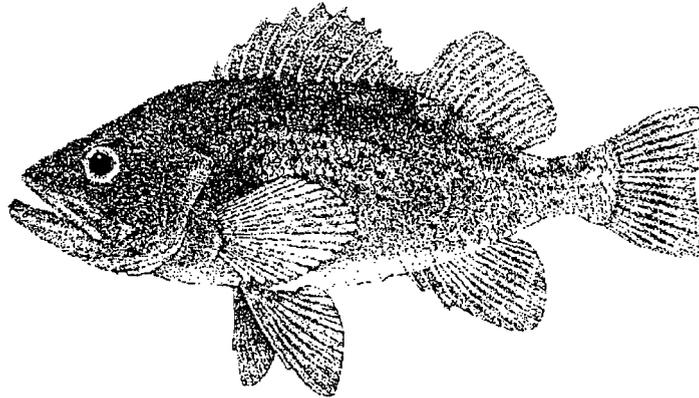


**A SYNOPSIS OF
LIFE HISTORY AND ASSESSMENT OF
COOK INLET ROCKFISH**



By
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TABLE OF CONTENTS

LIST OF TABLES	iv
LIST OF FIGURES	v
ABSTRACT.....	vi
INTRODUCTION	1
GENERAL BIOLOGY AND DISTRIBUTION	2
COOK INLET MANAGEMENT STRATEGIES.....	4
Management Area and Habitat	4
Harvest Strategies	4
DATA COLLECTION AND ANALYSIS.....	5
RESULTS	6
DISCUSSION.....	7
LITERATURE CITED	9

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Some species and assemblage names applied in Central Region rockfish management.....	12
2. Months of parturition for some female rockfish occurring in the northern Pacific Ocean.....	13
3. Month in which some male rockfish that occur in the northern Pacific Ocean have been observed in a ripe spawning condition.....	14
4. Biological parameters for some rockfishes found in Gulf of Alaska fisheries.....	15
5. Commercial harvests of rockfish assemblage by gear type in the North Gulf District, 1987-1998.....	16
6. Annual rockfish commercial catch by all gear types in the North Gulf District, 1987-1998.....	17
7. Commercial harvests by gear and rockfish assemblage in the Cook Inlet District, 1987-1998.....	18
8. Annual rockfish commercial catch by all gear types in the Cook Inlet District, 1987-1998.....	19
9. Commercial and recreational harvests of rockfish assemblages from the Cook Inlet Management Area, 1991-1997.....	20

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Typical habitat distribution of rockfish species assemblages.....	21
2. Comparisons of natural mortality rates to longevity for a variety of marine species.....	22
3. Distribution of rockfish longevity and natural mortality by species assemblage.....	23
4. Groundfish fishery districts of the Cook Inlet Management Area.....	24
5. Size distribution of black rockfish sampled from the North Gulf District in 1991, 1992, and 1998.	25
6. Age distribution of black rockfish sampled from the North Gulf District, 1991.....	26
7. Size-at-age of black rockfish caught in the North Gulf District, 1991-1992.....	27
8. Size composition of yelloweye rockfish caught from commercial deliveries in the North Gulf District, 1991 and 1992.....	28
9. Age composition of yelloweye rockfish caught from commercial deliveries in the North Gulf District, 1991 and 1992.....	29
10. Size-at-age of yelloweye rockfish caught in the North Gulf District, 1991-1994.....	30
11. Size composition of rougheye rockfish caught by ADF&G trawl surveys in the Cook Inlet District, 1991-1998.....	31
12. Age composition of rougheye rockfish sampled in the Cook Inlet Management Area, 1991-1995.....	32
13. Size-at-age of rougheye rockfish sampled from ADF&G trawl surveys and commercial fisheries in the Cook Inlet Management Area, 1991-1995.....	33
14. Rockfish harvest composition by gear and species assemblage in the North Gulf District, 1987-1998.....	34
15. Rockfish harvest composition by gear and species assemblage in the Cook Inlet District, 1987-1998.....	35

ABSTRACT

I provide a general description of rockfish (genera *Sebastes* and *Sebastolobus*) life histories, including examples of natural mortality and longevity. Size, age, and growth data from rockfish caught in the Cook Inlet Management Area are used as examples of rockfish species assemblages. Specifically, black rockfish *Sebastes melanops* is used to represent pelagic shelf rockfish, yelloweye rockfish *S. ruberrimus* is used to represent demersal shelf rockfish, and rougheye rockfish *S. aleutianus* is used to represent slope rockfish. Typical habitat distributions of species assemblages, and efficiencies of different gears within various habitats, are suggested as causal factors for differences in rockfish catches between the Cook Inlet and the North Gulf districts within the management area.

