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Current Assessment and 1998 Management Recommendations for Walleye Pollock in Prince William Sound

by
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ABSTRACT

Prior to 1995, less than 4 metric tons (mt) of walleye pollock *Theragra chalcogramma* were annually harvested, mainly by jig and bottom trawl gears, from Prince William Sound (PWS), Alaska. An annual fishery using mid-water trawls developed beginning in 1995. This fishery occurs within internal waters of PWS and is managed by the Alaska Department of Fish and Game (ADF&G). Walleye pollock occurring in PWS during the summer have not been included in Gulf of Alaska assessments conducted by the National Marine Fisheries Service (NMFS). Due to the lack of adequate, recent survey data, the annual pollock harvest guideline for PWS in 1996 and 1997 was based on (1) PWS pollock population estimates from the last non-winter survey in 1994, scaled by (2) a relative change that was similar to that in the allowable biological catch recommended for pollock in adjacent federal waters. The approach assumed that ecosystem processes affecting PWS pollock were similar in magnitude and direction to ecosystem processes affecting adjacent pollock stocks in adjacent federal waters. The relationship between pollock in PWS and adjacent federal waters remains unknown. In 1997, ADF&G conducted summer trawl and longline surveys in PWS and coordinated a winter acoustic survey of pre-spawning pollock. In addition to sampling pollock for length, weight, sex, maturity, and age from survey and commercial fishery catches in PWS, ADF&G collected genetic samples and the Prince William Science Center collected tissue isotope samples from pollock caught in PWS and adjacent federal waters. Analyses of these samples may help clarify stock definitions. Several alternatives to calculating the exploitable pollock biomass for 1998 were explored, including again scaling by the same relative change as in the federal pollock fisheries. However, based on a blend of PWS survey results and a correction for survey gear catchability, the recommended guideline harvest level for PWS pollock in 1998 is 1,900 mt (4.2 million lb). This is a 100 mt increase over the 1997 harvest guideline.

KEY WORDS: commercial fishery, groundfish management, Prince William Sound, *Theragra chalcogramma,* walleye pollock

INTRODUCTION

Prior to 1995, less than 4 mt of walleye pollock *Theragra chalcogramma* were commercially harvested annually, mainly by jig and bottom trawl gear, within Prince William Sound, Alaska. In 1995 the annual harvest from this area increased dramatically with the landing of 2,900 mt of walleye pollock, mainly by mid-water trawl gear. The objectives of this report are to present updated information on the walleye pollock resource of Prince William Sound; to provide a description and summary of commercial harvests of this species for this area; and to make recommendations for the future management and research needs for this species in Prince William Sound.

GENERAL BIOLOGY

Walleye pollock have been reported along the west coast of North American from Carmel, central California, through the Bering Sea to St. Lawrence Island, and on the Asia coast to Kamchatka, the Okhotsk Sea, and the southern Sea of Japan (Hart 1973; Bakkala et al. 1986). Walleye pollock are generally considered to be semidemersal, inhabiting continental shelf and slope waters to depths of 650 m, but they may also be pelagic in some areas. Genetic differences between walleye pollock of the eastern and western Pacific, as well as regional differences in age, growth, morphometric, and meristic characteristics, suggest that multiple stocks exist (Okada, K. 1986).

Walleye pollock typically spawn in the first half of the calendar year, but may spawn later in the year at higher latitudes. The pelagic eggs are 1.35 to 1.45 mm in diameter. Age-0 walleye pollock in the Bering Sea typically occupy the upper 40 m of the water column until fall months when they begin a semidemersal existence (Traynor and Nelson 1983). Age-1 and -2 walleye pollock occupy discrete schools between 30 m and the bottom in the eastern Bering Sea. Age-1, -2, and -3 fish generally occur higher in the water column and are rarely captured in demersal trawls, while most fish age-4 and older are located closer to the bottom and are commonly captured in pelagic or demersal trawls. In the Gulf of Alaska, age-1 and -2 walleye pollock are approximately 13 cm and 25 cm in length, respectively (Janusz 1986). Size at first maturity appears to be about 35 cm, which is usually attained at age-3.

The size, number, and variety of prey increase with walleye pollock size. Walleye pollock yolk-sac larvae, 3-6 mm in length, feed primarily on copepod nauplii (Nishiyama et al. 1986). Euphausiids and shrimp are important prey items for both juveniles and adults, particularly in the spring (Dwyer et al. 1986; Yang 1993). In summer, calanoid copepods and amphipods become an important component of the diet of small walleye pollock, while fishes are a major prey of large walleye pollock. In the Bering Sea during summer, age-0 walleye pollock were major prey items of larger walleye pollock (Livingston et al.

1993). By autumn cannibalism represented a major diet component of both large and small fish. In the Gulf of Alaska, a variety of fishes are consumed by walleye pollock during the summer, with the most important prey item often being capelin *Mallotus villosus*. In winter, fish again composed the greatest portion of the diet of walleye pollock, but only the larger individuals commonly preyed upon other walleye pollock.

Walleye pollock are harvested in several fisheries and are also prey upon by a variety of organisms. Population models for pollock resources occurring in federal waters incorporate a variety of data sources including recent efforts to model predation upon pollock (Hollowed et al. 1997).

MANAGEMENT AREA

Prince William Sound, Alaska, (PWS) is a complex fjord-type system located along the northern Gulf of Alaska (Muensch and Schmidt 1974). The commercial pollock fishery described in this report occurs within the Inside District of the PWS Management Area. The Inside District includes all waters enclosed by lines drawn from Pt. Whitshed to Pt. Bentinck, Cape Hinchinbrook to Zaikof Point, and Cape Cleare to Cape Puget (Figure 1). PWS is recognized as internal waters of the State of Alaska and groundfish harvests within PWS are managed by the Alaska Department of Fish and Game (ADF&G).

