

AN ANALYSIS OF RECENT RECRUITMENT TO  
WASHINGTON AND OREGON PACIFIC OCEAN PERCH STOCKS  
AS ASSESSED IN 1990

By

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## INTRODUCTION

A detailed assessment of the Pacific ocean perch (Sebastes alutus) stocks in waters off the Washington and Oregon coast was conducted in 1986 (Ito et al. 1986, 1987). In that assessment, trawl survey information and a variety of analytic models were employed to evaluate the current and future condition of the resource. The results of the assessment indicated that the Pacific ocean perch stocks were at depressed levels of abundance and that stock recovery will likely be a slow process. It is believed, however, that significant rebuilding may occur sooner if one or more strong year classes recruit to the stocks.

From a fishery management standpoint it is valuable to know when such year classes have recruited to the stocks. If detected early enough, fishery managers can begin developing management strategies that take full advantage of these year classes to produce the maximum benefit to the fishery and/or to the resource. For example, one strategy may be to conduct the fishery in such a way as to maximize the yield from the strong recruitment. Another tactic may be to lightly exploit the strong year class(es) with the expectation that the surviving recruits will contribute significantly to the reproductive potential of the stocks in future years. In any case, the identification of incoming strong year classes is valuable information for fishery managers.

Ito (1987) analyzed commercial and research fishery data to detect the presence of incoming strong year classes. His analysis was based on commercial length information collected by Washington Department of Fisheries (WDF) port samplers from 1981 to 1986. The research data employed was based on the National Marine Fisheries Service (NMFS) groundfish trawl surveys conducted in 1979, 1985, and 1986. Since Ito's 1987 assessment, however, new information has become available. More recent commercial length information from the Oregon Department of Fish and Wildlife (ODFW) and preliminary information from the 1989 NMFS triennial groundfish trawl survey is now available. The purpose of the current study is to use these recent data sources to update the previous stock assessments.

## METHODS

The Pacific Fishery Management Council (PFMC), charged with management of offshore fisheries from Washington to California, manages the Pacific ocean perch resource as two discrete stocks, one stock inhabiting the International North Pacific Fisheries Commission (INPFC) Vancouver area and the other stock occupying the Columbia area. Because the PFMC's management authority is restricted to U.S. waters, only data from the U.S. portion of the Vancouver area were analyzed. Analyses of the data were conducted separately for each management area.

The primary goal of this study was to determine whether or not strong year classes have recently entered the west coast Pacific ocean perch populations. To accomplish this objective, length data from the commercial trawl fishery and length and age data from research trawl surveys were analyzed. The commercial fishery data consisted of length samples collected by WDF and ODFW port samplers. The length data were based on random samples from commercial trawlers fishing in the INPFC Vancouver and Columbia areas.

Although WDF has been collecting Pacific ocean perch samples since 1966, only data from 1981 to 1986 were extracted from WDF's database and analyzed. Data collected in 1987 by WDF port samplers were not readily available in time for this report. Since 1988, WDF has ceased collecting sufficient biological information on Pacific ocean perch. Fortunately, commercial length data are available from ODFW port samples through 1989, but these data are only available for the INPFC Columbia area. Age data determined by the currently accepted "break-and-burn" age determination technique were not available for all years in which length data were collected.

The research data used in this study were derived from four trawl surveys completed during 1979, 1985, 1986 and 1989. The four surveys were conducted primarily by the Alaska Fisheries Science Center (AFSC) of the National Marine Fisheries Service (NMFS). The 1979 and 1985 surveys were designed to specifically assess the distribution, abundance, and biological features of the west coast Pacific ocean perch resource (Wilkins and Golden 1983; Wilkins and Weinberg 1987). The 1986 and 1989 surveys, however, were a general groundfish survey that did not target specifically on Pacific ocean perch.

Length data were collected during all four surveys, with age structures (otoliths) collected during the 1979 and 1985 surveys. The 1979 otolith samples were read according to the surface aging technique of Westrheim (1973) which is now known to underestimate the age of older fish. Otolith samples from the 1985 survey were aged according to the currently accepted "break-and-burn" aging technique (Chilton and Beamish 1982; Beamish 1979a, b). This relatively new aging technique apparently provides more accurate age and growth information, especially in older fish. Stanley (1987) showed that the two aging methods give comparable ages up to about age 14-15. Therefore, only data through age 15 years were used in the comparisons. All age structures were read by the AFSC Age and Growth unit.

To determine the presence or absence of strong year classes, the length and age data were summarized by pooling the sexes and then generating length and age frequency distributions for each management area. The resulting distributions were then examined.

## RESULTS AND DISCUSSION

### Commercial Fishery Data

Since 1981, the average size of Pacific ocean perch in the commercial catch has varied by less than 4.4 cm in both the INPFC U.S.-Vancouver or Columbia areas (Table 1). Mean length, sexes combined, has ranged from 38.7 to 39.8 cm in the U.S.-Vancouver area and from 37.0 to 41.4 cm in the Columbia area. The commercial trawl fishery apparently captures a wide range of sizes, from 25 to 53 cm (Figures 1-3). However, the bulk of the catch is generally comprised of individuals between 35 and 45 cm. Fish less than 30 cm are generally not suitable for market use.

The length frequency distributions from the commercial catch were typically unimodal in shape, with modes between 38 and 41 cm (Figures 1-3). Based on these distributions, there does not appear to be significantly strong

year classes entering the commercial fishery in either of the two INPFC areas. The last dominant year class to enter the fishery was the 1970 cohort. This year class showed up as a dominant 32-33 cm mode in the length frequency distribution of the 1977 commercial landings (Golden et al. 1980). If a dominant year class were to have entered the current fishery, one would expect a shift to a lower average size and perhaps a pronounced, bimodal length frequency distribution. No evidence of this was found from analyses of the WDF or ODFW commercial fishery length data.

