of Alaska migrate at least to the central Aleutian Island area (175°W) as part of their migration at either age .1 or age .2. Otherwise they tend to shift southward during the winter and then northward again during the spring during their feeding migrations as immature fish or during their homing migrations as maturing fish. Typically the maturing fish tend to be centered farther northward than the immature fish (French et al. in press).

Data of this sort for chinook salmon, coho salmon, steelhead trout are much fewer, but tag returns indicate that at least some individuals of these species do migrate well offshore and make a seasonal southward and northward migration. A large portion of coho and chinook salmon remain in coastal waters for their entire life, however. This does not seem to be the case for steelhead which tend to migrate offshore rather early[6] in their ocean migrations and tend to remain generally farther south than the other species (Sutherland 1973).

---

[6]Hartt, Allan C. and Michael B. Dell. MS 1976. Life history of Pacific salmon and steelhead trout during their first summer in the open sea. Fish. Res. Inst., Univ. Washington, Seattle, WA, unpublished manuscript.

LITERATURE CITED

Atkinson, C. E., J. H. Rose, and T. O. Duncan. 1967. Salmon of the North Pacific Ocean, Pt. IV. Spawning populations of North Pacific Salmon in the United States. Int. N. Pac. Fish. Comm. Bull. 23:43-223.

Clemens, W. A., and G. V. Wilby. 1961. Fishes of the Pacific Coast of Canada. Fish. Res. Board Can. Bull. 68. 443 pp.

Donaldson, John R. 1963. Limnological consideration in the evaluation of artificial environment for salmonid propagation. Pages 130-133 *in* Rep. Second Governor's Conference on Pacific Salmon. Washington State Printing Plant, Olympia.

Fredin, R. A., and D. D. Worlund. 1974. Catches of sockeye salmon of Bristol Bay origin by the Japanese mothership fishery, 1956-70. Int. N. Pac. Fish. Comm. Bull. 30:1-80.

French, R., H. Bilton, M. Osako, A. Hartt. [In press.] Distribution and origin of sockeye salmon (*Oncorhynchus nerka*) in offshore waters of the North Pacific Ocean. Int. N. Pac. Fish. Comm. Bull.

French, Robert R., and Richard G. Bakkala. 1974. A new model of ocean migrations of Bristol Bay sockeye salmon. U.S. Dep. Commerce, NMFS Fish. Bull. 72(2):589-614.

French, Robert R., Richard G. Bakkala, and Doyle F. Sutherland. 1975. Ocean distribution of stocks of Pacific salmon, *Oncorhynchus* spp., and steelhead trout, *Salmo gairdneri*, as shown by tagging experiments. Nat. Mar. Fish. Serv. Spec. Rep. No. 689. 89 pp.

Godfrey, Harold, K. A. Henry, and S. Machidori. 1973. Distribution and abundance of coho salmon in offshore waters of the North Pacific Ocean. Int. N. Pac. Fish. Comm. Bull. 31:1-80.

Hart, John. 1973. Pacific fishes of Canada. Fis. Res. Board Can. Bull. No. 180. 740 pp.

Hartman, W. L., W. R. Heard, and B. Drucker. 1967. Migratory behavior of sockeye salmon fry and smolts. J. Fish. Res. Board Can. 24(10): 2069-2099.

Hartt, Allan C. 1962. Movement of salmon in the North Pacific Ocean and Bering Sea as determined by seining and tagging, 1956-1958. Int. N. Pac. Fish. Comm. Bull. No. 6. 157 p.

Healey, M. C. 1969. Orientation of pink salmon during early marine migration from Bella Coola River. J. Fish. Res. Board Canada 24: 2321-2338.

Helle, John H., Richard S. Williamson, and Jack E. Bailey. 1964. Intertidal ecology and life history of pink salmon at Olsen Creek, Prince William Sound, Alaska. U.S. Fish Wildl. Serv. Spec. Rep. 483. 26 p.

Int. N. Pac. Fish. Comm. Statistical Yearbooks, 1955-74. Vancouver, Canada.

Jones, Darwin E. 1972. A study of steelhead-cutthroat trout in Alaska. Alaska Dep. Fish and Game, Fed. Aid in Fish Restoration, Annu. Prog. Rep. 1971-72, Project F-9-4, 13:91-108.

Jones, Darwin E. 1973. Steelhead and sea-run cutthroat life history in Southeast Alaska Dep. Fish and Game, Fed. Aid. in Fish Restoration, Annu. Prog. Rep. 1972-73. Project AFS-42, Vol. 14. 18 pp.

Jones, Darwin E. 1974. The study of cutthroat-steelhead in Alaska. Alaska Dep. Fish and Game, Fed. Aid in Fish Restoration, Annu. Prog. Rep. 1973-74. Project AFS-42, Vol. 15. 31 pp.

Jones, Darwin E. 1975. Steelhead and sea-run cutthroat trout life history study, Southeast Alaska. Alaska Dep. Fish and Game, Fed. Aid in Fish Restoration, Annu. Prog. Rep. 1974-75. 16:42.

Koo, Ted S. Y. 1962. Age designation in salmon. Pages 37-48 *in* Studies of Alaska red salmon. Ted S. Y. Koo [ed.], Univ. Washington Press. Seattle. 469 pp.

Lagler, K. F., and Asa T. Wright. 1962. The Dolly Varden, *Salvelinus malma*, and its predatory relationships to young salmon, *Oncorhynchus* spp., in an estuary of Southeastern Alaska. Trans. Amer. Fish. Soc. 91(1):90-93.

MacKinnon, D. 1960. A successful transplant of salmon eggs in the Robertson Creek spawning channel. Can. Fish Cult. 27:25-31.

Major, Richard L., Jun Ito, Sotoo Ito, and Harold Godfrey. [In press.] Distribution and abundance of chinook salmon in offshore waters of the North Pacific Ocean. Int. N. Pac. Fish. Comm. Bull.

Meehan, W. R., and D. B. Siniff. 1962. A study of the downstream migration of anadromous fishes of the Taku River, Alaska. Trans. Amer. Fish. Soc. 91(4):399-407.

Milne, D. J. 1957. Recent British Columbia spring and coho salmon tagging experiments, and a comparison with those conducted from 1925 to 1930. Fish. Res. Board Can. Bull. 113. 56 p.

Neave, Ferris. 1964. Ocean migration of Pacific Salmon. J. Fish. Res. Board Can. 21(5):1227-1244.

Neave, Ferris, Tomotsu Yonemori, and Richard G. Bakkala. [In press.] Distribution and origin of chum salmon in offshore waters of the North Pacific Ocean. Int. N. Pac. Fish. Comm. Bull.

Neave, Ferris and Teruo Ishida, and Sueto Murai. 1967. Salmon of the North Pacific Ocean, Part VII. Pink salmon in offshore waters. Int. N. Pac. Fish. Comm. Bull. 22:1-39.

Noerenberg, Wallace A. 1963. Salmon forecast studies on 1963 runs in Prince William Sound. Alaska Dep. Fish and Game Inf. Leafl. No. 21. 29 pp.

Noerenberg, Wallace H. and David G. Savoie. 1963. Salmon tagging experiments in Prince William Sound 1960-61. Alaska Dep. Fish and Game Inf. Leafl. No. 28. 38 p.

Prakash. A. 1962. Seasonal changes in feeding of coho and chinook (spring) salmon in southern British Columbia waters. J. Fish. Res. Board Can. 19(5):851-866.

Royce, William F., Lynwood S. Smith, and Allan C. Hartt. 1968. Models of oceanic migrations of Pacific salmon and comments on guidance mechanisms. U.S. Fish. Wildl. Serv. Fish. Bull. Vol. 66. p. 441-462.

Sakagawa, Gary T. 1972. The dynamics of juvenile salmon, with particular emphasis on pink salmon (*Oncorhynchus gorbuscha*), during their early marine life. Ph.D. Thesis, Univ. Univ. Washington, Seattle. 352 p.

Shephard, M. P., A. C. Hartt, and T. Yonemori. 1968. Chum salmon in offshore waters. Int. N. Pac. Fish. Comm. Bull. 25:1-69.

Sutherland, Doyle F. 1973. Distribution, seasonal abundance, and some biological features of steelhead trout in the North Pacific Ocean. U.S. Nat. Mar. Fish. Serv. Fish. Bull. Vol. 71, No. 3. 787-827 pp.

Tait, D. H., and James B. Kirkwood. 1957. Estimating abundance of pink and chum salmon fry in Prince William Sound 1957. U.S. Fish. Wildl. Serv. Spec. Sci. Rep. No. 429. 21 pp.

Takagi, K., K. V. Aro, A. C. Hartt, and M. B. Dell. [In press.] Pink salmon in offshore waters. Int. N. Pac. Fish. Comm. Bull.

Thompson, Seton H. 1931. Salmon-tagging experiments in Alaska, 1929. U.S. Bur. Fish. Bull. 46:177-195.

Turner, C. E., and K. V. Aro. 1968. Atlas of salmon catches made by longlines in the eastern North Pacific Ocean, 1961 to 1967. Fish. Res. Board Can., Manuscript Rep. Series No. 983.

Verhoeven, Leon A. 1952. A report to the salmon fishing industry of Alaska on the results of the 1947 tagging experiments. Univ. Washington Fish. Res. Inst. Circ. 28. 22 pp.

Williams, Fred T. 1972. Inventory and cataloging of sport fish of Prince William Sound. Alaska Dep. Fish and Game Prog. Rpt. Vol. 13, No. 1-F.

Table 1. Summary of salmon catch statistics[1] for the 48-year period 1925-1972 in thousands of fish by species for Prince William Sound, Copper River, Bering River and Yakutat districts

District	Sockeye	Pink (odd)	Pink (even)	Chum	Coho	Chinook	Total[2]
Prince William Sound							
Average catch	120	4710	5414	501	57	2	5742
95% confidence interval	±20	±1336	±1402	±83	±14	±1	±1487
Peak catch	286	11632	11543	1754	259	12	13898
1975 catch	186	1201	--	80	3	2	1472
Copper River							
Average catch	624	2	2	1	196	17	840
95% confidence interval	±75	±1	±1	±1	±42	±3	±122
Peak catch	1136	11	10	10	710	47	1914
1975 catch	335	<1	--	1	54	20	410
Bering River							
Average catch	32	<1	<1	<1	56	<1	88
95% confidence interval	±8	<1	<1	<1	±11	<1	±19
Peak catch	72	<1	<1	<1	92	2	165
1975 catch	22	<1	--	--	24	2	48
Yakutat							
Average catch	161	36	29	11	143	9	356
95% confidence interval	±28	±22	±16	±6	±20	±6	±79
Peak catch	407	127	246	111	341	83	1128
1975 catch	73	80	--	4	38	6	200
Totals							
Average catch	937	4748	5445	512	451	28	7025
95% confidence interval	±131	±1359	±1419	±89	±88	±10	±1707
Peak catch	1901	11771	11799	1874	1401	143	17104
1975 catch	616	1282	--	85	119	29	2130

[1]Source: INPFC. MS 1974. Historical catch statistics for salmon of the North Pacific Ocean. Manuscript version (2nd draft) of compilation proposed for publication.

[2]Determined using mean of even- and odd-year pink catches.

Table 2. Summary of salmon catch statistics[1] for the 21-year period 1955-1975 in thousands of fish by detailed statistical area and species for the districts shown in Table 1

Statistical area	Sockeye		Pink (even)		Pink (odd)		Chum		Coho		Chinook		Total	
	Mean catch	Peak catch	Mean catch	Peak catch	Mean catch	Peak catch	Mean catch	Peak catch	Mean catch	Peak catch	Mean catch	Peak catch		
Prince William Sound														
220	<1	(<1)	1*	(3)	<1*	(<1)	<1*	(<1)	1*	(1)	3*	(12)	6	(16)
221	3	(11)	870	(1666)	991	(1975)	197	(452)	6	(18)	<1	(<1)	1137	(2302)
222	14	(90)	411	(1275)	168	(666)	51	(155)	2	(14)	<1	(<1)	357	(1230)
223	51	(136)	255	(854)	168	(489)	52	(121)	1	(2)	<1	(1)	316	(932)
224	10	(21)	525	(1442)	319	(786)	68	(322)	2	(12)	<1	(1)	503	(1470)
225	20	(62)	112	(316)	33	(113)	19	(56)	1	(4)	<1	(<1)	113	(337)
226	19	(69)	1128	(1579)	1568	(3902)	41	(111)	7	(35)	<1	(<1)	1416	(2956)
227	5	(45)	479	(2030)	183	(896)	57	(227)	6	(26)	1	(3)	400	(1764)
228	<1	(1)	231*	(570)	636	(1307)	34	(66)	2*	(8)	<1	(1)	471	(1015)
229	2	(2)	463*	(823)	<1	(<1)	9*	(15)	1	(1)	<1	(<1)	244	(430)
Total	124	(437)	4475	(10558)	4066	(10134)	528	(1525)	29	(121)	5	(20)	4963	(12452)
Copper River														
212	588	(1116)	3	(10)	2	(9)	1	(10)	137	(243)	14	(22)	743	(1401)
Total	588	(1116)	3	(10)	2	(9)	1	(10)	137	(243)	14	(22)	743	(1401)
Bering River														
200	30	(72)	<1	(<1)	<1	(<1)	<1	(<1)	54	(89)	<1	(1)	86	(163)
	30	(72)	<1	(<1)	<1	(<1)	<1	(<1)	54	(89)	<1	(1)	86	(163)
Yakutat														
181	11*	(39)	1	(3)	1	(6)	9	(36)	3	(9)	1	(4)	25	(93)
182	70	(175)	4	(18)	7	(26)	8	(49)	28	(105)	2	(3)	114	(354)
183	7	(16)	3	(22)	25	(77)	<1	(5)	14	(34)	2	(6)	38	(111)
184	3*	(7)	1	(4)	3*	(13)	2*	(12)	7	(23)	<1*	(1)	15	(52)
185	35	(48)	5	(13)	8*	(13)	<1*	(<1)	20	(64)	<1*	(<1)	63	(126)
191	<1*	(<1)	<1	(<1)	<1	(<1)	<1*	(<1)	1	(71)	1*	(3)	4	(76)
192	<1*	(<1)	<1	(<1)	<1*	(<1)	<1*	(<1)	33	(67)	<1	(<1)	34	(68)
Total	127	(286)	15	(61)	45	(136)	21	(104)	106	(373)	7	(18)	293	(880)
Grand total	869	(1911)	4494	(10630)	4114	(10280)	551	(1640)	326	(826)	27	(61)	6085	(14896)

[1]Source: INPFC Statistical Yearbooks (1955-74), Alaska Department of Fish and Game.
*Sporadic reports only.