CATCH HISTORY

Prior to 1995, annual commercial harvests of walleye pollock from PWS were less than 4 mt (Table 1; Bechtol 1995*a*, 1995*b*). These harvests were primarily taken incidentally by trawl or longline gear, although some directed effort with jig gear occurred in 1994. Little information on at-sea discards is available, but walleye pollock discards probably only occur at low levels on longline gear.

In January 1995, mid-water trawl vessels transiting the southwest portion of PWS observed sonar echoes from what appeared to be walleye pollock aggregations. Although historical assessment surveys indicated that walleye pollock reside year-round within PWS (Parks and Zenger 1979; Haynes and Urban 1991; C. Wilson, NMFS, unpublished data), a harvest guideline had not previously been established for pollock in PWS due to low levels of catch and effort (Bechtol 1995*b*). The most recent survey, a series of bottom trawl tows made during the summer of 1989 following the *T/V Exxon Valdez* oil spill, indicated that 9,500 mt of walleye pollock were in PWS at the time of the survey (Haynes and Urban 1991). Therefore, for the 1995 fishery ADF&G set a guideline harvest range of 950-2,000 mt of walleye pollock based on an exploitation rate of 10-20% of the 1989 biomass estimate. It was anticipated that midwater trawl vessels would harvest the bulk of

the guideline. The 1995 trawl fishery lasted from 31 January until 16 February 1995 with a total of nine midwater trawl vessels delivering 2,857 mt (6.2 million lb). Following the trawl closure walleye pollock fishing was not closed to other gear types because non-trawl catches were expected to be small. The total PWS walleye pollock harvest in 1995 was 2,960 mt (6.5 million lb), which included about 4 mt landed by longline and jig gear and 98 mt landed by a combination test fishery and acoustic survey conducted by ADF&G in late February and early March (Trowbridge 1996).

The 1996 midwater trawl fishery from 20-25 January yielded a harvest of 1,480 mt (3.3 million lb) by 11 vessels (Trowbridge 1996). The total harvest of pollock in 1996 was 1,672 mt (3.7 million lb), including 191 mt landed by an ADF&G test fishery and <1 mt landed as bycatch in other pot, longline, and trawl fisheries.

The 1997 midwater trawl fishery from 20-28 January yielded a harvest of 1,613 mt (3.6 million lb). The total harvest of pollock in 1997 was 1,860 mt (4.1 million lb), including approximately 244 mt landed by an ADF&G test fishery and <2 mt landed as bycatch in other pot, longline, and trawl fisheries.

The directed pollock fishery has typically involved midwater trawl vessels targeting dense aggregations of pre-spawning pollock in the southwest portion of the Inside District (Figure 1). Catcher vessels delivered to shore-based processing plants once every 2 to 3 days or to tender vessels on the grounds once or twice daily. Individual deliveries usually consisted of 70-140 mt of walleye pollock, captured in one or two tows, depending upon vessel size and capacity and fish aggregations. Most of the directed fishery catch has been processed into fillets with some marketing of the roe.

The length distributions of pollock sampled from the PWS fisheries were similar during the directed fisheries of 1995 to 1997 (Figure 2). In contrast, pollock sampled from the 1996 PWS fishery exhibited a slightly larger size mode than pollock sampled from fisheries in Gulf of Alaska management areas 610, 620, 630, and 631 (Figure 3).

FISHERY MANAGEMENT CONSIDERATIONS

Because the mid-water trawl fishery for walleye pollock in PWS is relatively new, long-term management strategies are still being developed. Although previous surveys indicated that walleye pollock resided year-round within PWS (Parks and Zenger 1979; Haynes and Urban 1991), the relationship between walleye pollock inside PWS and those in the adjacent Gulf of Alaska is not clear. Even if walleye pollock occurring in PWS intermingle with the Gulf of Alaska stock, the PWS component is not assessed by the National Marine Fisheries Service (NMFS) triennial trawl survey conducted during summer months in the Gulf of Alaska (Chris Wilson, NMFS, Seattle, WA, personal communication). Groundfish resources off the coast of Alaska are co-managed by

ADF&G and NMFS (Trowbridge 1996). In the absence of area and gear specific regulations established by the Alaska Board of Fisheries or management measures developed by ADF&G through internal and public review, fisheries in state waters typically coincide with seasons in the adjacent federal waters. However, allowing the pollock fishery in PWS to be prosecuted as part of the total allowable catch (TAC) established for adjacent federal waters of the Gulf of Alaska fails to accommodate resource levels in PWS and could potentially lead to local depletions. In contrast, a sustainable walleye pollock fishery in PWS can be established if: (1) estimates of walleye pollock biomass inside PWS are available, (2) a conservative harvest guideline level is set, (3) fishery management measures are adopted to ensure harvests can be controlled, and (4) further research is conducted to explore the relationship between pollock in PWS and those in the adjacent waters of the Gulf of Alaska.

Available Survey Data

1989 Trawl Surveys

Following the *Exxon Valdez* oil spill, ADF&G and NMFS conducted two multi-species bottom trawl surveys of PWS in the summer of 1989 using a 400 mesh Eastern otter trawl (Haynes and Urban 1991). The first survey, designed to emulate a previous survey conducted in April 1978 (Parks and Zenger 1979), included 61 hauls during 17 May through 23 June 1989. The second survey, based on a random stratified sampling design, included 63 hauls during 7 August through 13 September 1989 and estimated walleye pollock biomass was 9,500 mt. Actual pollock biomass was probably greater because the semi-pelagic habits of this species likely made a portion of the population unavailable to bottom trawl survey gear. Furthermore, the 400-mesh Eastern gear has a lower rise opening than bottom trawls currently used in the NMFS triennial surveys (Anne Hollowed, NMFS, Seattle, WA, personal communication), so abundance data collected in PWS were not directly comparable to data collected in the Gulf of Alaska.