#### Research Trawl Surveys

Research trawl surveys provide a valuable source of recruitment information. These surveys generally capture smaller and younger Pacific ocean perch than do the commercial fleet and, therefore, are probably the best source of data for detecting incoming strong year classes. Data from four trawl surveys were examined: length and age data from the 1985 Pacific ocean perch survey; age data from the 1979 Pacific ocean perch survey; and length data from the 1986 and 1989 triennial groundfish trawl surveys.

#### Length and Age Data -- 1985 Pacific Ocean Perch Survey

The 1985 trawl survey sampled a greater percentage of smaller sized fish than those observed in the 1985 commercial landings (Figures 4 and 5; subpanels A and B). Fish sampled during this survey ranged in length from 15 to 51 cm, with fish less than 30 cm accounting for about 26% of the total length distribution in the U.S.-Vancouver area and about 11% in the Columbia area. Based on the 1981-86 WDF length data from the commercial fishery, however, fish less than 30 cm never comprised more than 1.5% of the landed catch. Mean length of Pacific ocean perch from survey catches, sexes combined, was 35.0 cm for the U.S. Vancouver area and 36.5 cm for the Columbia area. Average length from the commercial landings was 4.5 and 2.5 cm greater, respectively.

The survey length frequency distributions from both the U.S.-Vancouver and Columbia areas were bimodal (Figures 4 and 5; subpanel B). The first mode in the U.S.-Vancouver length data occurred at 25 cm which preceded a major mode at 38-40 cm. In the Columbia area, bimodality was much more distinct. The incoming mode in this case occurred at 30 cm, with the larger mode occurring at 37-38 cm. The bimodal distribution in both areas is an encouraging sign because it indicates that recruitment may be improving.

Age structures were collected during the 1985 survey and were read by the now accepted "break-and-burn" aging technique. The ages from the 1985 survey ranged from 2 to 71 years in the U.S.-Vancouver area and from 3 to 76 years in the Columbia area; only ages through 60 years were included in the age composition histograms (Figures 4 and 5; subpanel C). In the U.S.-Vancouver area, the 1979-81 year classes (4-6 year olds) were the three most abundant year classes in the population during 1985. In the Columbia area, the 1979 and 1980 year classes contributed strongly to the 1985 population as did the 1970-75 year classes (10-15 years old).

Based on the percentage of 2-4 year olds in the 1985 population, recent recruitment appears to have been stronger in the U.S.-Vancouver area than in the Columbia area. The 2-4 year olds in the U.S.-Vancouver area comprised

over 15% of the total population; whereas, the same age groups in the Columbia area accounted for just under 1.5%. The abundance of these three age groups evidently resulted in the 25 cm mode observed in the U.S.-Vancouver length frequency distribution (Figure 4; subpanel B and C). A mode at this short length was absent in the Columbia area length data (Figure 5; subpanel B). The distinct mode that did occur at 30 cm in the Columbia area was probably comprised mainly of 5-8 year olds.

#### Age Comparisons -- 1979 and 1985 Pacific Ocean Perch Surveys

The analysis of recruitment up to this point was based solely on examining length and age groups expressed as percentages of the total sample or population. Although this provides a descriptive means of noting relative differences within distributions, it does not adequately describe interannual changes in absolute abundance. For example, if two age samples collected in different years, show that 5 year old fish comprise 25% of the total population, one could infer that recruitment was good in both years. However, this may not be the case in terms of absolute numbers. The stock abundance in one year may be considerably higher or lower than in another year. For this reason the 1985 age data were compared, in terms of absolute numbers, with age data collected during the 1979 Pacific ocean perch survey (Table 2; Wilkins, personal comm., AFSC, Seattle).

Changes in recruitment were analyzed by comparing the absolute abundance of pre-recruits (i.e., those ages less than the age at full recruitment) in 1979 with those in 1985. Generally, Pacific ocean perch begin entering the commercial trawl fishery as 5 or 6 year olds and are fully recruited anywhere from age 11 to 14 (Gunderson 1977). The age of recruitment has varied with time and is related to a variety of factors such as growth, fishing mortality, year-class strength, and year to year variations in availability. For purposes of this study it was assumed that recruitment was "knife-edged" at age 11. The total number of pre-recruits was estimated as the sum of the individuals in each age group from ages 2 through 10.

The estimated number of pre-recruits in the 1979 population totaled 2,410,200 fish in the U.S.-Vancouver area and 7,750,900 in the Columbia area. The 1985 survey results, however, showed a sizeable decline in the total number of pre-recruits six years later. In 1985, the abundance of these recruits accounted for 1,228,800 and 2,602,600 individuals in the U.S.-Vancouver and Columbia areas, respectively. These numbers represented a decline in the number of pre-recruits of about 49.0% in the U.S.-Vancouver area and 66.4% in the Columbia area during the period from 1979 through 1985. It should be noted, however, that the pre-recruits in the 1979 population contained the strong 1970 year class. No year classes rivalling the magnitude of the 1970 year class have been detected to date.

#### Length Data -- 1986 and 1989 Triennial Groundfish Survey

The most recent source of information for examining year class strength was the length data collected during the 1986 and 1989 triennial groundfish surveys. Unfortunately, Pacific ocean perch otoliths were not collected during the 1986 survey and those that were collected in the 1989 survey have yet to be read. Unlike the 1979 and 1985 surveys, which targeted specifically on Pacific ocean perch, the 1986 and 1989 surveys were general groundfish

surveys. It should be further noted that the 1986 and 1989 surveys took place in August-September, whereas the 1979 and 1985 surveys were conducted in March-May. Pacific ocean perch exhibit pronounced seasonal migrations that may result in quite different distributions during these two periods. For this reason, only length data from the 1986 and 1989 surveys were compared and no direct comparisons were attempted between the triennial surveys and the 1979 and 1985 Pacific ocean perch surveys.