Table 3. Estimates[1] of the average total runs of salmon (catch plus estimated escapements) in thousands of fish by statistical area and species for Prince William Sound, Copper River, Bering River, and Yakutat for the 21-year period 1955-1975

Statistical area	Sockeye		Pink (even)		Pink (odd)		Chum		Coho		Chinook		Total[2]	
	Mean catch	Peak catch	Mean catch	Peak catch	Mean catch	Peak catch	Mean catch	Peak catch	Mean catch	Peak catch	Mean catch	Peak catch		
Prince William Sound														
220	<1	(<1)	2	(4)	<1	(<1)	<1	(<1)	2	(2)	4	(17)	7	(23)
221	4	(16)	1246	(2379)	1415	(2820)	281	(646)	8	(26)	<1	(1)	1624	(3289)
222	20	(128)	587	(1821)	240	(951)	72	(221)	2	(20)	<1	(1)	508	(1757)
223	73	(194)	364	(1220)	240	(699)	75	(172)	1	(3)	<1	(1)	451	(1331)
224	14	(29)	749	(2059)	27	(1122)	97	(460)	2	(18)	<1	(1)	501	(2100)
225	29	(88)	160	(451)	48	(162)	27	(80)	1	(5)	<1	(<1)	161	(481)
226	27	(99)	1610	(2254)	2239	(5571)	59	(158)	9	(50)	<1	(<1)	2020	(4223)
227	7	(65)	684	(2899)	262	(1280)	82	(324)	9	(36)	1	(4)	572	(2520)
228	<1	(1)	330	(814)	908	(1866)	48	(95)	3	(12)	<1	(1)	670	(1450)
229	3	(3)	662	(1175)	<1	(<1)	12	(21)	1	(2)	<1	(<1)	347	(614)
Total	177	(623)	6394	(15076)	5379	(14471)	753	(2177)	38	(174)	5	(26)	6861	(17788)
Copper River														
212	839	(1593)	5	(14)	3	(13)	2	(15)	196	(347)	20	(32)	1061	(2001)
Total	839	(1593)	5	(14)	3	(13)	2	(15)	196	(347)	20	(32)	1061	(2001)
Bering River														
200	42	(103)	<1	(<1)	<1	(<1)	<1	(<1)	77	(127)	<1	(1)	122	(233)
Total	42	(103)	<1	(<1)	<1	(<1)	<1	(<1)	77	(127)	<1	(1)	122	(233)
Yakutat														
181	16	(56)	2	(5)	2	(8)	13	(52)	4	(13)	1	(6)	36	(133)
182	70	(250)	5	(26)	11	(38)	12	(70)	40	(151)	3	(5)	163	(506)
183	9	(22)	4	(32)	35	(110)	1	(7)	19	(49)	3	(8)	54	(159)
184	4	(10)	2	(6)	5	(19)	3	(18)	11	(33)	1	(1)	21	(74)
185	50	(69)	7	(19)	11	(19)	<1	(<1)	29	(92)	<1	(1)	90	(180)
191	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	2	(101)	2	(4)	6	(109)
192	<1	(1)	<1	(<1)	<1	(<1)	<1	(<1)	47	(96)	<1	(<1)	49	(97)
Total	149	(408)	20	(88)	64	(194)	29	(147)	152	(535)	10	(25)	419	(1258)
Region total	1207	(2727)	6419	(15178)	5446	(14678)	784	(2339)	463	(1183)	35	(84)	8463	(21280)

[1]Calculated from Table 2.
[2]Pink salmon values are the mean of odd- and even-years.

Table 4. The average percent contribution[1] of each detailed statistical area to the commercial salmon catch within districts and within the whole region (1955-1975). The percent contributions to the entire region are enclosed in parentheses

Statistical area	Sockeye		Pink (even)		Pink (odd)		Chum		Coho		Chinook		Total	
	District catch	Region catch	District catch	Region catch	District catch	Region catch	District catch	Region catch	District catch	Region catch	District catch	Region catch		
Prince William Sound														
220	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)
221	<1	(<1)	18	(14)	20	(16)	4	(3)	<1	(<1)	<1	(<1)	23	(19)
222	<1	(<1)	8	(7)	3	(3)	1	(1)	<1	(<1)	<1	(<1)	7	(6)
223	1	(1)	5	(4)	3	(3)	1	(1)	<1	(<1)	<1	(<1)	6	(5)
224	<1	(<1)	11	(9)	6	(5)	1	(1)	<1	(<1)	<1	(<1)	10	(8)
225	<1	(<1)	2	(2)	1	(1)	<1	(<1)	<1	(<1)	<1	(<1)	2	(2)
226	<1	(<1)	23	(19)	32	(26)	1	(1)	<1	(<1)	<1	(<1)	29	(23)
227	<1	(<1)	10	(8)	4	(3)	1	(1)	<1	(<1)	<1	(<1)	8	(7)
228	<1	(<1)	5	(4)	13	(10)	1	(1)	<1	(<1)	<1	(<1)	10	(8)
229	<1	(<1)	9	(8)	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	5	(4)
Total	2	(2)	90	(74)	82	(67)	11	(9)	1	(<1)	<1	(<1)	100	(82)
Copper River														
212	79	(10)	<1	(<1)	<1	(<1)	<1	(<1)	18	(2)	2	(<1)	100	(12)
Total	79	(10)	<1	(<1)	<1	(<1)	<1	(<1)	18	(2)	2	(<1)	100	(12)
Bering River														
200	35	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	63	(1)	<1	(<1)	100	(1)
Total	35	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	63	(1)	<1	(<1)	100	(1)
Yakutat														
181	4	(<1)	<1	(<1)	<1	(<1)	3	(<1)	1	(<1)	<1	(<1)	9	(<1)
182	24	(1)	1	(<1)	2	(<1)	3	(<1)	10	(<1)	1	(<1)	39	(2)
183	2	(<1)	1	(<1)	9	(<1)	<1	(<1)	5	(<1)	1	(<1)	13	(1)
184	1	(<1)	<1	(<1)	1	(<1)	1	(<1)	2	(<1)	<1	(<1)	5	(<1)
185	12	(1)	2	(<1)	3	(<1)	<1	(<1)	7	(<1)	<1	(<1)	22	(1)
191	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	1	(<1)
192	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1)	11	(<1)	<1	(<1)	12	(1)
Total	43	(2)	5	(<1)	15	(1)	7	(<1)	36	(2)	2	(<1)	100	(5)
Region total	--	(14)	--	(74)	--	(68)	--	(9)	--	(5)	--	(<1)	--	(100)

[1]Calculated from Table 2.

Table 5. Run timing of adult salmonids in selected southeastern Alaska streams

Species	River	Beginning	Peak	End	Source
Sockeye	Petersburgh Creek	May	July	September	Jones 1974, 1975
Pink	Petersburgh Creek	June	August	September	Jones 1973, 1974, 1975
Chum	Petersburgh Creek	June	July	October	Jones 1973, 1974, 1975
Coho	Petersburgh Creek	August	--	November	Jones 1973, 1974, 1975
Steelhead	Petersburgh Creek	March	May	June	Jones 1973, 1974, 1975
	Peterson Creek	March	May	June	Jones 1972
Char	Petersburgh Creek	June	August	October	Jones 1973, 1974, 1975
Sea-run cutthroat	Petersburgh Creek	July	September	October	Jones 1973, 1974, 1975
	Peterson Creek	August	September	October	Jones 1972

Table 6. Population estimates[1] of juvenile salmon in millions of fish by district and species based on parent spawning stock size

District	Sockeye	Pink (even)	Pink (odd)	Chum	Coho	Chinook	Total
Prince William Sound							
Average	1.9	191.8	161.4	33.9	0.4	0.1	212.8
Peak	6.5	452.3	434.1	98.0	1.8	0.3	549.8
Copper River							
Average	8.8	0.2	0.1	0.1	2.1	0.2	11.4
Peak	16.7	0.4	0.4	0.7	3.6	0.4	21.8
Bering River							
Average	0.4	<0.1	<0.1	<0.1	0.8	<0.1	1.2
Peak	1.1	<0.1	<0.1	<0.1	1.3	<0.1	2.4
Yakutat							
Average	1.6	0.6	1.9	1.3	1.6	0.1	5.9
Peak	4.3	2.6	5.8	6.6	5.6	0.3	21.0
Region total							
Average	12.7	192.6	163.4	35.3	4.9	0.4	231.3
Peak	28.6	455.3	440.3	105.3	12.3	1.0	595.0

[1]*See* text for calculation.

Table 7. The timing[1] of downstream migration of juvenile salmonids in selected locations in the northeastern Gulf of Alaska

Species	Location	Beginning	Peak	End
Sockeye	Taku River	April	May	June
Pink	Prince William Sound (8 bays)	April	May	June
	Sashin Creek	--	April	June
Chum	Prince William Sound (8 bays)	April	May	June
	Sashin Creek	--	May	--
Coho	Petersburgh Creek	March	May	August
	Sashin Creek	--	May	--
	Taku River	April	May	June
Chinook	Taku River	April	May	June
Steelhead	Petersburgh Creek	April	June	August
	Peterson Creek	May	June	July
Char	Taku River	April	May	June
Sea-run cutthroat	Petersburgh Creek	May	May	July
	Peterson Creek	May	July	July

[1]Source: Jones 1972, 1973, 1974, 1975.
Lagler and Wright 1962.
Meehan and Siniff 1962.
Tait and Kirkwood 1957.

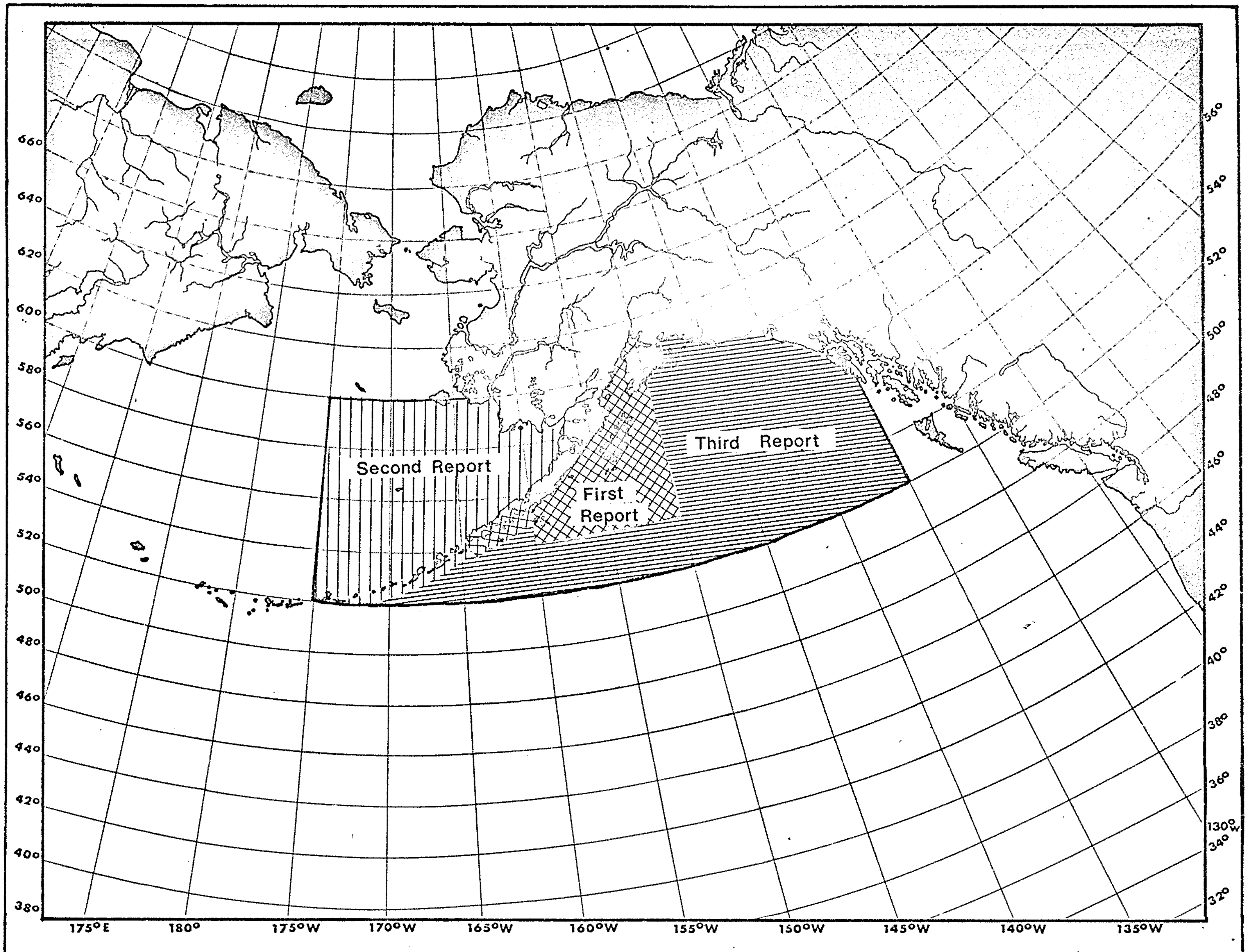

Fig. 1. Map of study area showing geographic coverage of each report.

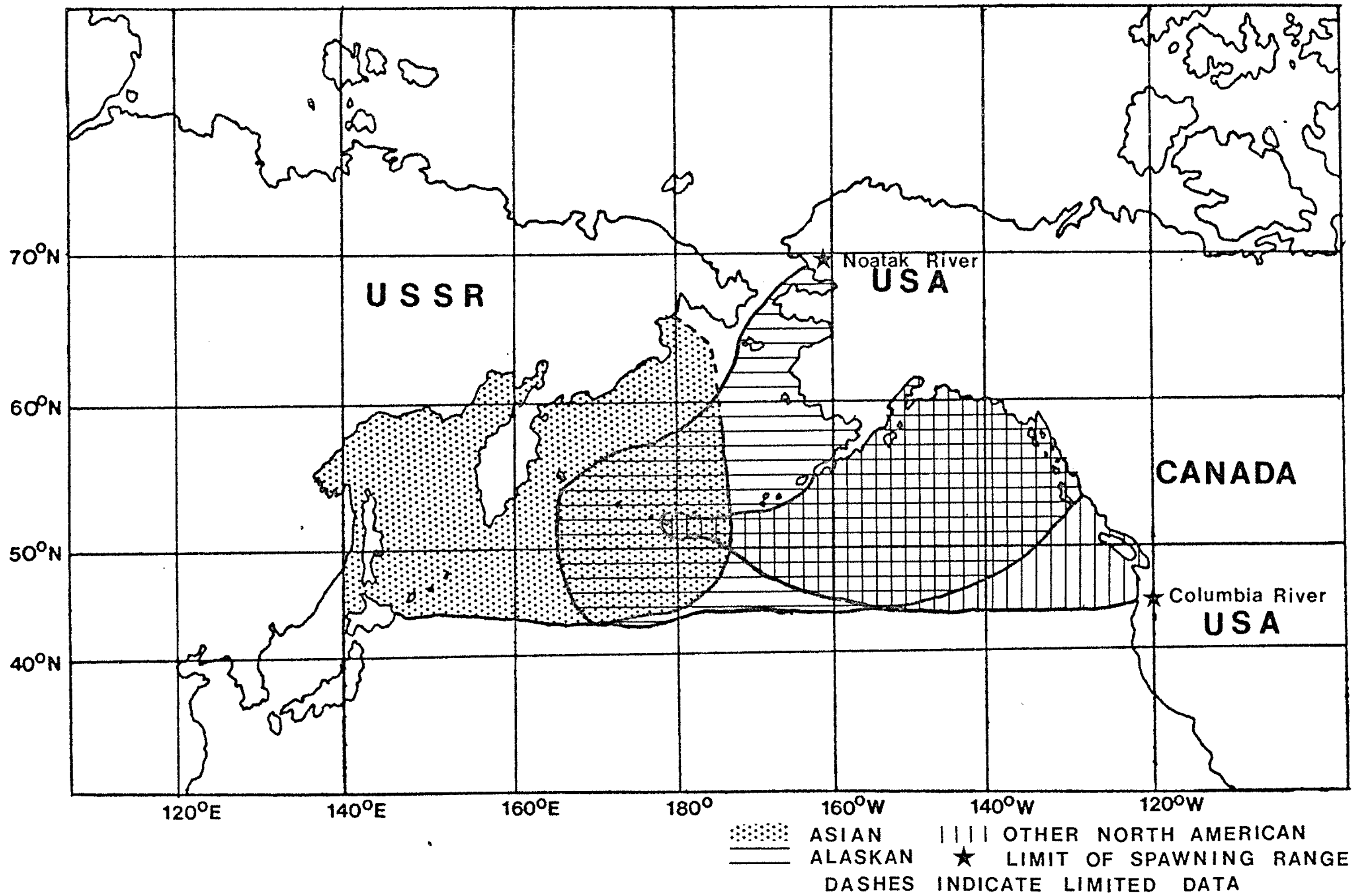

Fig. 2. The range of spawning stocks and offshore distribution of sockeye salmon. (From Hart 1973.)