Acoustic Surveys

During early and late May 1994, an acoustic survey was conducted in PWS as part of the *Exxon Valdez* Trustee Council Sound Ecosystem Assessment (SEA) project. Expansion of survey data resulted in a walleye pollock biomass estimate of 24,328 mt within the 40-125 m depth range of PWS (Table 2; Jay Kirsch, Prince William Sound Science Center, Cordova, AK, personal communication). Three factors, however, make it difficult to assess the accuracy of this estimate. First, walleye pollock were widely distributed at depths greater than 20 m during the acoustic survey, but estimation of pollock at depths shallower than 40 m was problematic due to echo scattering by a plankton layer. Second, the acoustic survey did not assess pollock biomass below 125 m, ADF&G trawl and longline surveys have shown walleye pollock to occur deeper than 125 m in PWS

(personal observation). These two factors may have resulted in an underestimate of walleye pollock biomass in 1994. Third, the acoustic survey only covered western PWS, so errors introduced into the biomass estimate by directly extrapolating acoustic density estimates from western to eastern PWS are not known.

In a cooperative project, ADF&G worked with the Prince William Sound Science Center and the fishing industry to obtain more information on the biomass and distribution of walleye pollock in PWS during the winter of 1995. Commercial vessels, using staff and acoustic equipment provided by the Prince William Sound Science Center, conducted an acoustic survey of pollock in PWS after the 1995 winter fishery (Thomas and Stables 1995). The survey involved two legs, primarily focused in the southwest portion of PWS, with acoustically-estimated aggregations sampled by a mid-water trawl. The first leg, conducted from 24 to 25 February, provided a walleye pollock biomass estimate of 19,756 mt. The second leg, conducted from 28 February to 1 March, provided an estimate of 37,953 mt. During both legs, pre-spawning walleye pollock aggregations were concentrated in Port Bainbridge, Knight Island Passage, and Montague Strait with Port Bainbridge yielding 93% of the observed biomass in the first leg and 72% in the second leg. Scattered targets were observed in other areas of PWS but not assessed for abundance or biomass estimates. The wide range in estimates over the relative short temporal scale separating the two survey legs may have indicated short-term spawning movements.

In the winter of 1997, ADF&G again worked with the Prince William Sound Science Center and the fishing industry to conduct an acoustic survey of pre-spawning pollock aggregations in PWS during 23 to 27 February, after the winter fishery (Kirsch 1997). Pollock aggregations were again concentrated in Port Bainbridge, Knight Island Passage, and Montague Strait. The survey yielded a pollock biomass estimate of 37,894 mt, excluding aggregations assessed in Orca Bay, east of Green Island, and in the northern end of Montague Strait. However, the pollock distribution with approximately 27,000 mt, or 72% of the biomass, in the Knight Island area and 11,000 mt in Port Bainbridge differed substantially from the 1995 distribution. Pollock were again sampled with a midwater trawl during the acoustic survey. The length distributions of pollock collected from the Port Bainbridge and southern Knight Island Passage areas were similar to distributions from the commercial fishery, but smaller pollock occurred in samples from the North Montague and Orca Bay areas (Figure 4).

1997 Trawl and Longline Surveys

A 1997 trawl survey with the research vessel *Pandalus* used a 400 mesh Eastern bottom trawl to conduct 53 tows in PWS (Bechtol *in preparation*). After dividing PWS into quadrants delineated at 147° N longitude and 60°30' N latitude, a total of 26 tows in the southwest quadrant, 25 stations in the northeast, and 2 in the southeast (Figure 5). Each survey station was 1 square nautical mile and was sampled by a 1.0 nautical mile long tow.

Average catches of pollock per nautical mile towed were 98.6 kg (217.4 lb) in the southwest, 74.3 kg (163.8 lb) in the northeast, and 1.8 kg (4.0 lb) in the southeast.

A 1997 longline survey with the research vessel *Montague* used a gear configuration similar to surveys conducted for sablefish *Anoplopoma fimbria* in federal waters by the National Marine Fisheries Service (Mike Sigler, NMFS, Juneau, personal communication; Bechtol *in preparation*). Within PWS 24 stations in the northwest area and 14 stations in the southwest area were sampled. Although the target species of the PWS survey was sablefish, a secondary objective was to evaluate the relative abundance and distribution of all species caught. Although only an index, the southwest area yielded an average catch of 3.1 pollock per set while the northwest area of PWS yielded an average catch of 4.7 pollock per set, or an average catch rate of 49.5% greater than the northwest area.

Relative Change in the Gulf of Alaska Federal Waters

Several previous estimates of surplus production for the PWS pollock population were based on the assumption that changes in ecosystem productivity are directed by large-scale processes that affect the entire northern Gulf of Alaska. Thus, a change in the pollock population of the Central/Western Gulf of Alaska Regulatory Areas was assumed to parallel a similar relative change in the PWS pollock population. As a result, the relative change in the recommended allowable biological catch of pollock in the adjacent federal waters of the Central/Western Regulatory Areas of the Gulf of Alaska had previously been used to scale changes in the PWS pollock guideline (Hollowed et al. 1995, 1996; Bechtol *unpublished data*). The allowable biological catch for the Gulf of Alaska declined by 77% from 1995 to 1996, increased by 42% from 1996 to 1997, and has been recommended to increase by 63% from 1997 to 1998 (Hollowed et al. 1997). Applying the same relative change, the PWS pollock guideline harvest level would also increase by 63% from the 1997 level of 1,800 mt to 2934 mt in 1998.