The mean lengths of Pacific ocean perch in the 1986 survey were 35.6 and 31.5 cm for the U.S.-Vancouver and Columbia areas, respectively. These compare with the 1989 survey results of 33.6 cm for the U.S.-Vancouver area and 31.9 cm for the Columbia area. At first glance, the reduction in average length in the U.S.-Vancouver area from 35.6 cm in 1986 to 33.6 cm in 1989 indicates increased recruitment. A closer look at the data, however, suggests otherwise. In terms of percent frequency by length, there appeared to be no significant differences in the length frequency distributions up to about 31 cm in the U.S.-Vancouver area (Figure 6, top panel). Recall that Pacific ocean perch generally do not enter the commercial fishery until sizes of 30 cm or greater (Figures 1-3). If recruitment were to have significantly improved over the 1986 survey, one would expect a shift to smaller sizes in the 1989 length frequency distribution for fish less than 30 cm. This did not occur.

The reason for the two cm decrease in average size in the U.S.-Vancouver area may have been due to the fishery culling the larger sized individuals from the population. For fish larger than 31 cm, the 1989 length frequency distribution shifted more towards the smaller sizes (Figure 6, top panel), leading to the observed reduction in average length. Such pronounced shifts in the length frequency distribution did not occur in the Columbia area (Figure 6, bottom panel). In fact, the length frequency distributions look almost identical from one survey year to the next, with the average length estimated at 31.5 cm in 1986 and 31.9 cm in 1989.

Up to this point, the analysis of recruitment from the 1986 and 1989 surveys was based on length distributions expressed in terms of percentages of the total population. While this approach provides a descriptive means of noting relative differences between distributions, it does not adequately describe interannual changes in absolute abundance. For this reason, the length distributions from the 1986 and 1989 surveys were recast in terms of absolute numbers (Figure 7).

The total number of individuals in the U.S.-Vancouver area was estimated at about 1,555,000 individuals in 1986. And for the Columbia area, the estimate came in at about 2,752,000 individuals. Three years later the total abundance in both areas increased. The Columbia area showed a slight increase from 2,752,000 fish in 1986 to about 3,089,000 individuals in 1989. However, the greatest increase in abundance occurred in the U.S.-Vancouver area. Total abundance in this area jumped to over 19,723,000 fish in 1989 from an estimated abundance of 1,555,000 individuals in 1986, an increase of over 18,168,000 fish (a 12.7 fold increase) in just three years. An examination of the length frequency distribution associated with this increase (Figure 7, top panel), shows substantial increases in abundance for almost all size categories. Obviously, such an increase is unrealistic and highlights the difficulties with using trawl surveys to estimate changes in absolute abundance of rockfish populations.

## CONCLUSIONS AND RECOMMENDATIONS

The primary goal of this study was to determine whether strong year classes have recently entered the west coast Pacific ocean perch stocks. Length data from the commercial trawl fishery and length and age data from research trawl surveys were analyzed in an attempt to accomplish this objective. Analysis of the commercial fishery length data did not indicate any significantly strong year classes entering the fishery in either of the two INPFC areas. The research surveys, which generally capture smaller and younger fish did indicate some evidence of incoming strong year classes. Although these data did not demonstrate any year classes rivalling the magnitude of the 1970 cohort, they did indicate that recruitment has not failed and may have stabilized. In light of the Pacific Fishery Management Council's goal of rebuilding the Pacific ocean perch stocks, this is encouraging. It suggests that the Council's current management practices of restricting harvests are appropriate and that continued restrictive management is warranted.



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Table 1. Mean lengths of Pacific ocean perch from samples of commercial trawl landings collected by Washington Department of Fisheries (WDF) and Oregon Department of Fisheries and Wildlife (ODFW) port samplers.

Year	U.S.-Vancouver <sup>1</sup>			Columbia <sup>1</sup>		
	Sample Size	Mean Length (cm)	S.D.	Sample Size	Mean Length (cm)	S.D.
				W D F		
1981	1,185	39.5	3.6	699	40.1	3.8
1982	1,299	39.4	3.2	500	40.6	3.0
1983	1,300	39.8	3.5	300	39.8	2.9
1984	1,400	38.8	3.0	500	39.0	3.1
1985	1,200	39.5	3.6	899	39.0	3.3
1986	900	38.7	4.1	800	41.4	2.8
				O D F W		
1984				1,203	37.0	2.9
1985				1,410	38.7	3.8
1986				1,304	38.8	3.1
1987	N O D A T A			1,905	38.1	3.1
1988				352	39.6	4.0
1989				798	38.1	3.0

<sup>1</sup>International North Pacific Fisheries Commission (INPFC) areas

Table 2. Abundance (in thousands of individuals) by age group (2-15 year olds) as estimated by the 1979 and 1985 Pacific ocean perch surveys. Numbers in parenthesis denote the year class.

Age	U.S.-Vancouver <sup>1</sup>		Columbia <sup>1</sup>	
	1979 survey	1985 survey	1979 survey	1985 survey
2	0.2 (77)	21.2 (83)	2.3 (77)	--
3	7.5 (76)	111.8 (82)	5.8 (76)	10.6 (82)
4	101.3 (75)	258.1 (81)	127.0 (75)	74.2 (81)
5	200.6 (74)	192.4 (80)	466.4 (74)	538.8 (80)
6	139.4 (73)	250.5 (79)	512.9 (73)	766.7 (79)
7	178.3 (72)	123.2 (78)	691.9 (72)	295.4 (78)
8	411.8 (71)	103.0 (77)	1,929.4 (71)	187.2 (77)
9	812.2 (70)	76.2 (76)	2,910.2 (70)	218.3 (76)
10	558.9 (69)	92.4 (75)	1,105.0 (69)	511.4 (75)
11	543.7 (68)	50.2 (74)	604.7 (68)	473.4 (74)
12	618.7 (67)	36.7 (73)	550.5 (67)	264.5 (73)
13	482.3 (66)	45.8 (72)	522.7 (66)	359.3 (72)
14	603.0 (65)	71.2 (71)	477.8 (65)	482.0 (71)
15	470.5 (64)	49.0 (70)	463.2 (64)	505.2 (70)
Total	5,128.4	1,481.7	10,369.8	4,687.0