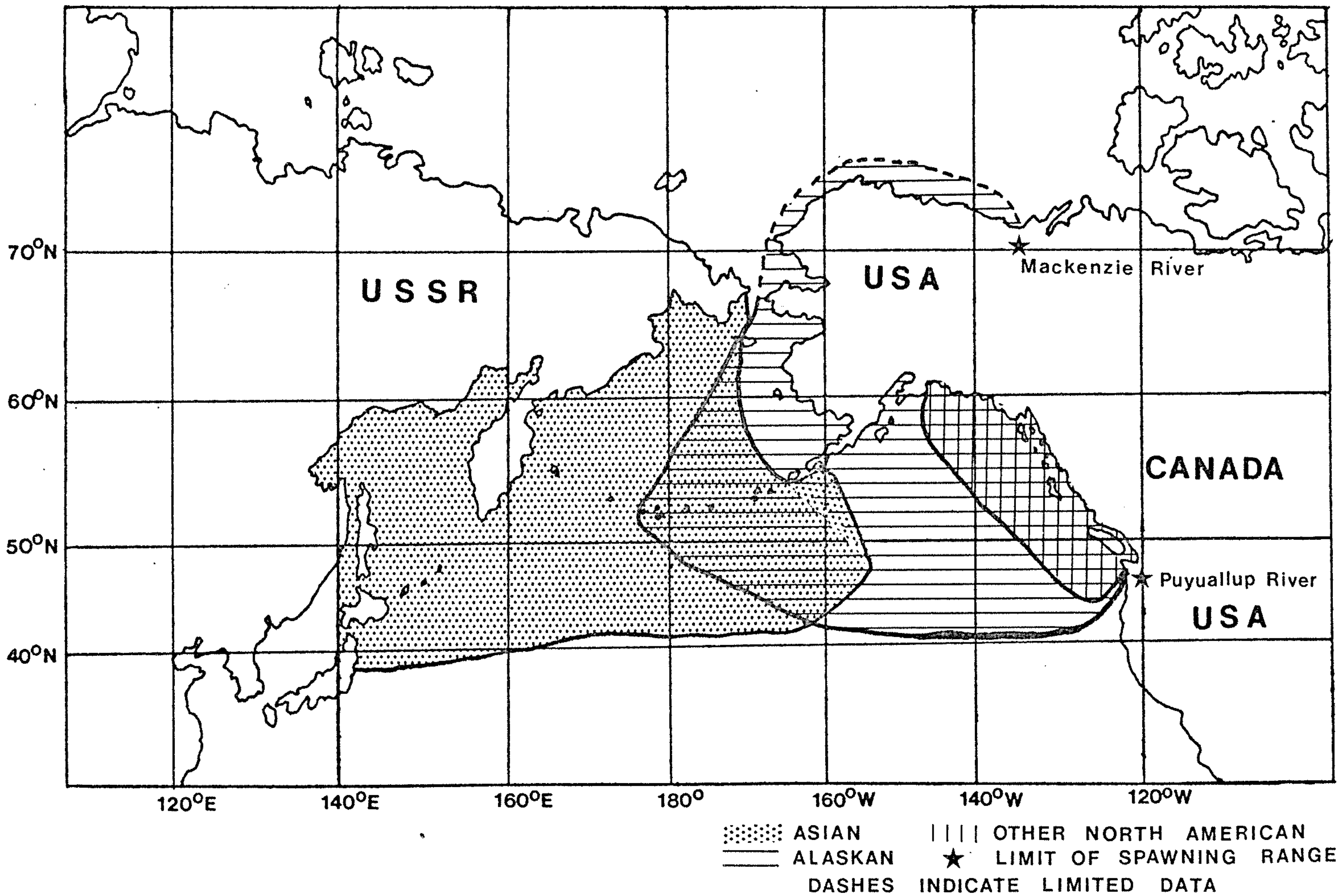

Fig. 3. The range of spawning stocks and offshore distribution of pink salmon. (From Hart 1973.)

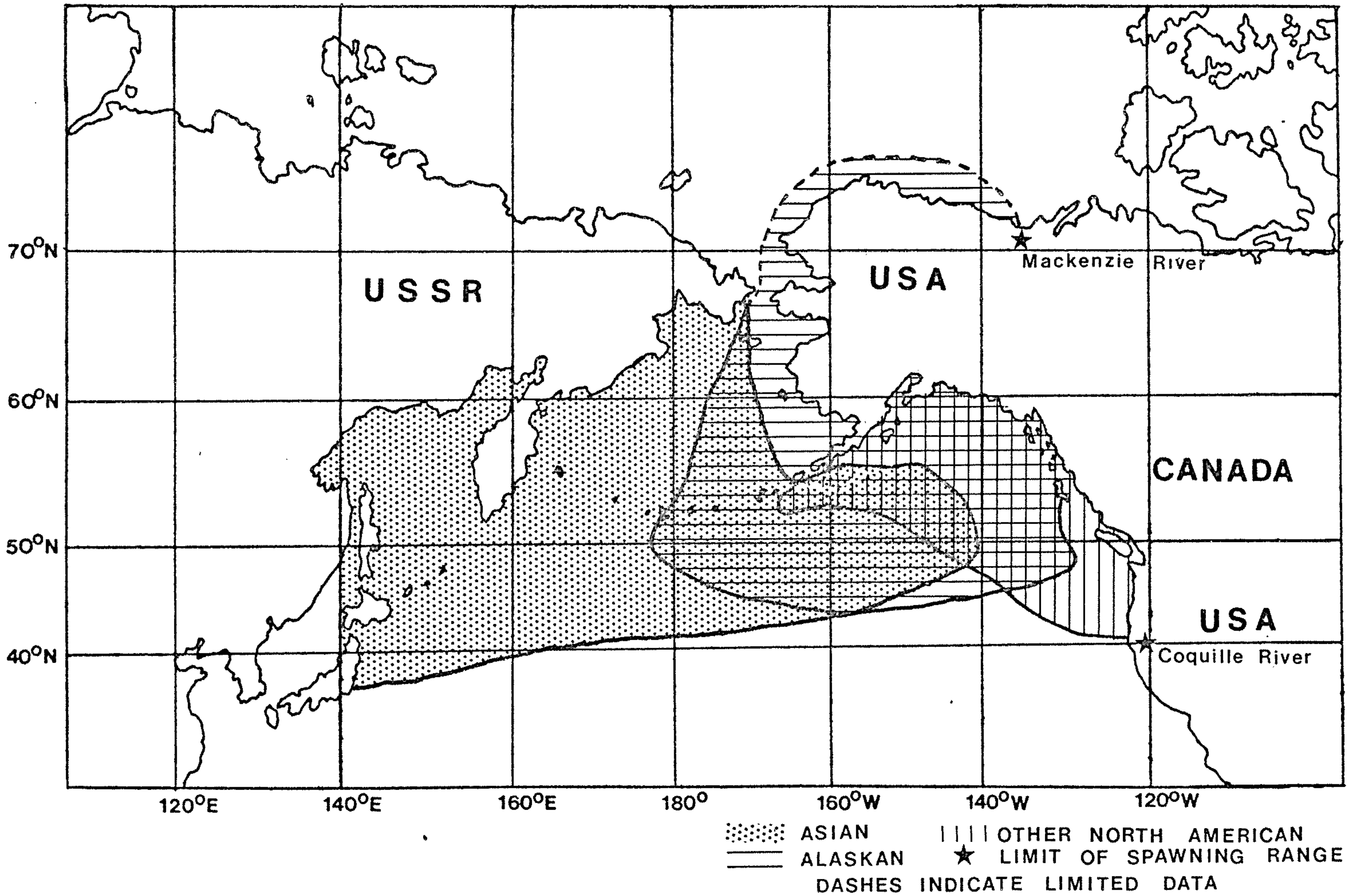

Fig. 4. The range of spawning stocks and offshore distribution of chum salmon. (From Hart 1973.)

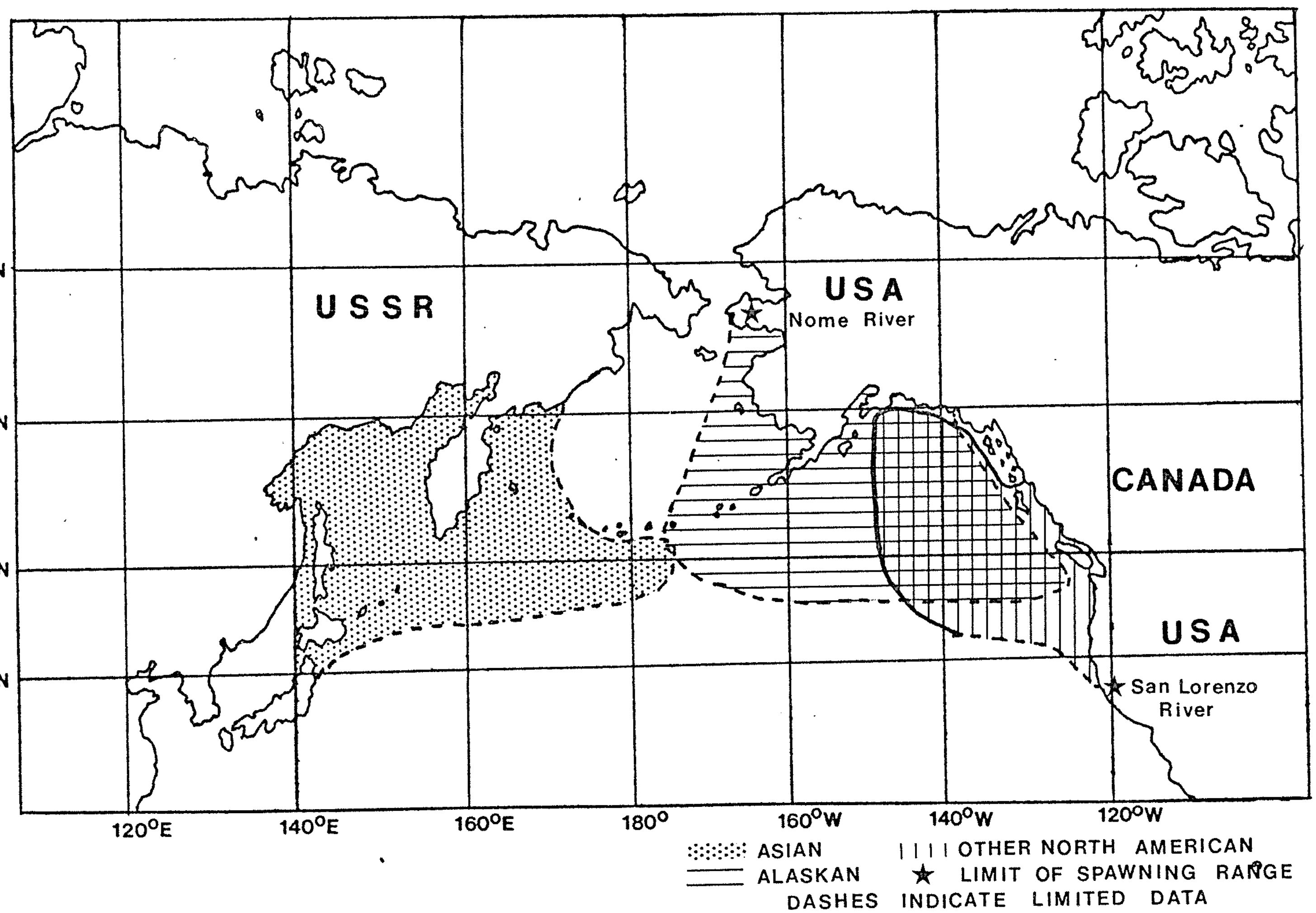

Fig. 5. The range of spawning stocks and offshore distribution of coho salmon. (From Hart 1973, and French et al. 1975.)