KEY WORDS: Rockfish, *Sebastes*, *Sebastolobus*, life history Cook Inlet, North Gulf District

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) has management responsibility for groundfish resources in the territorial seas (0-3 miles from shore) off the coast of Alaska. Effort and harvest in these fisheries has increased in the last decade as traditional fisheries, such as salmon and crab, have experienced biological or economic declines (Bechtol 1995; Trowbridge 1996). Due to lack of extensive groundfish research or management programs in territorial waters of the Central Region, the ADF&G, with some exceptions, has adopted the same inseason management actions announced by the National Marine Fisheries Service (NMFS) for adjacent federal waters of the Exclusive Economic Zone (EEZ). Specifically, federal openings and closures have been simultaneously implemented in nearshore state waters. However, given area-specific stock characteristics, federal management strategies may be inappropriate for some species, notably nearshore rockfish inhabiting territorial seas. To address concerns about rapid increases in annual commercial harvests of Central Region rockfish resources, the Alaska Board of Fisheries adopted rockfish management plans in 1992 (Bechtol 1992). Plan components included guideline harvest levels (GHL), district-specific trip limits, and a provision to implement bycatch-only retention for rockfish.

To ensure long-term, sustainable yield, stock management needs to be appropriate for both the resource and the fisheries harvesting the resource. This report summarizes information on nearshore rockfish, with emphasis on assessment data compiled by the ADF&G Division of Commercial Fisheries program within Central Region. Specifically, this report describes:

- (1) a generalized review of rockfish life history;
- (2) rockfish habitat within the management area;
- (3) stock composition information; and
- (4) recommendations for rockfish management.

GENERAL BIOLOGY AND DISTRIBUTION

Rockfish include fishes of the genera *Sebastes* and *Sebastolobus* (Eschmeyer et al. 1984; Kramer and O'Connell 1995). In some areas of the Pacific coast, rockfish management is based on species assemblages (Pacific States Marine Fisheries Commission 1994) defined by characteristic habitats and the prevalence of co-occurring species (Table 1; Figure 1). These habitats to some extent determine which fisheries harvest particular assemblages.

Pelagic shelf rockfish, defined in regulation 5 AAC 39.975(37), (e.g., black rockfish) are typically associated with nearshore, rocky reef areas in territorial seas and are harvested primarily in directed fisheries, often with mechanical and hand jigs. In some waters of the EEZ, pelagic shelf species, such as dusky rockfish, exhibit a midwater, schooling behavior and can be taken by trawl gear (Clausen and Heifetz 1997).

Demersal shelf rockfish, defined in regulation 5 AAC 39.975(34) (e.g., yelloweye and quillback rockfishes) are also typically associated with rocky, reef areas, but tend to be bottom-dwelling and occur at greater depths than pelagic shelf species (O'Connell and Carlile 1993). Demersal shelf species are distributed beyond territorial seas, and harvests occur in both directed and incidental fisheries (O'Connell et al. 1997). Demersal shelf rockfish may be taken in trawls, but are more commonly harvested with jig or longline gear.

Slope rockfish (e.g., rougheye rockfish) are defined in regulation 5 AAC 39.975(38) as any species of *Sebastes* not specified as either demersal shelf rockfish or pelagic shelf rockfish. As adults, slope rockfish are typically found near the bottom in waters deeper than 200 m, such as waters found along the break of the continental shelf (Heifetz et al. 1997) or in the bottoms of deep coastal fiords. In territorial seas, slope rockfish are generally captured incidental to other fisheries such as halibut, sablefish, or trawl shrimp, and are typically taken by longline or bottom trawl gears.

Thornyhead rockfish are defined in regulation 5 AAC 39.975(39) as any species of the genus *Sebastolobus*, although only shortspine thornyhead occur in the Cook Inlet Management Area. Adult shortspine thornyhead are found near the bottom in waters deeper than 200 m, such as waters found along the break of the continental shelf (Janelli et al. 1997). In the territorial seas, shortspine thornyhead are captured incidentally by fisheries directed at other species, sablefish or shrimp, and are typically taken by longline or bottom trawl gears.