<sup>1</sup>International North Pacific Fisheries Commission (INPFC) areas

INPFC U.S.-Vancouver

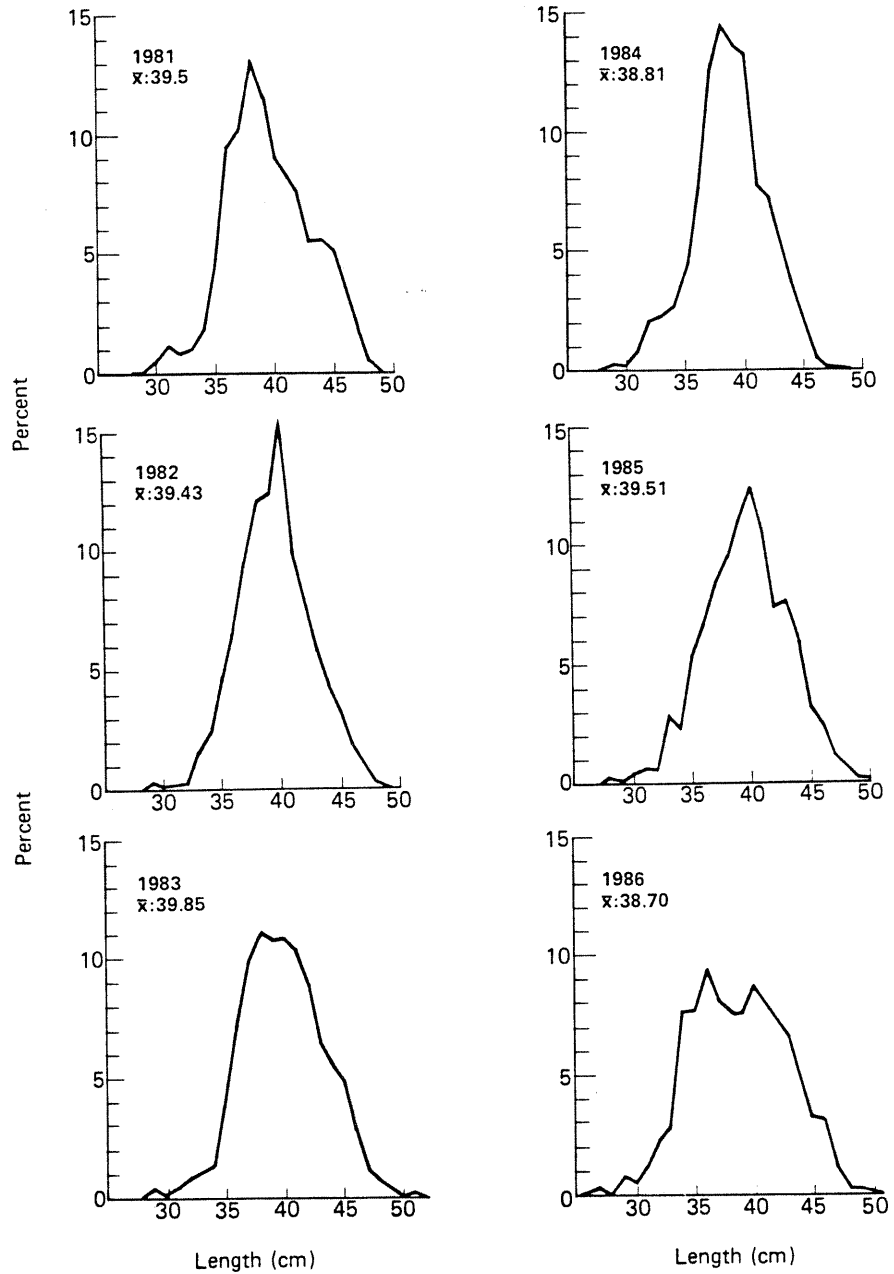


Figure 1.--Size composition of trawl caught Pacific ocean perch in the INPFC U.S.-Vancouver area as shown by data collected by Washington Department of Fisheries port samplers from 1981 to 1986.