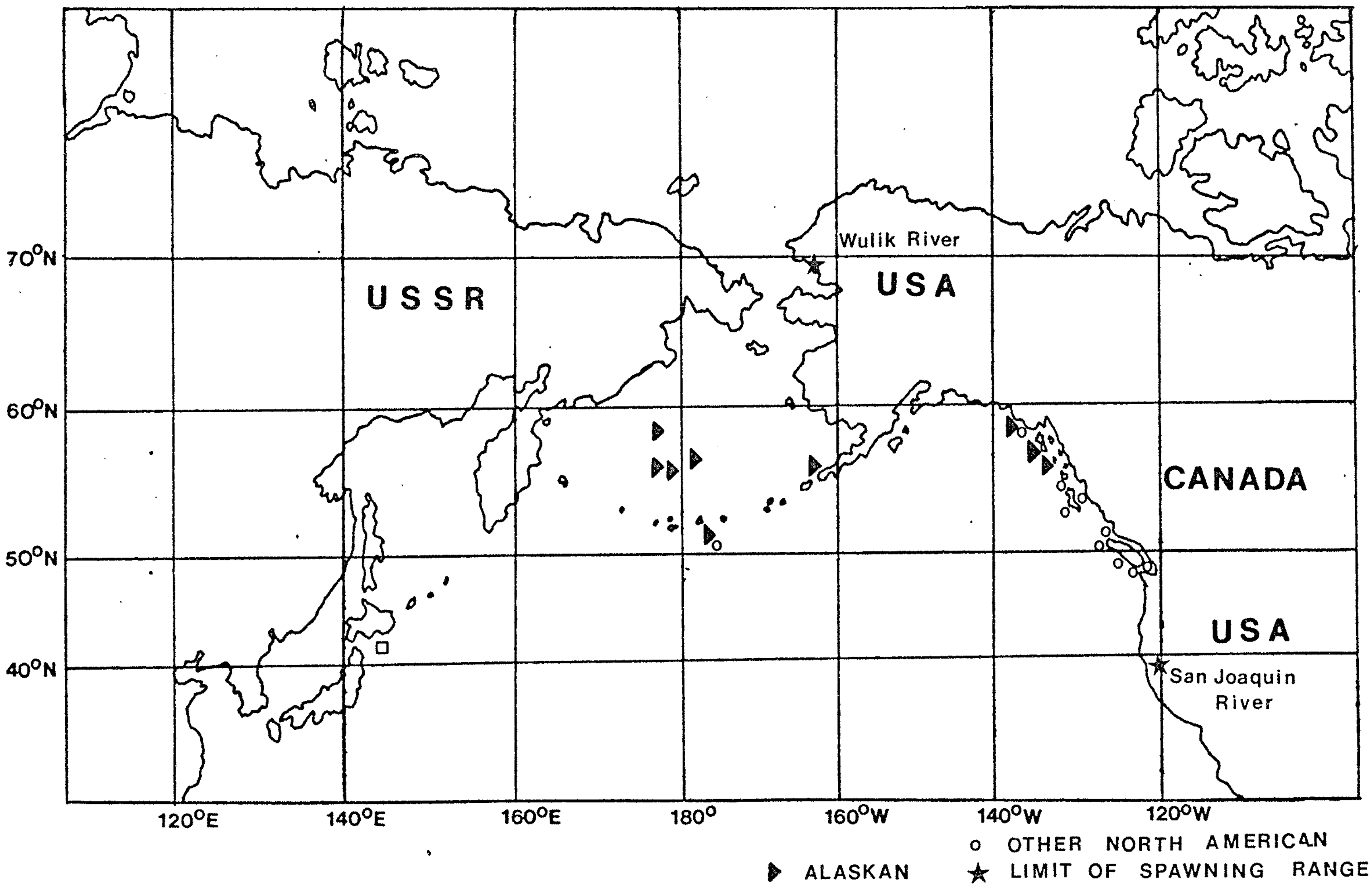

Fig. 6. The range of North American spawning stocks and offshore distribution of chinook salmon. (From Major et al., in press.)

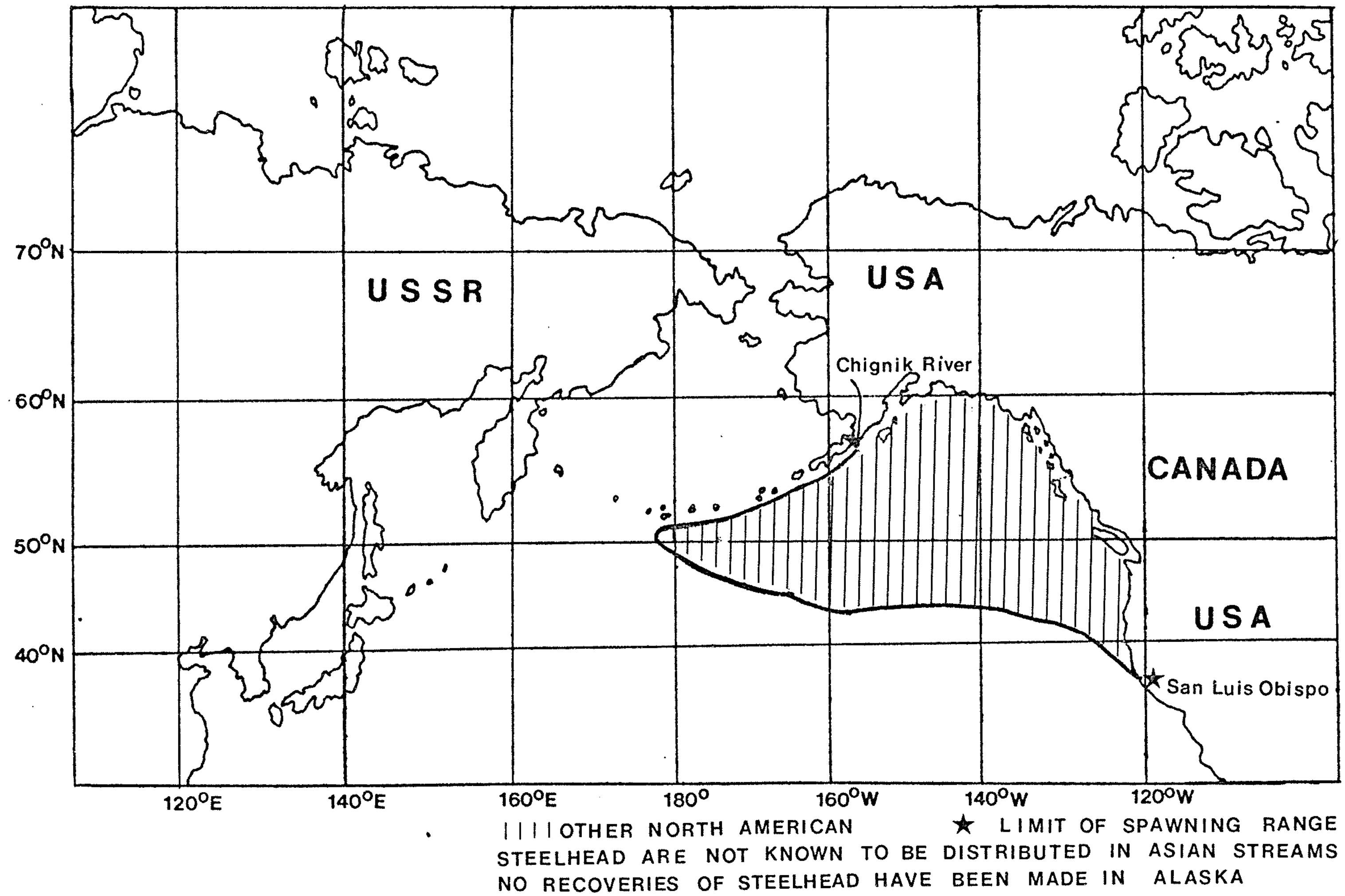

Fig. 7. The range of North American spawning stocks and offshore distribution of steelhead trout. (From Hart 1973.)

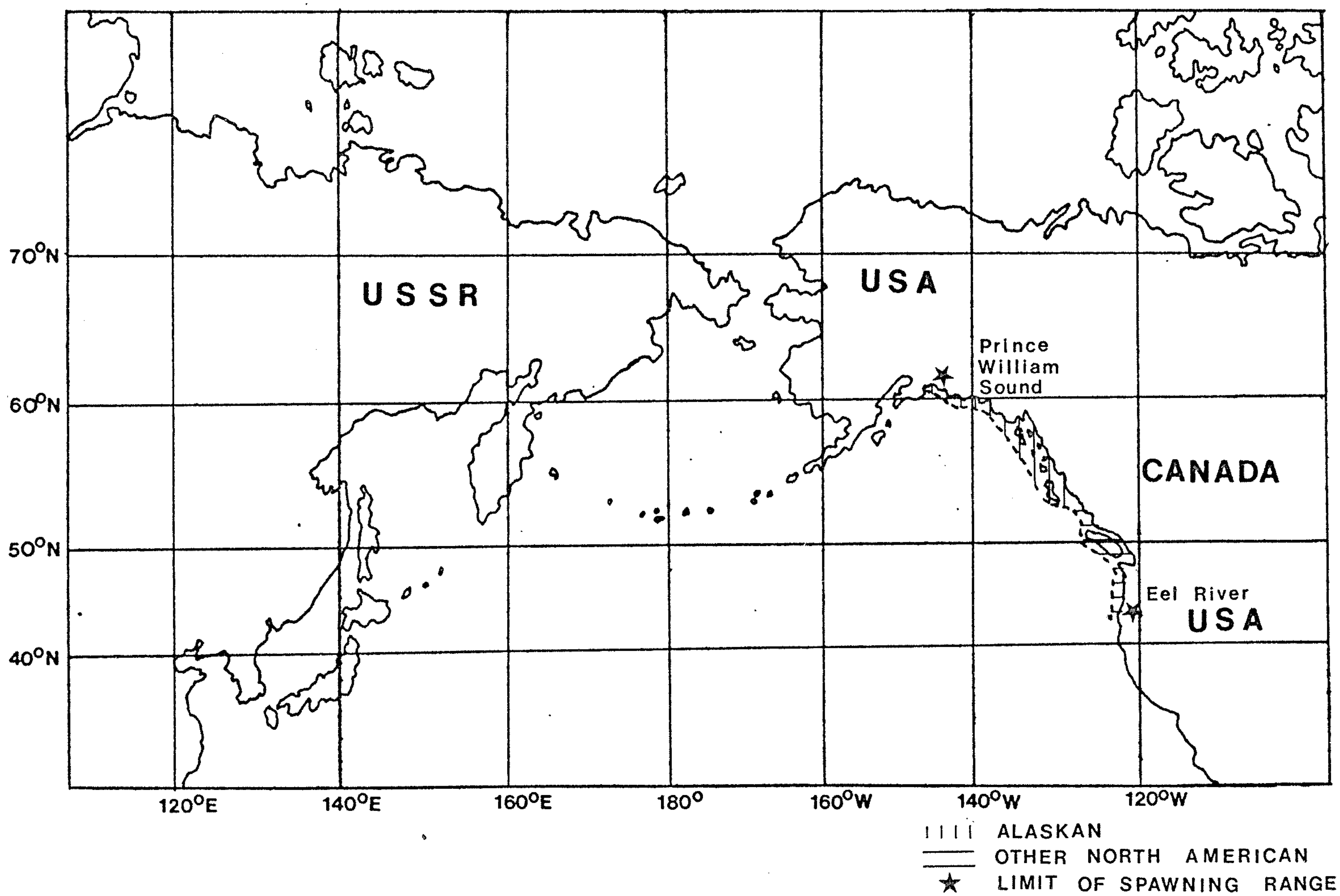

Fig. 8. The range of North American spawning stocks and offshore distribution of sea-run cutthroat trout. (From Hart 1973.)

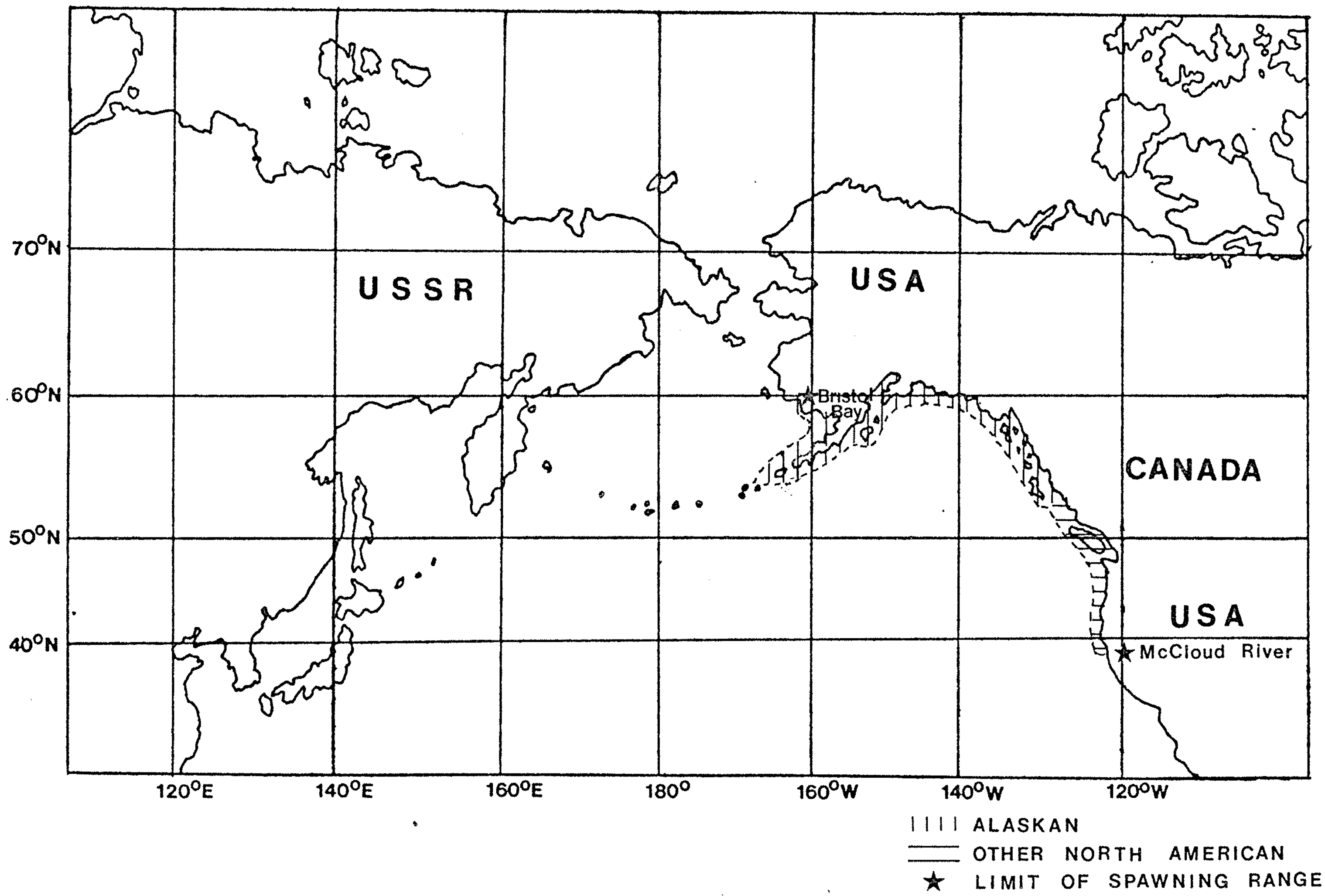

Fig. 9. The range of North American spawning stocks and offshore distribution of Pacific char. (From Hart 1973.)

Fig. 10. Statistical districts of the Alaskan commercial salmon fishery.