GUIDELINE HARVEST RECOMMENDATIONS

NMFS has conducted acoustic surveys annually since 1982 to assess pollock resources in the Gulf of Alaska (Guttormsen and Wilson 1997). The surveys have focused primarily on the Shelikof Strait area with survey results used as an index for modeling Gulf of Alaska pollock stock(Hollowed et al. 1997). In PWS, the 1995 and 1997 winter acoustic surveys of pre-spawning pollock aggregations yielded biomass estimates that were similar between survey years but were substantially higher than the recent summer population estimates. However, the relationship between these winter, pre-spawning aggregations and the summer population unassessed by the NMFS surveys is unknown. Further research is needed to explore the utility of winter pollock data for determining the exploitable

biomass for the PWS pollock resources. Therefore, the guideline harvest level for the PWS pollock fishery has been based on model estimates of the local population not assessed by NMFS surveys in adjacent federal waters. Although a substantial summer pollock population was detected in PWS by a variety of studies following the *EXXON Valdez* Oil Spill (EVOS Trustee Council 1993), most of these studies focused on juvenile pollock as predators of rearing Pacific herring (*Clupea pallasi*) and salmonids (*Ocorhynchus* spp.). A comprehensive assessment of the adult summer pollock population in PWS has been hampered by the wide variety of habitats and areas with depths that exceed 700 m, factors that likely enhance productivity in this area. Thus, the best estimate of the PWS pollock population requires a merger of data from a variety of surveys.

Data from more recent surveys was assumed to be most representative of current resource abundance. Because only two stations were sampled by the ADF&G trawl survey in the southeast area in 1997 (Bechtol *in preparation*), the northeast and southeast areas were pooled into an "eastern area" for biomass analysis (Figure 5). Based on delineation of PWS into a sample station grid of 1 nautical mile squares, the 1997 trawl survey sampled 17% of the available stations in the eastern portion of PWS. The average trawl survey catch of 73.5 kg (162.0 lb) in the eastern area was extrapolated across the 162 square nautical miles of available habitat, using a factor of 151.9 to expand the area swept by the trawl mouth, to yield an eastern area trawlable population estimate of 1,808 mt (4.0 million lb). Trawl tows in the southwest area also sampled 17% of the available habitat. Extrapolating the average tow catch of 98.6 kg (217.4 lb) per nautical mile across the 154 available stations yielded a pollock estimate of 2,307 mt (5.1 million lb) in the southwest area. No trawl survey estimates were available for 1997 in the northwest area. However, longline survey data from 1997 was used to provide an index of relative catch rates between the southwest and northwest areas (Bechtol *in preparation*).

The mean trawl catch rate in the northwest area was estimated by adjusting the mean trawl catch rate from the southwest area using the ratio of the relative population numbers between longline catches in the southwest and northwest areas. The mean longline catch rate of pollock was 49.5% greater in northwest area than that in the southwest area, giving an expected trawl catch rate of 147.5 kg (325.1 lb) per nautical mile in the northwest. Extrapolating this mean trawl catch rate across the 180 available stations yielded a northwest area population estimate of 4,032 mt (8.9 million lb). Survey population estimates among all areas totaled 8,147 mt (18.0 million lb). However, comparison of NMFS triennial bottom trawl population estimates with post-survey stock synthesis and other model estimates (Methot 1990; Hollowed et al. 1997) indicated the NMFS triennial trawl surveys in 1993 and 1996 under-estimated the true pollock population by an average of 36% per survey. If the PWS pollock survey estimate is expanded by this catchability factor, the estimated population biomass becomes 12,663 mt (27.9 million lb). This was seen as a conservative estimate because the NMFS survey used a high-rise trawl that was probably more selective for pollock than the 400 mesh Eastern used by ADF&G (Eric Brown, NMFS, Seattle, personal communication). Applying a

conservative harvest rate of 15% to the estimated biomass will yield a harvest of 1,900 mt (4.2 million lb) for the 1998 fishery.

The alternative method of estimating the available 1998 harvest was based on scaling the PWS guideline by the relative change in the allowable biological catch in adjacent federal waters. However, this approach failed to incorporate the new PWS pollock data provided by the 1997 trawl and longline surveys. The 1,900 mt is more representative of the local PWS resource and, thus, is recommended for the 1998 fishery harvest guideline. A 1998 guideline of 1,900 mt would be 100 mt larger than the guideline for the 1997 fishery.

Ongoing PWS Pollock Research

To provide for long-term, sustainable yield, a greater understanding of the relationship of pollock stocks in PWS to those in adjacent federal waters is needed (W. Bechtol, Report of the Prince William Sound pollock research meeting, Anchorage, 9 January 1997, unpublished report). In an effort to pursue this understanding, several research projects were implemented in 1997.

Biological markers could yield information on intermixing, or intermixing of pollock from PWS with those in adjacent federal waters. In late-winter 1997 ADF&G collected pollock tissue samples for genetic analyses and the Prince William Sound Science Center collected isotope samples from pollock. Pollock were sampled from several locations inside PWS as well as at sites outside PWS, including Middleton Island, Resurrection Bay, and the Central Gulf of Alaska (NMFS survey).

In late October 1997, NMFS and ADF&G conducted a project (Eric Brown, National Marine Fisheries Service, Seattle, personal communication) off the southern end of Kodiak to compare bottom trawl catchabilities among the NMFS survey trawl gear and the 400 mesh Eastern nets used on the ADF&G vessels *Resolution* (Kodiak) and *Pandalus* (Homer). This study will compare catches of major target species by the different survey vessels trawling in the same area.

A third option that was not pursued in 1997 was the tagging of pollock. While this could be used to examine pollock movement, several methodology problems need to be resolved, such as capture and tagging mortality, tag loss, tag recovery options, and the appropriate sample size.

