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**U.S. DEPARTMENT OF COMMERCE**
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by
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# ABSTRACT

The Alaska Fisheries Science Center has conducted an annual longline survey of sablefish (Anoplopoma fimbria) and other groundfish in the Gulf of Alaska since 1987. This survey replicates as closely as practical the Gulf of Alaska portion of a Japan-U.S. cooperative longline survey conducted from 1979 to 1994 and also samples gullies not sampled during the cooperative longline survey. In 1989, 73 stations were sampled from 26 June to 12 September. Each day, 16 km of groundline containing 7,200 hooks baited with squid was set from the chartered fishing-vessel Ocean Prowler.

Sablefish relative population numbers (RPN) on the upper continental slope decreased significantly: 18% from 1988 to 1989. Most of the decrease was observed in the western and central areas of the Gulf of Alaska; the RPN remained -about the same in the eastern areas. The strong 1984 year class expected to recruit in 1989 was not apparent in the survey results, nor was there evidence for later strong year classes. The rougheye (Sebastes aleutianus)- and shortraker (S. borealis) rockfish RPN increased 35% from 1988 to 1989; this increase was not statistically significant. The thornyhead [Sebastolobus alascanus) RPN increased. significantly (77%).

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## INTRODUCTION

From 1979 to 1994, Japan and the United States annually conducted a cooperative longline survey covering the upper continental slope of the eastern Bering Sea, the Aleutian Islands, and the Gulf of Alaska. The research has supplied information needed to estimate the abundance of sablefish (Anoplopoma fimbria) and other groundfish species (Lowe and Sigler 1989; Yoshimura and Sasaki 1989; Clausen and Sigler in press).

Since 1987, the National Oceanic and Atmospheric Administration's (NOAA) Alaska Fisheries Science Center has conducted an additional annual longline survey designed to continue the time series of the Gulf of Alaska portion of the Japan-U.S. cooperative longline survey. The domestic longline survey covers the same stations, (Fig. 1) and season, and uses similar sampling gear as used on the Gulf of Alaska portion of the cooperative longline survey. The primary purpose of the domestic longline survey is to determine annually the relative abundance and size composition of sablefish, shortspine thornyhead ***(Sebastolobus alascanus),*** rougheye rockfish ***(Sebastes aleutianus),*** and shortraker rockfish ***(Sebastes borealis)*** in the Gulf of Alaska.

This report presents results of the 1989 domestic longline survey and updates the 1987 and 1988 surveys (Sigler and Zenger 1989; Zenger et al. 1992). The analysis of sablefish for the 1989 Japan-U.S. cooperative longline survey is reported in Fujioka (1991) for the Gulf of Alaska and in Lowe (1991) for the eastern Bering Sea and Aleutian Islands. A comparison of the catch rates of sablefish between the domestic and cooperative longline surveys will be reported in a separate document (Zenger 1992).

## METHODS

### Vessel and Gear

The survey vessel was the chartered fishing vessel ***Ocean Prowler (47*** m, 155 ft). Each day, 16 km (8.6 nautical miles) of groundline was set. The groundline consisted of 160 sections called skates; each skate was 100 m (55 fathoms) long and included 45 Mustad[1] size 13/0 circle hooks spaced 2 m (6.5 ft) apart. The groundline was weighted with 3.2-kg (7-1b) lead balls snapped on at the end of every skate. Each hook was baited by hand with chopped squid (Illex spp.) at a rate of about 5.5 kg (12.0 lb) per 100 hooks.

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[1]**Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.**

Bait type, gangion and becket line strength, and hook brand differed between 1987 and 1988-1989. Details and reasons for the changes are described in Zenger et al. (1992). Because of these differences, the 1987 survey was considered experimental and is not included in the 1988-1989 time series.

## Survey Area and Operations

The survey area extends from Islands of Four Mountains (lat. 52°45'N, long. 170°W) eastward to Dixon Entrance (Fig. 1) and covers the upper continental slope and selected gullies. The area of the sablefish commercial fishery generally corresponds to the upper continental slope and gullies with bottom depths greater than 400 m, such as Spencer Gully. Adult sablefish also inhabit shallower gullies (bottom depths 200-400 m) not targeted during the commercial fishery. Sampling of gullies has expanded each year (1987-89) of the domestic longline survey to increase the amount of adult sablefish habitat sampled (Table 1). With this expansion, the survey area in 1989 generally corresponded to the area inhabited by adult sablefish. Sampled depths ranged from about 200 to 1,000 m, although at some stations depths less than 150 m were sampled.

The survey was from 26 June to 12 September 1989. Seventy-three stations were sampled--45 along the upper continental slope, 27 in gullies, and 1 on the continental shelf[2].

The sampling gear was set from shallow to deep and usually was retrieved in the same order. Set and retrieval began about 0630 and 0930 hours, respectively, and retrieval was completed about 2000 hours. Soak time ranged from 3 to 11 hours.

## Data Collection

Fish species and hook condition were recorded during sampling gear retrieval. Hook condition was classified as baited, unbaited, or ineffective. Ineffective hooks were missing, broken, or tangled. Time and depth were recorded when every fifth skate was hauled aboard.

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**[1]The 45 stations on the upper continental elope correspond to station numbers 62-86, 88-102, and 104-108 of the Japan-U.S. cooperative longline survey (Yoshimura and Sasaki 1989). Gully station 26 corresponds to station 87 of the cooperative longline survey. Shelf station 42 corresponds to station 103 of the cooperative longline survey and is on the continental shelf off Baranof Island. The remaining 26 gully stations are additional to the original 47 stations of the cooperative longline survey.**

Sablefish, Pacific cod ***(Gadus macrocephalus),*** arrow-tooth -flounder ***(Atheresthes stomias),*** rockfish ***(Sebastes*** spp.), and thornyhead ***(Sebastolobus*** spp.) fork lengths were measured. Vent length--the length from snout to vent (SV)--was measured, for grenadiers (Macrouridae). Sablefish and Pacific cod were sorted into eight depth strata (Table 2) for measuring length and determining sex, whereas other species were not.

## Analytical Methods

The number of fish caught per skate (catch per unit effort, CPUE) was calculated by species for each stratum at a station. The CPUE for each stratum of a station was multiplied by the area of the stratum (Table 3) to compute relative population numbers (RPN, an index of relative abundance in numbers) (Gulland 1969; Quinn et al. 1982; Sasaki 1985). The resultant values were averaged within the area to obtain an RPN for each stratum and area. Relative population numbers were calculated only for depths 201-1,000 m because this range generally corresponds to the depths sampled. Relative population numbers were not calculated for shallower depths because depths less than 200 m were sampled at only some stations (see Survey Area and Operations).

Relative population number weighted length frequencies (RPN LF) were computed for depths 201-1,000 m to examine the size compositions of the species. Catch per unit effort weighted length frequencies (CPUE LF) of sablefish were computed for depths 101-200 m for evidence of relatively strong year classes. Length compositions for depths 101-200 m from previous Japan-U.S. cooperative longline surveys were used to document the relatively strong 1977 and 1980 year classes of sablefish (Sigler and Fujioka 1988). A CPUE LF was calculated instead of an RPN LF because RPNs were not estimated for these depths for the reason noted in the previous paragraph. Relative population weights (RPW, an index of relative abundance in weight) were computed from the RPN LF and length-weight equations to assess relative biomass. Computation of the RPN, RPW, and length compositions is described in more detail in Sigler and Zenger (1989)[3].

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**[3]All stations established by the cooperative longline survey (stations 1-47) previously were classified as upper continental slope stations, although this classification was incorrect for two stationa. These two stations, 26 in Amatuli Gully and 42 off Baranof Island, have been reclassified now that the domestic longline survey extensively samples gully areas. As a result, the RPNs and RPWs for 1980 presented in Zenger and Sigler (unpubl. manuscr.) differ slightly from those presented in this report:**

The RPNs apply only to the area surveyed and represent only the portion of each species' population that is resident in the survey area. For sablefish, rougheye and shortraker rockfishes, and shortspine thornyheads, the survey area covers most of the area inhabited by the adults of these species (M. Sigler, unpubl. data) and therefore generally represents the adult fraction of these species' populations. In contrast, the area inhabited by Pacific cod, Pacific halibut ***(Hippoglossus stenolepis),*** rockfish species other than rougheye and shortraker rockfishes, grenadiers, and arrowtooth flounder is broader than the survey area. Thus, the RPNs do not reflect the abundance of these species as a whole.

As noted earlier, fewer gullies were sampled in 1988 than in 1989 (Table 1). Therefore, to compare gulf-wide abundance interannually, overall RPNs are restricted to gullies sampled in both 1988 and 1989 and the upper continental slope. The area sampled in 1988 was 88% of the size sampled in 1989. Unlike overall 1989 RPN, overall 1989 length compositions are not restricted to areas also sampled in 1988, because their shape was similar to overall length compositions that included all areas sampled in 1989.

Relative population numbers for the upper continental slope in 1988 and 1989 were compared to determine whether differences between years were statistically significant. The null hypothesis tested was that $RPN_{i,j} - RPN_{i',j} = 0$, where i = 1988, i' = 1989, j = species. As in Sigle: and Fujioka (1988), the bootstrap method (Efron 1982; Efron and Tibshirani 1986) was used to compare RPNs. Only the RPNs for the upper continental slope for each species were compared because of the limited number of gullies sampled in 1988.

## ANALYSIS OF THE CATCH

### Sablefish

Sablefish abundance for the upper continental slope decreased 18% from 1988 to 1989 (Table 4); this drop in RPN was statistically significant (p c 0.001). Abundance decreased only for the western and central Gulf of Alaska, dropping 46, 27, and 13% for the Shumagin, Chirikof, and Kodiak International North Pacific Fisheries Commission's (INPFC) statistical areas, respectively, and remained about the same for the Yakutat and Southeastern INPFC areas. The RPN for the four gullies sampled in both 1988 and 1989 (Shumagin Gully, Shelikof Trough, Amatuli Gully, and Spencer Gully) increased slightly from 1988 to 1989. The overall RPN combining these gullies and the upper continental slope

decreased slightly (10%) from 668,186 in 1988 to 601,517 in 1989.

Mean length increased from 1988 to 1989 in several areas (Fig. 2): females and males in the Kodiak (Fig. 2c) and Yakutat INPFC areas (Fig. 2d), Shumagin Gully (Fig. 2g), Shelikof Trough (Fig. 2h), Amatuli Gully (Fig. 2i), and Spencer Gully (Fig. 2j). This increase in mean length was due to an increase in the proportion of relatively large fish. In the remaining INPFC areas--females and males in Shumagin (Fig. 2a), Chirikof (Fig. 2b), and Southeastern (Fig. 2e) --length compositions were similar in shape and location in 1988 and 1989. Overall, from 1988 to 1989, the number of relatively small fish decreased for females and was similar for males, and the number of relatively large fish increased for both females and males (Fig. 2k).

From 1988 to 1989, RPW decreased (12%) for the upper continental slope and increased (8%) for the four gullies sampled both years (Table 5). The percentage changes differ 'from those for the corresponding RPNs because of an increased proportion of larger sablefish from 1988 to 1989 (i.e., although there were fewer sablefish in 1989 than in 1988, they were larger; therefore, the RPW did not decrease as much as the RPN).

There was no evidence from the length compositions for 101-200 m of any upcoming strong year classes in 1985 or later. Length-at-age distributions for sablefish in the Gulf of Alaska sampled previously in the cooperative longline survey showed age-4 males were mostly 46-54 cm fork length (FL) (mean 51.7 cm) and age-4 females 46-58 cm FL (mean 54.6 cm) (Clausen and Sigler in press). There were no distinct modes at or below these length ranges in 1988 or 1989 (Fig. 3) except for a mode about 54 cm FL in 1988 for both males and females in the Yakutat INPFC area (Fig. 3d).

The length compositions for 101-200 m changed somewhat from 1988 to 1989, probably due to a year class originating before 1985. From 1988 to 1989, the proportion of fish 55-65 cm FL often decreased (Shumagin (Fig. 3a) and Yakutat INPFC areas (Fig. 3d)), whereas the proportion of fish 60-70 cm FL often increased (Chirikof (Fig. 3b) and Yakutat INPFC areas (Fig. 3d), Shumagin Gully (Fig. 3f) and Shelikof Trough (Fig. 3g)). In the Shumagin and Chirikof INPFC areas and in Shelikof Trough and Shumagin Gully, the FL mode progressed from 57-59 cm in 1988 to 60-62 cm in 1989 for males, and from 59-61 cm to 63 cm for females. Based on the length-at-age data from the cooperative longline survey (Fig. 4), the modes represent 4- or 5-year-old fish in 1988 (1984 or 1983 year class) and 5-year-old fish in 1989 (1984 year class).

## Rougheye and Shortraker Rockfish

The combined RPN for rougheye and shortraker rockfish on the upper continental slope increased 35% from 1988 to 1989 (Table 6); however, this increase in the RPN was not statistically significant ($p = 0.064$). The PPN increased in all areas of the upper continental slope. The RPN for the Southeastern INPFC area increased the most (92%).

The number of rougheye and shortraker rockfish in gullies is relatively unimportant compared to the number on the upper continental slope and accounted for only 9% of the total rougheye and shortraker rockfish PPN in 1989. A notable change in population size was observed for Shelikof Trough, where abundance increased 105%. This change is suspect, however, because the RPNs are based on catches of only 38 rockfish in 1988 and 85 rockfish in 1989. (The RPN appears relatively large because of the large area of Shelikof Trough.)

The combined RPW for rougheye and shortraker rockfish for the upper continental slope also increased markedly from 1988 to 1989 (Table 7). The increase is due to increased rougheye rockfish RPW (81%). Shortraker rockfish RPW remained about the same.

From 1988 to 1989, the length composition was similar for rougheye rockfish (Fig. 5) and dissimilar for shortraker rockfish (Fig. 6a). The change for shortraker rockfish was due to differences in the length compositions at lengths less than 55 cm FL. (At larger sizes, the length compositions were similar.) A distinct mode (composed of two smaller modes) at 35-50 cm FL was observed in 1988, but not in 1989. This mode and subsequent change is attributable to the length compositions observed in the Shumagin INPFC area (Fig. 6b).

## Thornyheads

Thornyhead abundance on the upper continental slope increased 77% from 1988 to 1989 (Table 8); this increase in the RPN was significant ($p < 0.001$). The gully RPN accounted for 21% of the total RPN in 1989. Thus, the gully fraction is an important part of the thornyhead population. In 1989, relatively large numbers of thornyheads were found in Amatuli Gully, Yakutat Valley, Ommaney Trench, and Dixon Entrance. Of these areas, only Amatuli Gully was sampled in both 1988 and 1989. The RPN increased 95% in Amatuli Gully.

Like the RPN, the thornyhead RPW for the upper continental slope increased markedly (69%) (Table 9). The RPW increased in all areas of the upper continental slope and

also in Amatuli Gully. The size composition was similar in 1988 and 1989 (Fig. 7). The mean length decreased slightly.

## Other Species

As mentioned in the Analytical Methods section, only an unknown fraction of the following species' populations was sampled. Thus, these results do not represent the populations as a whole.

Grenadier abundance on the upper continental slope increased 87% from 1988 to 1989 (Table 10); this increase in the RPN was significant ($p < 0.001$). Greatest increases were in the Shumagin, Chirikof, and Kodiak areas, accounting for 96% of the change. In contrast to the large numbers of grenadier on the upper continental slope, the number in the gullies was trivial, less than 1% of the total grenadier RPN.

The proportion of giant grenadiers (Albatrossia pectoralis) shorter than 31 cm SV increased from 1988 to 1989 (Fig. 8), and, as a result, the mean length decreased 1 cm. This change was apparent in the Shumagin and Chirikof areas, but not in the remaining INPFC areas of the upper continental slope. Unlike giant grenadiers, the length composition for popeye grenadier ***(Coryphaenoides cinereus)*** was similar from 1988 to 1989 (Fig. 9). (Popeye grenadier were caught primarily in the Kodiak, Yakutat, and Southeastern INPFC areas.)

Pacific cod abundance on the upper continental slope decreased 28% from 1988 to 1989 (Table 11); this change in the RPN was not statistically significant ($p = 0.182$). Abundance decreased in all INPFC areas of the upper continental slope except the Kodiak area, where abundance remained about the same.

The gully fraction was an important part of the sampled Pacific cod population, 82% of the total RPN for 1989. The most important area was Shelikof Trough, which comprised 76% of the total RPN in 1989. The RPN for sampled gullies decreased 13% from 1988 to 1989 (Table 11).

The length composition was similar in 1988 and 1989, except the proportion of females at 65-77 cm FL increased (Fig. 10). The mean length increased 1 cm as a result of this change. The additional females at 65-77 cm FL were apparent only in Shelikof Trough (Fig., 10b).

Pacific halibut abundance on the upper continental slope increased 15% from 1988 to 1989 (Table 12); this change in the RPN was not significant ($p = 0.366$). The RPN increased in the Shumagin and Chirikof INPFC areas, remained about the

same in the Kodiak INPFC area, and decreased in the Yakutat and Southeastern INPFC areas. The gully fraction was an important part of the sampled Pacific halibut population, 73% of the total Pacific halibut RPN in 1989. The RPN for gullies sampled both years was similar.

Arrowtooth flounder abundance for the upper continental slope increased 13% from 1988 to 1989 (Table 13); this increase in the RPN was not significant ($p = 0.400$). The RPN increased in the Shumagin and Kodiak INPFC areas, remained about the same in the Chirikof and Southeastern INPFC areas, and decreased in the Yakutat INPFC area. The gully fraction was an important part of the sampled arrowtooth flounder population, 69% of the total arrowtooth flounder RPN in 1989.

The arrowtooth flounder size composition for 1988 was bimodal with modes at 55 and 70 cm FL (Fig. 11a). In 1989, the number of arrow-tooth flounder 55-70 cm FL increased and a single mode at 58 cm FL was observed. Mean length increased from 59.6 to 62.3 cm FL from 1988 to 1989. The change in the size composition was due to increased numbers of 55-70 cm FL fish in the Shumagin, Chirikof (Fig. 11b), Kodiak, and Yakutat INPFC areas, Amatuli Gully, and a shift in the mode from 55 to 59 cm FL in Shelikof Trough (Fig. 11c).

Skate abundance on the upper continental slope increased 14% from 1988 to 1989 (Table 14); this increase in RPN was not significant ($p = 0.715$). The gully fraction of the skate population was important, 86% of the total skate RPN in 1989. Two gullies (Shelikof Trough and Amatuli Gully) accounted for 68% of the total skate RPN in 1989. The RPN increased 77% in Shelikof Trough and decreased 21% in Amatuli Gully.

Forty-seven additional species (or species groups) were caught during the survey (Table 15). They were a minor component of the catch: less than 2% of the total RPN in 1989.

## Year-Class Strength of Sablefish

There was no evidence from 1988 or 1989 length compositions for the 101-200 m depth stratum of a strong year class of sablefish originating in 1985 or later (Fig. 3a-i). These length compositions indicate a distinct, though not necessarily strong, year class originating in 1983 or 1984. Previous evidence for a strong 1984 year class is conflicting (Clausen and Sigler in press). Supporting information includes an observed abundance of age-l sablefish in the inside waters of Southeast Alaska in 1985 (Fujioka 1987), and length compositions from the 1986 trawl survey of the eastern Bering Sea (McDevitt 1987), the cooperative longline survey in 1986-87 (Sigler 1987, 1989), and the domestic longline

survey in 1987 (Sigler and Zenger 1989). More recent evidence does not support the presence of a strong 1984 year class and includes length compositions from the 1987 trawl survey in the eastern Bering Sea (McDevitt 1988) and the cooperative longline survey in 1988 (Clausen and Sigler in press) and sampling in inside waters of Southeast Alaska in 1988 (Bracken 1988).

Further evidence contrary to the presence of a strong 1984 year class is the decrease from 1988 to 1989 in the numbers of relatively small females and the absence of change in the numbers of relatively small males in the length compositions for 201-1,000 m (Fig. 2k). These observations indicate the lack of substantial recruitment to the upper continental slope in 1989. Previous strong year classes in 1977 and 1980 fueled sharp jumps in sablefish abundance in 1980-82 and 1984-85, respectively (Sigler and Fujioka 1988), which led to the expectation that the 1984 year class would primarily recruit to the upper continental slope in 1989 (Sigler 1989). The lack of substantial recruitment in 1989 indicates that the 1984 year class is not strong. Further, the absence of substantial recruitment to replace fish lost to fishing and natural mortality probably accounts for the decline in sablefish abundance from 1988 to 1989.

## Possible Reasons for Changes in Sablefish RPN

The number of relatively large fish increased from 1988 to 1989 (Fig. 2k), perhaps due to growth in length or migration of sablefish into the Gulf of Alaska. A recent migration study concludes that a nontrivial number of sablefish migrate in and out of the Gulf of Alaska each year (Heifetz and Fujioka 1991). A similar unexplained increase in the number of relatively large sablefish was observed in 1985 (Fujioka 1987).

The Shumagin INPFC area RPN decreased sharply from 1988 to 1989. There is some concern that the commercial fishery, which was in progress at the time of the survey, may have depressed survey catch rates. A "season effect" is unlikely to account for the entire drop because the fishery and survey also co-occurred in the Shumagin INPFC area in 1988 (Table 16) and because the RPN also dropped sharply in the adjacent Chirikof INPFC area, where most commercial fishing finished more than 4 weeks before the 1989 survey began.

## Relationship Between Changes in Sablefish, Thornyhead, and Grenadier RPNs

Grenadier RPN nearly doubled from 1988 to 1989. Their catch rates (Fig. 12) increased primarily in areas where sablefish catch rates declined (Fig. 13), indicating 'that the

two changes are related. One scenario is that as sablefish numbers decreased, the number of baited hooks available to grenadiers increased. (We believe that sablefish can outcompete grenadiers for baited hooks, although this hypothesis has not been tested.) Under this scenario, the increase in the grenadier RPN reflects the increased availability of baited hooks and not a change in the number of grenadiers in the survey area. Another scenario is that grenadiers, whose range extends deeper than the surveyed depths, moved upslope into the survey area as sablefish abundance decreased. This theory is reasonable because the distance to move upslope is relatively short--less than several kilometers. Under this scenario, the number of grenadiers within the survey area increased.

Thornyhead RPN also increased from 1988 to 1989; again, the change may reflect the decrease in sablefish abundance. Thornyhead RPN increased in all areas of the Gulf of Alaska (Table 8), whereas sablefish RPN decreased only in the western and central areas of the gulf (Table 4); thornyhead catch rates generally increased where sablefish catch rates declined (e.g., stations 2-16, especially at depths greater than 401 m; stations 37-40, depths less than 400 m) (Fig. 14). Unlike grenadiers, however, the increased numbers of thornyheads are not due to immigration because the survey generally covers the adult thornyhead range in the Gulf of Alaska. Instead, increased availability of baited hooks due to decreased sablefish numbers may be the cause of the increased thornyhead RPN.[4]

Rockfish RPN also increased from 1988 to 1989. The increased rockfish RPN is due primarily to increased catch rates at stations 34-38 (Yakutat INPFC area) at depths 201-400 m and stations 39-47 (Southeastern INPFC area) at depths 201-800 m (Fig. 15). These increased rockfish catches are not related to decreased sablefish catches. Further, the survey area generally covers the extent of rougheye and shortraker rockfish habitat in the Gulf of Alaska; thus, the changes in RPN are probably not because of immigration.

The increases in the grenadier and thornyhead RPN (Tables 8, 10) were statistically significant, whereas the RPN increases for rockfish (Table 7) were not. Thus the

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**[4]We assume that sablefish can outcompete grenadiers, thornyheads, and rockfish for baited hooks, but do not know among these latter three species which is the best competitor. In this discussion, we are assuming that they are equal competitors, thus implying that increased numbers of baited hooks will result in increased RPN for all three species.**

change in the rockfish RPN may be due to inherent variability in the index rather than a real change in abundance.

Alternatively, the increased RPN for grenadiers, thornyheads, and rockfish may be due to recruitment of young fish. The lack of change in the length compositions for thornyhead and rockfish (except for shortrakers in the Shumagin INPFC area) (Figs. 5-7) indicates that recruitment was not responsible for the RPN changes for these two species. For giant grenadiers, the proportion of fish shorter than 31 cm SV increased (Fig. 8), indicating that recruitment might be responsible for the increased RPN. The likelihood of this scenario cannot be differentiated from the other two scenarios previously discussed for grenadiers, however.

The apparent connection between changes in the grenadier, thornyhead, and sablefish RPN indicates the danger of simply, interpreting longline catch rate changes as reflecting real changes in abundance. The previous discussion indicates that the changes in grenadier and thornyhead RPN do not reflect changes in their abundance. Experiments with hook timers, electromechanical devices which measure the arrival time of fish to the hook, imply that sablefish longline catch rate is a linear function of sablefish density (Sigler 1993). Similar experiments could be completed to examine the functional form of this relationship for grenadiers and thornyheads.