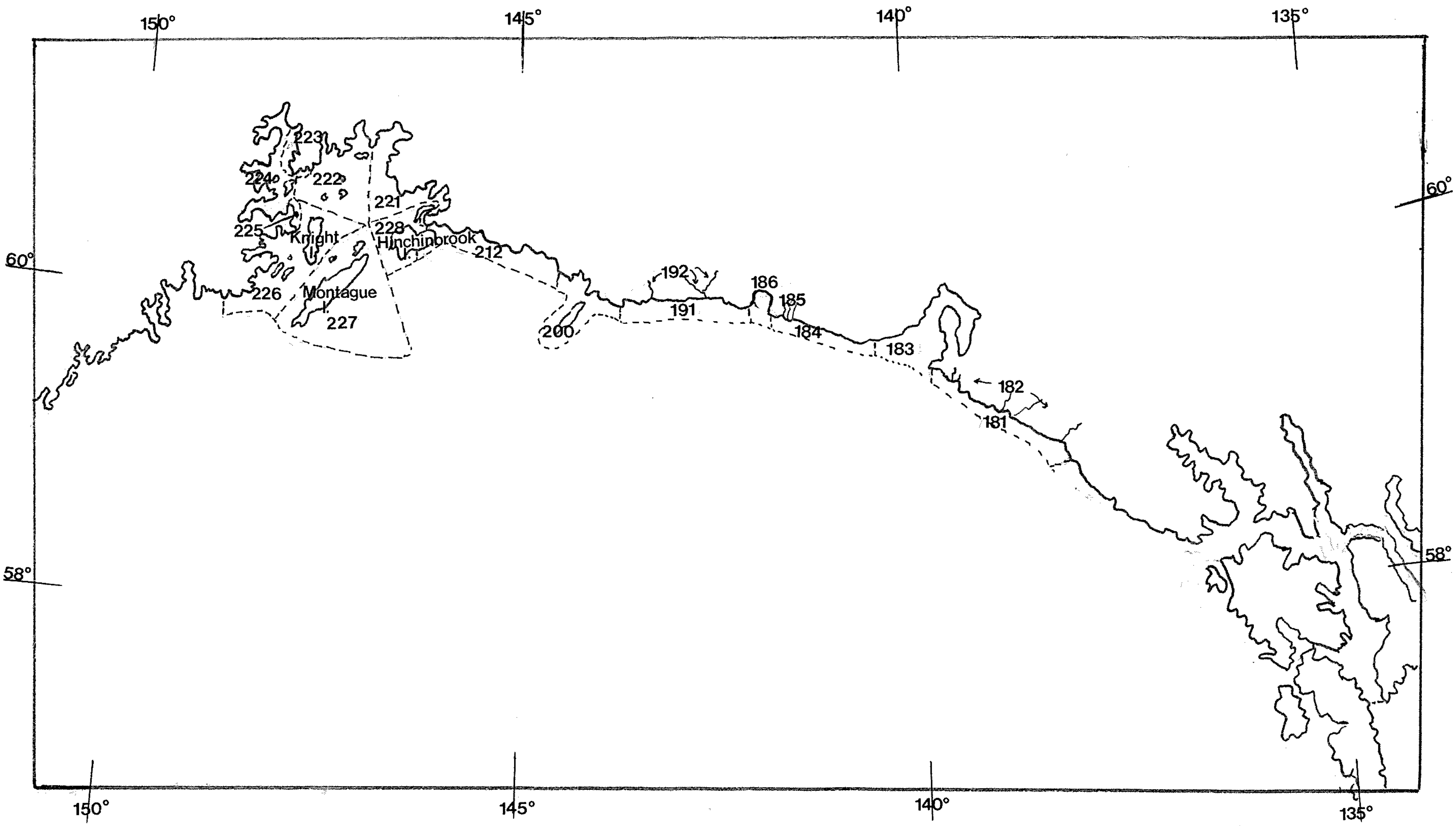

Fig. 11. Alaska Department of Fish and Game statistical areas covered by the third report.

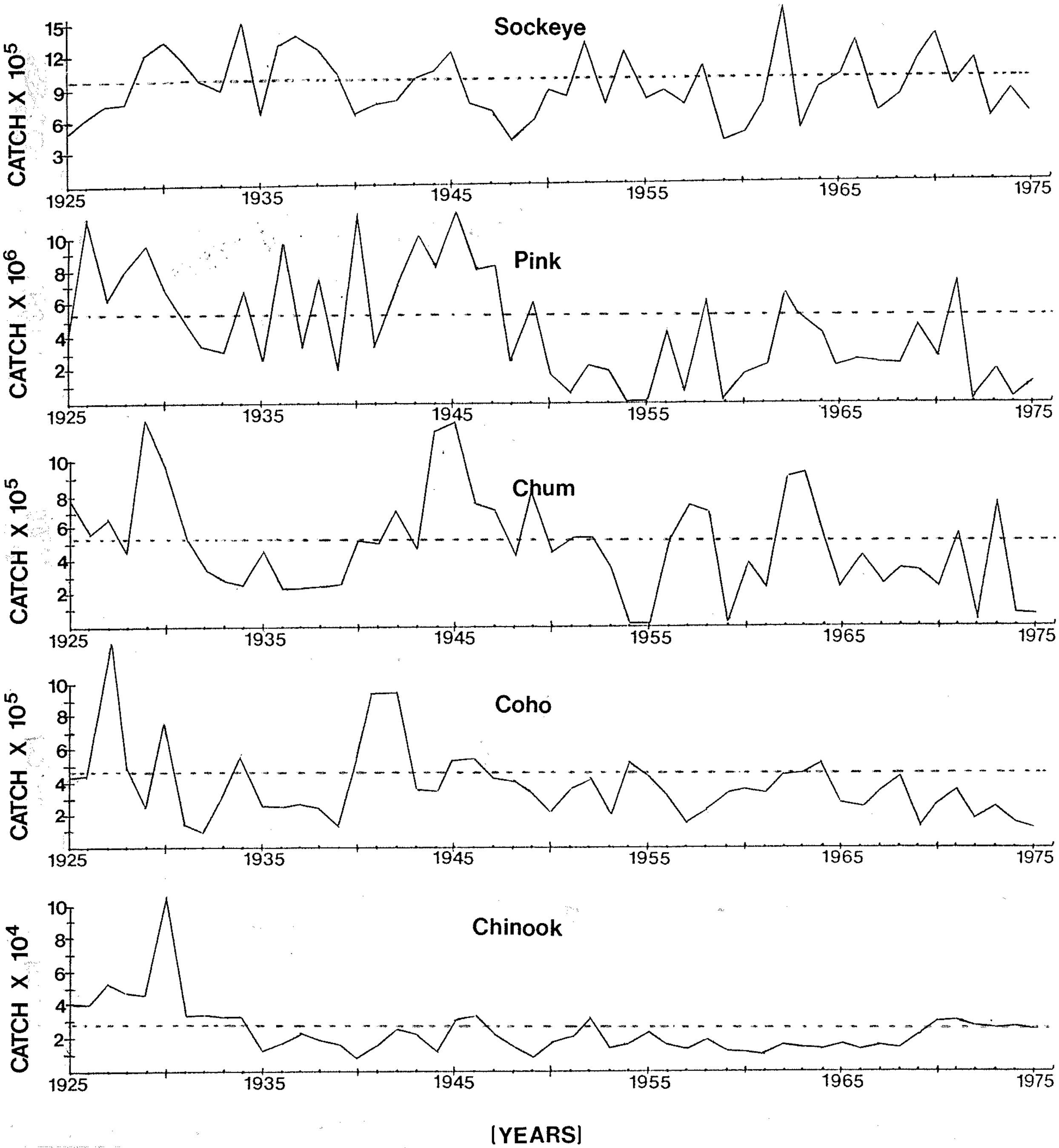

Fig. 12. Commercial catches of salmon[1] by species and year (1925-75) in numbers of fish for the Prince William Sound, Copper River, Bering River, and Yakutat districts. The dotted lines show the 51-year average (1925-75).

[1]Source: INPFC. MS 1974. Historical catch statistics for salmon of the North Pacific Ocean. Manuscript version of compilation proposed for publication in INPFC bulletin series. INPFC Statistical Yearbooks (1972-74), Alaska Department Fish Game Preliminary Data (1975).

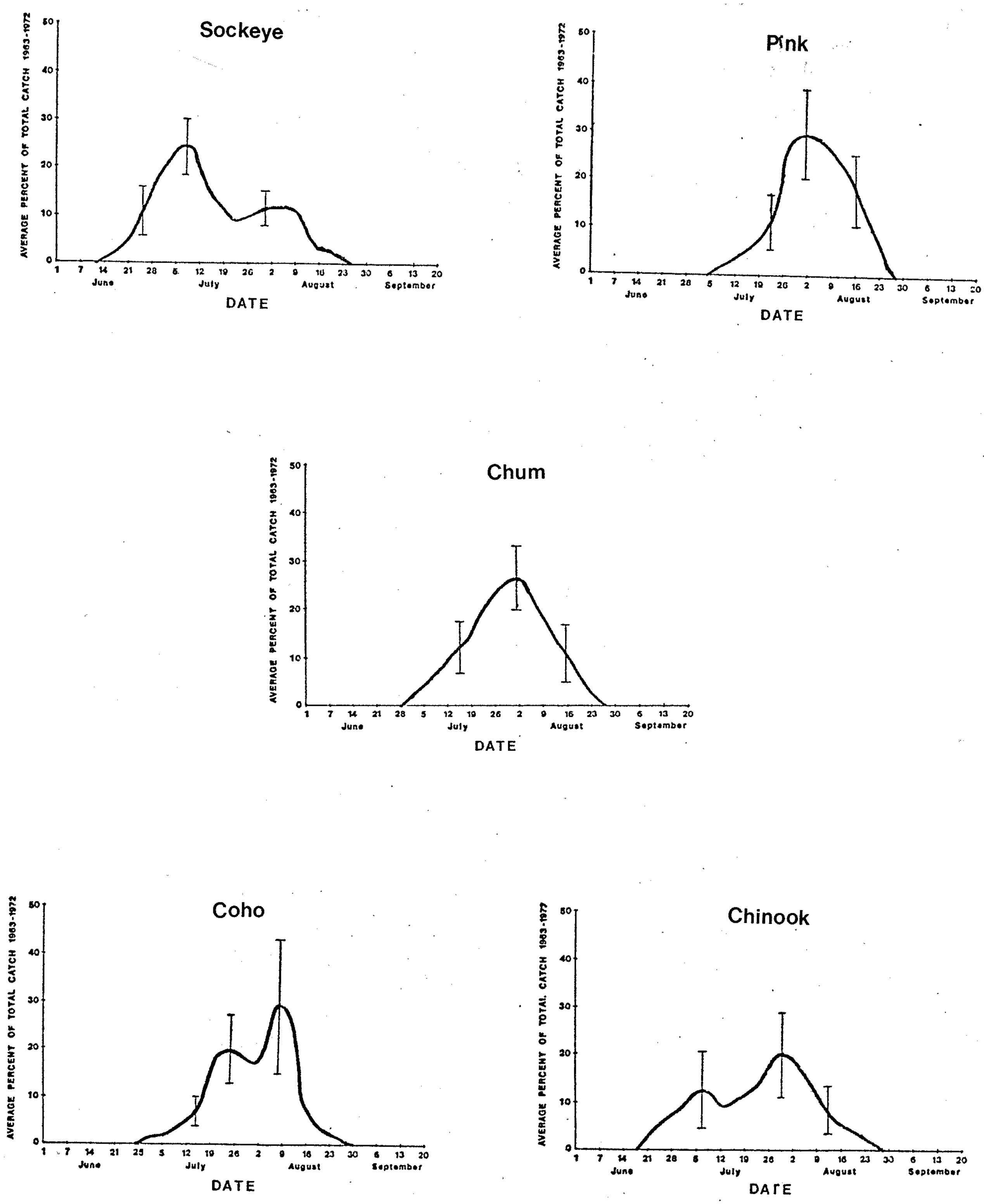

Fig. 13. The average timing of salmon runs to the Prince William Sound district as derived from weekly catch statistics (1963-72). The symbols along the curve indicate 95% confidence intervals for the percent catch on selected dates.

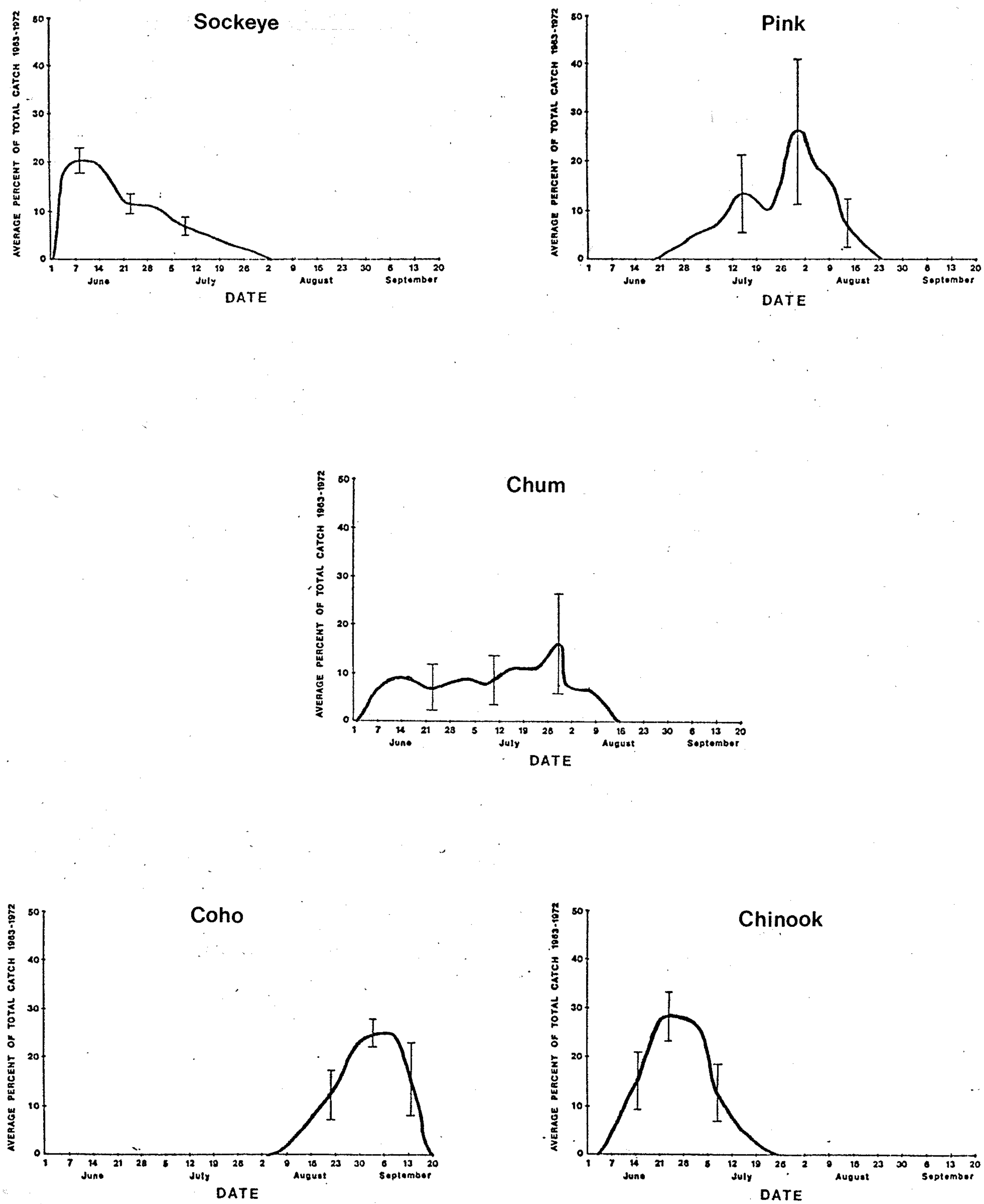

Fig. 14. The average timing of salmon runs to the Copper River district as derived from weekly catch statistics (1963-72). The symbols along the curve indicate 95% confidence intervals for the percent catch on selected dates.