INPFC COLUMBIA

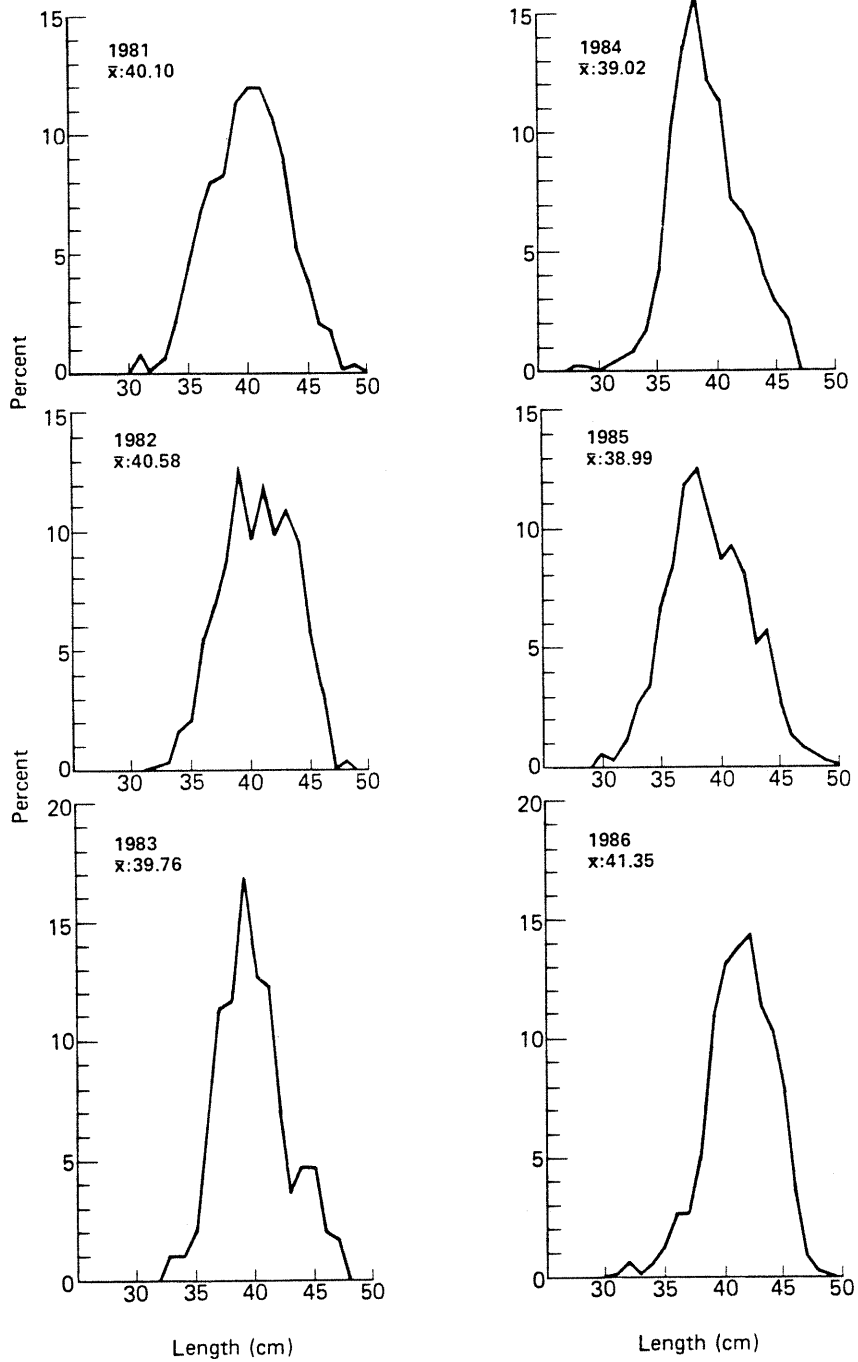


Figure 2.--Size composition of trawl caught Pacific ocean perch in the INPFC Columbia area as shown by data collected by Washington Department of Fisheries port samplers from 1981 to 1986.

# INPFC Columbia

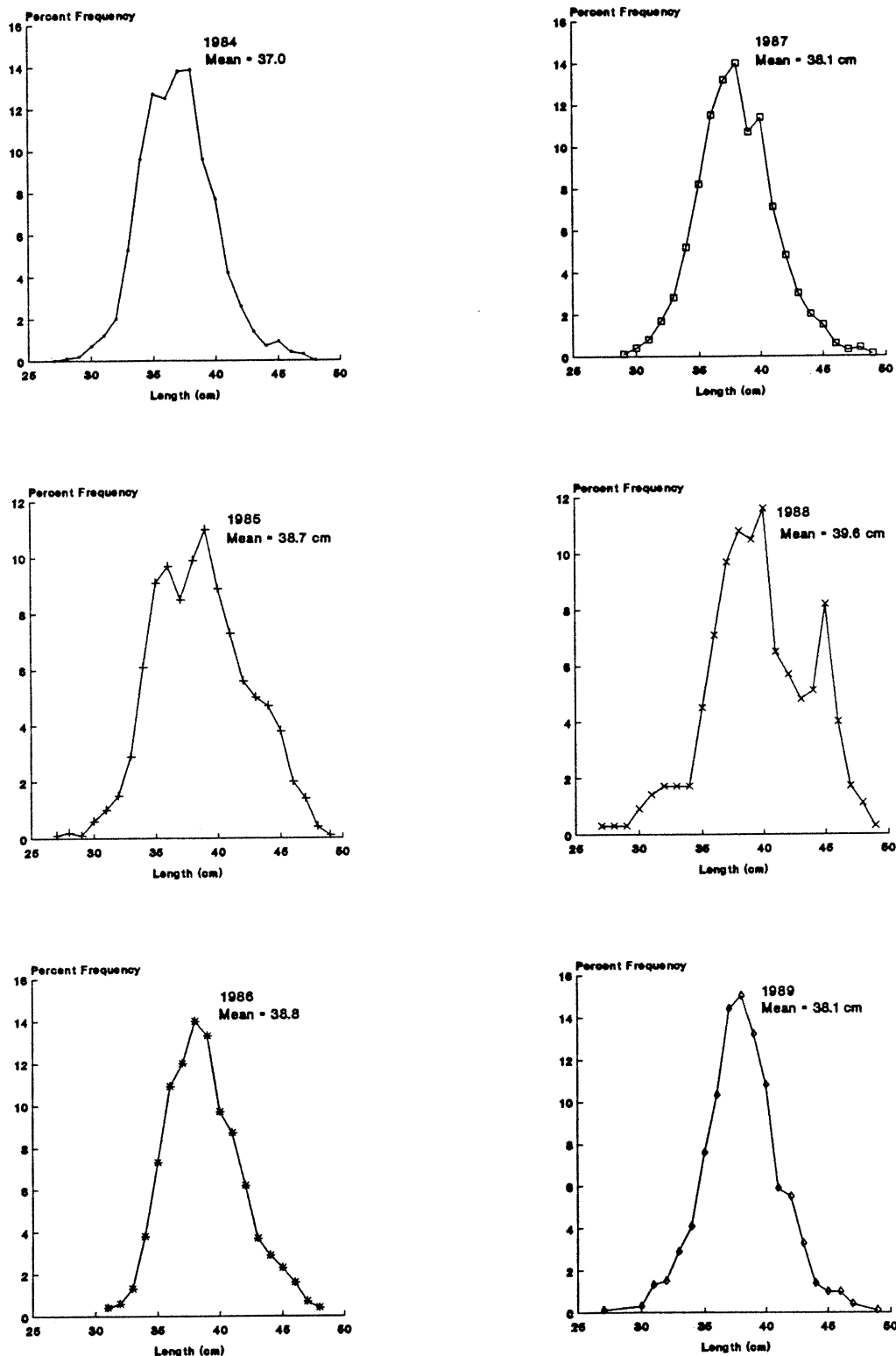


Figure 3.--Size composition of trawl caught Pacific ocean perch in the INPFC Columbia area as shown by data collected by Oregon Department of Fish and Wildlife port samplers from 1984 to 1989.