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# TABLES

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Table 1.--Number of stations sampled in Gulf of Alaska gullies by year. Domestic longline surveys, 1987-89.

| Gully name | 1987 | 1988 | 1989 |
|---|---|---|---|
| Shumagin Gully | | 3 | 2 |
| Shelikof Trough | 2 | 4 | 8 |
| Amatuli Gully | 1 | 2 | 3 |
| W-grounds | | | 2 |
| Yakutat Valley | | | 2 |
| Alsek Strath | | | 2 |
| Spencer Gully | | 1 | 2 |
| Ommaney Trench | 2 | | 2 |
| Iphigenia Gully | | | 2 |
| Dixon Entrance | | | 2 |

Table 2.--Depth stratification. Domestic longline surveys, 1987-89.

| Strata | Depth range (m) |
|---|---|
| 0 | All depths |
| 1 | 0- 100 |
| 2 | 101- 200 |
| 3 | 201- 300 |
| 4 | 301- 400 |
| 5 | 401- 600 |
| 6 | 601- 800 |
| 7 | 801-1,000 |
| 8 | 1,001-1,200 |

Table 3.--Area ($km^2$) of the Gulf of Alaska for depths 201-1,000 m. Area is listed by International North Pacific Fisheries Commission area for the upper continental slope and by gully for the gully areas.

| Sampled site | Depth: (m) | Area ($km^2$) 201-300 | 301-400 | 401-600 | 601-800 | 801-1,000 | 201-1,000 |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| Shumagin | | 2,737 | 1,264 | 2,269 | 1,629 | 1,248 | 9,147 |
| Chirikof | | 1,533 | 817 | 1,766 | 1,955 | 2,012 | 8,083 |
| Kodiak | | 1,626 | 1,480 | 2,255 | 1,923 | 2,296 | 9,580 |
| Yakutat | | 1,494 | 1,494 | 1,666 | 1,470 | 1,489 | 7,613 |
| Southeastern | | 891 | 891 | 822 | 1,006 | 1,165 | 4,774 |
| Total | | 8,281 | 5,946 | 8,778 | 7,983 | 8,210 | 39,197 |
| | | Gullies | | | | | |
| Shumagin Gully | | 665 | 0 | 0 | 0 | 0 | 665 |
| Shelikof Trough | | 13,076 | 0 | 0 | 0 | 0 | 13,076 |
| Amatuli Gully | | 6,346 | 0 | 0 | 0 | 0 | 6,346 |
| W-Grounds | | 1,008 | 302 | 0 | 0 | 0 | 1,310 |
| Yakutat Valley | | 1,268 | 768 | 0 | 0 | 0 | 2,036 |
| Alsek Strath | | 565 | 0 | 0 | 0 | 0 | 565 |
| Spencer Gully | | 189 | 189 | 301 | 50 | 0 | 729 |
| Ommaney Trench | | 521 | 610 | 122 | 0 | 0 | 1,253 |
| Iphigenia Gully | | 1,918 | 0 | 0 | 0 | 0 | 1,918 |
| Dixon Entrance | | 1,130 | 793 | 58 | 0 | 0 | 1,980 |
| Total | | 26,685 | 2,662 | 481 | 50 | 0 | 29,878 |

Sources: E. Brown, Alaska Fisheries Science Center, RACE Division, Seattle, WA, pers. commun., 1985; R. Haight, Alaska Fisheries Science Center, Auke Bay Laboratory, pers. commun., 1986.

Discrepancies in totals are due to rounding.

Table 4.--Relative population number (RPN) for sablefish by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPN for areas sampled in both 1988 and 1989. Gully total is the combined RPN for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| Depth (m) | Year | RPN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| | | Shumagin | Chirikof | Kodiak | Yakutat | Southeastern | Total |
| 201- 300 | 1988 | 20,783 | 20,883 | 11,893 | 7,035 | 2,840 | 63,435 |
| | 1989 | 18,537 | 21,276 | 9,837 | 10,055 | 3,231 | 62,936 |
| 301- 400 | 1988 | 10,922 | 10,649 | 11,162 | 9,098 | 7,133 | 48,964 |
| | 1989 | 5,681 | 8,057 | 9,429 | 9,660 | 6,554 | 39,380 |
| 401- 600 | 1988 | 29,692 | 25,830 | 30,596 | 24,855 | 13,052 | 124,026 |
| | 1989 | 12,836 | 17,062 | 31,911 | 22,304 | 12,394 | 96,507 |
| 601- 800 | 1988 | 15,719 | 26,086 | 26,860 | 23,747 | 18,242 | 110,653 |
| | 1989 | 4,268 | 12,484 | 30,885 | 21,928 | 18,543 | 88,108 |
| 801-1000 | 1988 | 7,045 | 5,185 | 28,279 | 13,482 | 19,210 | 73,202 |
| | 1989 | 4,020 | 6,231 | 13,090 | 14,999 | 20,698 | 59,038 |
| 201-1000 | 1988 | 84,161 | 88,632 | 108,790 | 78,218 | 60,478 | 420,278 |
| | 1989 | 45,342 | 65,109 | 95,153 | 78,946 | 61,420 | 345,969 |
| | | Gullies | | | | | |
| | | Shumagin Gully | Shelikof Trough | Amatuli Gully | W-Ground | Yakutat Valley | Alsek Strath |
| 201- 300 | 1988 | 9,419 | 141,730 | 90,575 | | | |
| | 1989 | 12,210 | 142,693 | 92,806 | 16,020 | 12,994 | 2,712 |
| 301- 400 | 1988 | | | | | | |
| | 1989 | | | | 3,716 | 5,267 | |
| 201-1000 | 1988 | 9,419 | 141,730 | 90,575 | | | |
| | 1989 | 12,210 | 142,693 | 92,806 | 19,737 | 18,261 | 2,712 |

Table 4.--Continued.

| | | Spencer Gully | Ommaney Trench | Iphigenia Gully | Dixon Entrance | Gully total | GOA total |
|---|---|---|---|---|---|---|---|
| 201- 300 | 1988 | | | | | 241,723 | 305,158 |
| | 1989 | 2,967 | 1,957 | 11,922 | 6,274 | 247,710 | 310,646 |
| 301- 400 | 1988 | | | | | | 48,964 |
| | 1989 | 5,168 | 10,656 | | 15,261 | | 39,380 |
| 401- 600 | 1988 | 6,184 | | | | 6,184 | 130,210 |
| | 1989 | 7,839 | | | 1,024 | 7,839 | 104,346 |
| 601- 800 | 1988 | | | | | | 110,653 |
| | 1989 | 1,302 | | | | | 88,108 |
| 801-1000 | 1988 | | | | | | 73,202 |
| | 1989 | | | | | | 59,038 |
| 201-1000 | 1988 | 6,184 | | | | 247,908 | 668,186 |
| | 1989 | 17,276 | 12,613 | 11,922 | 22,559 | 255,548 | 601,517 |

Discrepancies in totals are due to rounding.

Table 5 .-&Relative population weight (RPW) for sablefish by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPW for areas sampled in both 1988 and 1989. Gully total is the combined RPW for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| Depth (m) | -Year | RPW | | | | | |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| | | Shumagin | Chirikof | Kodiak | Yakutat | Southeastern | Total |
| 201- 300 | 1988 | 58,765 | 63,560 | 37,392 | 24,852 | 9,760 | 194,329 |
| | 1989 | 50,611 | 61,872 | 32,760 | 40,945 | 11,388 | 197,576 |
| 301- 400 | 1988 | 33,477 | 34,848 | 34,401 | 18,240 | 24,968 | 145,935 |
| | 1989 | 16,703 | 26,718 | 29,961 | 36,307 | 21,161 | 130,850 |
| 401- 600 | 1988 | 103,138 | 86,365 | 95,341 | 85,983 | 45,222 | 416,049 |
| | 1989 | 45,558 | 62,927 | 111,752 | 79,739 | 39,979 | 339,954 |
| 601- 800 | 1988 | 57,697 | 89,923 | 91,176 | 85,137 | 63,396 | 387,329 |
| | 1989 | 16,110 | 51,335 | 129,040 | 85,686 | 66,182 | 348,353 |
| 801-1000 | 1988 | 25,585 | 20,942 | 92,747 | 53,111 | 73,397 | 265,781 |
| | 1989 | 14,408 | 11,454 | 58,428 | 67,593 | 78,431 | 230,314 |
| 201-1000 | 1988 | 278,662 | 295,637 | 351,057 | 267,323 | 216,743 | 1,409,423 |
| | 1989 | 143,390 | 214,305 | 361,941 | 310,269 | 217,141 | 1,247,047 |

| | | Gullies | | | | | |
|---|---|---|---|---|---|---|---|
| | | Shumagin 'Gully | Shelikof Trough | Amatuli Gully | W-Ground | Yakutat Valley | Alsek Strath |
| 201- 300 | 1988 | 23,406 | 397,913 | 307,237 | | | |
| | 1989 | 30,866 | 415,133 | 338,545 | 55,570 | 42,726 | 7,522 |
| 301- 400 | 1988 | | | | | | |
| | 1989 | | | | 12,267 | 18,247 | |
| 201-1000 | 1988 | 23,406 | 397,913 | 307,237 | | | |
| | 1989 | 30,866 | 415,133 | 338,545 | 67,837 | 60,973 | 7,522 |

Table 5.--Continued.

| | | Spencer Gully | Ommaney Trench | Iphigenia Gully | Dixon Entrance | Gully total | GOA total |
|---|---|---|---|---|---|---|---|
| 201- 300 | 1988 | | | | | 728,555 | 922,884 |
| | 1989 | 7,605 | 5,275 | 34,195 | 12,833 | 784,544 | 982,120 |
| 301- 400 | 1988 | | | | | | 145,935 |
| | 1989 | 16,320 | 33,705 | | 42,032 | | 130,850 |
| 401- 600 | 1988 | 21,220 | | | | 21,220 | 437,269 |
| | 1989 | 25,595 | | | 3,059 | 25,595 | 365,549 |
| 601- 800 | 1988 | | | | | | 387,329 |
| | 1989 | 4,252 | | | | | 348,353 |
| 801-1000 | 1988 | | | | | | 265,781 |
| | 1989 | | | | | | 230,314 |
| 201-1000 | 1988 | 21,220 | | | | 749,775 | 2,159,198 |
| | 1989 | 53,772 | 38,979 | 34,195 | 57,924 | 810,139 | 2,057,186 |

**Discrepancies in totals are due to rounding.**

Table 6.--Relative population number (RPN) for rougheye and shortraker rockfish by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPN for areas sampled in both 1988 and 1989. Gully total is the combined RPN for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| Depth (m) | Year | RPN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| | | Shumagin | Chirikof | Kodiak | Yakutat | Southeastern | Total |
| 201- 300 | 1988 | 2,551 | 194 | 889 | 1,612 | 468 | 5,714 |
| | 1989 | 3,444 | 1,062 | 1,483 | 1,926 | 1,439 | 9,354 |
| 301- 400 | 1988 | 3,470 | 1,957 | 3,732 | 5,465 | 3,811 | 18,435 |
| | 1989 | 3,973 | 1,639 | 4,112 | 6,819 | 6,694 | 23,237 |
| 401-600 | 1988 | 706 | 76 | 234 | 1,470 | 1,310 | 3,796 |
| | 1989 | 1,204 | 39 | 293 | 1,708 | 2,501 | 5,745 |
| 601- 800 | 1988 | 10 | 0 | 0 | 125 | 109 | 243 |
| | 1989 | 6 | 43 | 0 | 125 | 430 | 605 |
| 801-1000 | 1988 | 498 | 0 | 0 | 79 | 174 | 751 |
| | 1989 | 0 | 0 | 0 | 6 | 229 | 235 |
| 201-1000 | 1988 | 7,234 | 2,227 | 4,855 | 8,751 | 5,872 | 28,939 |
| | 1989 | 8,627 | 2,783 | 5,889 | 10,585 | 11,294 | 39,178 |
| | | Gullies | | | | | |
| | | Shumagin Gully | Shelikof Trough | Amatuli Gully | W-Ground | Yakutat Valley | Alsek Strath |
| 201- 300 | 1988 | 11 | 839 | 380 | | | |
| | 1989 | 28 | 1,719 | 478 | 0 | 66 | 191 |
| 301- 400 | 1988 | | | | | | |
| | 1989 | | | | 0 | 271 | |
| 201-1000 | 1988 | 11 | 839 | 380 | | | |
| | 1989 | 28 | 1,719 | 478 | 0 | 337 | 191 |

Table 6.--Continued.

| | | Spencer Gully | Ommaney Trench | Iphigenia Gully | Dixon Entrance | Gully total | GOA total |
|---|---|---|---|---|---|---|---|
| 201- 300 | 1988 | | | | | 1,230 | 6,944 |
| | 1989 | 0 | 39 | 49 | 0 | 2,225 | 11,580 |
| 301- 400 | 1988 | | | | | | 18,435 |
| | 1989 | 7 | 794 | | 34 | | 23,237 |
| 401- 600 | 1988 | 21 | | | | 21 | 3,816 |
| | 1989 | 13 | | | 12 | 13 | 5,758 |
| 601- 800 | 1988 | | | | | | 243 |
| | 1989 | 2 | | | | | 605 |
| 801-1000 | 1988 | | | | | | 751 |
| | 1989 | | | | | | 235 |
| 201-1000 | 1988 | 21 | | | | 1,251 | 30,189 |
| | 1989 | 22 | 833 | 49 | 45 | 2,238 | 41,416 |

**Discrepancies in totals are due to rounding.**

Table 7.--Relative population weight (RPW) for rougheye and shortraker rockfish by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPW for areas sampled in both 1988 and 1989. Gully total is the combined RPW for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| | RPW | | | |
|---|---|---|---|---|
| | Rougheye | | Shortraker | |
| | 1988 | 1989 | 1988 | 1989 |
| | Upper continental slope | | | |
| Shumagin | 3,348 | 6,610 | 4,924 | 4,272 |
| Chirikof | 1,186 | 2,414 | 2,574 | 1,441 |
| Kodiak | 2,786 | 3,752 | 5,010 | 5,795 |
| Yakutat | 3,816 | 5,121 | 13,233 | 13,246 |
| Southeastern | 5,976 | 13,068 | 2,458 | 3,362 |
| Total | 17,112 | 30,965 | 28,199 | 28,116 |
| | Gullies | | | |
| Shumagin Gully | 8 | 8 | 0 | 7 |
| Shelikof Trough | 68 | 1,469 | 426 | 399 |
| Amatuli Gully | 237 | 160 | 0 | 179 |
| W-grounds | | 0 | | 0 |
| Yakutat Valley | | 271 | | 65 |
| Alsek Strath | | 129 | | 49 |
| Spencer Gully | 0 | 0 | 0 | 49 |
| Ommaney Trench | | 838 | | 897 |
| Iphigenia Gully | | 43 | | 35 |
| Dixon Entrance | | 96 | | 0 |
| Total | 313 | 3,014 | 426 | 1,680 |
| GOA total | 17,425 | 33,979 | 28,625 | 29,796 |

Table 8.--Relative population number (RPN) for thornyheads by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPN for areas sampled in both 1988 and 1989. Gully total is the combined RPN for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| Depth (m) | Year | RPN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| | | Shumagin | Chirikof | Kodiak | Yakutat | Southeastern | Total |
| 201- 300 | 1988 | 2,390 | 504 | 438 | 656 | 388 | 4,376 |
| | 1989 | 2,656 | 524 | 625 | 1,443 | 642 | 5,891 |
| 301- 400 | 1988 | 1,428 | 504 | 823 | 1,034 | 238 | 4,027 |
| | 1989 | 1,298 | 478 | 617 | 1,600 | 516 | 4,509 |
| 401- 600 | 1988 | 1,645 | 1,137 | 1,156 | 555 | 438 | 4,931 |
| | 1989 | 2,724 | 1,523 | 1,907 | 1,342 | 674 | 8,170 |
| 601- 800 | 1988 | 1,558 | 1,416 | 990 | 401 | 253 | 4,617 |
| | 1989 | 1,877 | 2,444 | 2,154 | 1,180 | 672 | 8,327 |
| 801-1000 | 1988 | 1,412 | 0 | 431 | 393 | 254 | 2,491 |
| | 1989 | 2,985 | 2,150 | 1,949 | 1,600 | 688 | 9,372 |
| 201-1000 | 1988 | 8,433 | 3,560 | 3,838 | 3,039 | 1,571 | 20,442 |
| | 1989 | 11,540 | 7,119 | 7,252 | 7,165 | 3,192 | 36,268 |
| | | Gullies | | | | | |
| | | Shumagin Gully | Shelikof Trough | Amatuli Gully | W-Ground | Yakutat Valley | Alsek Strath |
| 201- 300 | 1988 | 0 | 0 | 1,471 | | | |
| | 1989 | 0 | 0 | 2,874 | 526 | 1,077 | 54 |
| 301- 400 | 1988 | | | | | | |
| | 1989 | | | | 47 | 394 | |
| 201-1000 | 1988 | 0 | 0 | 1,471 | | | |
| | 1989 | 0 | 0 | 2,874 | 573 | 1,471 | 54 |

Table 8.--Continued.

| | | Spencer Gully | Ommaney Trench | Iphigenia Gully | Dixon Entrance | Gully total | GOA total |
|---|---|---|---|---|---|---|---|
| 201- 300 | 1988 | | | | | 1,471 | 5,847 |
| | 1989 | 0 | 852 | 449 | 1,895 | 2,874 | 8,765 |
| 301- 400 | 1988 | | | | | | 4,027 |
| | 1989 | 4 | 932 | | 445 | | 4,509 |
| 401- 600 | 1988 | 100 | | | | 100 | 5,030 |
| | 1989 | 160 | | | 75 | 160 | 8,329 |
| 601- 800 | 1988 | | | | | | 4,617 |
| | 1989 | 27 | | | | | 8,327 |
| 801-1000 | 1988 | | | | | | 2,491 |
| | 1989 | | | | | | 9,372 |
| 201-1000 | 1988 | 100 | | | | 1,571 | 22,012 |
| | 1989 | 190 | 1,784 | 449 | 2,415 | 3,034 | 39,301 |

**Discrepancies in totals are due to rounding.**

Table 9.--Relative population weight (RPW) for thornyheads by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPW for areas sampled in both 1988 and 1989. Gully total is the combined RPW for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| | Thornyhead RPW | |
|---|---|---|
| | 1988 | 1989 |
| **Upper continental slope** | | |
| Shumagin | 4,655 | 5,953 |
| Chirikof | 1,965 | 4,311 |
| Kodiak | 1,876 | 3,454 |
| Yakutat | 1,628 | 3,352 |
| Southeastern | 1,014 | 1,753 |
| Total | 11,138 | 18,823 |
| **Gullies** | | |
| Shumagin Gully | 0 | 0 |
| Shelikof Trough | 0 | 0 |
| Amatuli Gully | 500 | 1,202 |
| W-grounds | | 299 |
| Yakutat Valley | | 625 |
| Alsek Strath | | 50 |
| Spencer Gully | 0 | 90 |
| Ommaney Trench | | 757 |
| Iphigenia Gully | | 131 |
| Dixon Entrance | | 1,734 |
| Total | 500 | 4,888 |
| GOA total | 11,638 | 23,711 |

Table 10.--Relative population number (RPN) for grenadiers by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPN for areas sampled in both 1988 and 1989. Gully total is the combined RPN for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| Depth (m) | Year | RPN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| | | Shumagin | Chirikof | Kodiak | Yakutat | Southeastern | Total |
| 201- 300 | 1988 | 87 | 0 | 0 | 314 | 0 | 401 |
| | 1989 | 650 | 13 | 111 | 0 | 7 | 780 |
| 301- 400 | 1988 | 6,151 | 2,884 | 2,024 | 284 | 6 | 11,349 |
| | 1989 | 12,006 | 5,304 | 3,747 | 569 | 240 | 21,865 |
| 401- 600 | 1988 | 17,589 | 12,358 | 7,692 | 1,894 | 123 | 39,656 |
| | 1989 | 34,386 | 29,532 | 14,309 | 3,288 | 644 | 82,158 |
| 601- 800 | 1988 | 19,877 | 18,977 | 8,707 | 3,663 | 491 | 51,714 |
| | 1989 | 31,918 | 38,737 | 16,740 | 4,308 | 1,195 | 92,898 |
| 801-1000 | 1988 | 13,853 | 29,544 | 18,906 | 9,861 | 2,301 | 74,465 |
| | 1989 | 19,367 | 57,999 | 42,497 | 11,339 | 3,486 | 134,688 |
| 201-1000 | 1988 | 57,558 | 63,763 | 37,328 | 16,016 | 2,922 | 177,586 |
| | 1989 | 98,326 | 131,585 | 77,404 | 19,504 | 5,571 | 332,390 |
| | | Gullies | | | | | |
| | | Shumagin Gully | Shelikof Trough | Amatuli Gully | W-Ground | Yakutat Valley | Alsek Strath |
| 201- 300 | 1988 | 0 | 42 | 28 | | | |
| | 1989 | 0 | 0 | 0 | 0 | 0 | 0 |
| 301- 400 | 1988 | | | | | | |
| | 1989 | | | | 0 | 0 | |
| 201-1000 | 1988 | 0 | 42 | 28 | | | |
| | 1989 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 10.--Continued.

| | | Spencer Gully | Ommaney Trench | Iphigenia Gully | Dixon Entrance | Gully total | GOA total |
|---|---|---|---|---|---|---|---|
| 201- 300 | 1988 | | | | | 70 | 471 |
| | 1989 | 17 | 0 | 0 | 63 | 0 | 780 |
| 301- 400 | 1988 | | | | | | 11,349 |
| | 1989 | 210 | 0 | | 0 | | 21,865 |
| 401- 600 | 1988 | 48 | | | | 48 | 39,704 |
| | 1989 | 167 | | | 0 | 167 | 82,326 |
| 601- 800 | 1988 | | | | | | 51,714 |
| | 1989 | 28 | | | | | 92,898 |
| 801-1000 | 1988 | | | | | | 74,465 |
| | 1989 | | | | | | 134,688 |
| 201-1000 | 1988 | 48 | | | | 118 | 177,704 |
| | 1989 | 422 | 0 | 0 | 63 | 167 | 332,558 |

**Discrepancies in totals are due to rounding.**

Table 11.--Relative population number (RPN) for Pacific cod by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPN for areas sampled in both 1988 and 1989. Gully total is the combined RPN for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| Depth (m) | Year | RPN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| | | Shumagin | Chirikof | Kodiak | Yakutat | Southeastern | Total |
| 201- 300 | 1988 | 14,027 | 3,024 | 3,881 | 3,179 | 989 | 25,099 |
| | 1989 | 9,634 | 2,423 | 3,771 | 1,297 | 576 | 17,700 |
| 301- 400 | 1988 | 58 | 0 | 28 | 169 | 95 | 349 |
| | 1989 | 403 | 0 | 297 | 21 | 0 | 721 |
| 401- 600 | 1988 | 0 | 0 | 87 | 83 | 0 | 169 |
| | 1989 | 61 | 0 | 0 | 0 | 2 | 63 |
| 601- 800 | 1988 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1989 | 0 | 0 | 12 | 0 | 0 | 12 |
| 801-1000 | 1988 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1989 | 0 | 0 | 0 | 0 | 0 | 0 |
| 201-1000 | 1988 | 14,085 | 3,024 | 3,995 | 3,431 | 1,084 | 25,618 |
| | 1989 | 10,098 | 2,423 | 4,079 | 1,318 | 578 | 18,495 |
| | | Gullies | | | | | |
| | | Shumagin Gully | Shelikof Trough | Amatuli Gully | W-Ground | Yakutat Valley | Alsek Strath |
| 201- 300 | 1988 | 1,090 | 88,659 | 4,069 | | | |
| | 1989 | 166 | 79,441 | 2,305 | 26 | 132 | 38 |
| 301- 400 | 1988 | | | | | | |
| | 1989 | | | | 0 | 0 | |
| 201-1000 | 1988 | 1,090 | 88,659 | 4,069 | | | |
| | 1989 | 166 | 79,441 | 2,305 | 26 | 132 | 38 |

Table 11.--Continued.

| | | Spencer Gully | Ommaney Trench | Iphigenia Gully | Dixon Entrance | Gully total | GOA total |
|---|---|---|---|---|---|---|---|
| 201- 300 | 1988 | | | | | 93,818 | 118,917 |
| | 1989 | 0 | 835 | 3,145 | 378 | 81,913 | 99,613 |
| 301- 400 | 1988 | | | | | | 349 |
| | 1989 | 0 | 13 | | 26 | | 721 |
| 401- 600 | 1988 | 0 | | | | 0 | 169 |
| | 1989 | 0 | | | 2 | 0 | 63 |
| 601- 800 | 1988 | | | | | | 0 |
| | 1989 | 0 | | | | | 12 |
| 801-1000 | 1988 | | | | | | 0 |
| | 1989 | | | | | | 0 |
| 201-1000 | 1988 | 0 | | | | 93,818 | 119,436 |
| | 1989 | 0 | 848 | 3,145 | 406 | 81,913 | 100,408 |

Discrepancies in totals are due to rounding.