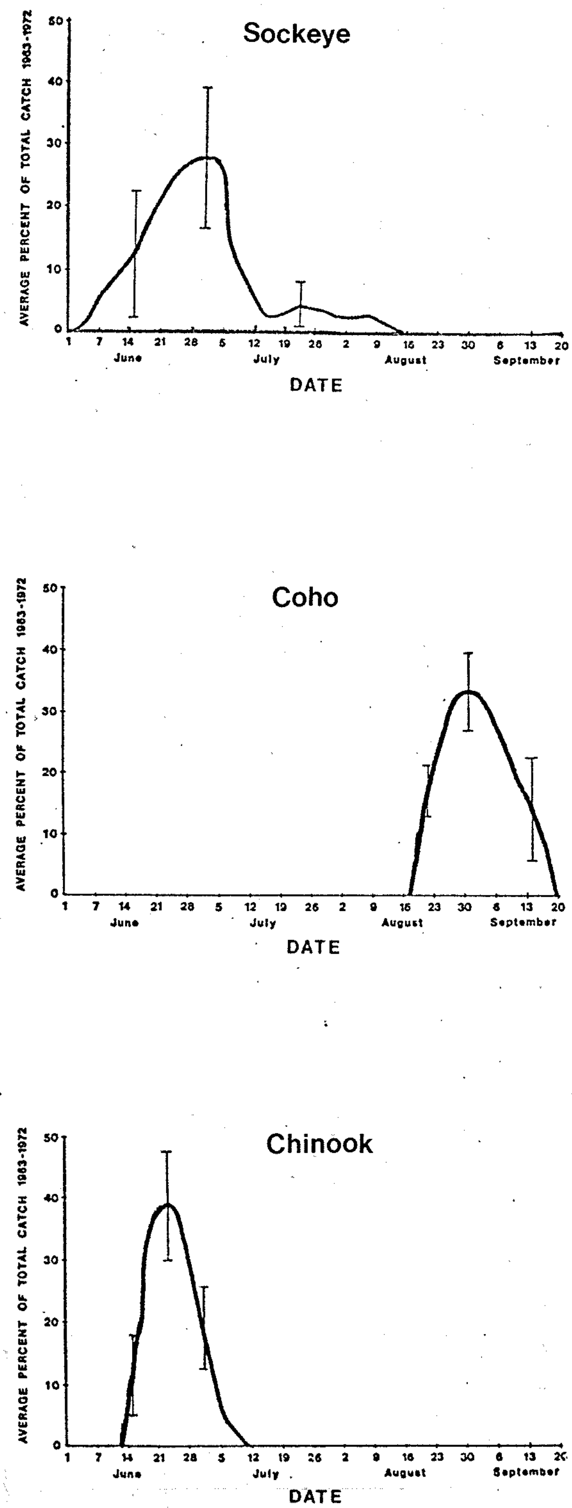

Fig. 15. The average timing of salmon runs to the Bering River district as derived from weekly catch statistics (1963-72). The symbols along the curve indicate 95% confidence intervals for the percent catch on selected dates.

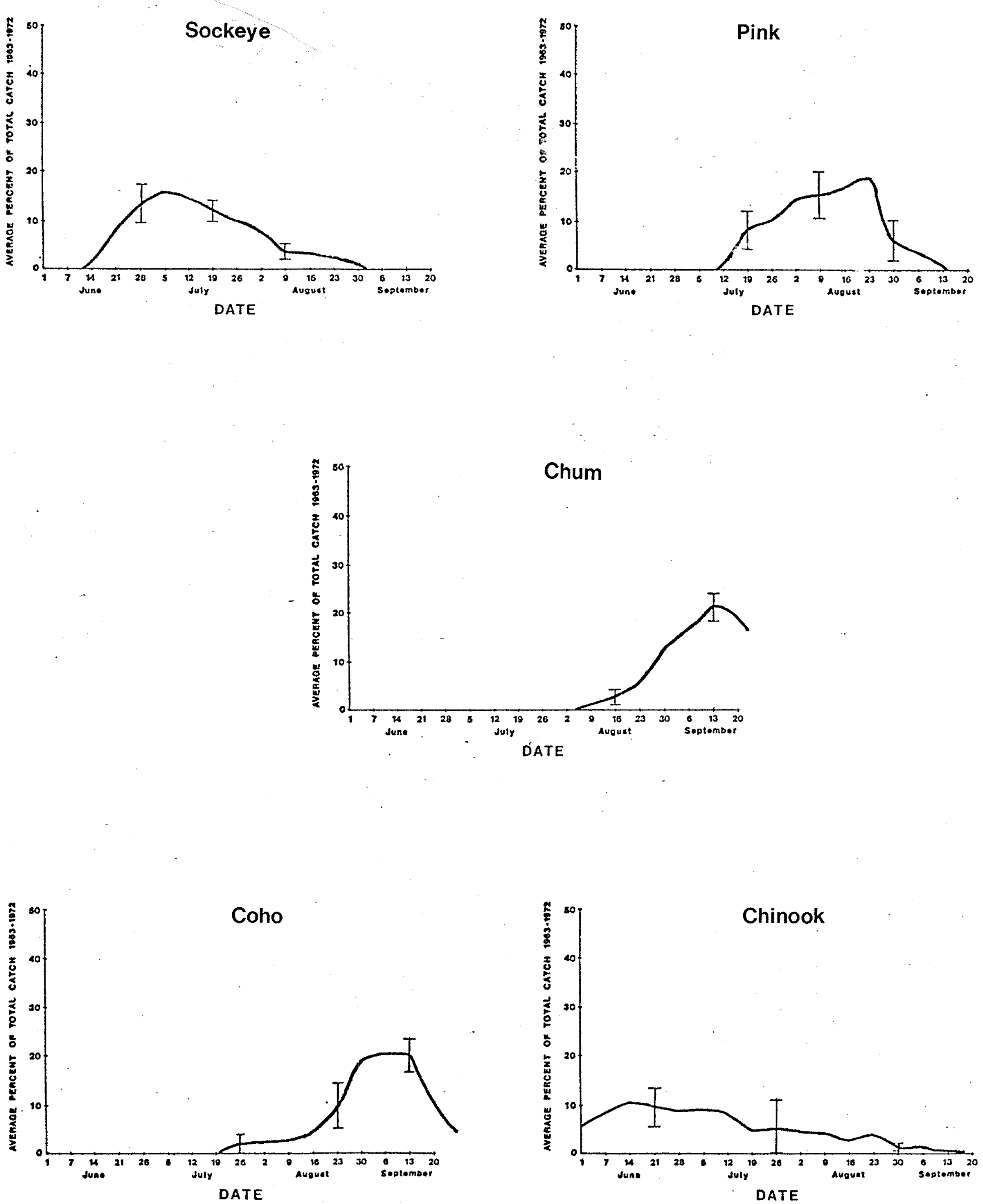

Fig. 16. The average timing of salmon runs to the Yakutat district as derived from weekly catch statistics (1963-72). The symbols along the curve indicate 95% confidence intervals for the percent catch on selected dates.

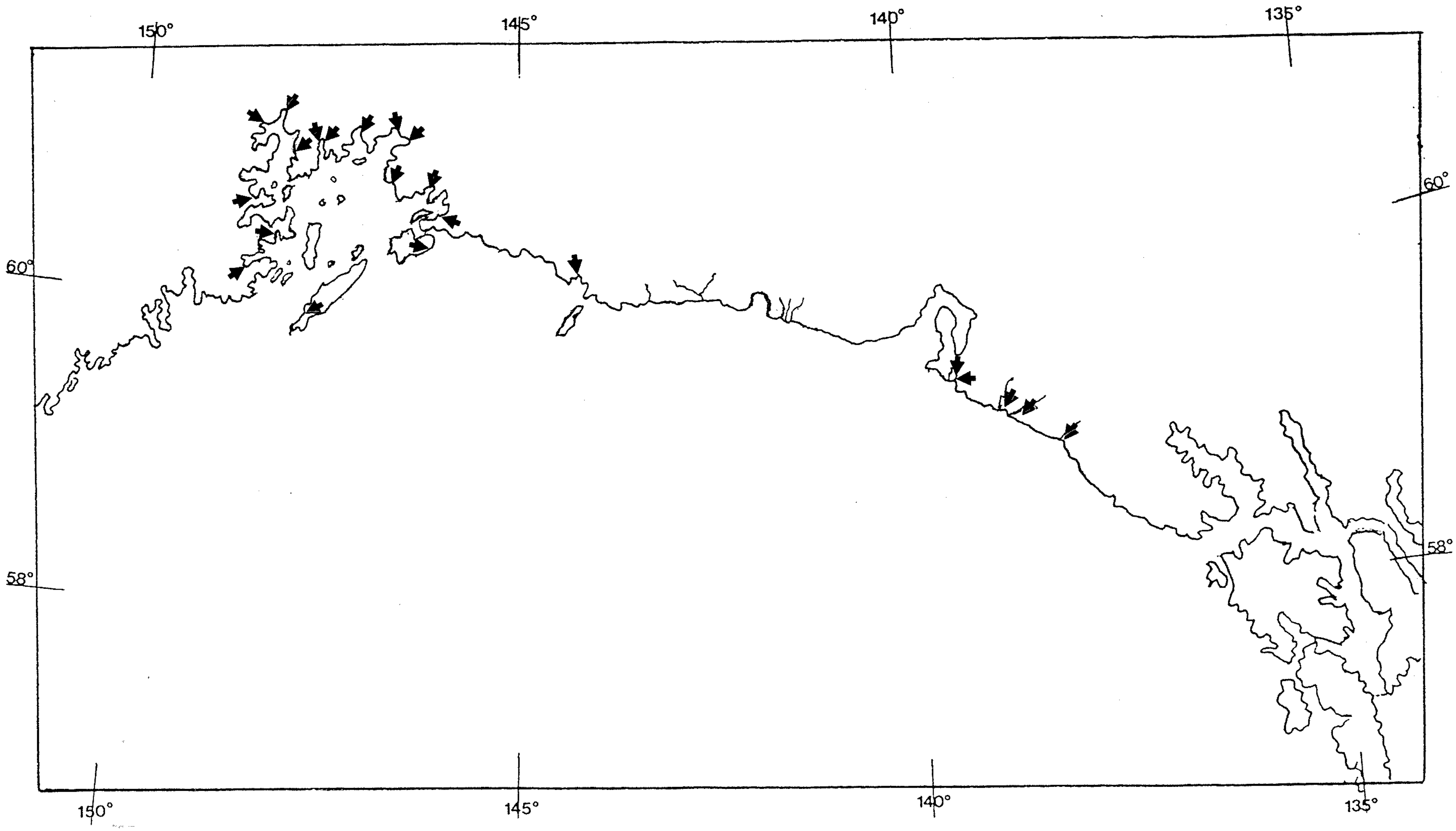

Fig. 17. Locations[1] of juvenile sockeye salmon entry into nearshore waters.

[1]Source: Figs. 53, 55, 59, Atkinson et al. 1967.

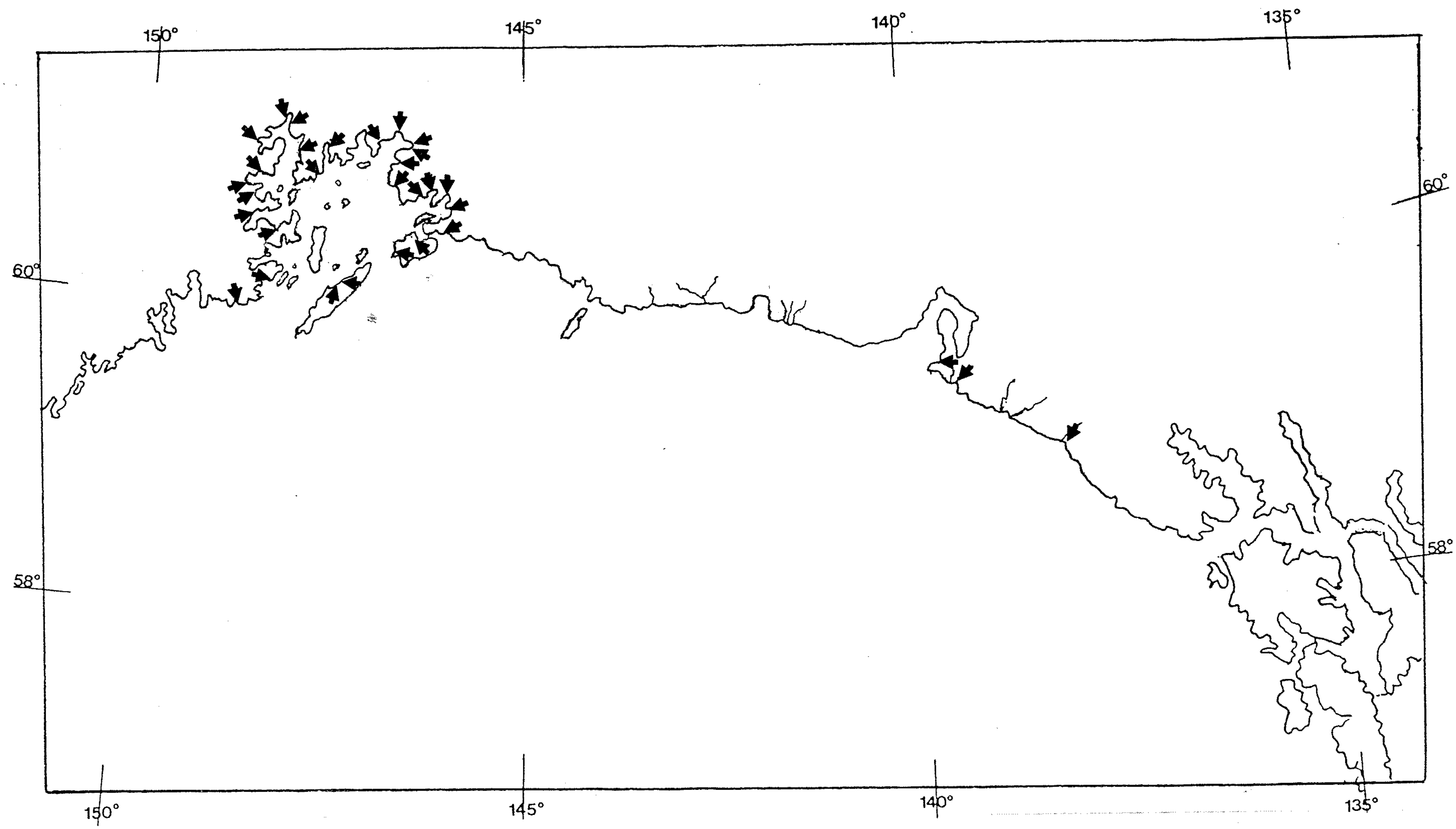

Fig. 18. Locations[1] of juvenile pink salmon entry into nearshore waters.

[1]Source: Figs. 52, 58, Atkinson et al. 1967.