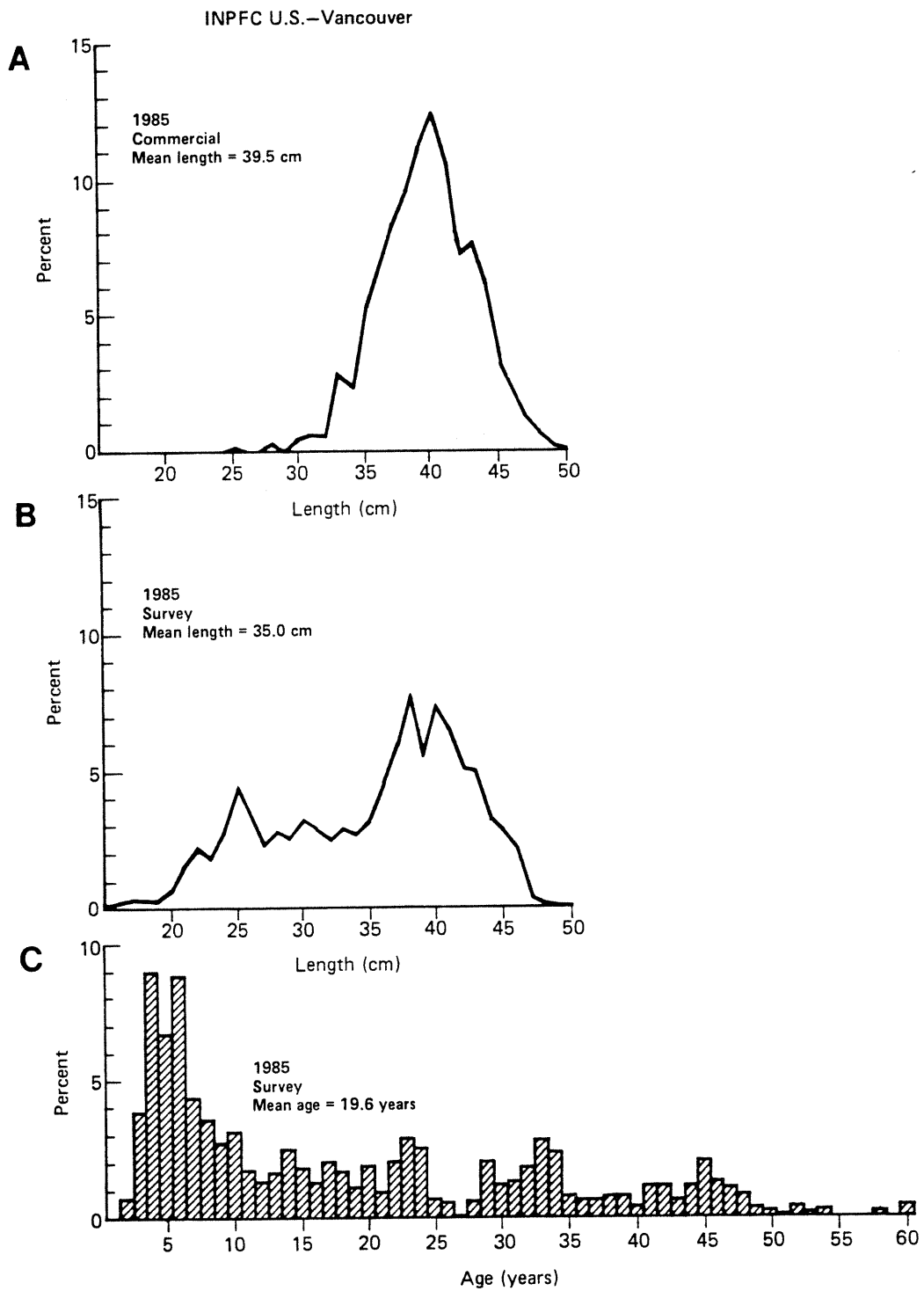


Figure 4.--Size and age composition of Pacific ocean perch in the in the INPFC U.S.-Vancouver area in 1985. Subpanel A: size composition from the commercial fishery. Subpanel B: size composition from the Pacific ocean perch survey. Subpanel C: age composition from the Pacific ocean perch survey.