Table 12.--Relative population number (RPN) for Pacific halibut by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPN for areas sampled in both 1988 and 1989. Gully total is the combined RPN for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| Depth (m) | Year | RPN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| | | Shumagin | Chirikof | Kodiak | Yakutat | Southeastern | Total |
| 201- 300 | 1988 | 3,239 | 978 | 2,379 | 2,359 | 2,549 | 11,503 |
| | 1989 | 5,004 | 2,861 | 2,580 | 1,340 | 1,152 | 12,936 |
| 301- 400 | 1988 | 301 | 119 | 664 | 432 | 384 | 1,901 |
| | 1989 | 559 | 608 | 772 | 205 | 193 | 2,337 |
| 401- 600 | 1988 | 7 | 11 | 12 | 16 | 11 | 57 |
| | 1989 | 8 | 25 | 68 | 30 | 33 | 165 |
| 601- 800 | 1988 | 0 | 0 | 0 | 0 | 2 | 2 |
| | 1989 | 0 | 0 | 0 | 0 | 0 | 0 |
| 801-1000 | 1988 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1989 | 0 | 0 | 0 | 0 | 0 | 0 |
| 201-1000 | 1988 | 3,547 | 1,108 | 3,055 | 2,806 | 2,946 | 13,463 |
| | 1989 | 5,571 | 3,494 | 3,420 | 1,575 | 1,378 | 15,438 |
| | | Gullies | | | | | |
| | | Shumagin Gully | Shelikof Trough | Amatuli Gully | W-Ground | Yakutat Valley | Alsek Strath |
| 201- 300 | 1988 | 145 | 19,944 | 3,921 | | | |
| | 1989 | 375 | 20,057 | 3,997 | 720 | 660 | 582 |
| 301- 400 | 1988 | | | | | | |
| | 1989 | | | | 76 | 409 | |
| 201-1000 | 1988 | 145 | 19,944 | 3,921 | | | |
| | 1989 | 375 | 20,057 | 3,997 | 796 | 1,069 | 582 |

Table 12.--Continued.

| | | Spencer Gully | Ommaney Trench | Iphigenia Gully | Dixon Entrance | Gully total | GOA total |
|---|---|---|---|---|---|---|---|
| 201- 300 | 1988 | | | | | 24,010 | 35,513 |
| | 1989 | 207 | 1,008 | 5,582 | 7,395 | 24,429 | 37,366 |
| 301- 400 | 1988 | | | | | | 1,901 |
| | 1989 | 5 | 360 | | 740 | | 2,337 |
| 401- 600 | 1988 | 0 | | | | 0 | 57 |
| | 1989 | 0 | | | 37 | 0 | 165 |
| 601- 800 | 1988 | | | | | | 2 |
| | 1989 | 0 | | | | | 0 |
| 801-1000 | 1988 | | | | | | 0 |
| | 1989 | | | | | | 0 |
| 201-1000 | 1988 | 0 | | | | 24,010 | 37,472 |
| | 1989 | 212 | 1,368 | 5,582 | 8,172 | 24,429 | 39,867 |

Discrepancies in totals are due to rounding.

Table 13.--Relative population number (RPN) for arrowtooth flounder by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPN for areas sampled in both 1988 and 1989. Gully total is the combined RPN for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| Depth (m) | Year | RPN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| | | Shumagin | Chirikof | Kodiak | Yakutat | Southeastern | Total |
| 201- 300 | 1988 | 4,975 | 3,718 | 4,872 | 2,254 | 685 | 16,505 |
| | 1989 | 6,772 | 3,012 | 4,858 | 1,956 | 583 | 17,182 |
| 301- 400 | 1988 | 1,806 | 983 | 1,753 | 1,511 | 448 | 6,501 |
| | 1989 | 1,884 | 1,336 | 2,428 | 1,026 | 363 | 7,037 |
| 401- 600 | 1988 | 376 | 160 | 160 | 236 | 86 | 1,018 |
| | 1989 | 1,207 | 436 | 920 | 188 | 161 | 2,911 |
| 601- 800 | 1988 | 7 | 66 | 4 | 6 | 19 | 101 |
| | 1989 | 42 | 73 | 29 | 8 | 38 | 191 |
| 801-1000 | 1988 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1989 | 0 | 0 | 0 | 0 | 5 | 5 |
| 201-1000 | 1988 | 7,165 | 4,927 | 6,789 | 4,007 | 1,236 | 24,124 |
| | 1989 | 9,906 | 4,857 | 8,235 | 3,179 | 1,150 | 27,326 |
| | | Gullies | | | | | |
| | | Shumagin Gully | Shelikof Trough | Amatuli Gully | W-Ground | Yakutat Valley | Alsek Strath |
| 201- 300 | 1988 | 509 | 19,510 | 7,005 | | | |
| | 1989 | 486 | 42,342 | 9,076 | 405 | 1,541 | 1,396 |
| 301- 400 | 1988 | | | | | | |
| | 1989 | | | | 14 | 322 | |
| 201-1000 | 1988 | 509 | 19,510 | 7,005 | | | |
| | 1989 | 486 | 42,342 | 9,076 | 419 | 1,863 | 1,396 |

Table 13.--Continued.

| | | Spencer Gully | Ommaney Trench | Iphigenia Gully | Dixon Entrance | Gully total | GOA total |
|---|---|---|---|---|---|---|---|
| 201- 300 | 1988 | | | | | 27,023 | 43,528 |
| | 1989 | 0 | 1,282 | 1,692 | 2,463 | 51,903 | 69,085 |
| 301- 400 | 1988 | | | | | | 6,501 |
| | 1989 | 11 | 786 | | 272 | | 7,037 |
| 401- 600 | 1988 | 66 | | | | 66 | 1,084 |
| | 1989 | 14 | | | 18 | 14 | 2,926 |
| 601- 800 | 1988 | | | | | | 101 |
| | 1989 | 2 | | | | | 191 |
| 801-1000 | 1988 | | | | | | 0 |
| | 1989 | | | | | | 5 |
| 201-1000 | 1988 | 66 | | | | 27,089 | 51,214 |
| | 1989 | 27 | 2,068 | 1,692 | 2,752 | 51,918 | 79,243 |

Discrepancies in totals are due to rounding.

Table 14.--Relative population number (RPN) for skates by International North Pacific Fisheries Commission area for the upper continental slope and by gully for gully areas. Gulf of Alaska (GOA) total is the combined RPN for areas sampled in both 1988 and 1989. Gully total is the combined RPN for gullies sampled in both 1988 and 1989. Domestic longline surveys, 1988 and 1989.

| Depth (m) | Year | RPN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Upper continental slope | | | | | |
| | | Shumagin | Chirikof | Kodiak | Yakutat | Southeastern | Total |
| 201- 300 | 1988 | 783 | 55 | 226 | 344 | 103 | 1,510 |
| | 1989 | 528 | 118 | 101 | 337 | 226 | 1,310 |
| 301- 400 | 1988 | 142 | 80 | 107 | 112 | 51 | 493 |
| | 1989 | 324 | 123 | 133 | 167 | 70 | 817 |
| 401- 600 | 1988 | 34 | 9 | 10 | 33 | 17 | 103 |
| | 1989 | 62 | 57 | 50 | 44 | 32 | 245 |
| 601- 800 | 1988 | 45 | 11 | 0 | 0 | 17 | 73 |
| | 1989 | 71 | 0 | 12 | 1 | 16 | 101 |
| 801-1000 | 1988 | 0 | 0 | 0 | 0 | 5 | 5 |
| | 1989 | 0 | 0 | 0 | 0 | 14 | 14 |
| 201-1000 | 1988 | 1,003 | 155 | 343 | 490 | 193 | 2,184 |
| | 1989 | 985 | 297 | 297 | 549 | 358 | 2,486 |
| | | Gullies | | | | | |
| | | Shumagin Gully | Shelikof Trough | Amatuli Gully | W-Ground | Yakutat Valley | Alsek Strath |
| 201- 300 | 1988 | 255 | 5,217 | 3,687 | | | |
| | 1989 | 60 | 9,242 | 2,918 | 130 | 148 | 229 |
| 301- 400 | 1988 | | | | | | |
| | 1989 | | | | 24 | 103 | |
| 201-1000 | 1988 | 255 | 5,217 | 3,687 | | | |
| | 1989 | 60 | 9,242 | 2,918 | 153 | 251 | 229 |

Table 14.--Continued.

| | | Spencer Gully | Ommaney Trench | Iphigenia Gully | Dixon Entrance | Gully total | GOA total |
|---|---|---|---|---|---|---|---|
| 201- 300 | 1988 | | | | | 9,158 | 10,669 |
| | 1989 | 103 | 233 | 721 | 639 | 12,220 | 13,531 |
| 301- 400 | 1988 | | | | | | 493 |
| | 1989 | 7 | 294 | | 445 | | 817 |
| 401- 600 | 1988 | 4 | | | | 4 | 107 |
| | 1989 | 0 | | | 41 | 0 | 245 |
| 601- 800 | 1988 | | | | | | 73 |
| | 1989 | 0 | | | | | 101 |
| 801-1000 | 1988 | | | | | | 5 |
| | 1989 | | | | | | 14 |
| 201-1000 | 1988 | 4 | | | | 9,163 | 11,347 |
| | 1989 | 110 | 527 | 721 | 1,125 | 12,220 | 14,706 |

Discrepancies in totals are due to rounding.

Table 15.--Numbers of each species caught during the 1989 domestic longline survey that are not discussed in the text.

| Common name | Scientific name | Number caught |
|---|---|---|
| Spiny dogfish | *Squalus acanthias* | 727 |
| Redbanded rockfish | *Sebastes babcocki* | 509 |
| Yelloweye rockfish | *Sebastes ruberrimus* | 420 |
| Dover sole | *Microstomus pacificus* | 206 |
| Walleye pollock | *Theragra chalcogramma* | 160 |
| Lingcod | *Ophiodon elongatus* | 125 |
| Starfish | Class Asteroidea | 125 |
| Flathead sole | *Hippoglossoides elassodon* | 78 |
| Yellow Irish lord | *Hemilepidotus jordani* | 48 |
| Pacific flatnose | *Antimora microlepis* | 39 |
| Sculpin unidentified | Cottidae | 32 |
| Rosethorn rockfish | *Sebastes helvomaculatus* | 27 |
| Coho salmon | *Oncorhynchus kisutch* | 25 |
| Spotted ratfish | *Hydrolagus colliei* | 24 |
| True Tanner crab | *Chionoecetes tanneri* | 18 |
| Pacific sleeper shark | *Somniosus pacificus* | 18 |
| Dusky rockfish | *Sebastes ciliatus* | 12 |
| Giant wrymouth | *Delolepis gigantea* | 11 |
| Octopus | Octopus, unidentified | 9 |
| Pacific pomfret | *Brama japonica* | 8 |
| Basketstarfish | Basketstarfish, unidentified | 7 |
| Searcher | *Bathymaster signatus* | 6 |
| Salmon shark | *Lamna ditropis* | 6 |
| Blue shark | *Prionace glauca* | 5 |
| Tanner crab | *Chionoecetes*, unidentified | 5 |
| Brittlestarfish | Ophiuroid, unidentified | 5 |
| Salmon | Salmonidae, unidentified | 5 |
| Scarlet king crab | *Lithodes couesi* | 4 |
| Silvergray rockfish | *Sebastes brevispinis* | 3 |
| Sponge, unidentified | | 3 |
| Rock sole | *Pleuronectes bilineatus* | 3 |
| Greenstriped rockfish | *Sebastes elongatus* | 3 |
| Blackfin sculpin | *Malacocottus kincaidi* | 3 |
| Crab, unidentified | | 2 |
| Canary rockfish | *Sebastes pinniger* | 2 |
| Prowfish | *Zaprora silenus* | 2 |
| Eelpout unidentified | Zoarcidae | 2 |
| Rex sole | *Errex zachirus* | 2 |
| Red king crab | *Paralithodes camtschaticus* | 1 |
| Rockfish unidentified | *Sebastes*, unidentified | 1 |
| Great sculpin | *Myoxocephalus polyacanthocephalus* | 1 |
| Aurora rockfish | *Sebastes aurora* | 1 |
| Crinoid, unidentified | | 1 |
| Harlequin rockfish | *Sebastes variegatus* | 1 |
| Golden king crab | *Lithodes aequispina* | 1 |
| Twoline eelpout | *Bothrocara brunneum* | 1 |
| Pomfret unidentified | Bramidae | 1 |

Table 16.--Sablefish commercial fishing season start and end dates, 1988-1989, in the Gulf of Alaska for the Central and Western North Pacific Fishery Management Council (NPFMC) management areas" and survey dates.

| Year | Area | Fishery | Dates | Survey dates |
|---|---|---|---|---|
| 1988 | Western | longline | 4/1-7/ 8 | 6/26-7/8 |
| | | trawl | 1/1-12/31 | |
| | Central | longline | 4/1-5/27 | 7/ 9-8/1 |
| | | trawl | 1/1-9/15 | |
| 1989 | Western | longline | 4/1-7/13 | 6/26-7/8 |
| | | trawl | 1/1-8/10 | |
| | Central | longline | 4/1-5/27 | 7/ 9-8/1 |
| | | trawl | 1/1-6/ 6 | |

[a]Ron Berg, National Marine Fisheries Service, Alaska Regional Office, P.O. Box 21668, Juneau, AK 99802. Pers. commun., July 1990.

# FIGURES

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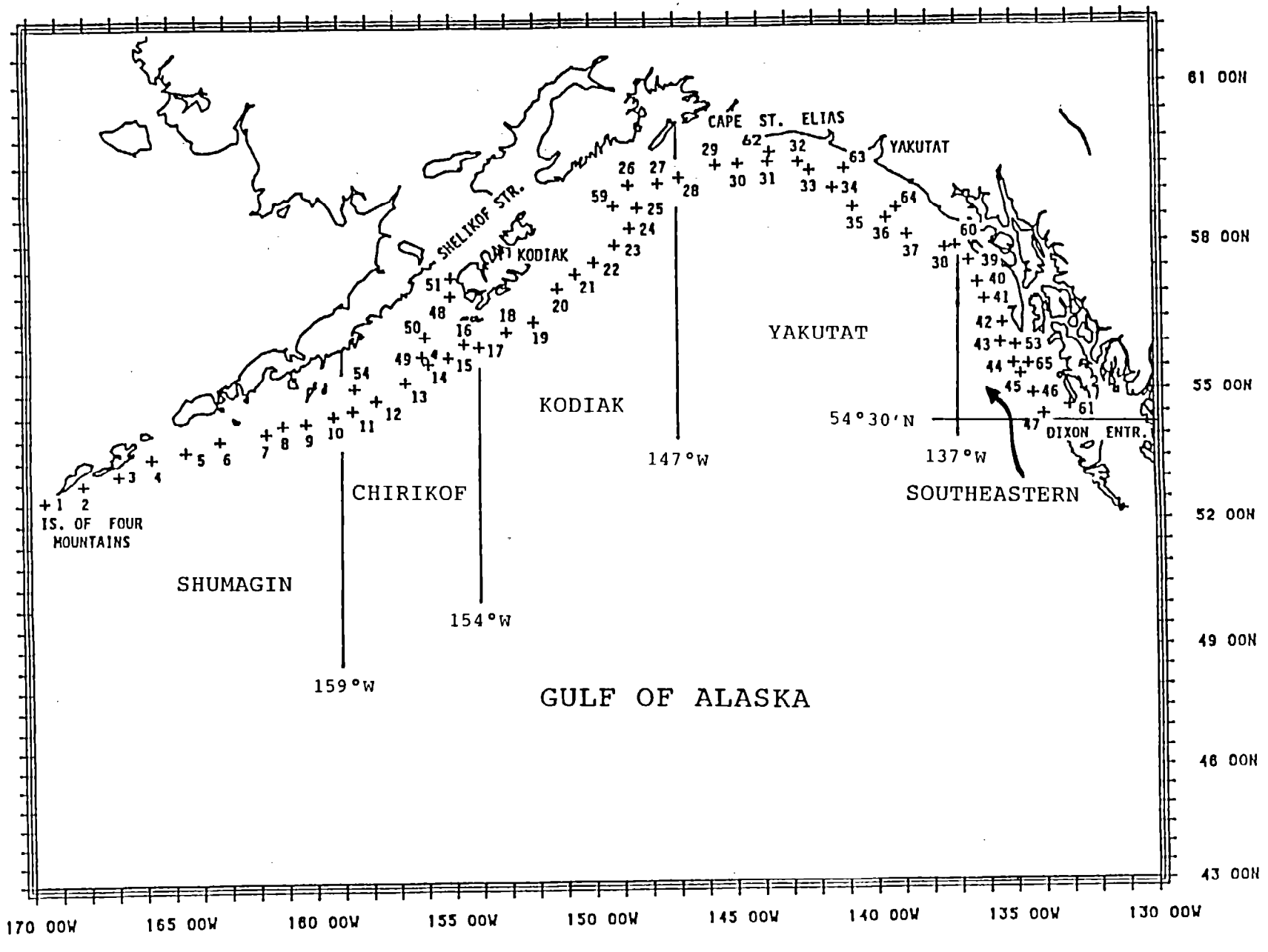


Figure 1 .--Station locations for the 1989 NMFS longline survey of the Gulf of Alaska and boundaries of International North Pacific Fisheries Commission statistical arcas.

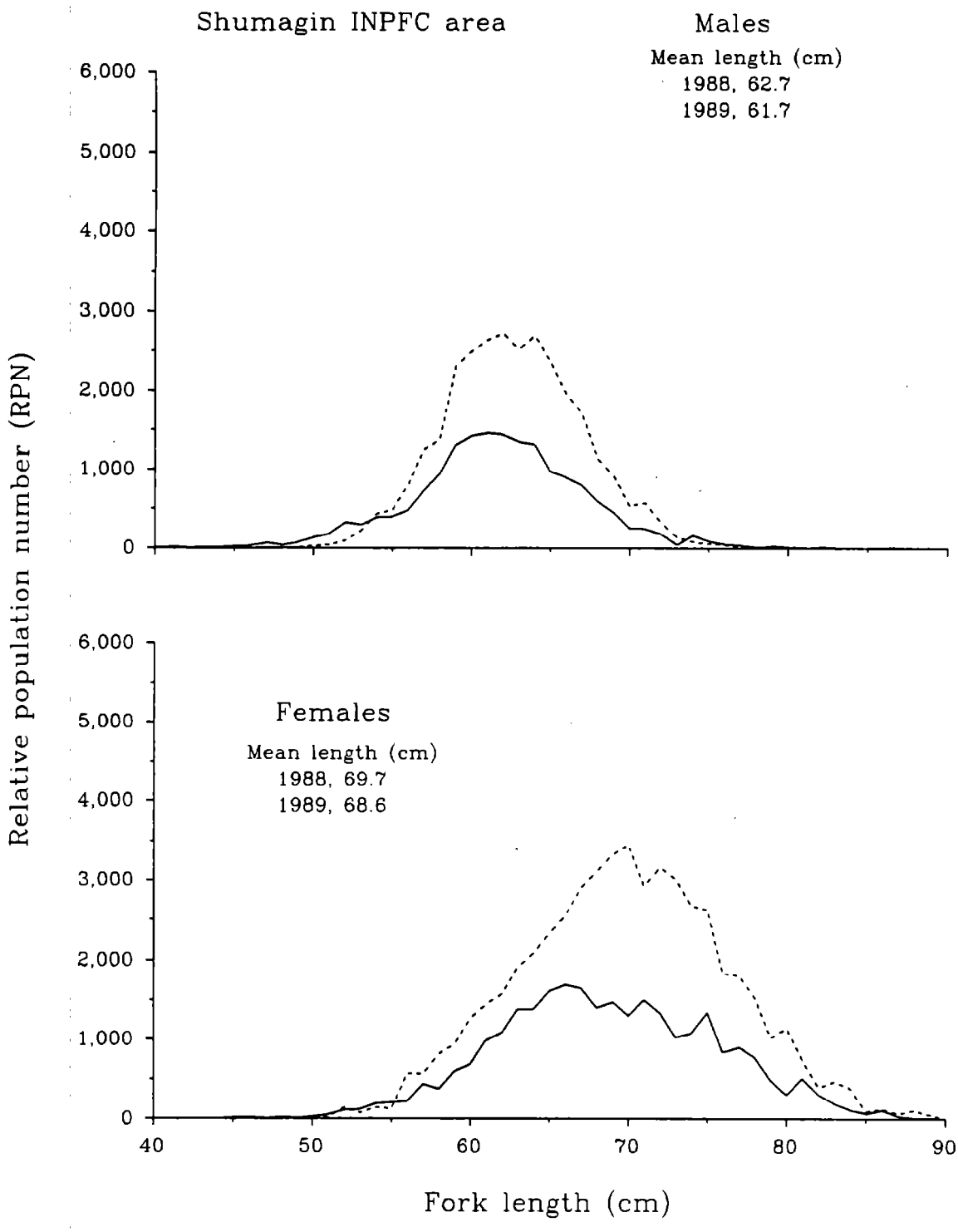


Figure 2a. - -Sablefish length frequencies weighted by relative population number, by sex, for the International North Pacific Fisheries Commission Shumagin statistical area, upper continental slope, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

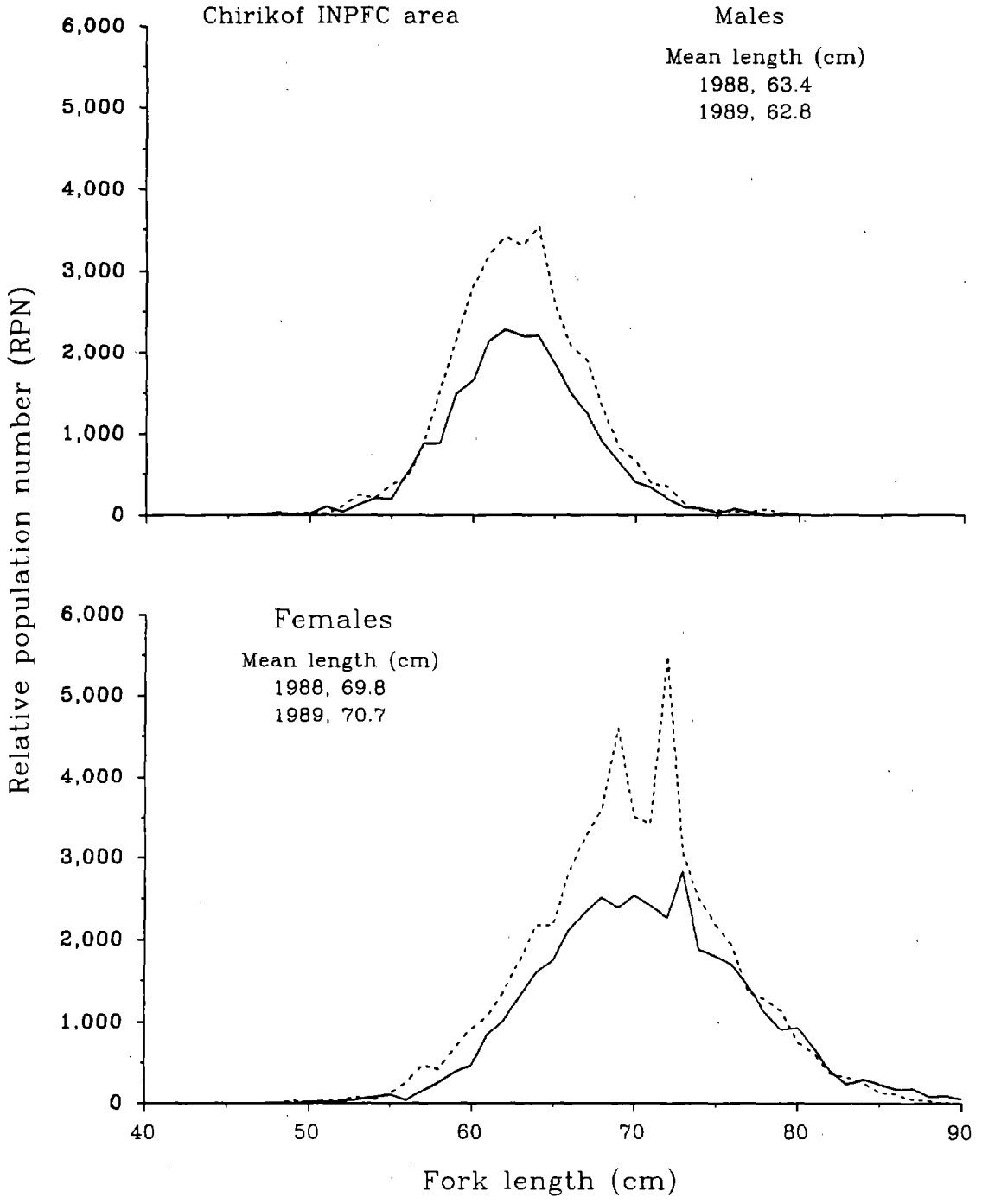


Figure 2b.--Sablefish length frequencies weighted by relative population number, by sex, for the International North Pacific Fisheries Commission Chirikof statistical area, upper continental slope, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