Fishery Management Measures

The fishing power of PWS mid-water trawl vessels make it possible to harvest, and exceed, the relatively small PWS harvest guideline within a short time frame. To meet stock conservation needs and allow for an orderly harvest, the Alaska Board of Fisheries

adopted a registration deadline of 13 January for any vessel used in the PWS pollock fishery. The board also adopted a regulation to allow fishing for pollock only under the terms of a permit issued by the Commissioner of ADF&G. This permit may specify requirements for logbooks, observers, harvest reporting procedures, and other requirements. The following measures will be implemented for the 1998 fishery:

Fishing Season - The fishery will open at 12:00 noon on 20 January 1997, and will remain open until the harvest guideline is taken. This opening will coincide with openings in the adjacent federal waters. Time and area closures may be used to reduce the bycatch of non-target species.

Check-In/Check-Out procedures - Vessel operators are required to check-in and check-out with the Cordova ADF&G office prior to fishing.

Observer Coverage - All vessels must carry an ADF&G observer if requested.

Logbook Reporting - All vessels will be required to maintain logbooks while participating in this fishery.

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Table 1. Annual commercial walleye pollock harvest from Prince William Sound, Alaska during 1987-1997.

Year	Round Weight (metric tons)			
	Longline	Trawl	Other	Total
1987	0.4			0.4
1988	0.7			0.7
1989	0.2	0.4	<0.1	0.7
1990	0.3	3.0		3.3
1991				0.0
1992	<0.1	2.7		2.7
1993	0.1	2.5		2.6
1994	<0.1		2.5	2.5
1995	1.6	2,954.5	2.7	2,958.8
1996	0.3	1,671.4	0.6	1,672.3
1997[a/]	1.6	1,857.8	0.1	1,859.5

[a/] Preliminary data through 15 October 1997.

Table 2. Walleye pollock biomass in Prince William Sound as estimated during 1989, 1994-1997 surveys.

Estimation Source	Survey Estimated Biomass (mt)		Comments
1989 Bottom Trawl Survey	9,500	Summer	Summer survey.
1994 Hydroacoustic Survey	24,328	Summer	Target discrimination problems >140 m and <20 m.
1995 Hydroacoustic Survey	37,953[a/]	Winter	Pre-spawning aggregation.
1997 Hydroacoustic Survey	37,894	Winter	Pre-spawning aggregation.
1997 Trawl Survey	4,115	Summer	NW area not included, no catchability adj.
1997 Longline Survey	NA	Summer	Provides relative abundance by area.
1997 Merged Survey Data	12,664	Summer	All areas; applies catchability estimates.

[a/] Second survey leg estimate (Thomas and Stables 1995).