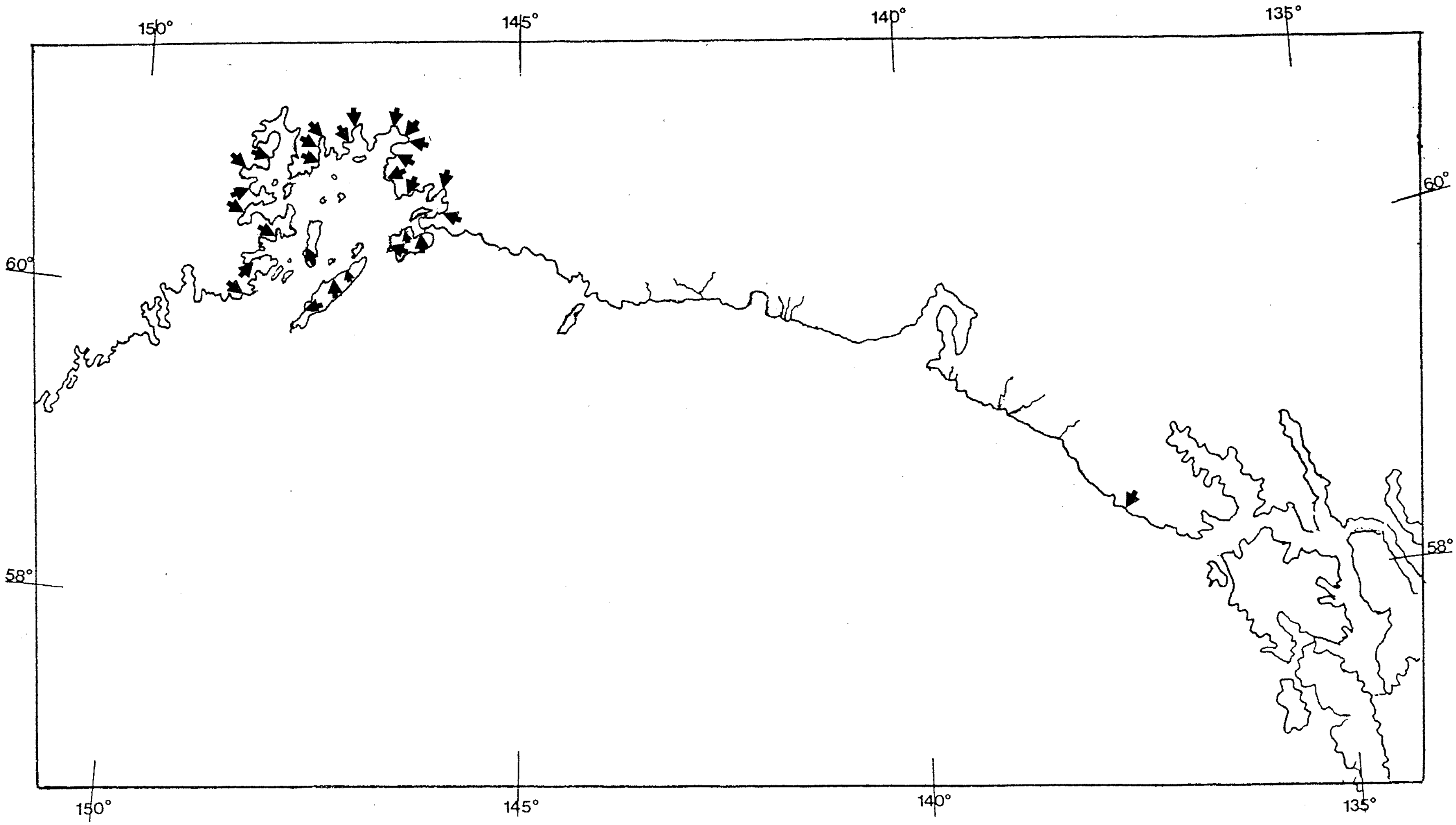

Fig. 19. Locations[1] of juvenile chum salmon entry into nearshore waters.

[1]Source: Figs. 50, 56, Atkinson et al. 1967.

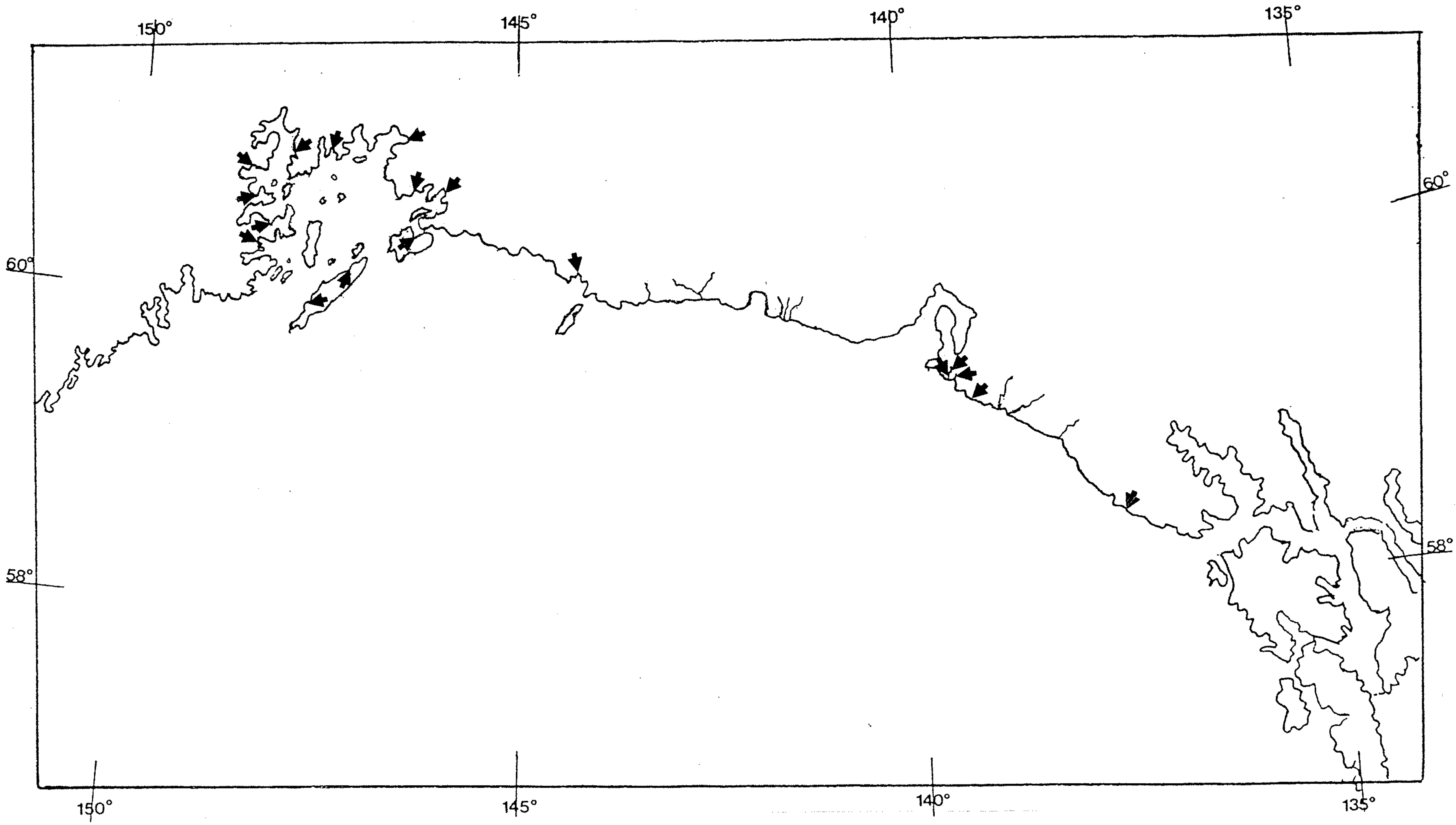

Fig. 20. Locations[1] of juvenile coho salmon entry into nearshore waters.

[1]Source: Figs. 51, 54, 57, Atkinson et al. 1967.

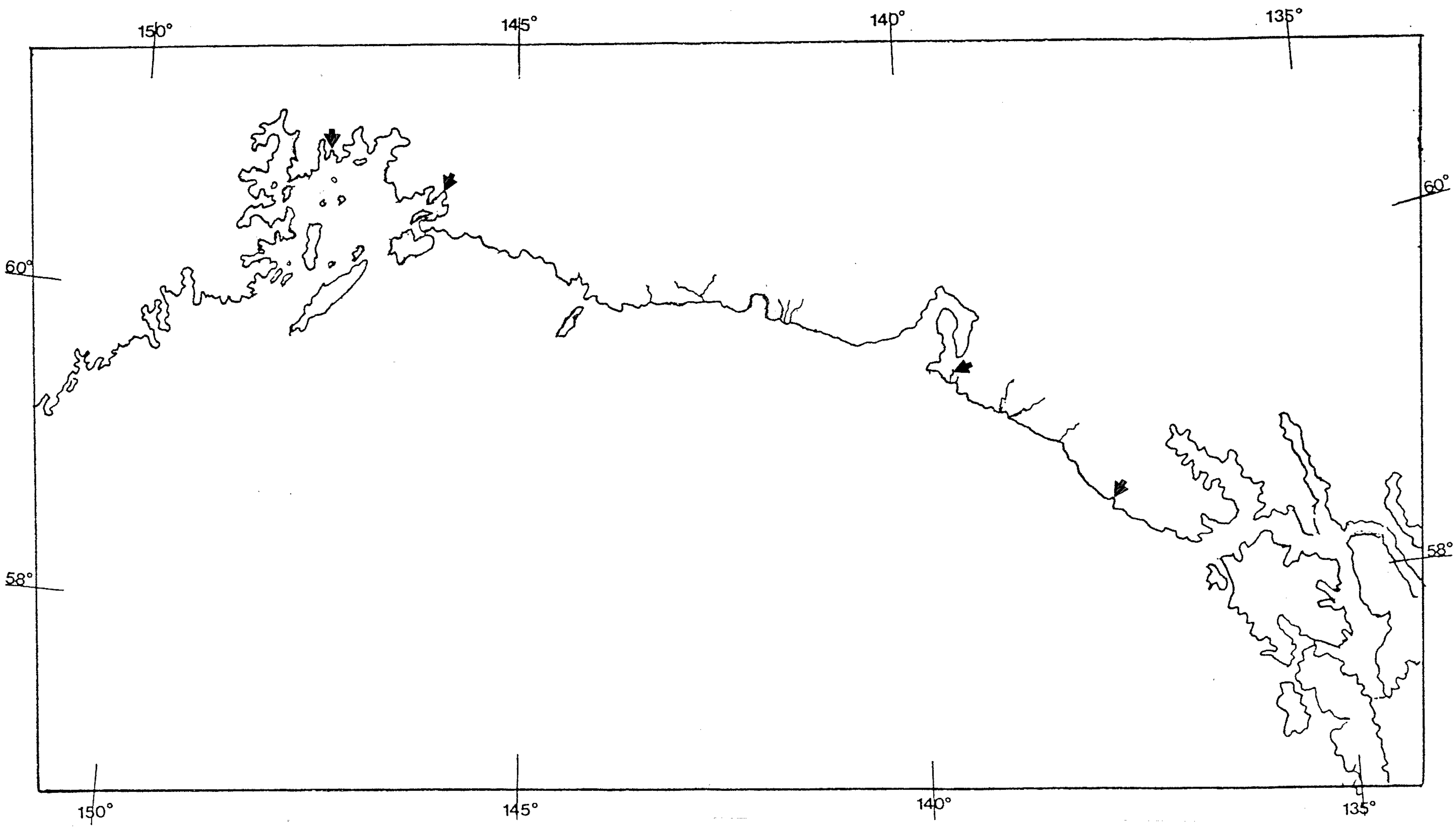

Fig. 21. Locations[1] of juvenile chinook salmon entry into nearshore waters.

[1]Source: Fig. 49, Atkinson et al. 1967.

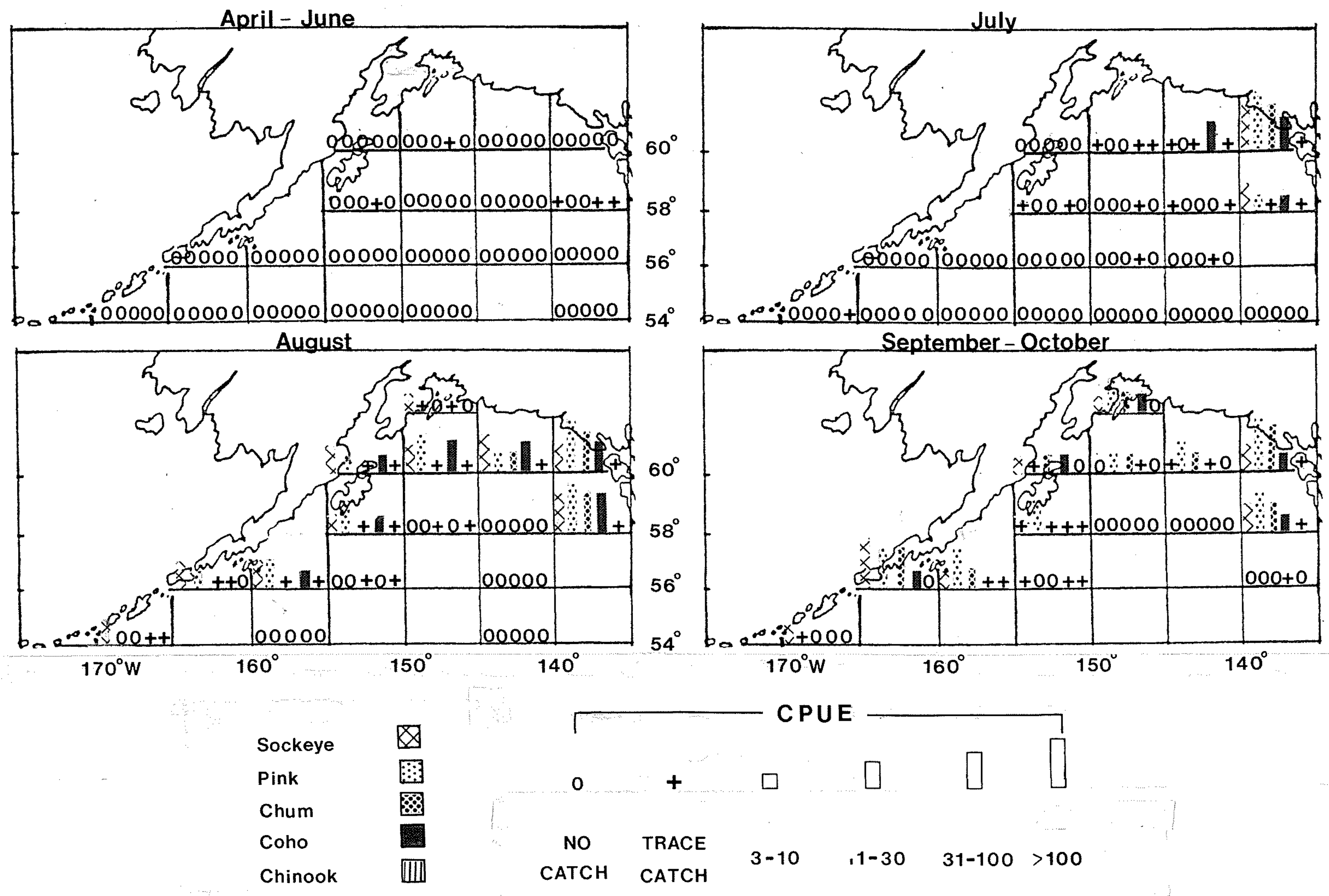

Fig. 22. The distribution and abundance of juvenile salmon in offshore waters as indicated by purse seine data[1] (1956-70). Units of catch are catch per set.