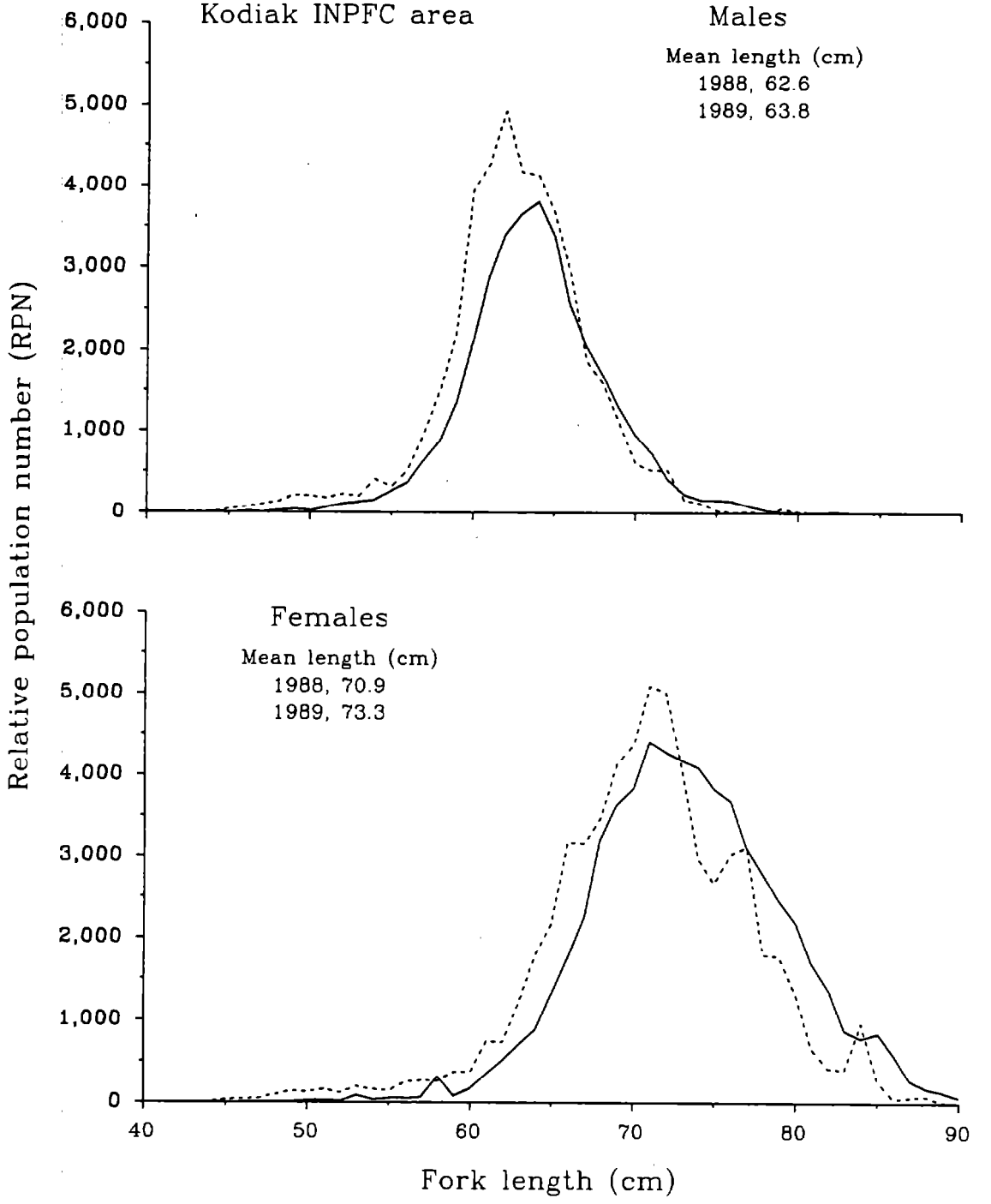


Figure 2c. - -Sablefish length frequencies weighted by relative population number, by sex, for the International North Pacific Fisheries Commission Kodiak statistical area, upper continental slope, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

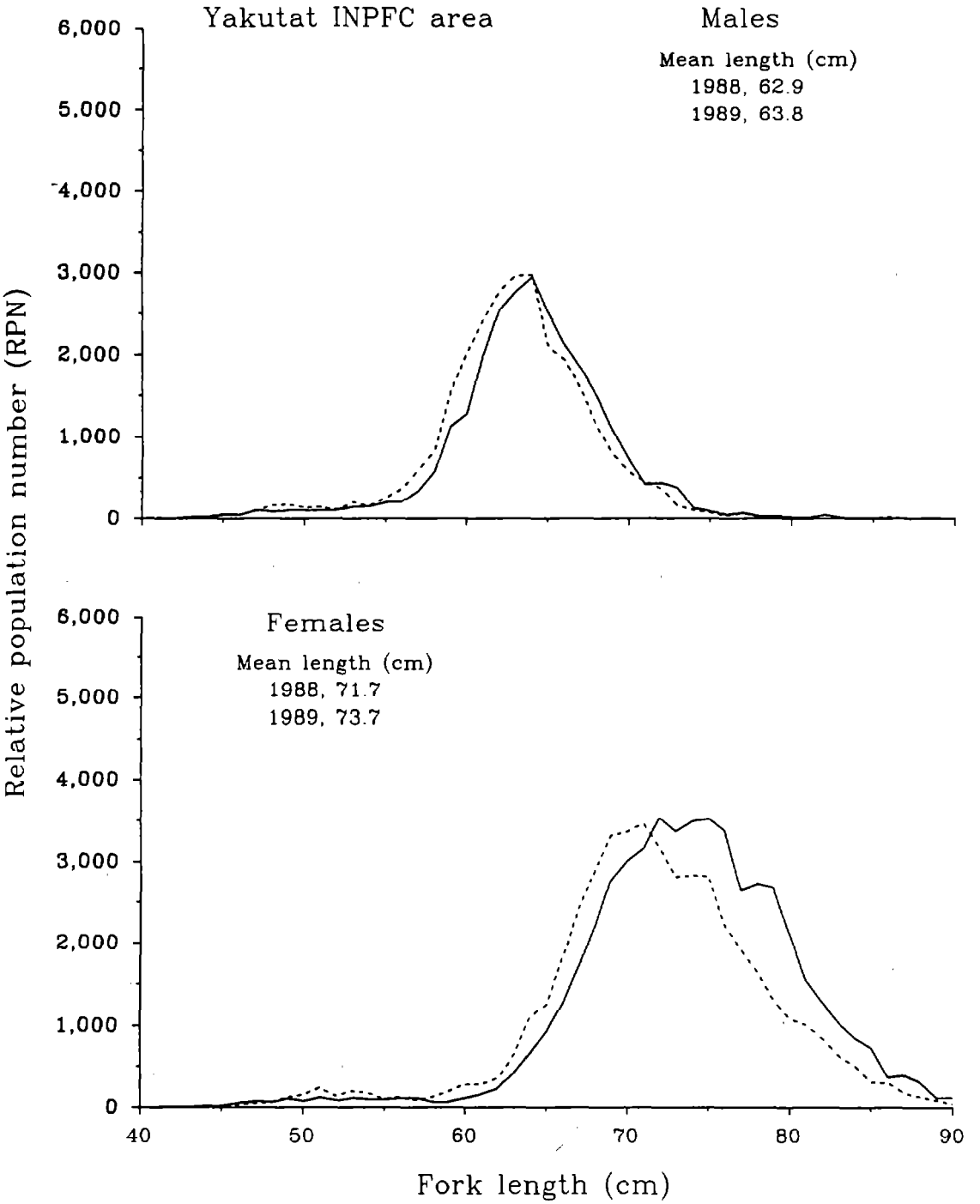


Figure 2d.--Sablefish length frequencies weighted by relative population number, by sex, for the International North Pacific Fisheries Commission Yakutat statistical area, upper continental slope, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

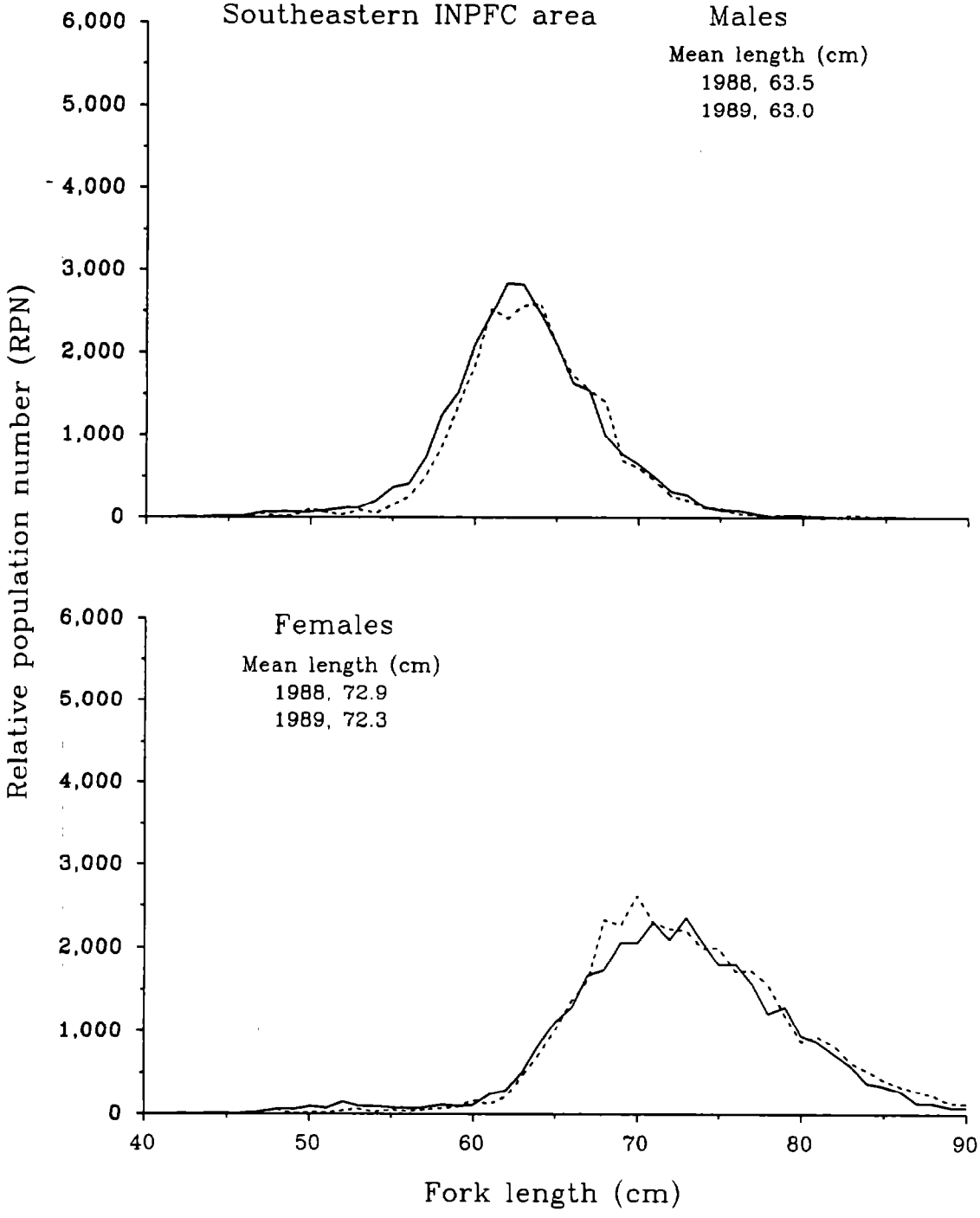


Figure 2e.--Sablefish length frequencies weighted by relative population number, by sex, for the International North Pacific Fisheries Commission Southeastern statistical area, upper continental slope, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

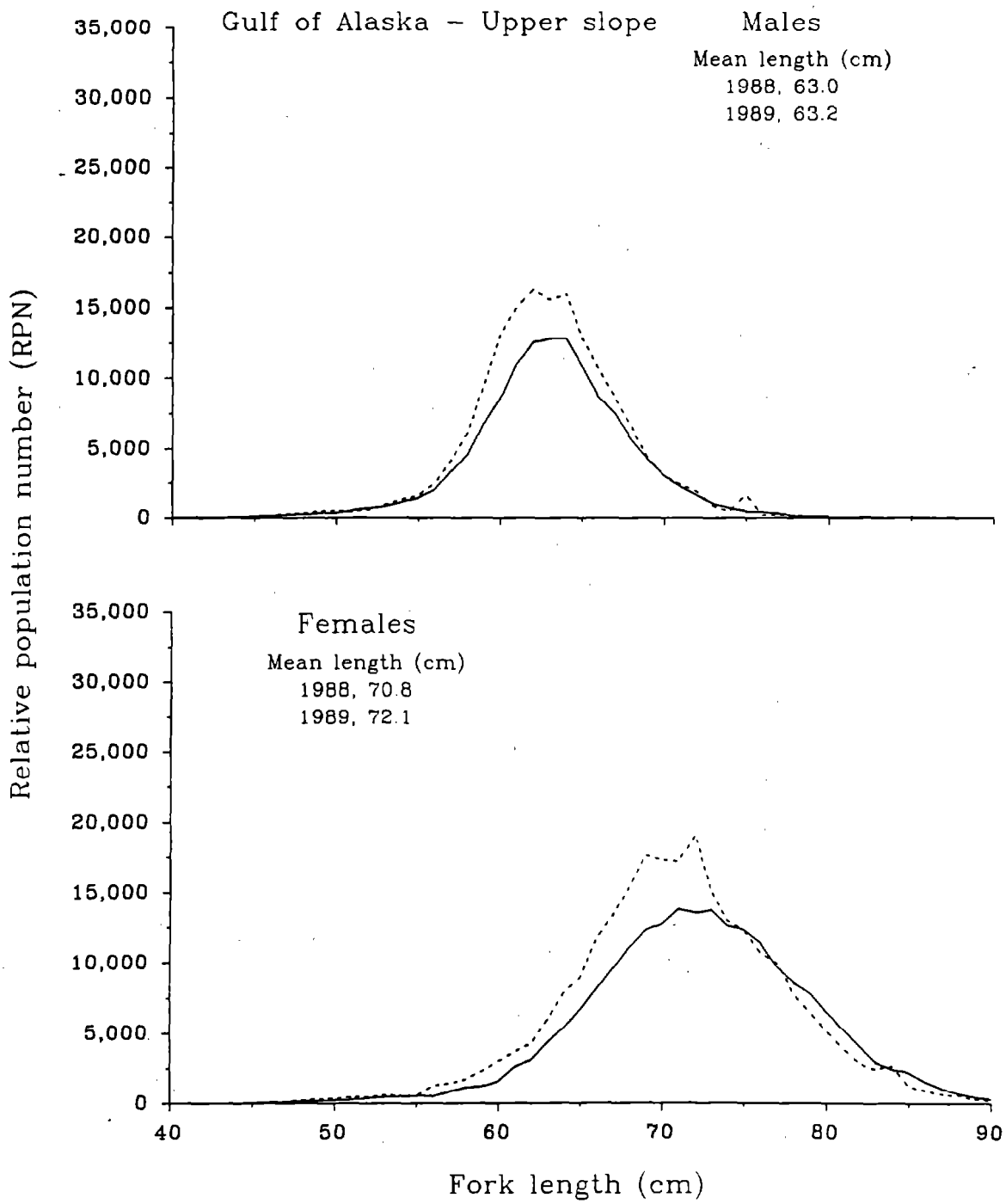


Figure 2f.-- Sablefish length frequencies weighted by relative population number, by sex, for the upper continental slope of the combined areas sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

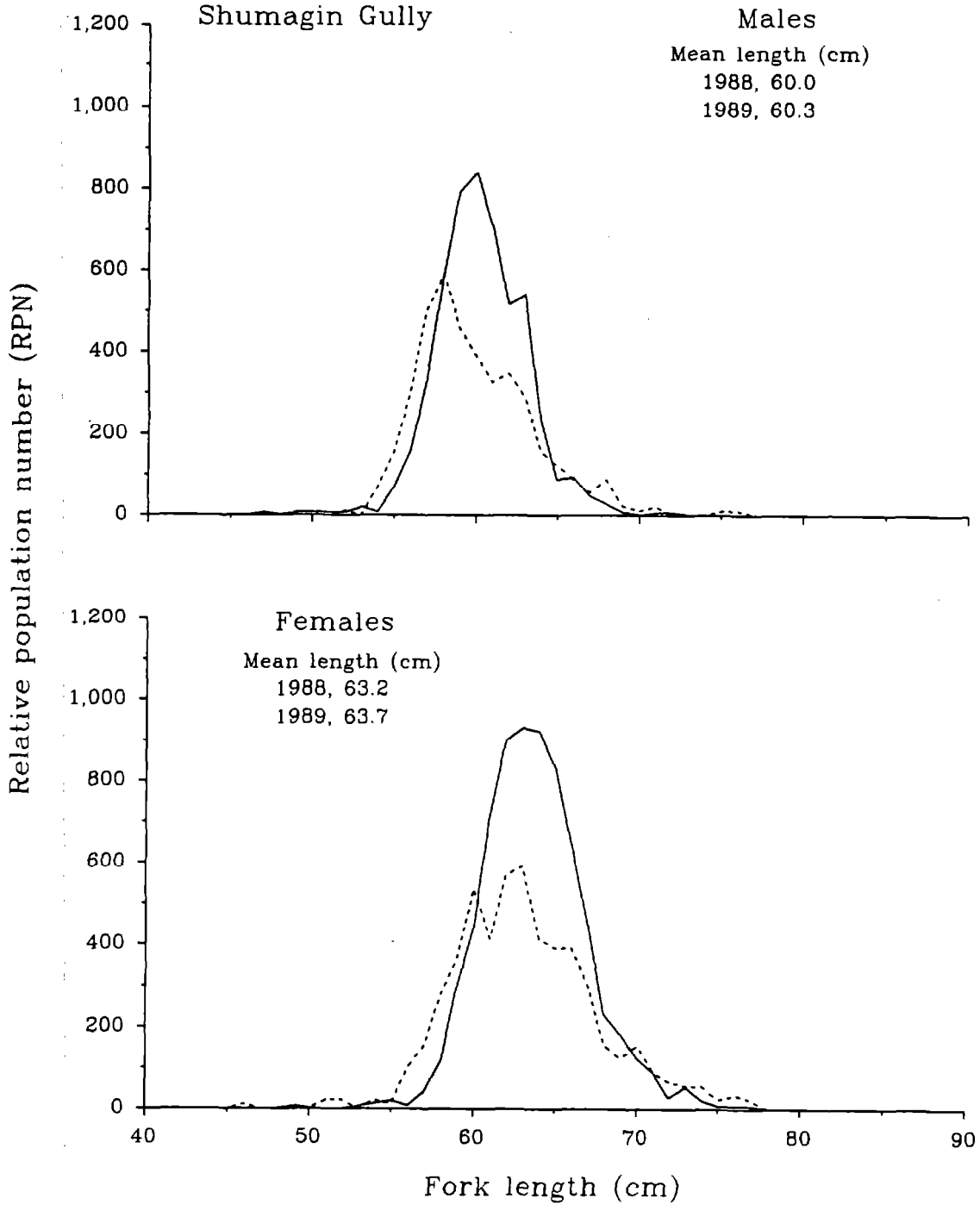


Figure 2g. --Sablefish length frequencies weighted by relative population number, by sex, for Shumagin Gully, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

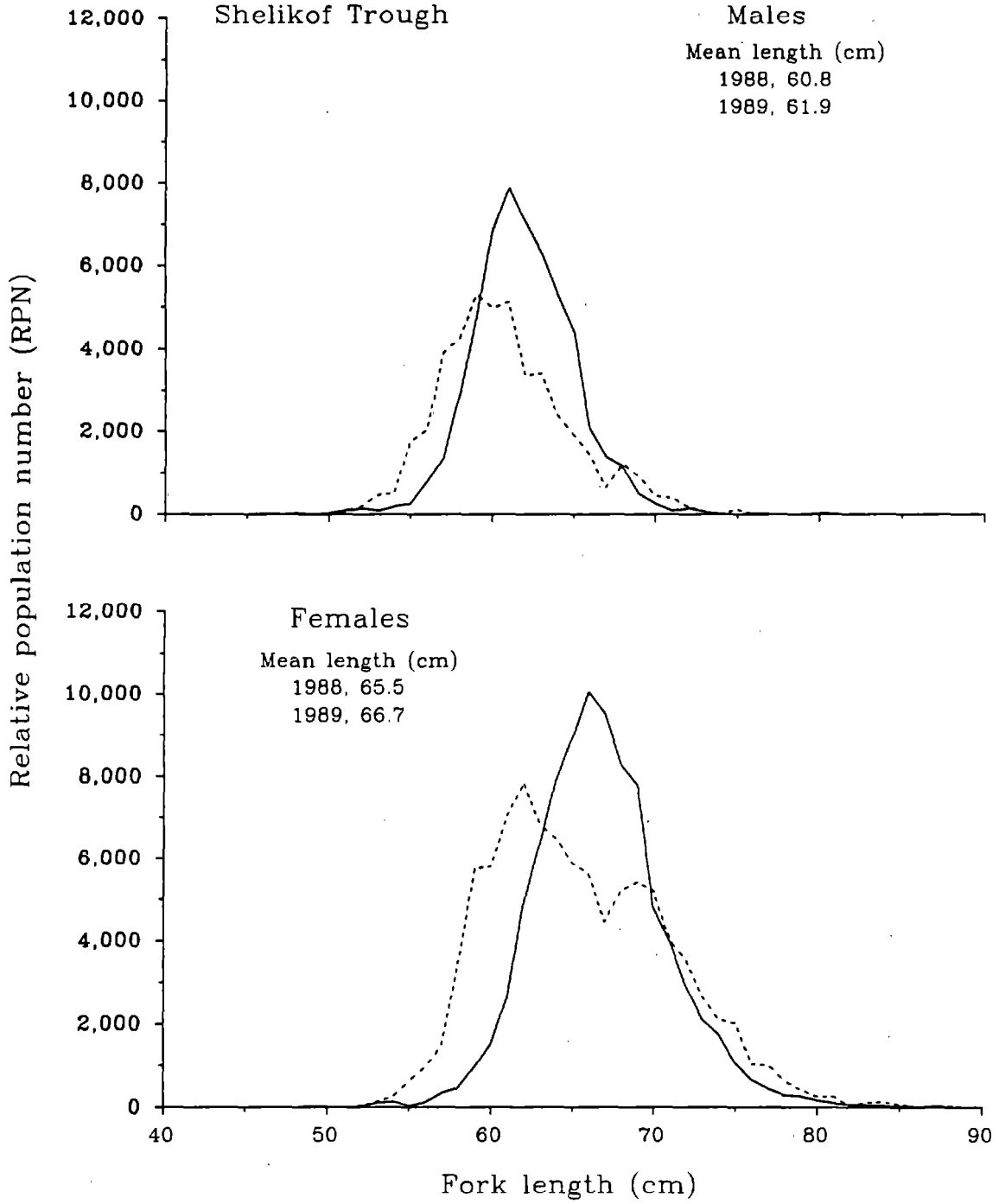


Figure 2h.--Sablefish length, frequencies weighted by relative population number, by sex, for Shelikof Trough, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

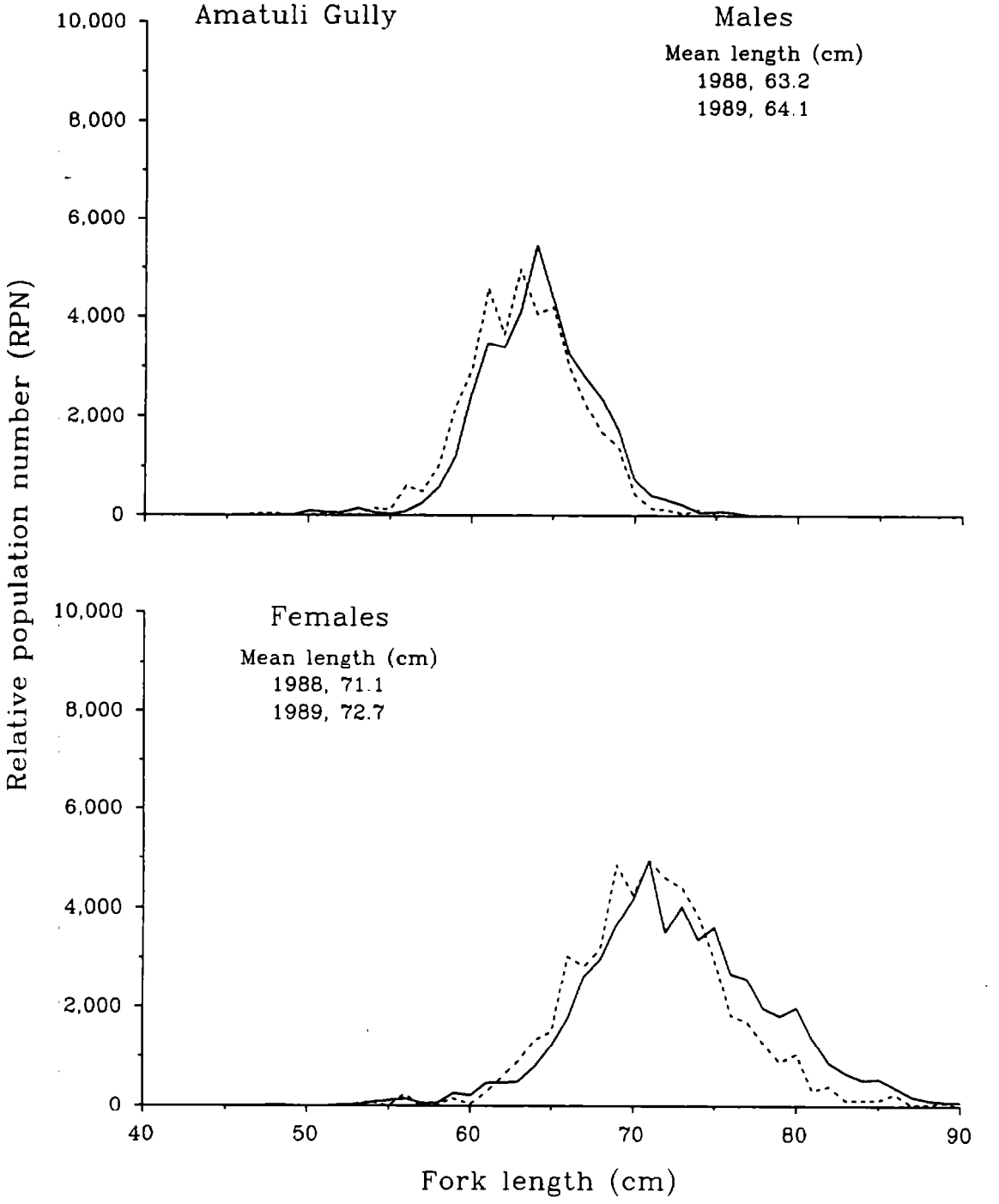


Figure 2i.--Sablefish length frequencies weighted by relative population number, by sex, for Amatuli Gully, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