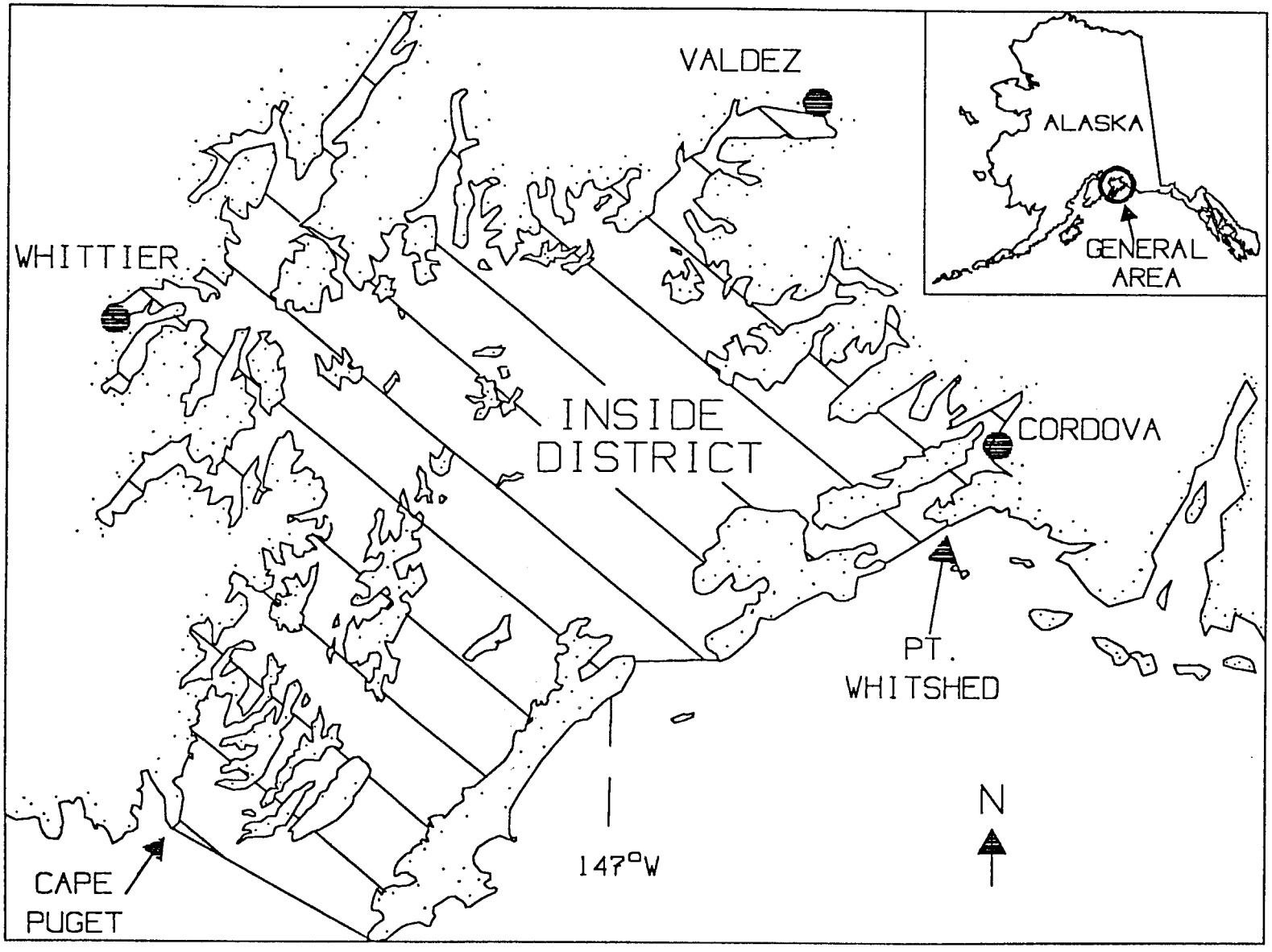

Figure 1. Inside District of the Prince William Sound management area.

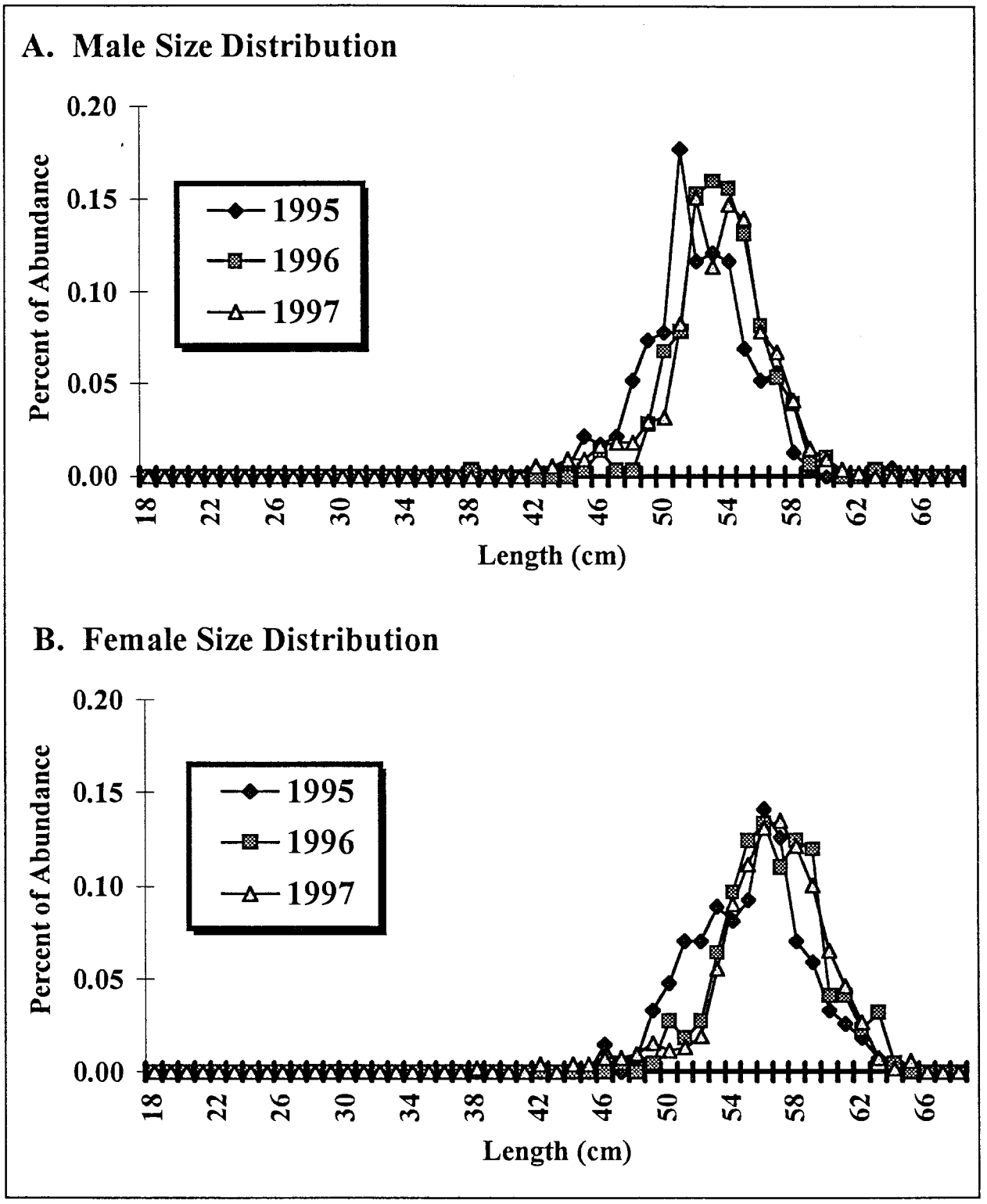

Figure 2. Length frequency distributions of (A) male and (B) female pollock caught by commercial trawl fisheries in Prince William Sound, Alaska, 1995-1997.