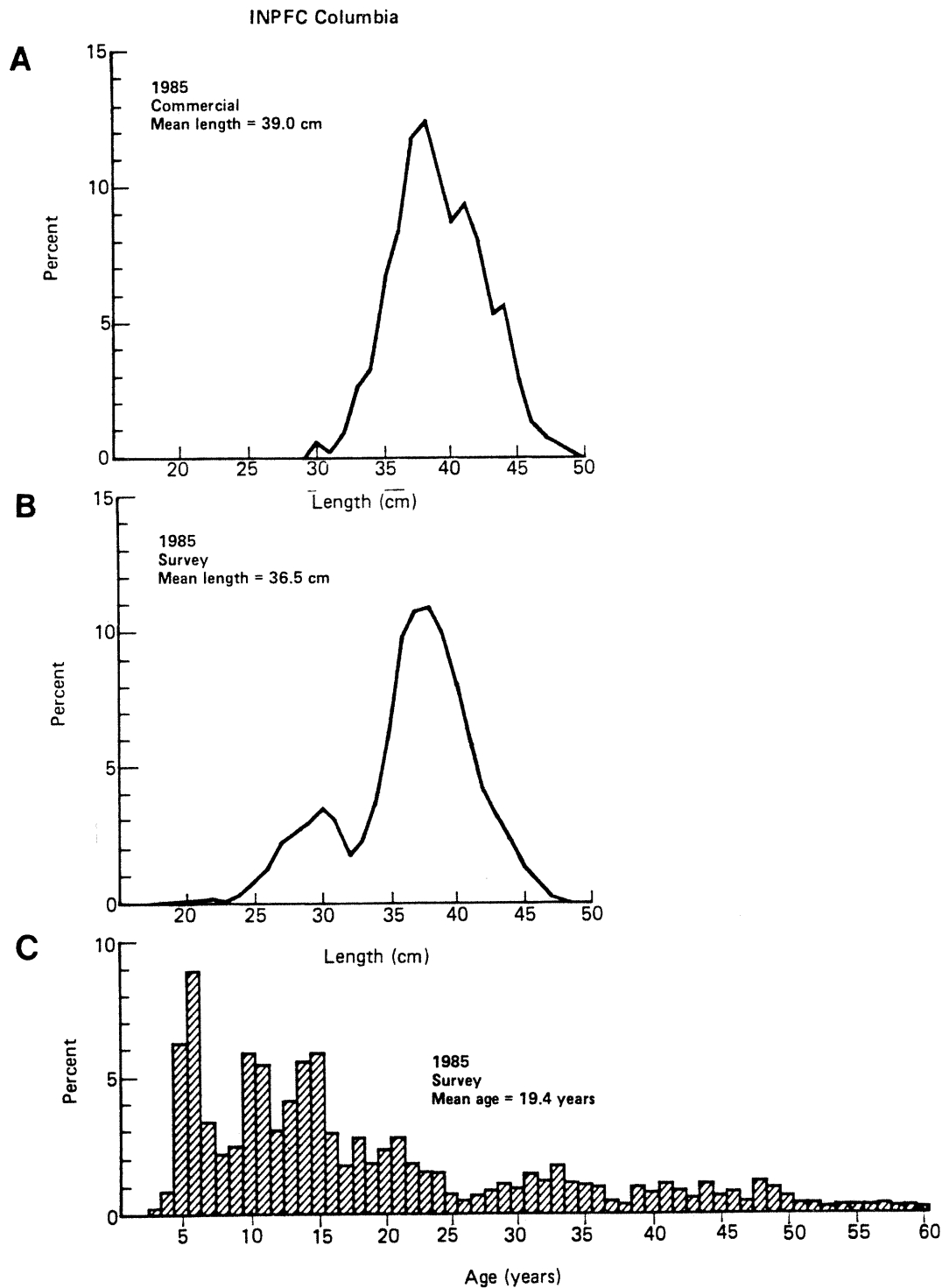
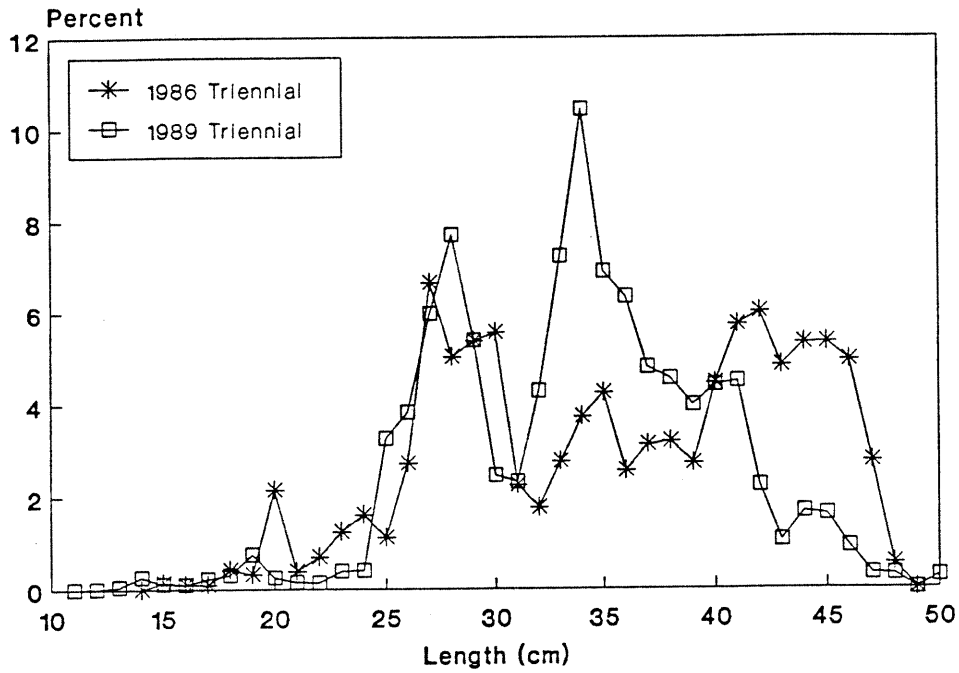


Figure 5.--Size and age composition of Pacific ocean perch in the INPFC Columbia area in 1985. Subpanel A: size composition from the commercial fishery. Subpanel B: size composition from the Pacific ocean perch survey. Subpanel C: age composition from the Pacific ocean perch survey.