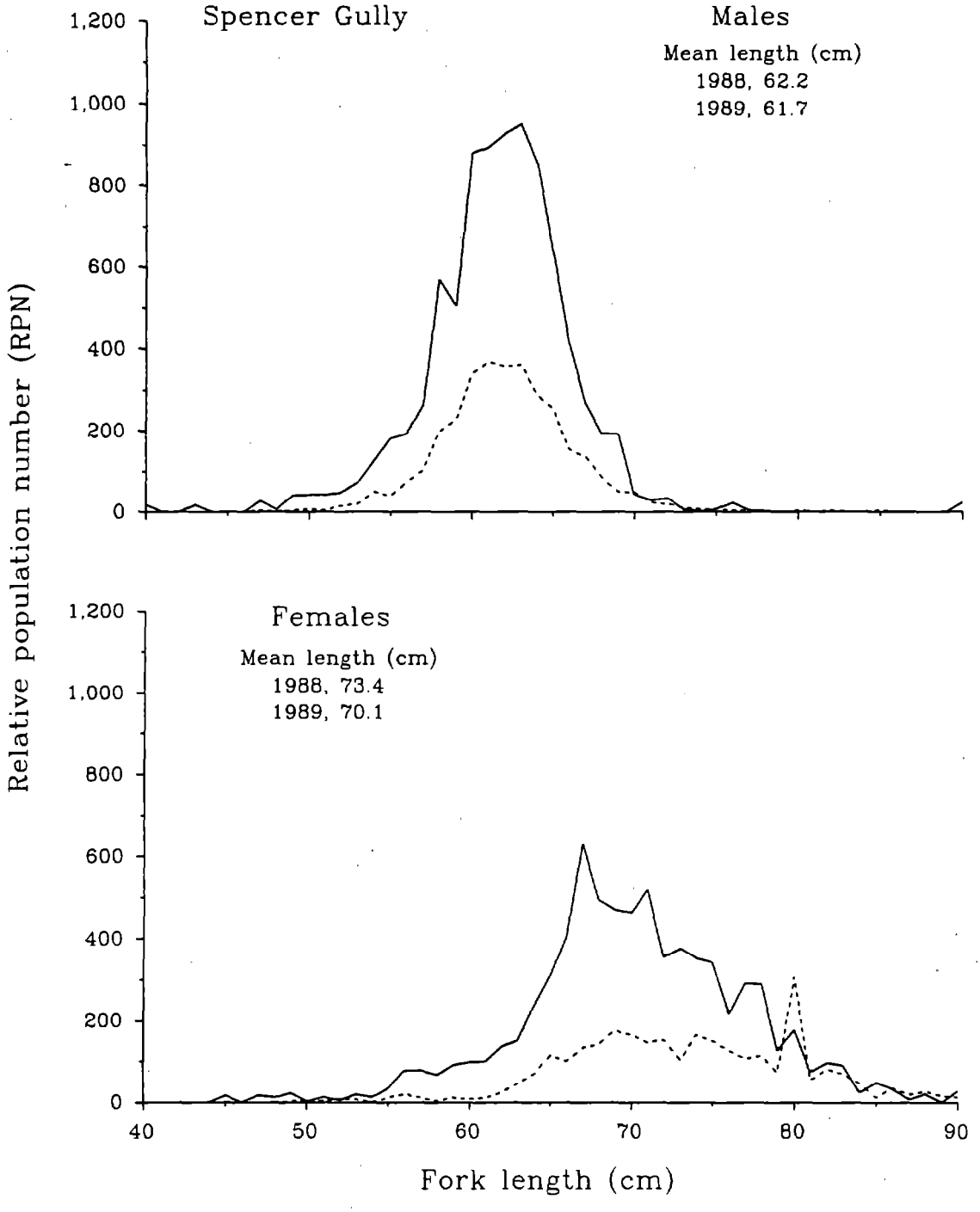


Figure 2j.--Sablefish length frequencies weighted by relative population number, by sex, for Spencer Gully, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-), Depth interval 401-600 m, only.

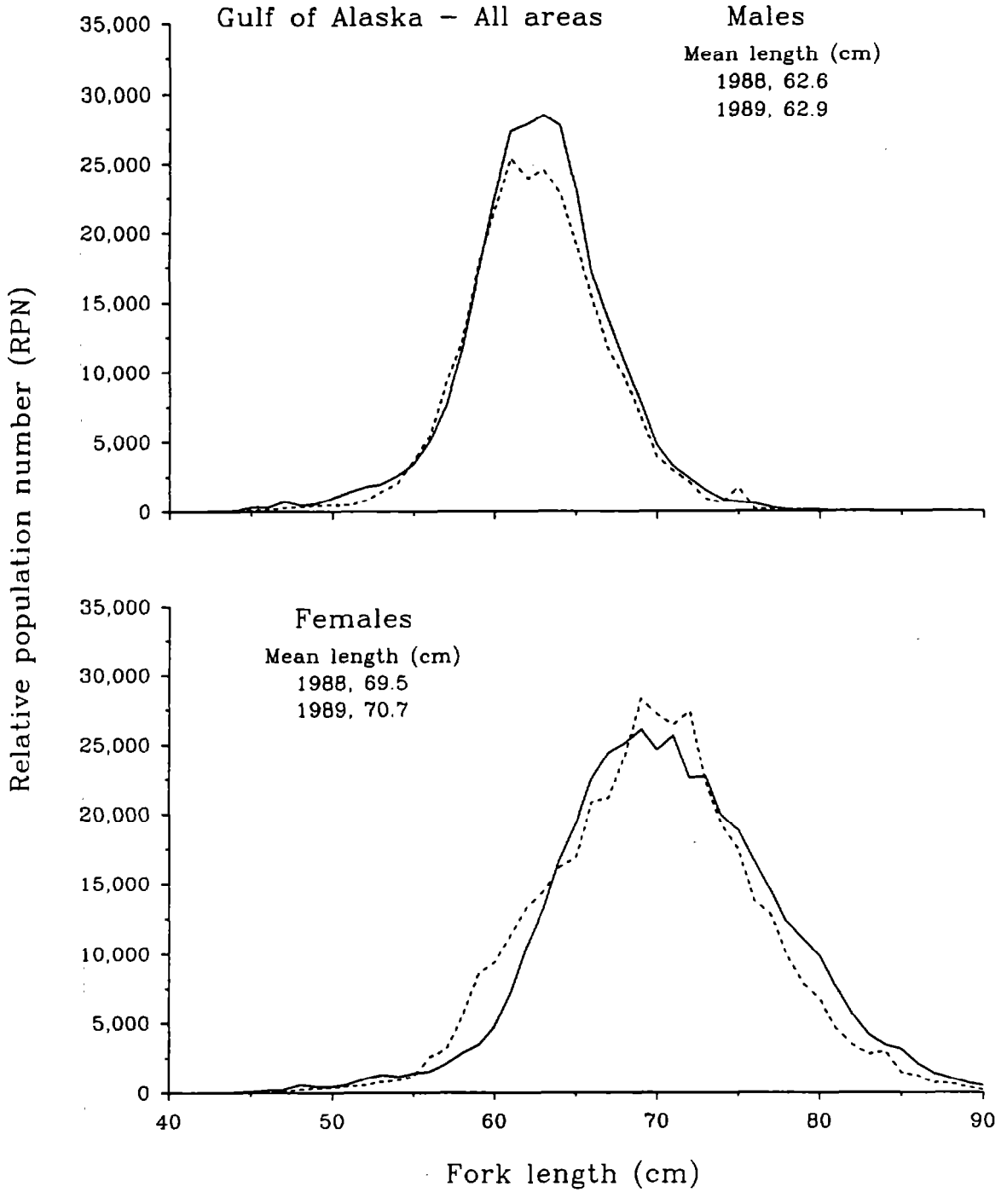


Figure 2k.--Sablefish length frequencies weighted by relative population number, by sex, for the combined areas sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-). Note: In 1988, sample included the upper continental slope, Shumagin Gully, Shelikof Trough, Amatuli Gully, and Spencer Gully; in 1989, sample included the above plus W-grounds, Yakutat Valley, Alsek Strath. Ommaney Trench, Iphigenia Gully, and Dixon Entrance.

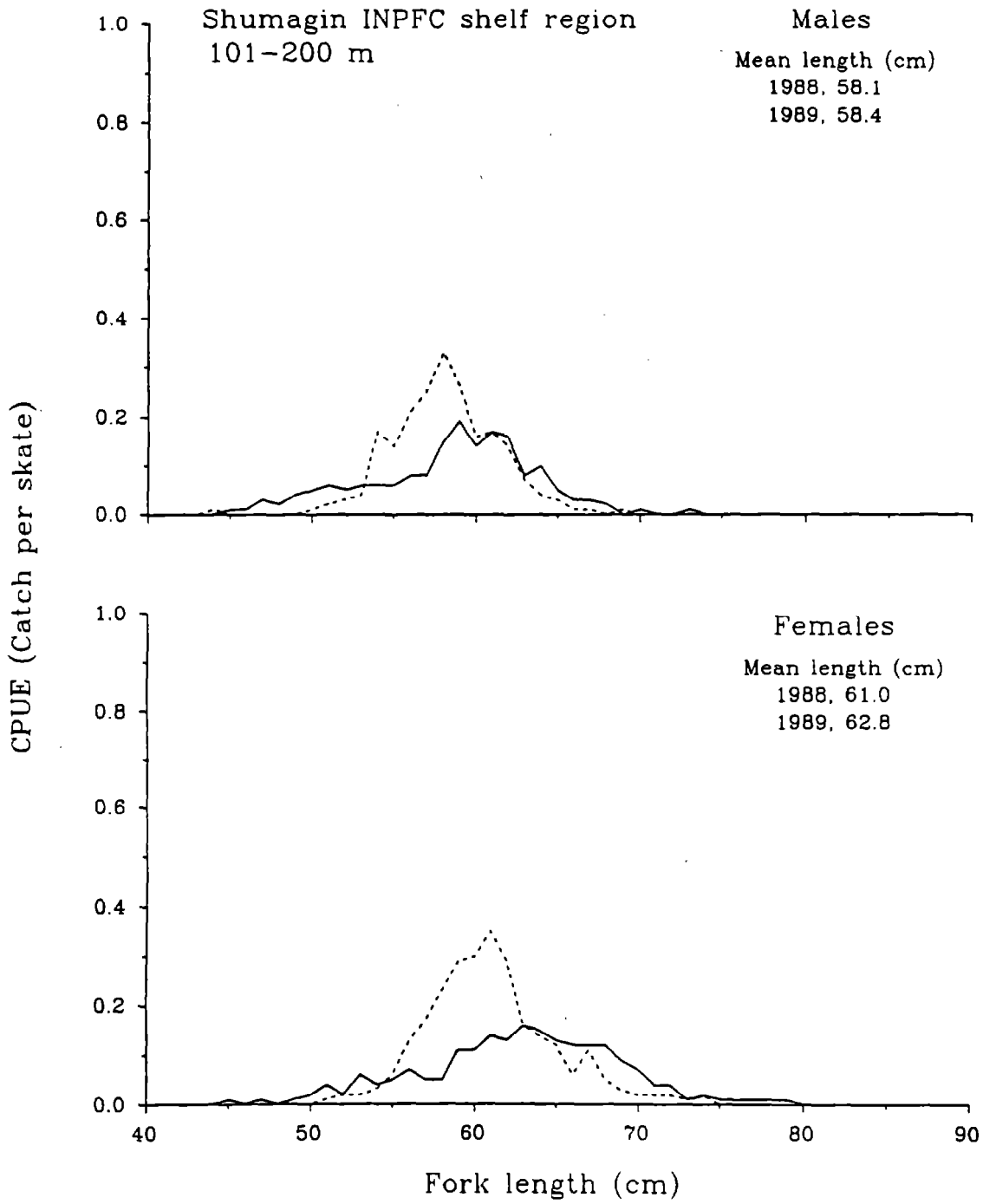


Figure 3a.--Sablefish length frequencies weighted by catch per unit effort (CPUE), by sex, for depths 101-200 m in the International North Pacific Fisheries Commission Shumagin statistical area, sampled along the outer continental shelf during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

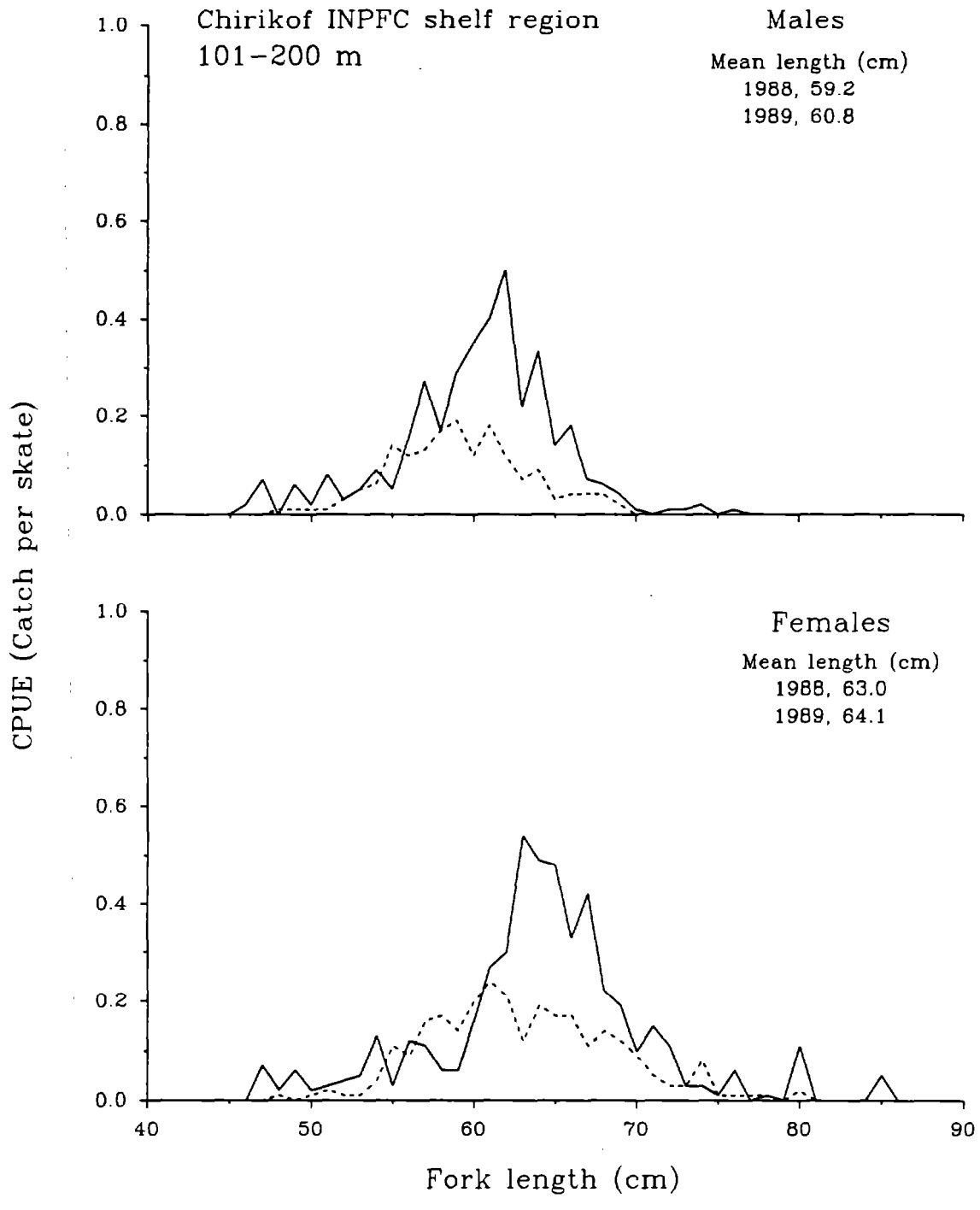


Figure 3b.--Sablefish length frequencies weighted by catch per unit effort (CPUE), by sex, for depths 101-200 m in the International North Pacific Fisheries Commission Chirikof statistical area, sampled along the outer continental shelf during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

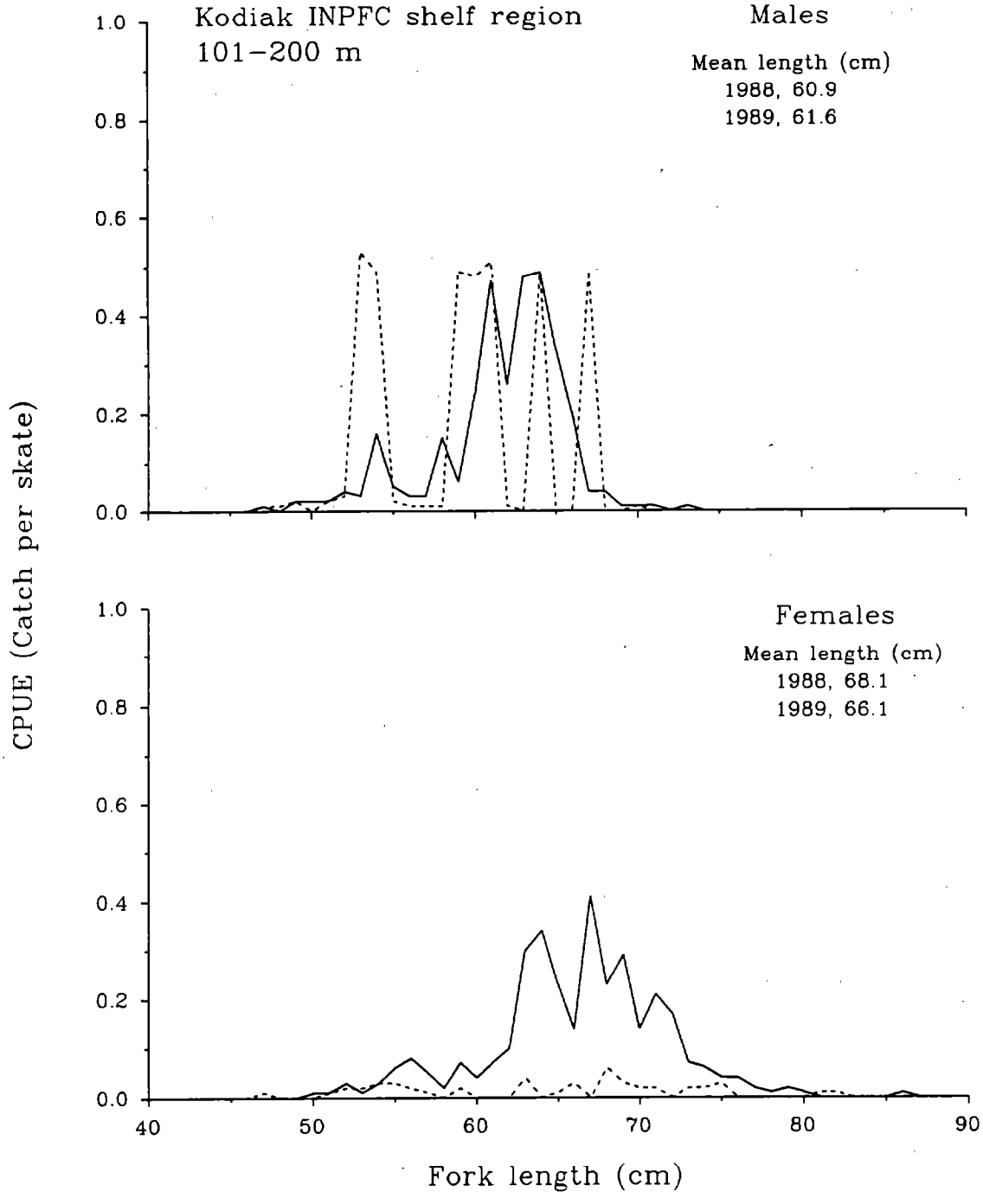


Figure 3c.--Sablefish length frequencies weighted by catch per unit effort (CPUE), by sex, for depths 101-200 m in the International North Pacific Fisheries Commission Kodiak statistical area, sampled along the outer continental shelf during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

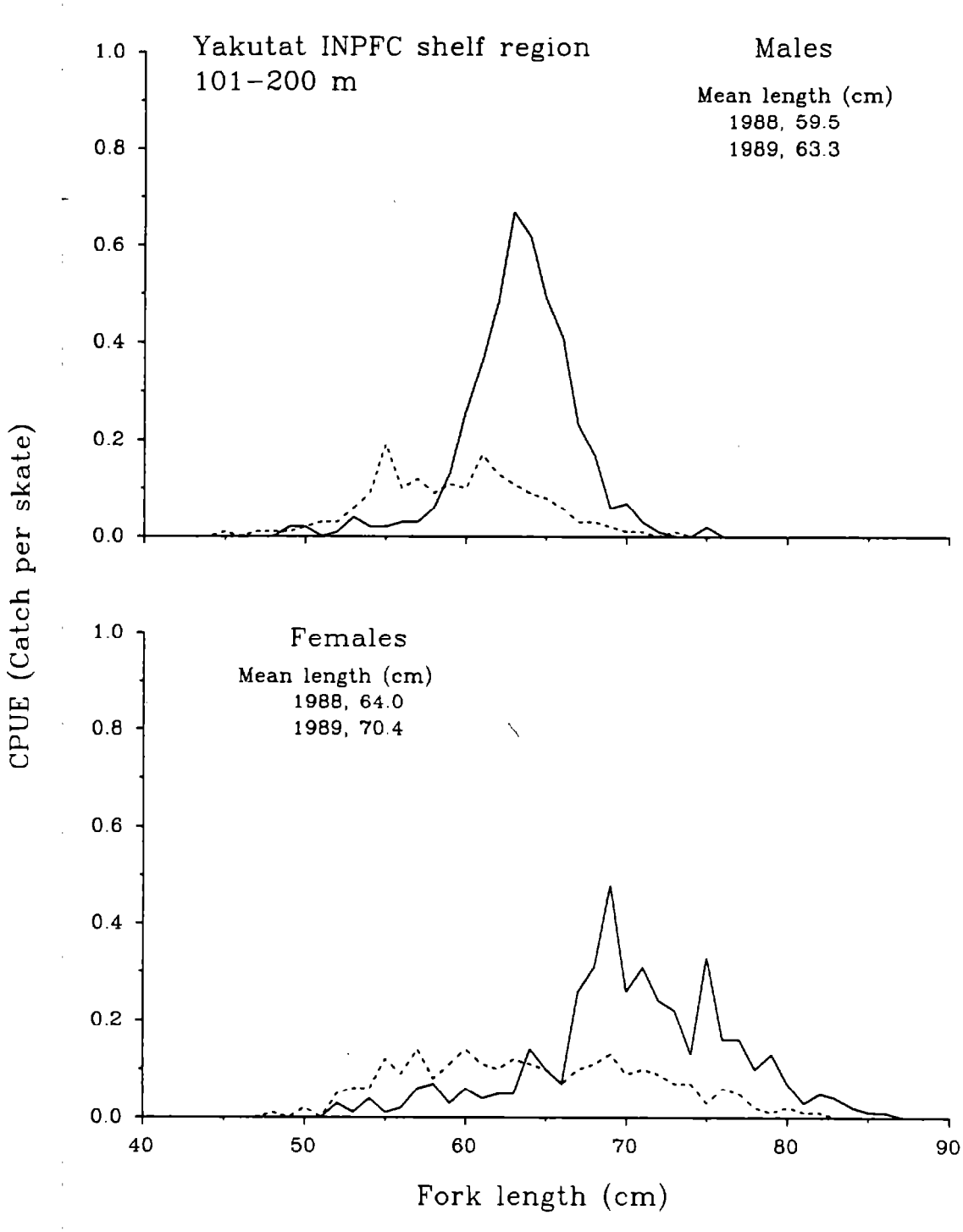


Figure 3d.--Sablefish length frequencies weighted by catch per unit effort (CPUE), by sex, for depths 101-200 m in the International North Pacific Fisheries Commission Yakutat statistical area, sampled along the outer continental shelf during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