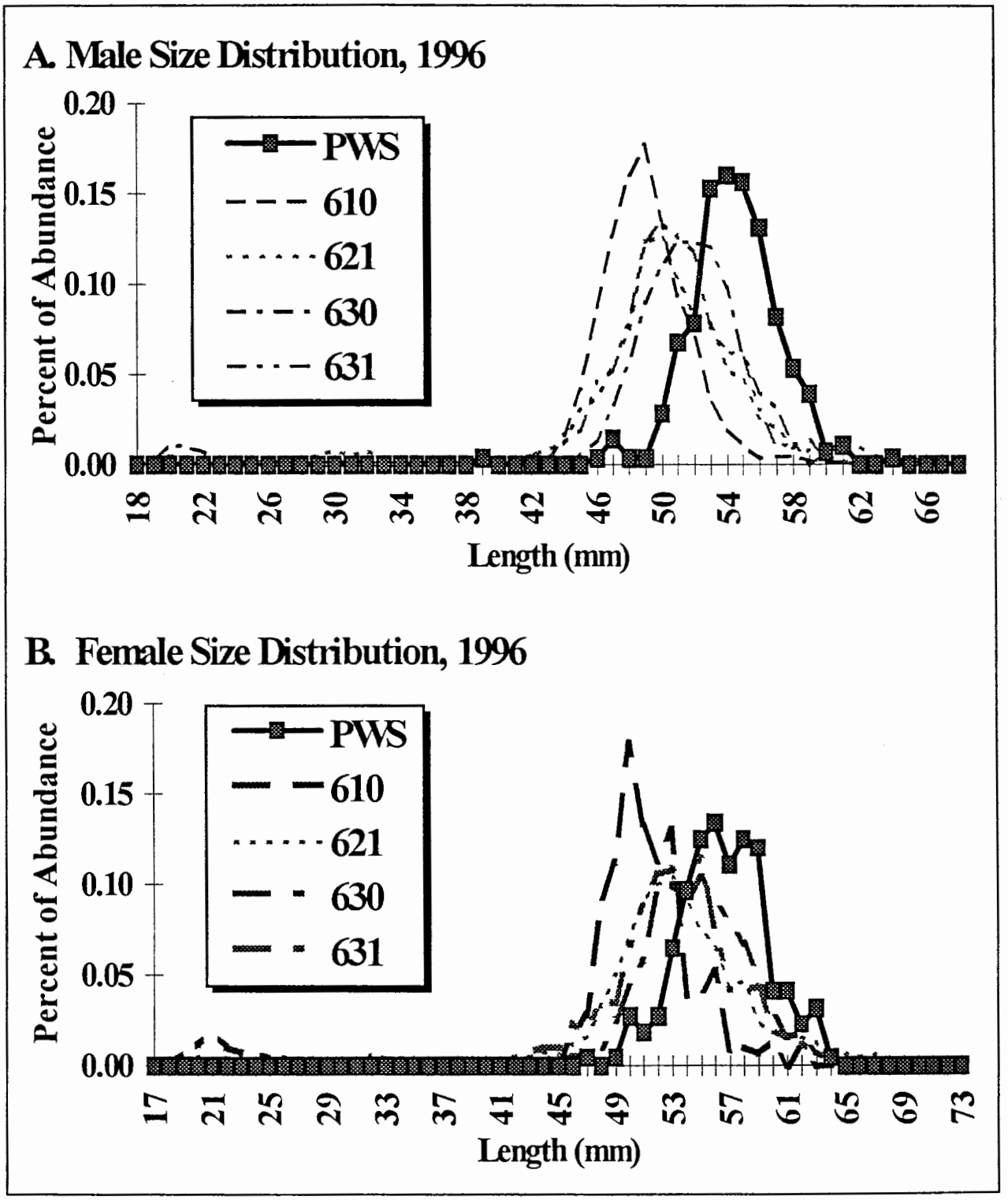

Figure 3. Length frequency distributions of (A) male and (B) female pollock caught during 1996 by commercial trawl fisheries in Prince William Sound and in federal regulatory areas 610, 620, 630, and 631 of the Gulf of Alaska.