## INPFC U.S.-Vancouver



## INPFC Columbia

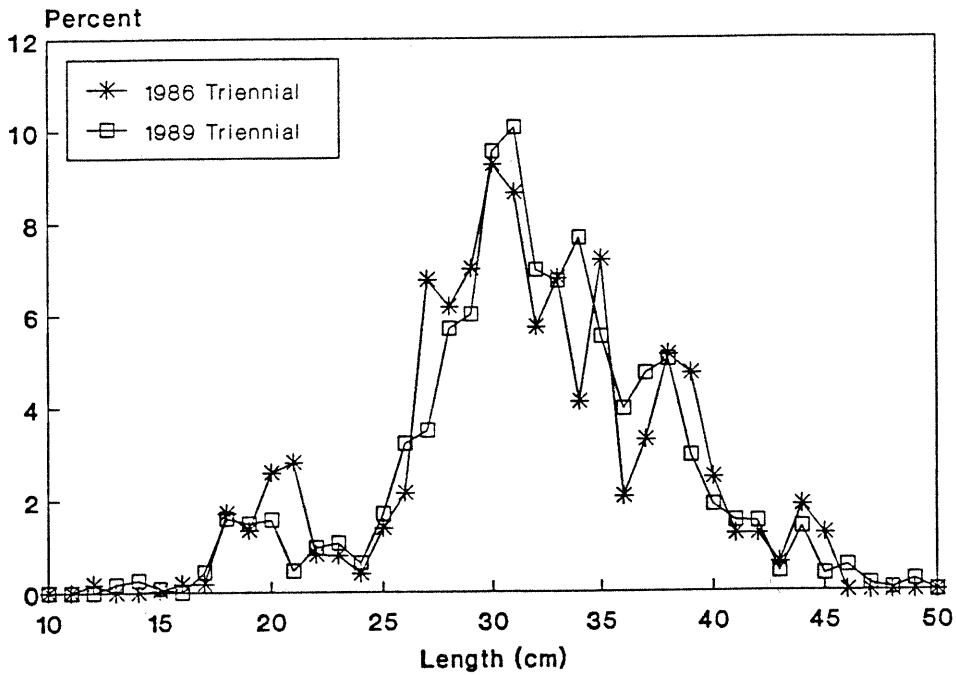
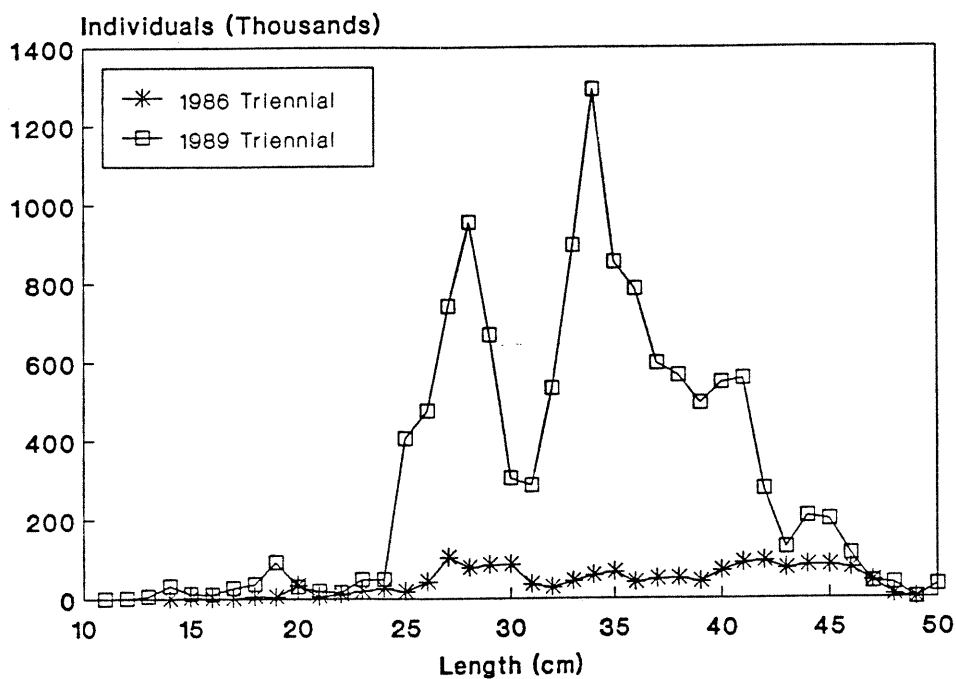


Figure 6.--Size composition (percent frequency) of Pacific ocean perch in the INPFC U.S.-Vancouver and Columbia areas as shown by data collected during the 1986 and 1989 triennial groundfish trawl surveys.

## INPFC U.S.-Vancouver



## INPFC Columbia

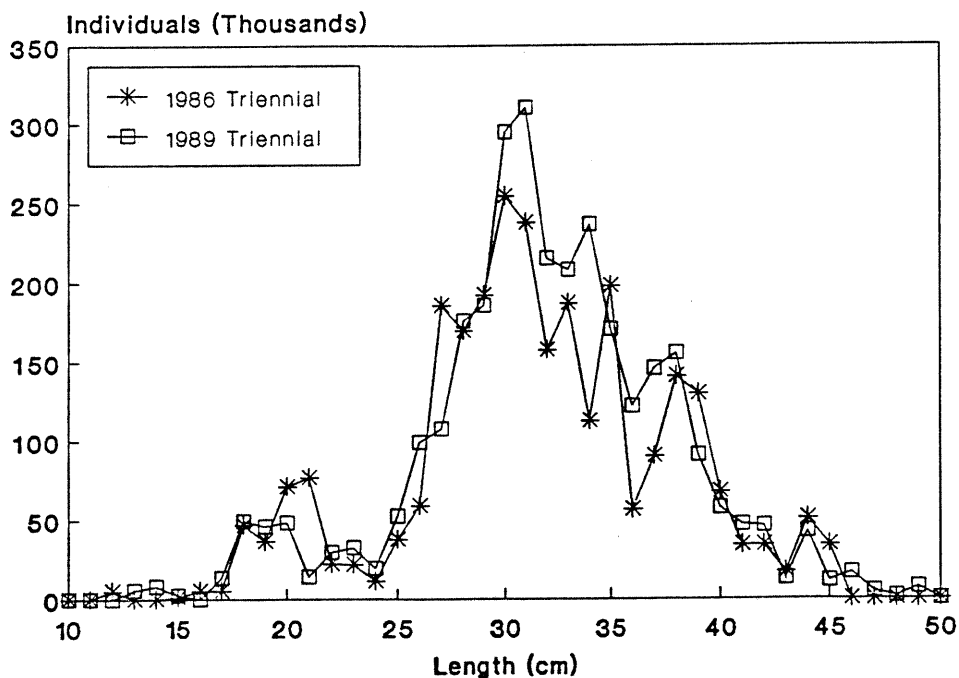


Figure 7.--Size composition (absolute abundance) of Pacific ocean perch in the INPFC U.S.-Vancouver and Columbia areas as shown by data collected during the 1986 and 1989 triennial groundfish trawl surveys.