[1]Source: Hartt, Allan C., and Michael B. Dell. MS 1976. Life history of Pacific salmon and steelhead trout during their first summer in the open sea. Fish. Res. Inst., Univ. Washington, Seattle, Washington.

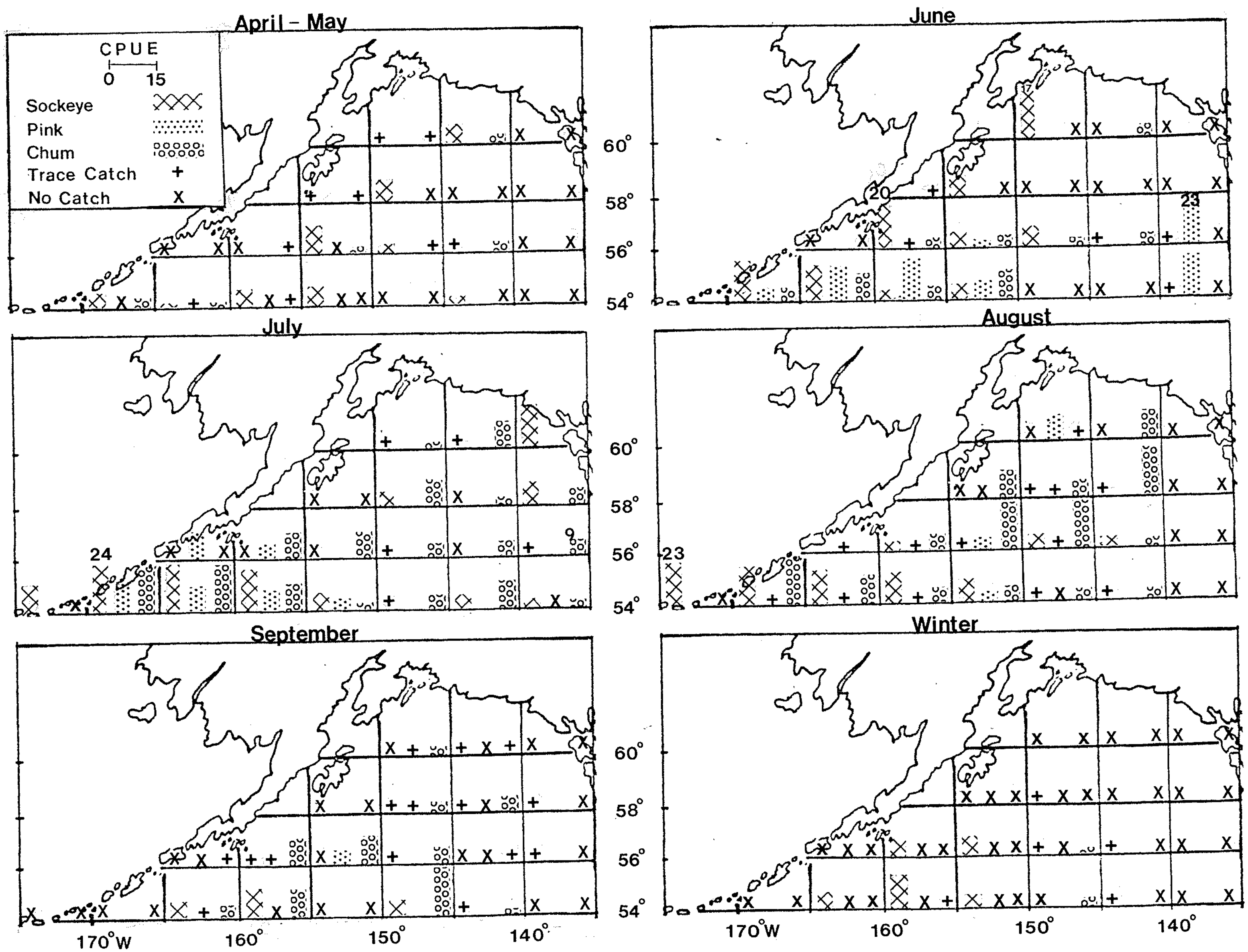

Fig. 23. The distribution and abundance of adult sockeye, pink, and chum salmon in offshore waters as indicated by gillnet catches.[1] Sockeye data: Canada 1956-60 and 1967, Japan 1960-71, U.S. 1956-71. Winter sockeye data: Canada 1963, U.S. 1962-65, 1967, 1969-71. Pink data: Canada, Japan, and U.S. 1961-71. Chum data: Canada, Japan, and U.S. 1956-71. Winter chum data: Canada, Japan, and U.S. 1962-71.

[1]Source: French et al. (in press), Neave et al. (in press), Takagi et al. (in press).

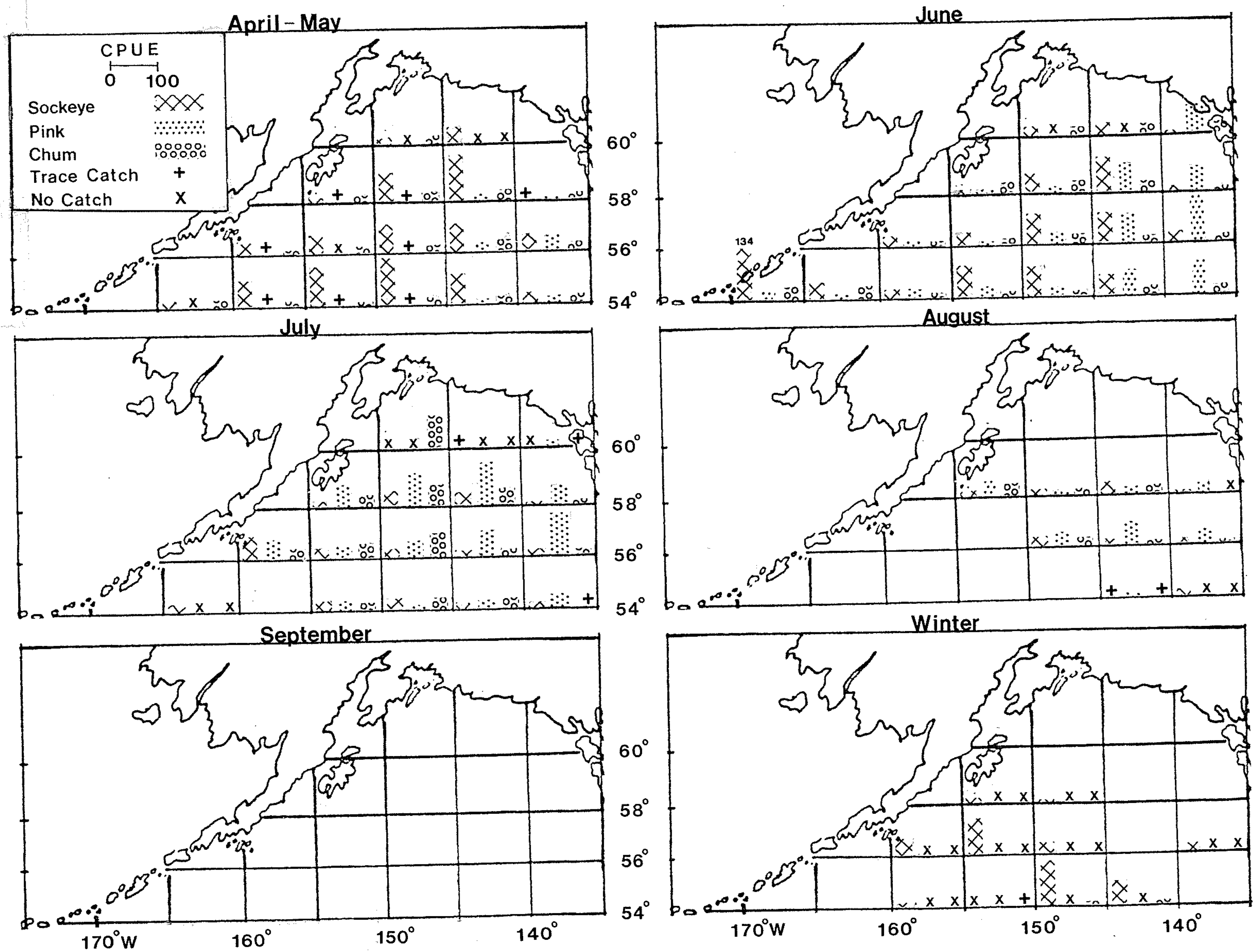

Fig. 24. The distribution and abundance of adult sockeye, chum, and pink salmon in offshore waters as indicated by longline catches[1] (1961-67). A unit of effort equals catch per thousand hooks.

[1]Source: Turner and Aro (1968).

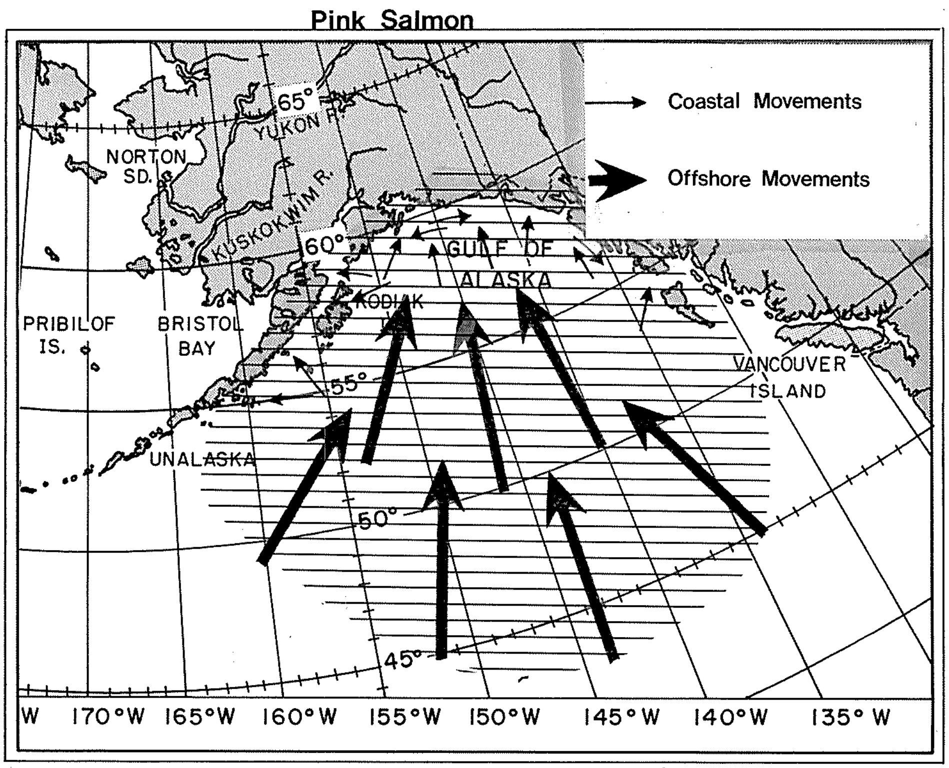

Fig. 25. Spring and summer migrations of northeastern Pacific stocks of pink salmon enroute to spawning grounds. (Adapted from Fig. 91, Takagi et al., in press.)

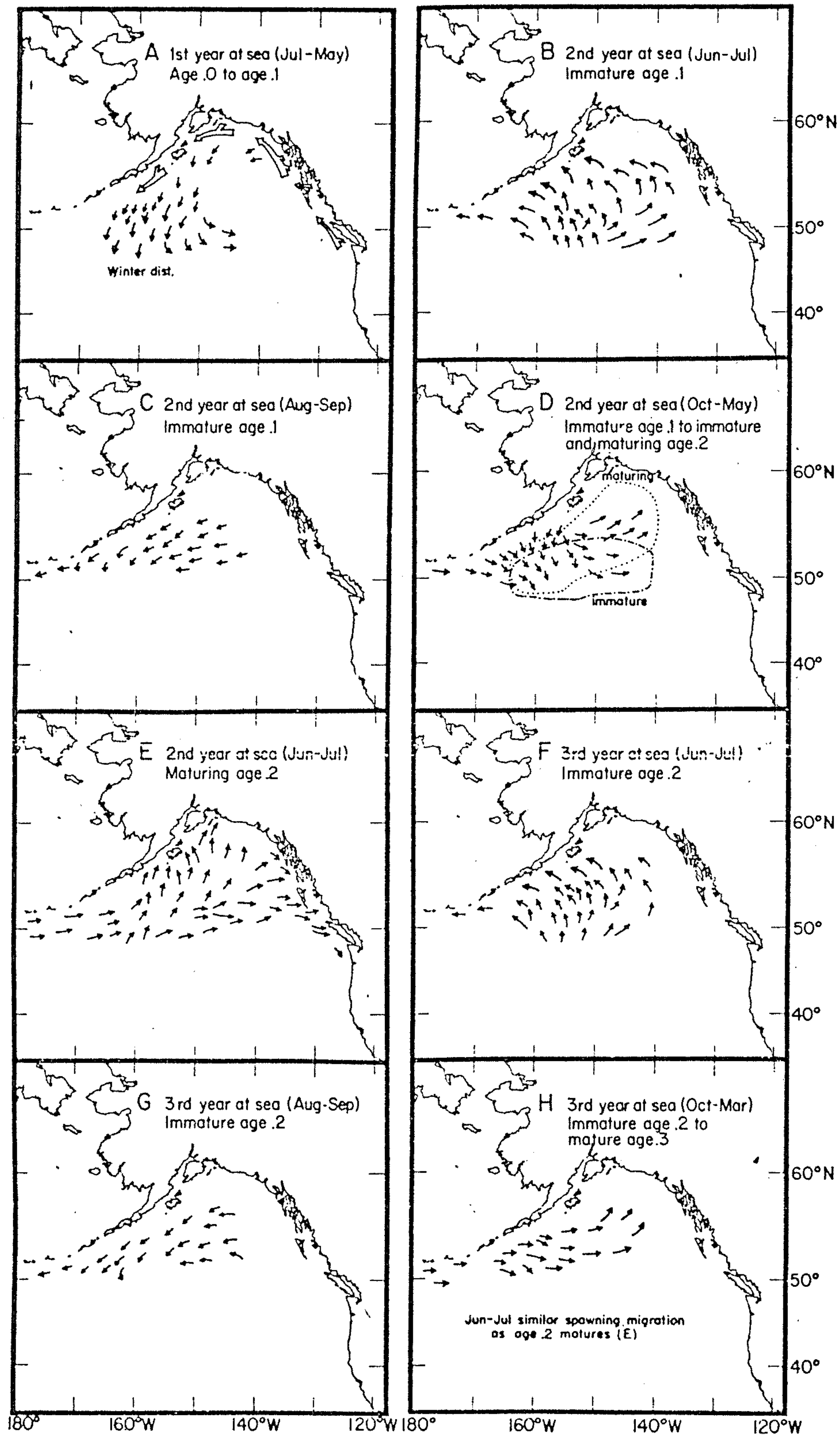

Fig. 26. The migratory routes of northeastern Pacific stocks of sockeye salmon. (From Fig. 94, French et al., in press.)