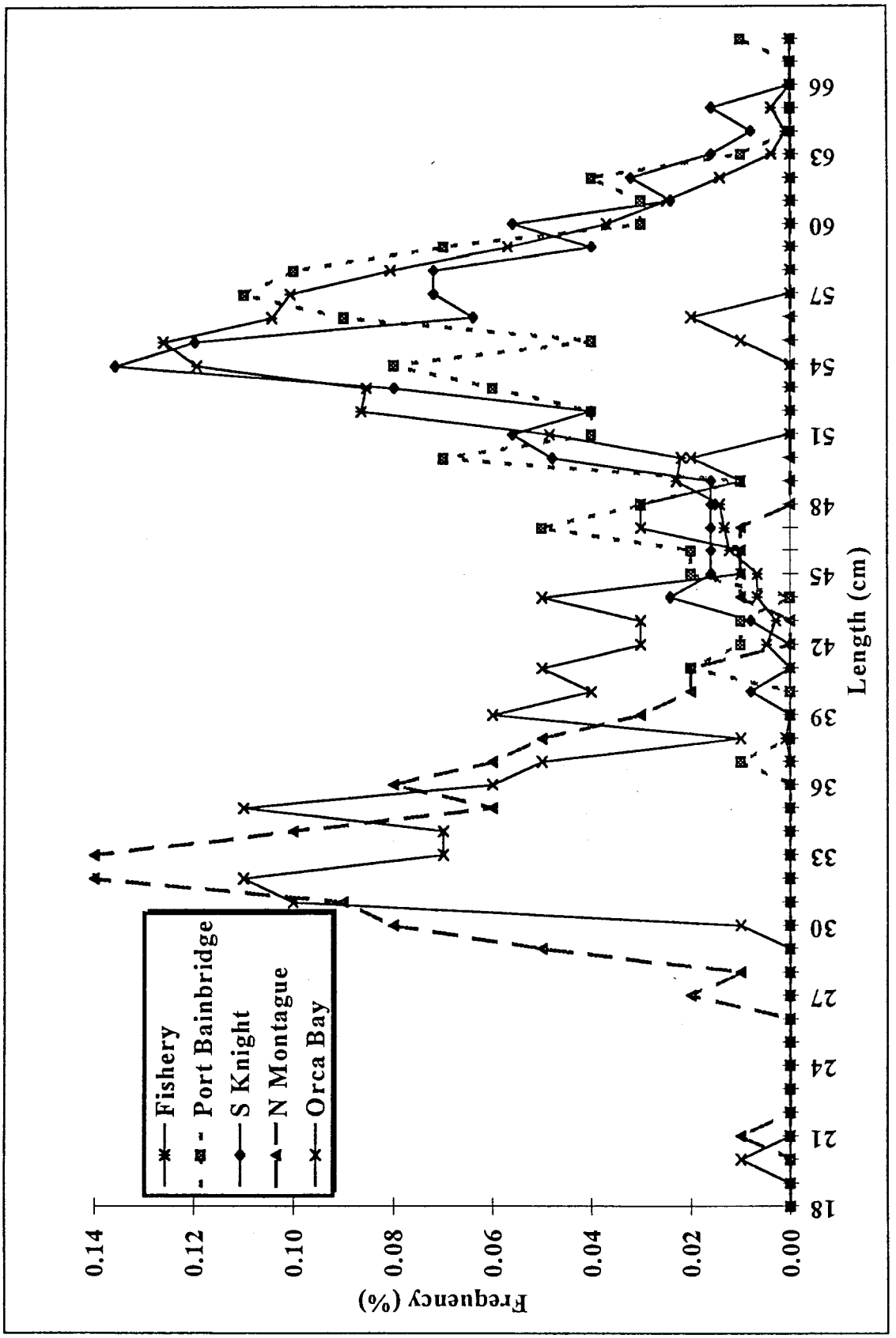

Figure 4. Length frequency distributions for pollock pooled across sex from the commercial fishery and from different areas sampled by the acoustic survey in Prince William Sound, 1997.

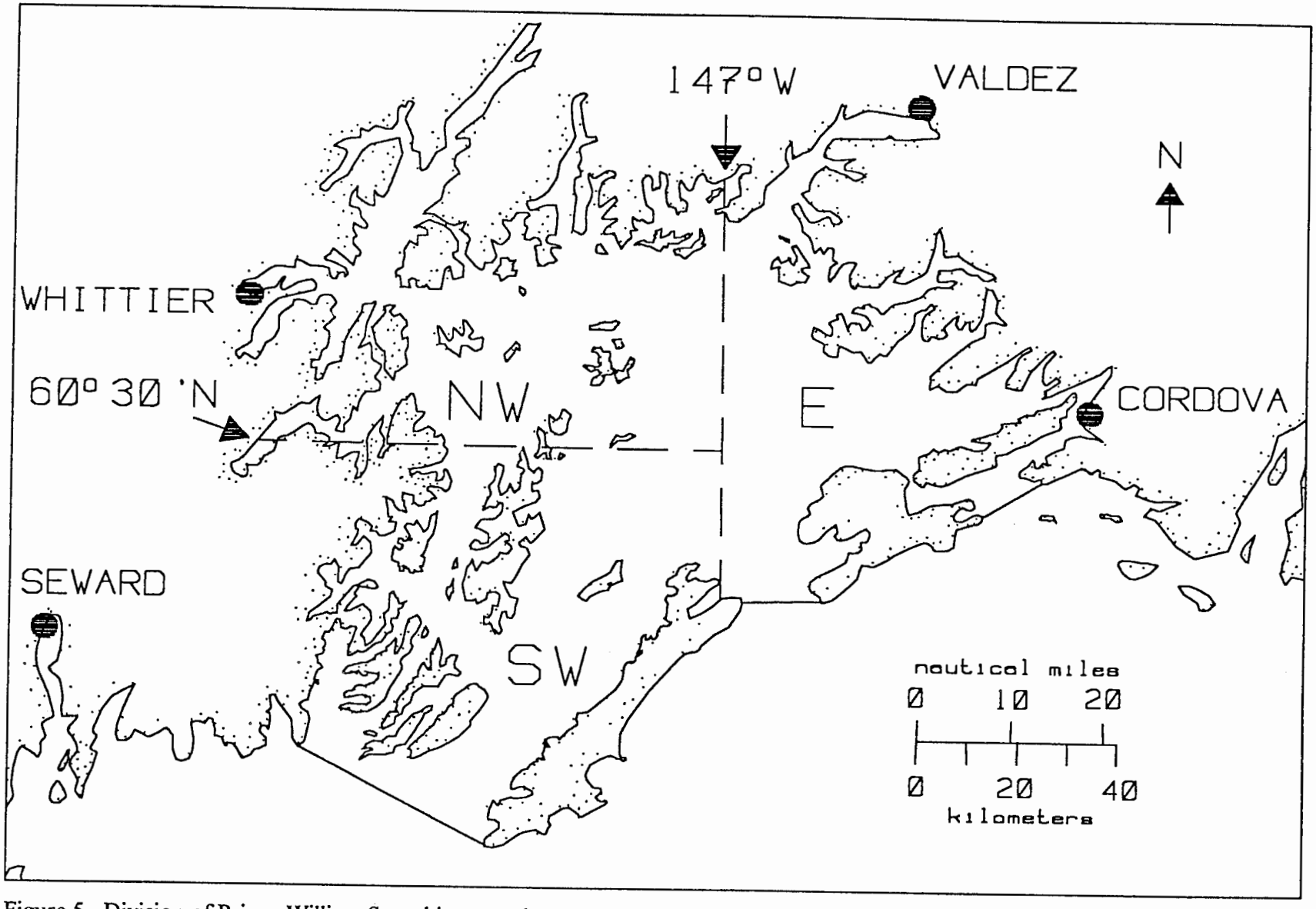

Figure 5. Division of Prince William Sound into northwestern, southwestern, and eastern survey areas by delineating at 147°00' W longitude and 60°30' N latitude.