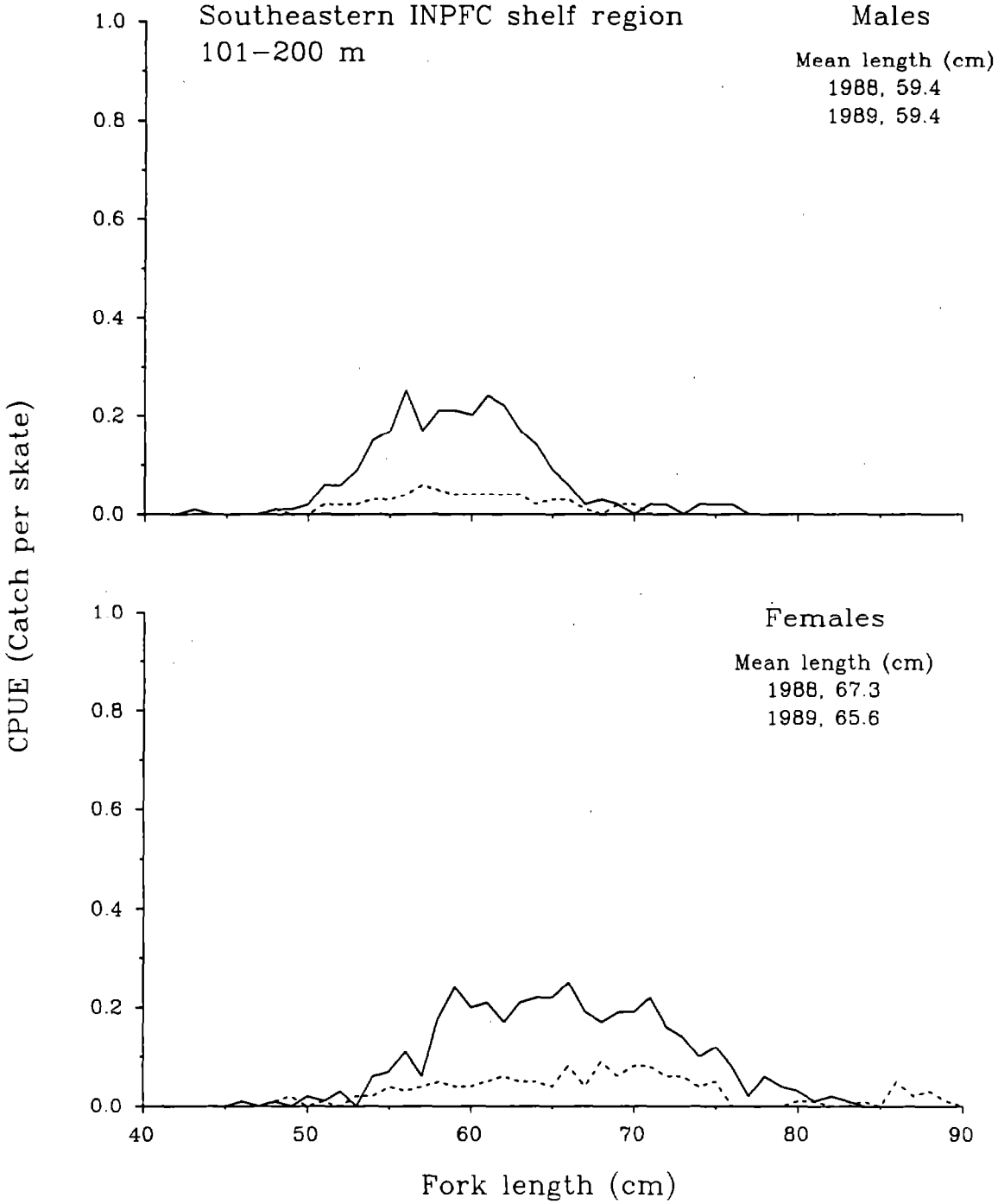


Figure 3e.--Sablefish length frequencies weighted by catch per unit effort (CPUE), by sex, for depths 101-200 m in the International North Pacific Fisheries Commission Southeastern statistical area, sampled along the outer continental shelf during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

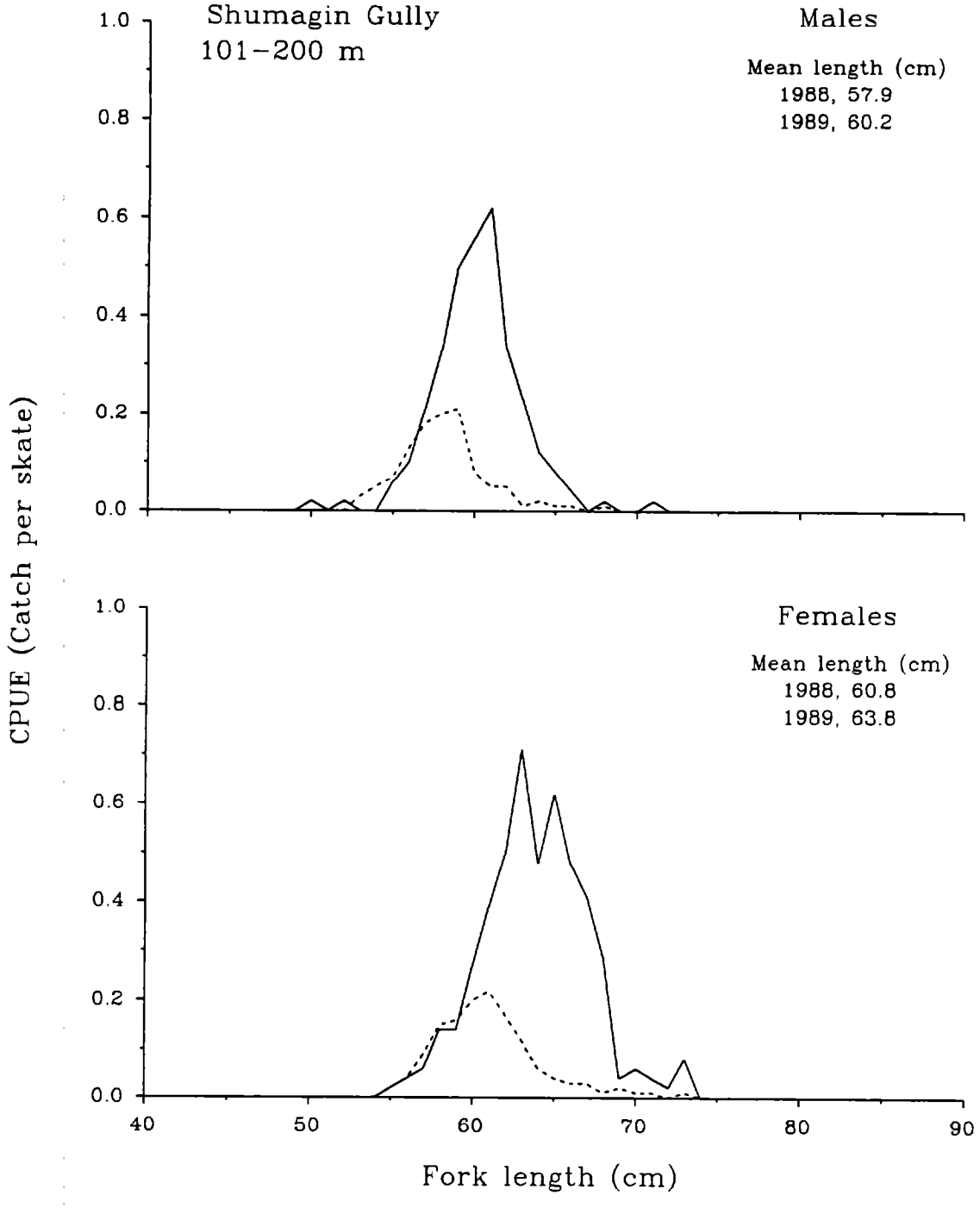


Figure 3f.--Sablefish length frequencies weighted by catch per unit effort (CPUE), by sex, for depths 101-200 m in Shumagin Gully, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

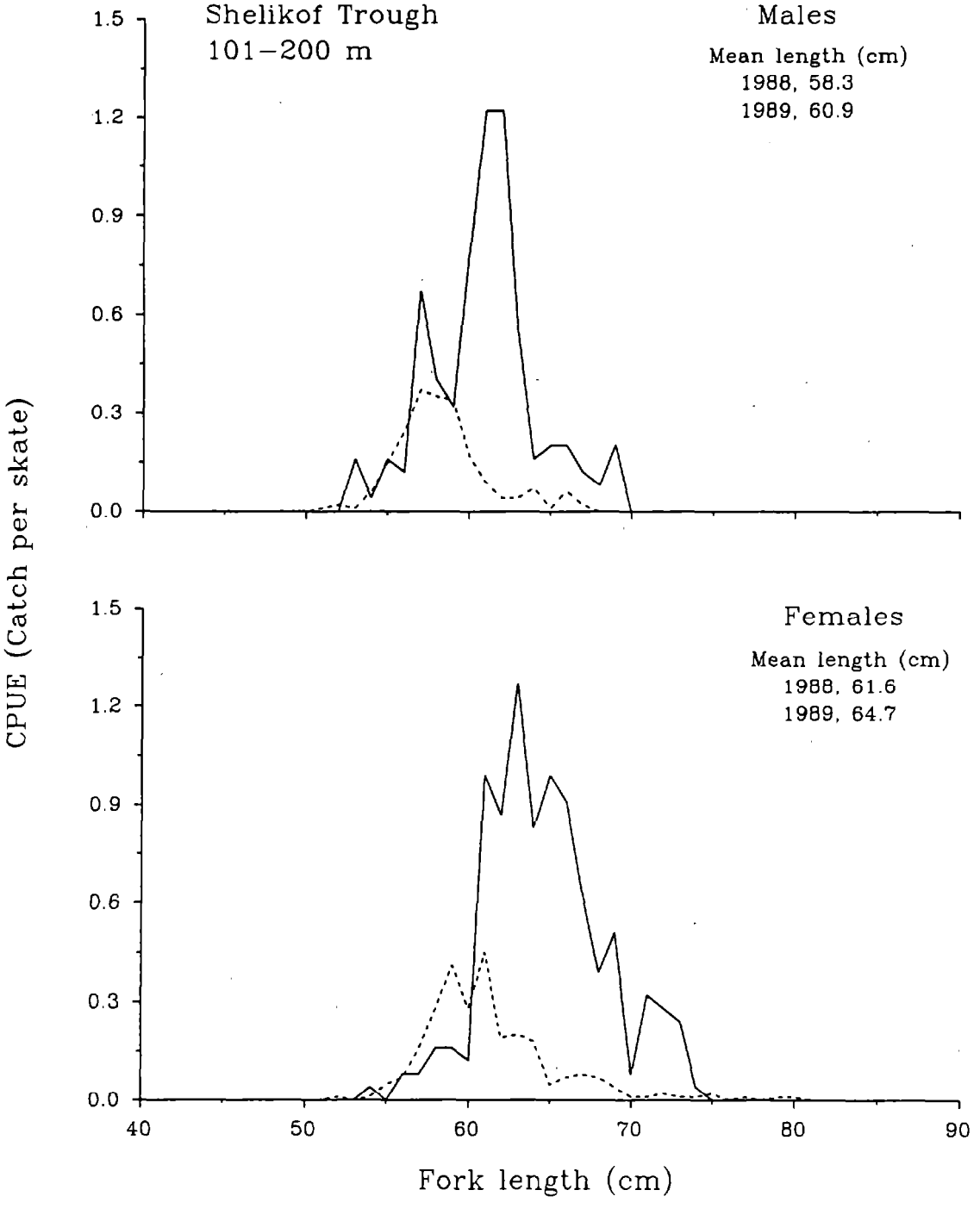


**Figure** 3g.--Sablefish length frequencies weighted by catch per unit effort (CPUE), by sex, for depths 101-200 m in Shelikof Trough, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

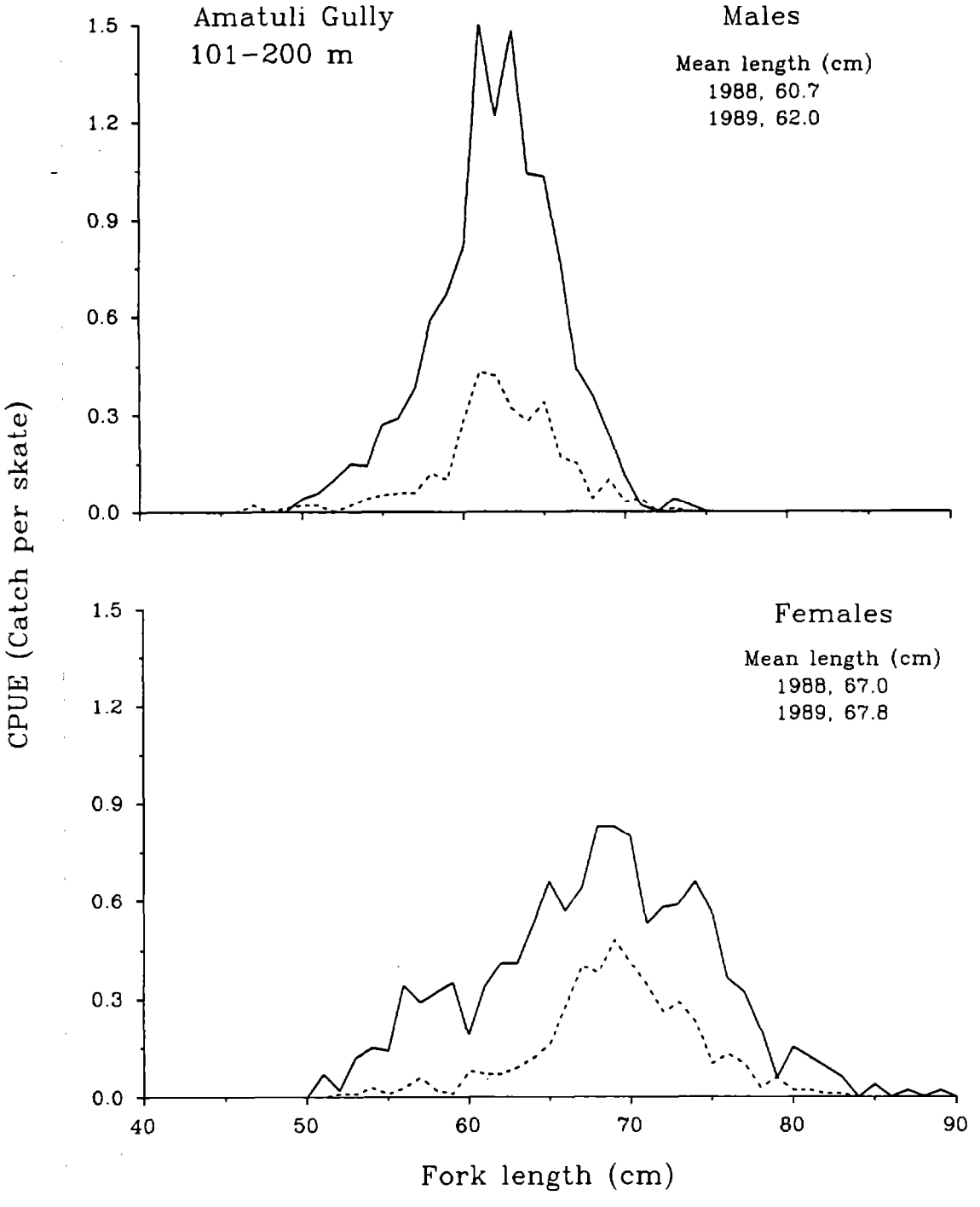


Figure 3h.--Sablefish length frequencies weighted by catch per unit effort (CPUE), by sex, for depths 101-200 m in Amatuli Gully, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

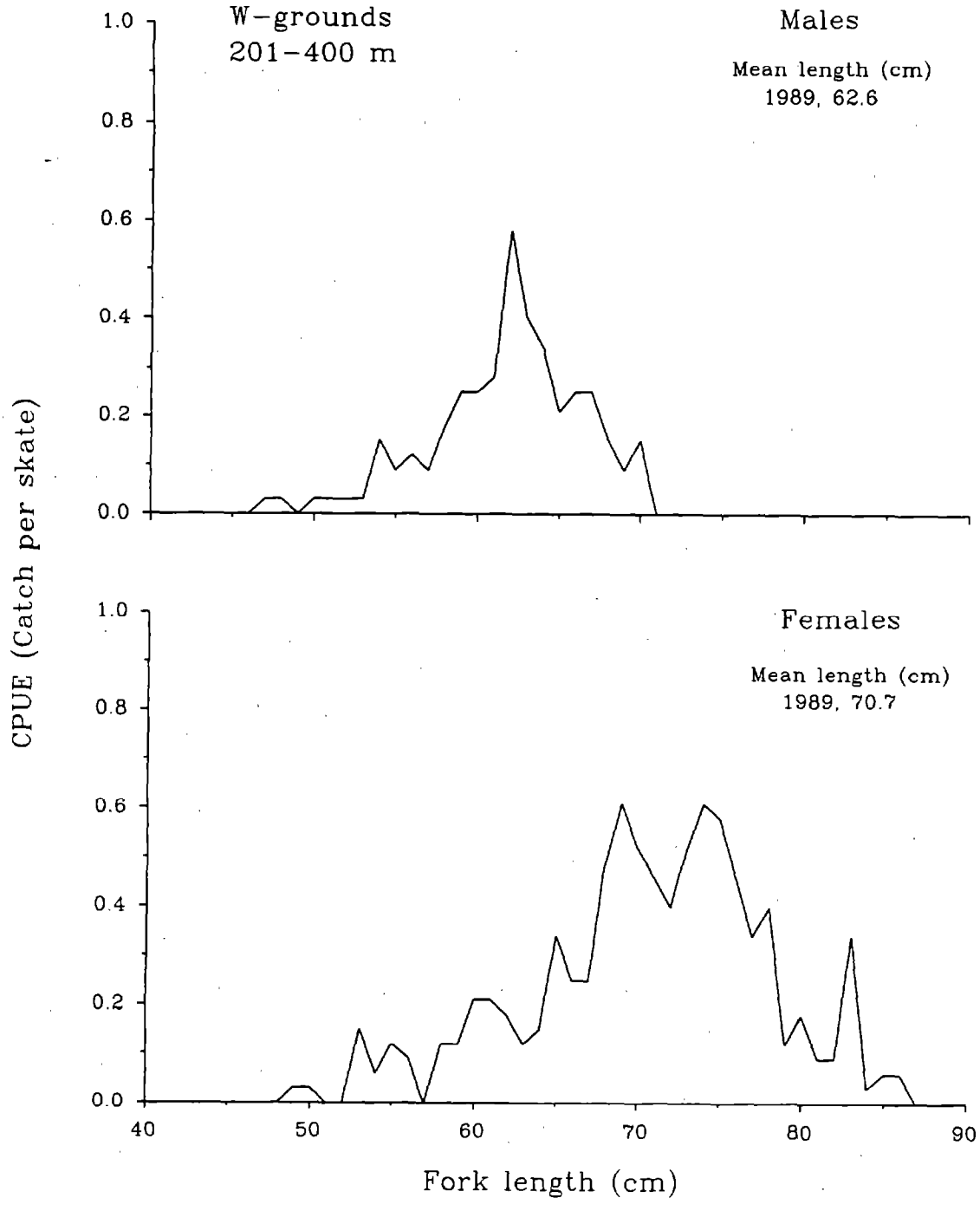


Figure 3i. --Sablefish length frequencies weighted by catch per unit effort (CPUE), by sex, for depths 101-200 m on the W-grounds, sampled during the 1989 National Marine Fisheries Service longline survey of the Gulf of Alaska.

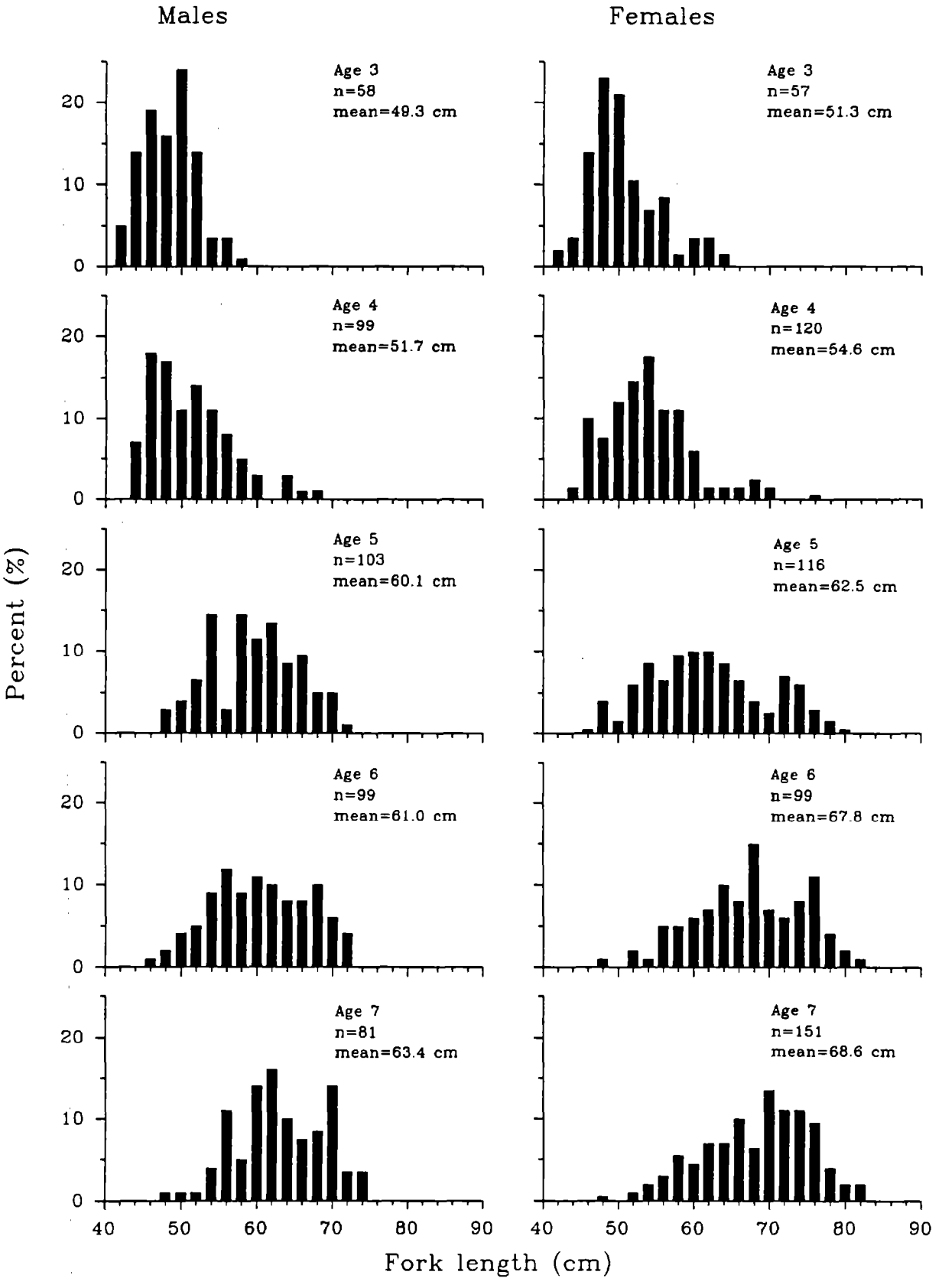


Figure 4.--Length-at-age distribution of sablefish for the upper continental slope of the Gulf of Alaska (201- 1,000 m depth), based on samples collected during the 1984 Japan-U.S. cooperative longline survey. "n" refers to the number of fish aged. (Ages determined by the "break-and-burn" method, a technique that is being reevaluated. Thus changes in the above ages may result. From Clausen and Sigler 1989).

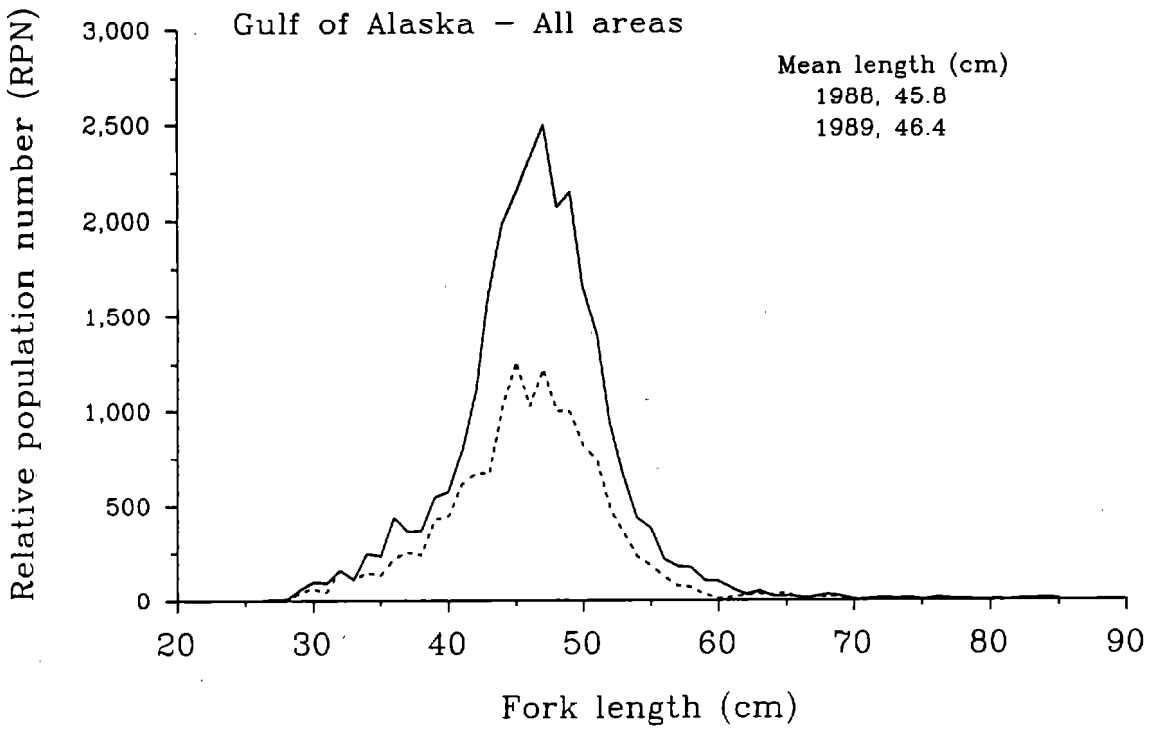


Figure 5.--Rougheye rockfish length frequencies weighted by relative population number, for the combined areas sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-). Note: In 1988, sample included the upper continental slope, Shumagin Gully, Shelikof Trough, Amatuli Gully, and Spencer Gully; in 1989, sample included the above plus W-grounds, Yakutat Valley, Alsek Strath. Ommany Trench, Iphigenia Gully, and Dixon Entrance.

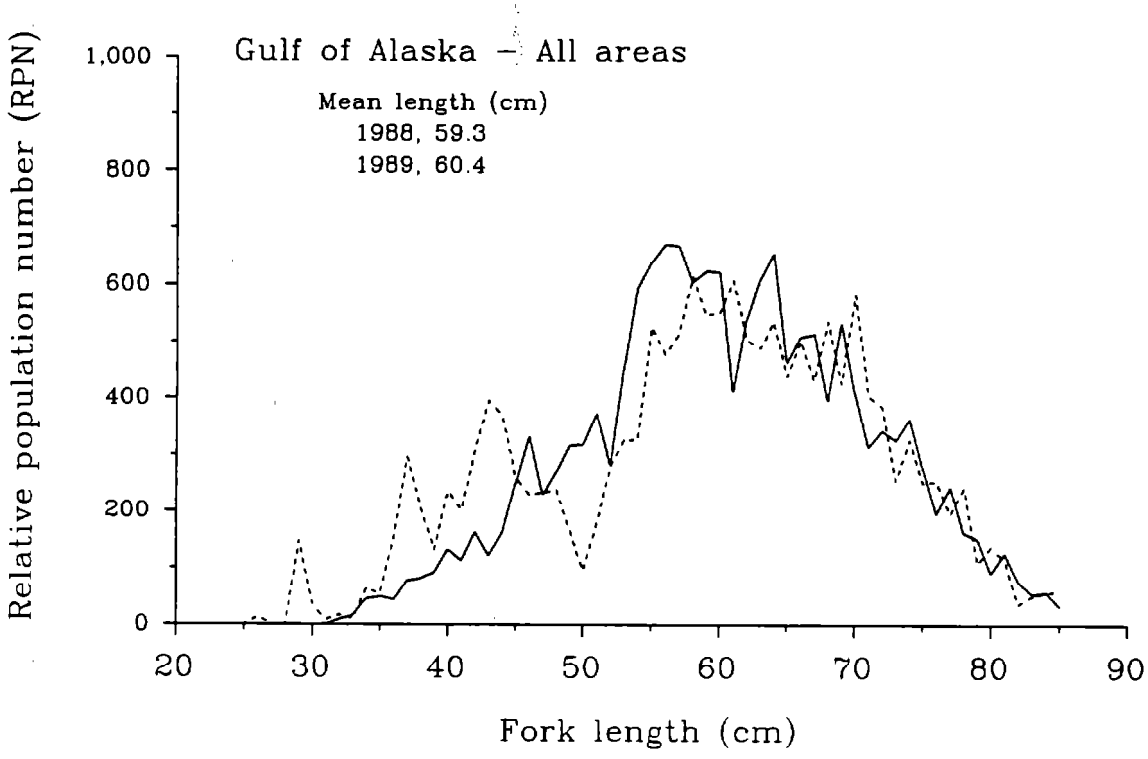


Figure 6a.--Shortraker rockfish length frequencies weighted by relative population number, for the combined areas sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-). Note: In 1988, sample included upper continental slope, Shumagin Gully, Shelikof Trough, Amatuli Gully, and Spencer Gully; in 1989, sample included the above plus W-grounds, Yakutat Valley, Alsek Strath, Ommaney Trench, Iphigenia Gully, and Dixon Entrance.

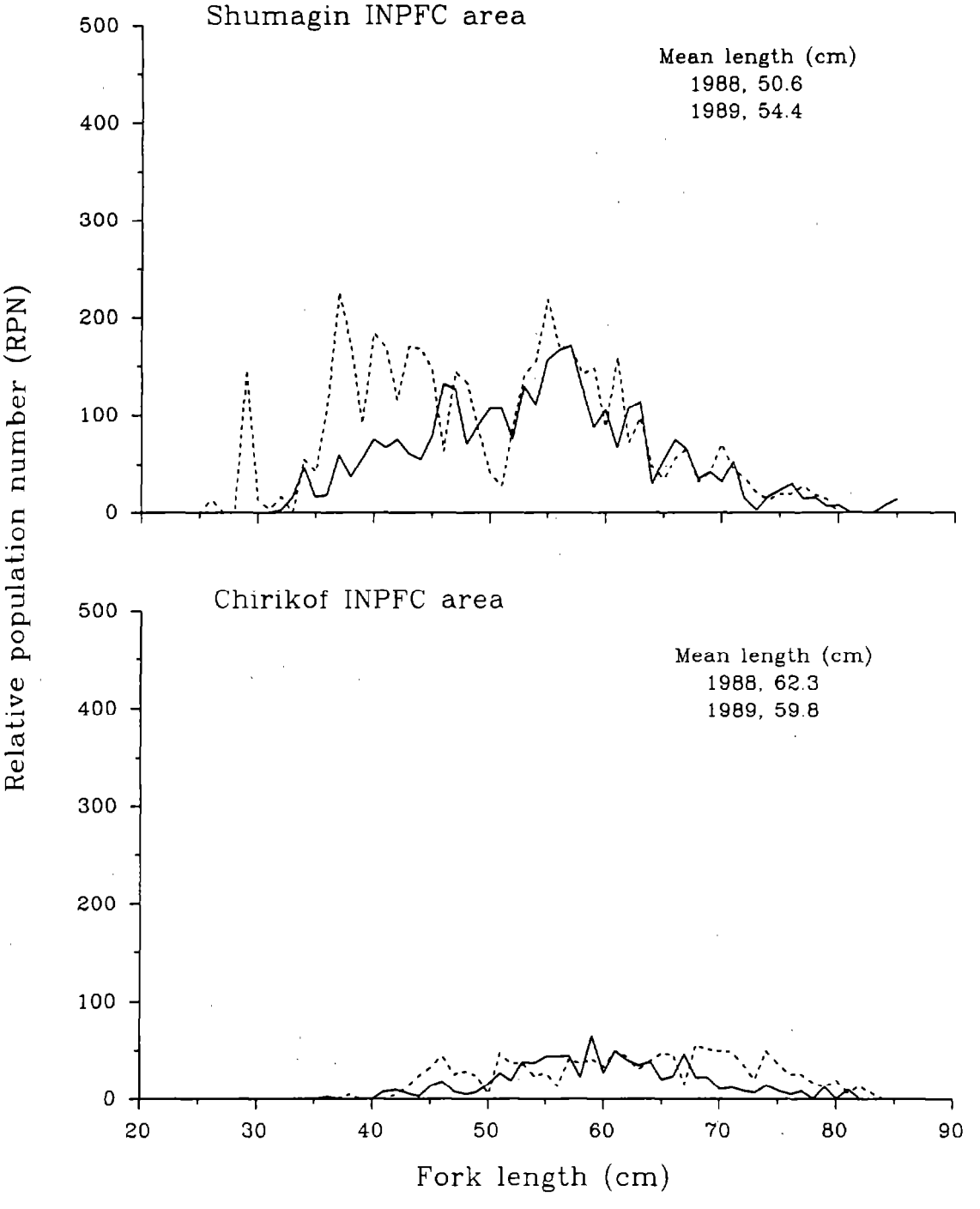


Figure 6b.--Shortraker rockfish length frequencies weighted by relative population number for the International North Pacific Fisheries Commission Shumagin and Chirikof statistical areas, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

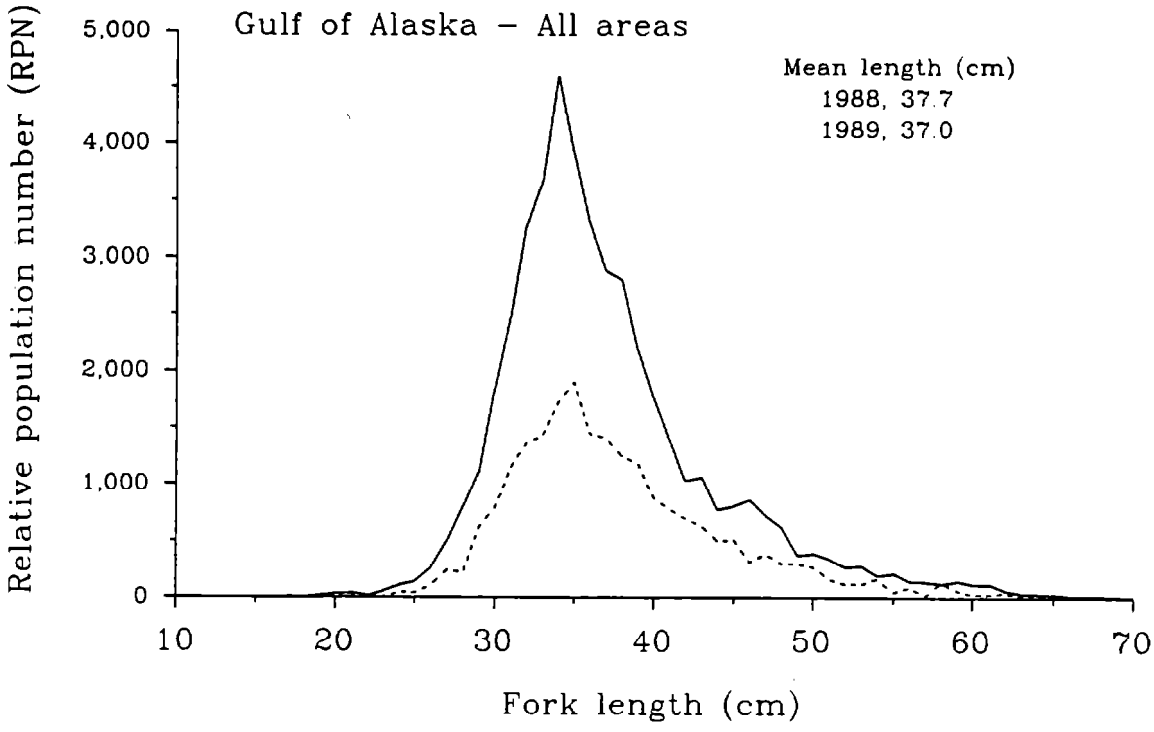


Figure 7.--Thornyhead rockfish length frequencies weighted by relative population number, for the combined areas sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-). Note: In 1988, sample included the upper continental slope, Shumagin Gully, Shelikof Trough, Amatuli Gully, and Spencer Gully; in 1989, sample included the above plus W-grounds, Yakutat Valley Alsek Strath, Ommaney Trench, Iphigenia Gully, and Dixon Entrance.

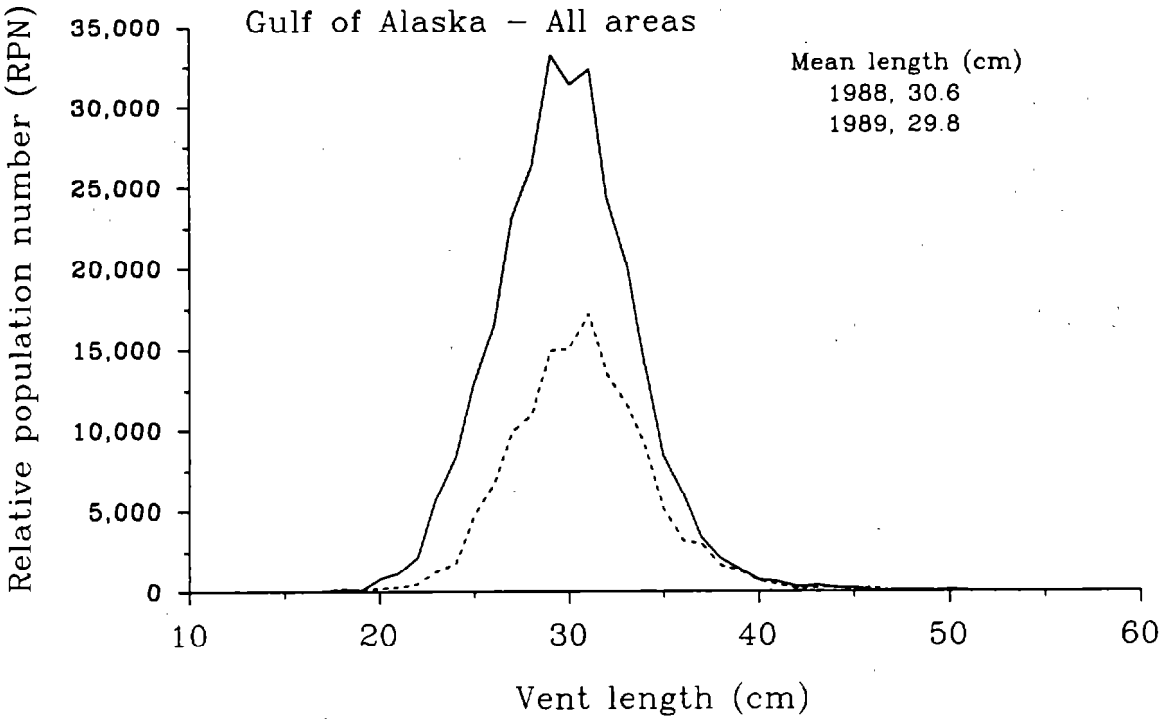


Figure 8.--Giant grenadier length frequencies weighted by relative population number, for the combined areas sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

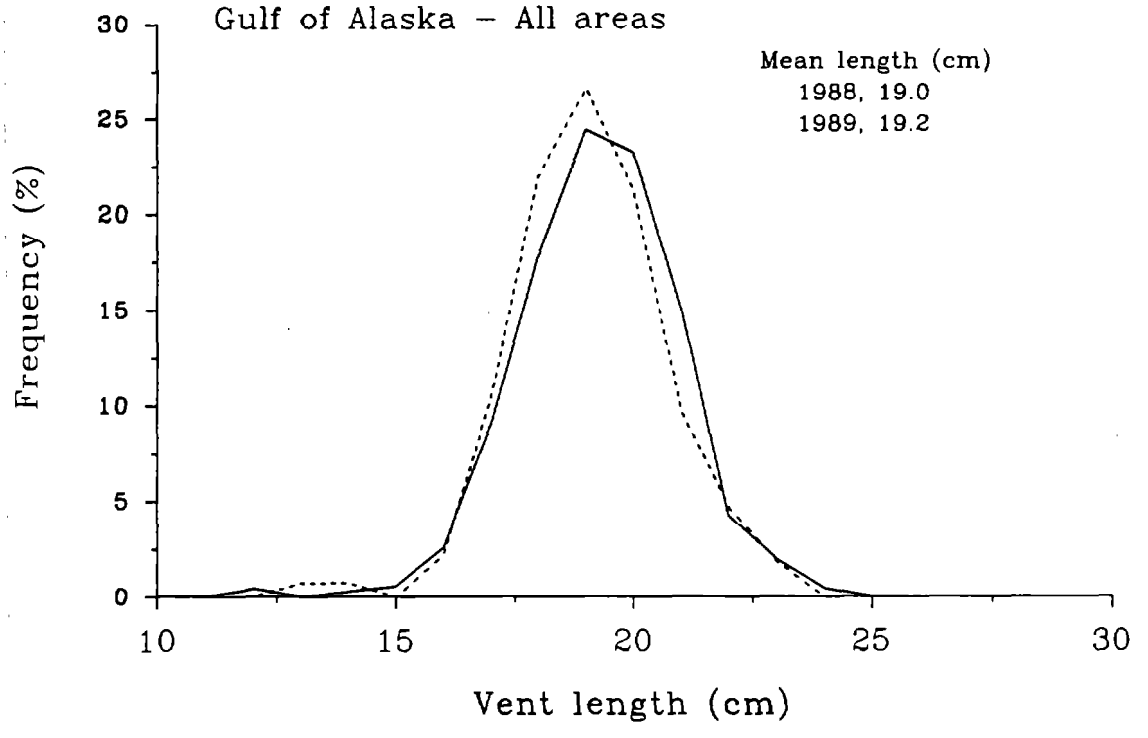


Figure 9.--Popeye grenadier percent length frequencies for the combined areas sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

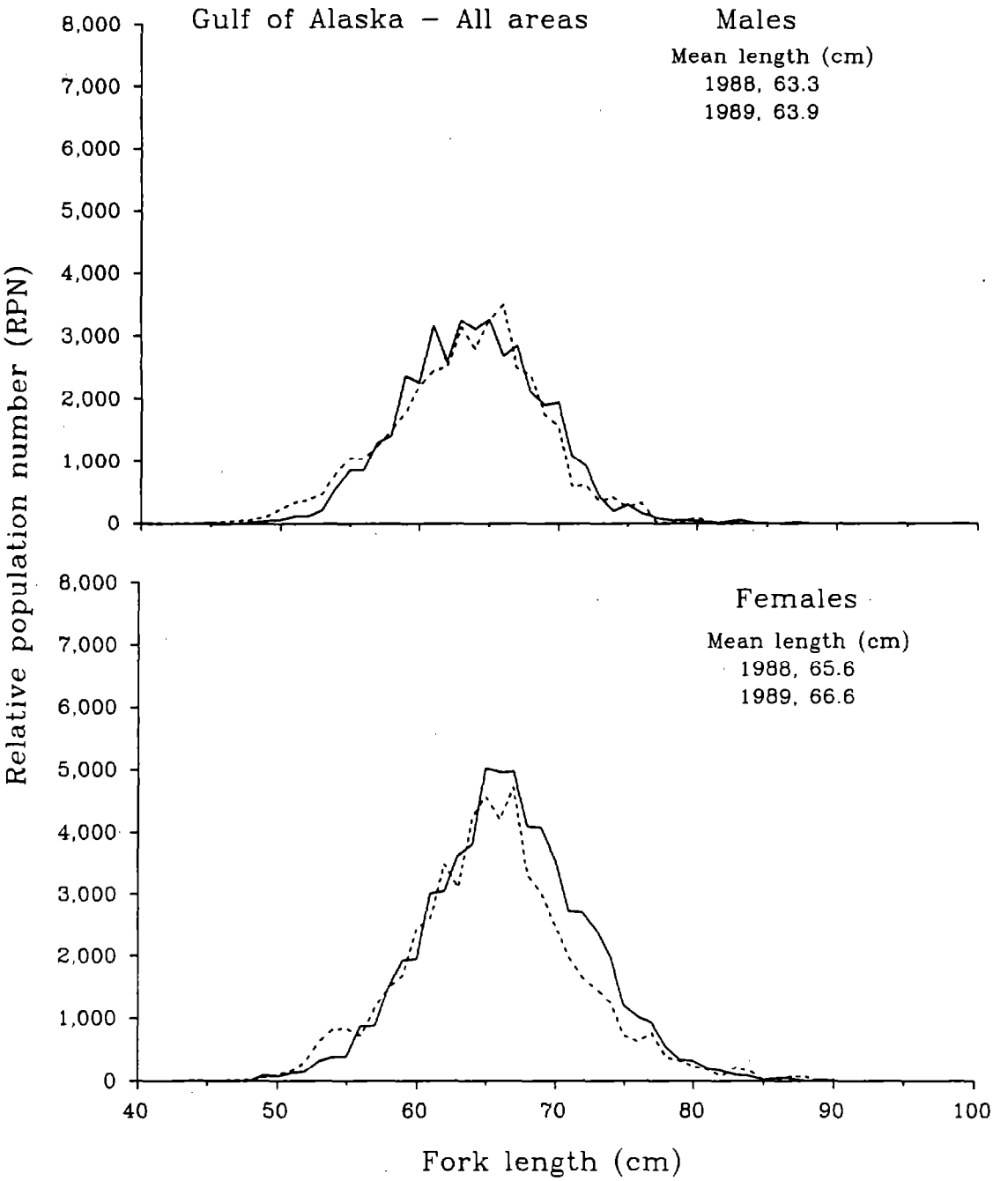


Figure 10a.--Pacific cod length frequencies weighted by relative population number, by sex, for the combined areas sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-). Note: In 1988, sample included the upper continental slope, Shumagin Gully, Shelikof Trough, Amatuli Gully, and Spencer Gully; in 1989, sample included the above plus W-grounds, Yakutat Valley, Alsek Strath, Ommaney Trench, Iphigenia Gully, and Dixon Entrance.

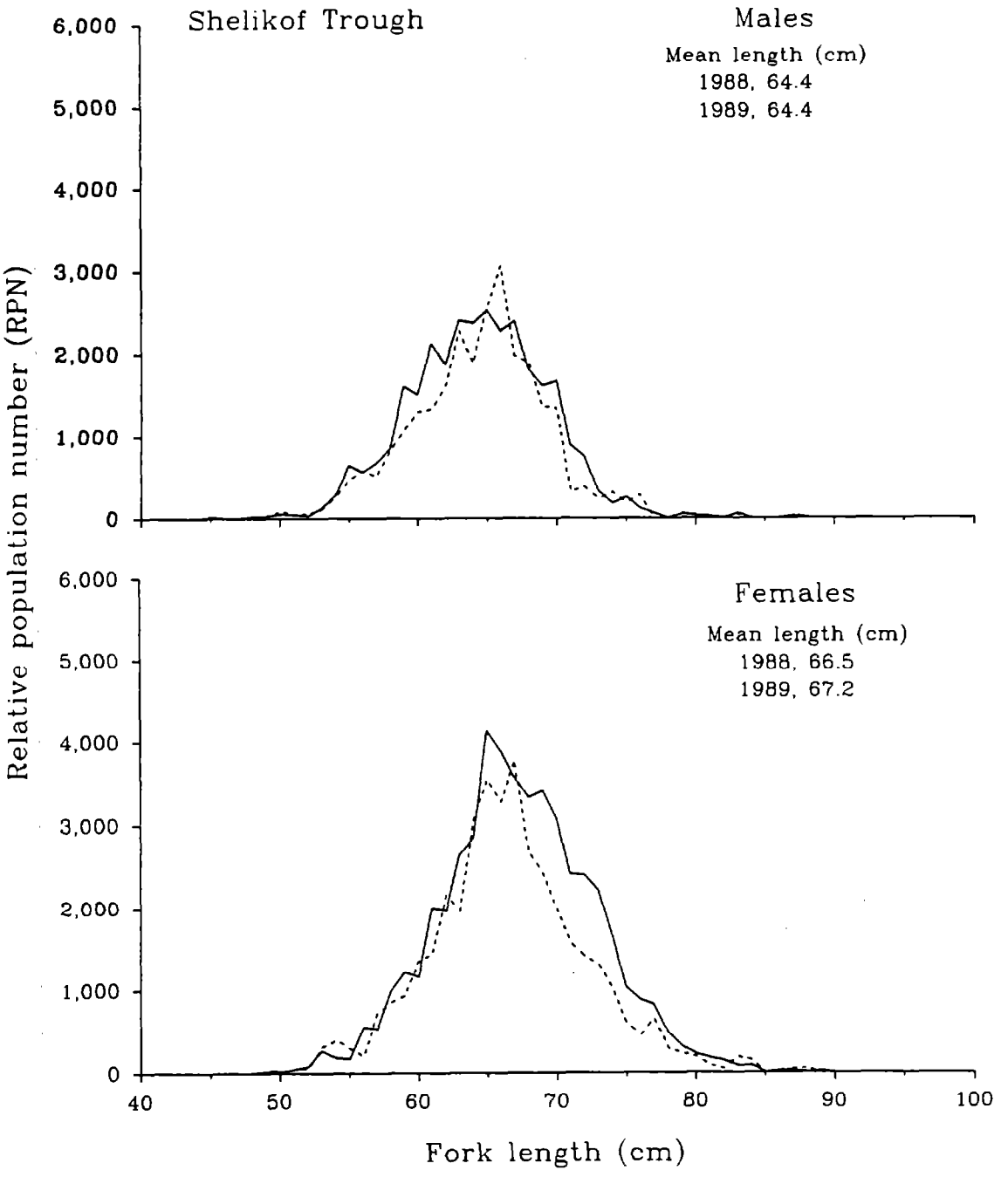


Figure 10b.--Pacific cod length frequencies weighted by relative population number, by sex, for Shelikof Trough, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

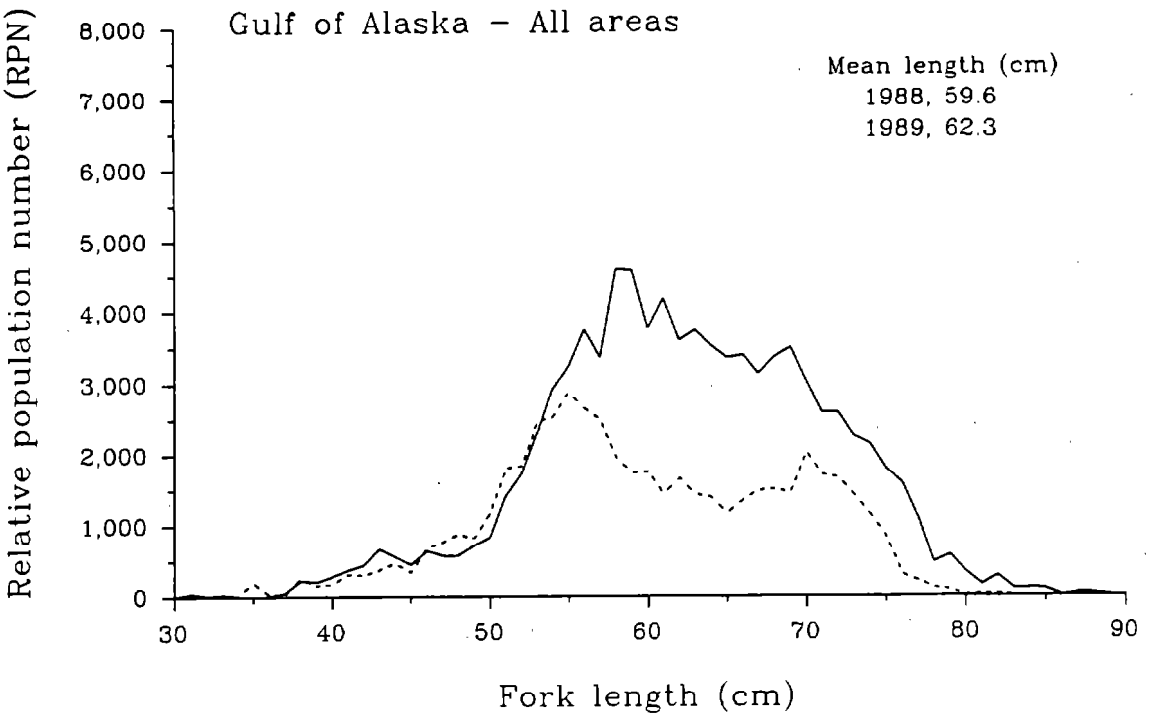


Figure 1 la.--Arrowtooth flounder length frequencies weighted by relative population number, for the combined areas sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-). Note: In 1988. sample included the upper continental slope, Shumagin Gully. Shelikof Trough, Amatuli Gully, and Spencer Gully; in 1989, sample included the above plus W-grounds, Yakutat Valley, Alsek Strath, Ommaney Trench, Iphigenia Gully, and Dixon Entrance.

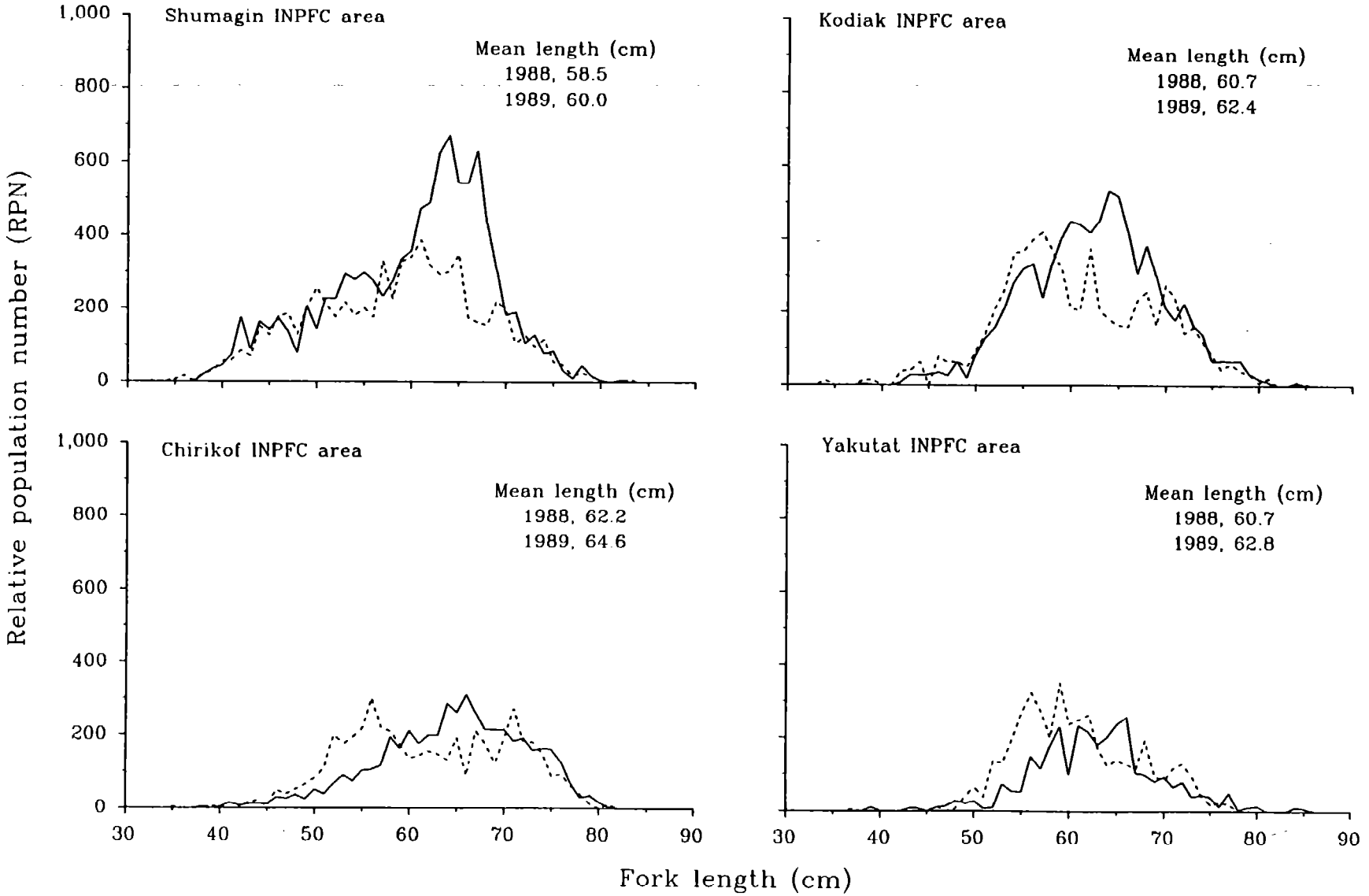


Figure 11 b.--Arrowtooth flounder length frequencies weighted by relative population number for the International North Pacific Fisheries Commission Shumagin, Chirikof, Kodiak, and Yakutat statistical areas, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

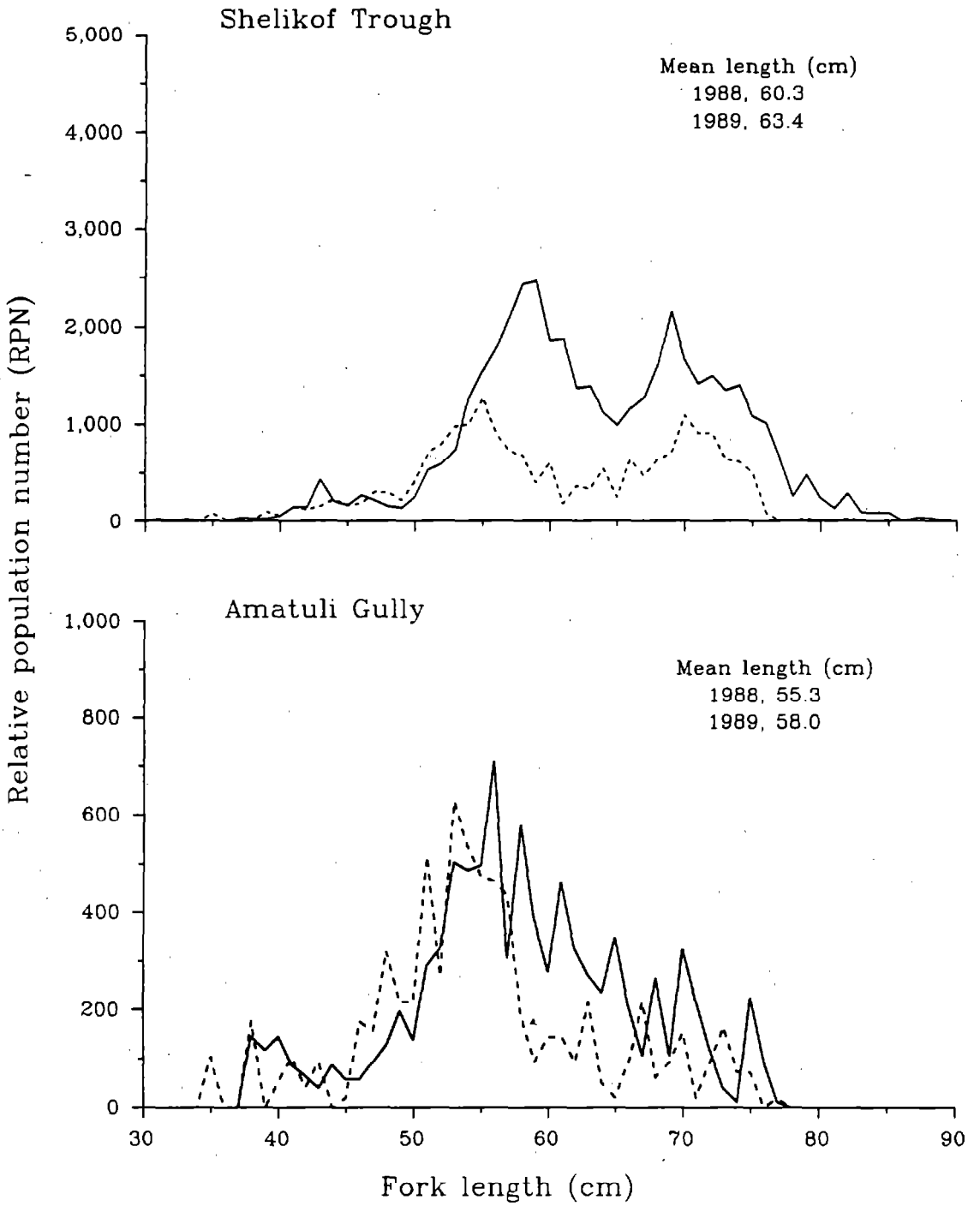


Figure 1lc.--Arrowtooth flounder length frequencies weighted by relative population number for Shelikof Trough and Amatuli Gully, sampled during National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988 (--) and 1989 (-).

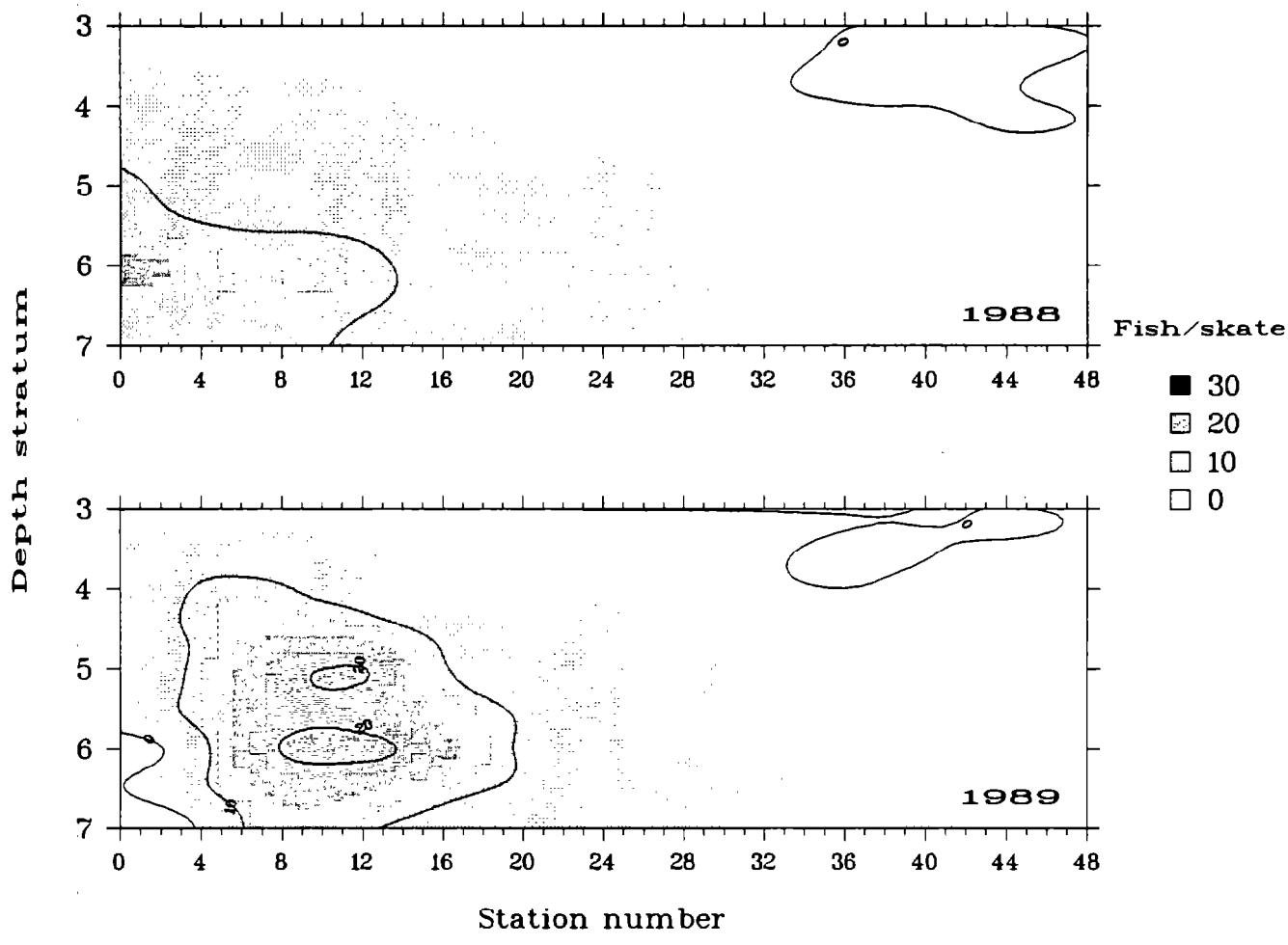


Figure 12.--Distribution of giant grenadier catch per unit effort (fish/skate) from National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988-89, smoothed by distance-weighted least squares with depth stratum and station number. Depth strata: 3 = 201-300 m; 4 = 301-400 m; 5 = 401-600 m; 6 = 601-800 m; and 7 = 801-1,000 m.

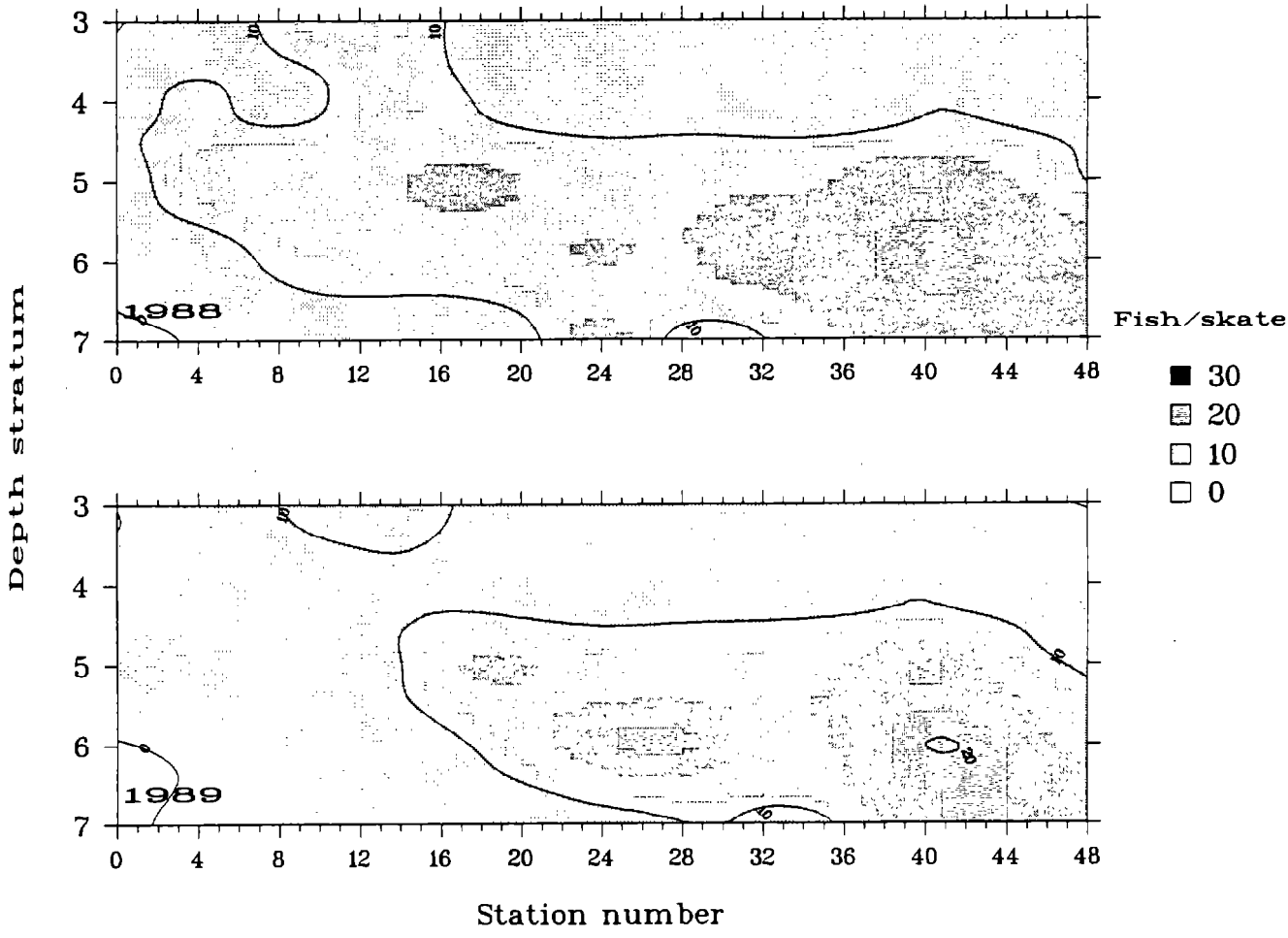


Figure 13.--Distribution of sablefish catch per unit effort (fish/skate) from National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988-89, smoothed by distance-weighted least squares with depth stratum and station number. Depth strata: 3 = 201-300 m; 4 = 301-400 m; 5 = 401-600 m; 6 = 601-800 m; and 7 = 801-1,000 m.

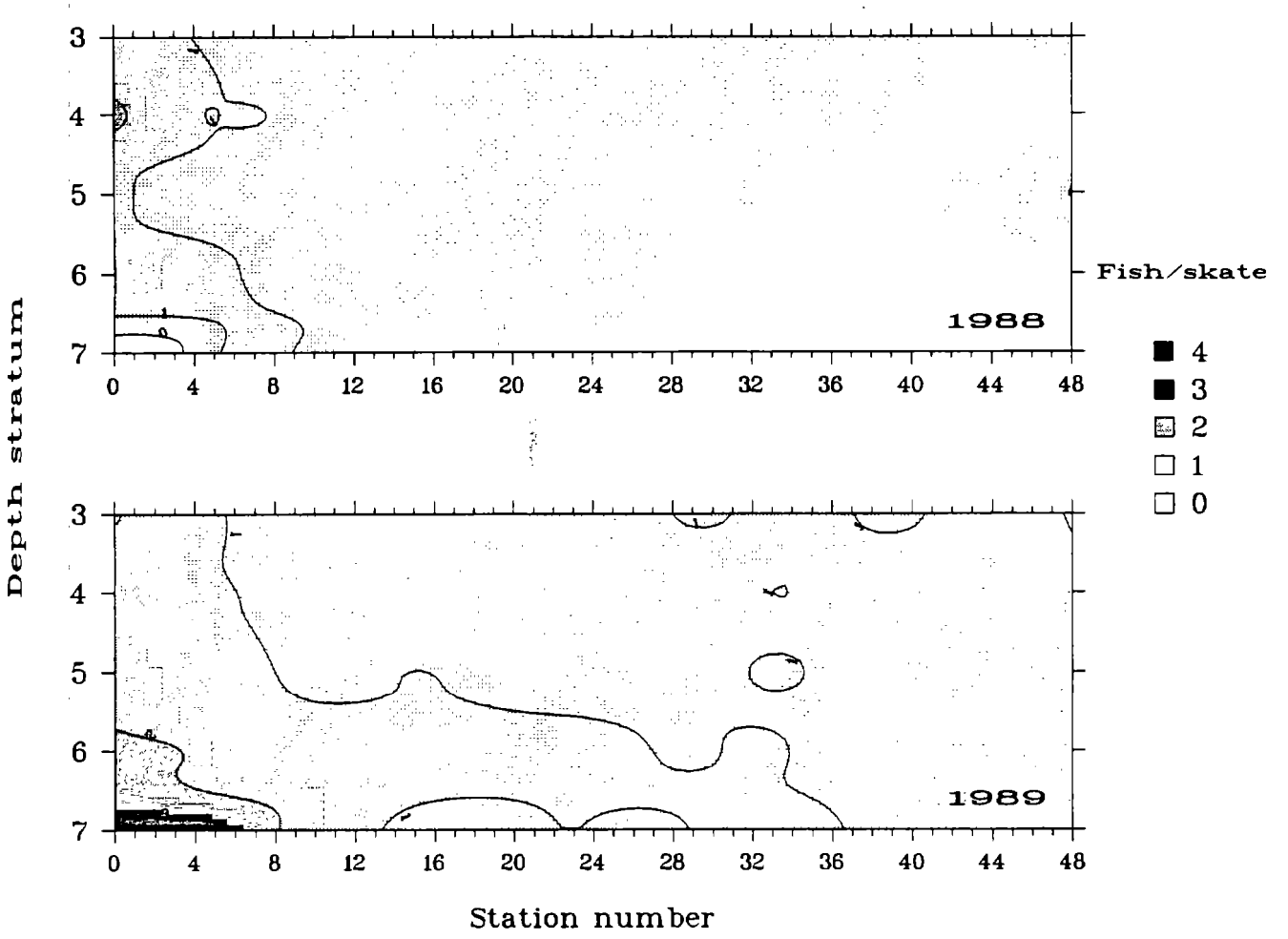


Figure 14.--Distribution of thornyhead catch per unit effort (fish/skate) from National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988-89, smoothed by distance-weighted least squares with depth stratum and station number. Depth strata: 3 = 201-300 m; 4 = 301-400 m; 5 = 401-600 m; 6 = 601-800 m; and 7 = 801-1,000 m.

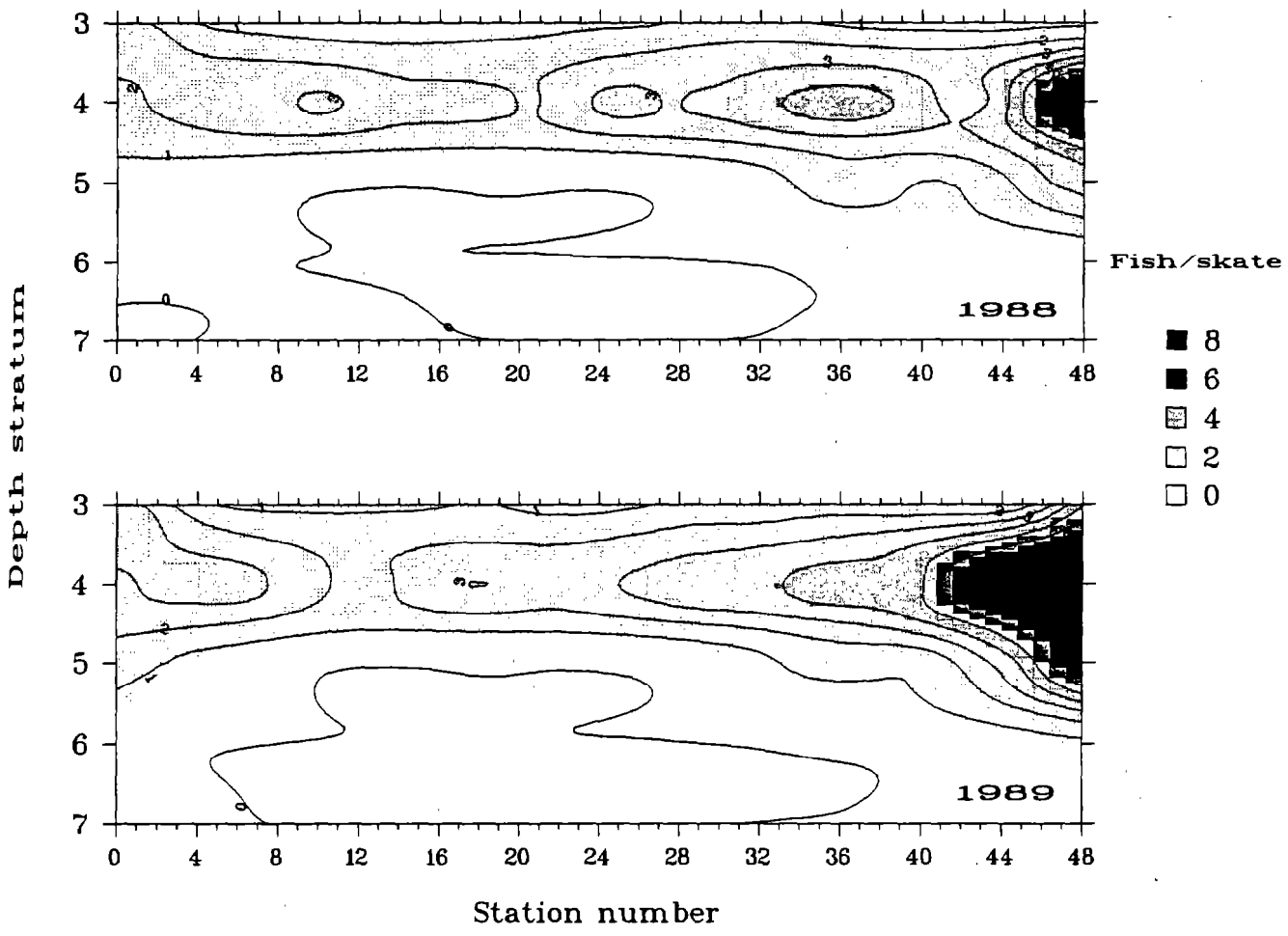


Figure 15.--Distribution of combined shortraker and rougheye rockfish catch per unit effort (fish/skate) from National Marine Fisheries Service longline surveys of the Gulf of Alaska, 1988-89, smoothed by distance-weighted least squares with depth stratum and station number. Depth strata: 3 = 201-300 m; 4 = 301-400 m; 5 = 401-600 m; 6 = 601-800 m; and 7 = 801-1,000 m.

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