Rockfish have unusual reproductive patterns. Most marine fishes produce free-floating eggs that are externally fertilized and undergo embryonic development within the water column. After hatching, the fish generally feed off a yolk-sac during which time pigmentation and free-feeding mechanisms develop. Less than 20% of the eggs of most marine fish survive the yolk-sac stage (Hempel 1979). In contrast, rockfish internally fertilize between 10 thousand and 1 million eggs that develop and hatch inside the ovary. An estimated 75% of these eggs survive to be extruded as planktonic, free-feeding larvae (Boehlert, et al. 1987). Larval release for most rockfishes occurs during the first six months of the year, although specific timing varies substantially within and between species (Wyllie Echeverria 1987). The period of larval release is poorly documented for rockfish species in the Cook Inlet Management Area. In southeast Alaska, the duration of larval

release varies from 1-9 months (Table 2; O'Connell 1987). The release period for a given species tends to be later and have a shorter duration in more northern latitudes (Kendall and Lenarz 1987). The occurrence of ripe male rockfish in southeast Alaska tends to overlap and slightly precede the period of larval release by females (Table 3).

The juvenile rockfish stage, defined as the stage at which the fin ray, gill raker, and lateral line pore counts are the same as in adults, begins at a length of 20-30 mm (1 inch; e.g., Matarese et al. 1989). Juvenile distribution and life history patterns are not well documented for most species. Juveniles of some species are either pelagic or associated with drifting objects such as kelp until they begin a benthic existence at about one year of age (Boehlert 1977). Other species do not begin a benthic existence until their second year of life (Carlson and Haight 1976). Nearshore movement (Anderson 1983) precedes juvenile settlement for some species.

After settlement, juvenile rockfish resemble and may associate with adults. Rockfish, in general, grow slower, live longer, and reach sexual maturity at an older age than many other marine fishes (Archibald et al. 1981). Growth is asymptotic with low annual growth rates for rockfish older than about 10 years. Maximum rockfish size and age is highly variable both within and between species. In addition, individual adult rockfish may reside within a very limited area. ADF&G SCUBA surveys conducted along the outer Kenai Peninsula in 1983 and 1984 observed black rockfish at the same location at which they were tagged 2-3 years previously. In southeast Alaska, yellowtail rockfish returned to a home reef after being tagged and moved 22.5 km (13 miles) from the reef (Carlson and Haight 1972). Homing and distribution characteristics may vary widely among species.

Rockfish species typically have lower natural mortality rates and greater longevity than many other marine fishes (Figure 2 and Table 4). Low natural mortality and great longevity are coupled with a relatively late onset of sexual maturity. Species-specific age of sexual maturity for rockfish can range from 6 to 20 years, and longevity may exceed 120 years in some species (e.g., O'Connell and Funk 1986). Pelagic shelf rockfish tend to reach sexual maturity earlier and have shorter lives than demersal shelf or slope rockfishes (Table 4; Figure 3). Low natural mortality, great longevity, and late sexual maturity are factors that indicate annual harvest rates should be kept low to ensure sustainability of this resource.

Another consideration in managing rockfish species is susceptibility to gear and mortality when caught. *Sebastes* species tend to embolize when brought to the surface from deeper than approximately 18 m (60 ft). Survival is thought to be low for released individuals, although this may depend on the total depth at which the fish captured and the speed at which the fish is retrieved. In some areas of the Pacific coast, efforts have been made to deflate the embolized swim bladder through use of a hypodermic needle and to push the stomach back into place with a rod. However, these methods are largely unevaluated, and a study of this method for blue rockfish (*S. mystinus*) indicated long-term survival to be low, particularly for fish requiring stomach replacement (Gottshall 1964). It is likely that embolism causes internal injuries in addition to an inverted swim bladder, and it is unlikely that swimbladder deflation would be effective for fish retrieved from great depths.

COOK INLET MANAGEMENT STRATEGIES

Management Area and Habitat

The Cook Inlet Management Area consists of all waters of Alaska enclosed by a line extending east from Cape Douglas (58° 51'06" N. lat.) and a line extending south from Cape Fairfield (148° 50'15" W. long.). The Cook Inlet Management Area includes two districts: North Gulf and Cook Inlet (Figure 4). The North Gulf District includes all remaining waters of Alaska in the Cook Inlet Management Area located south of a line from Cape Douglas to Point Adam and west of Cape Fairfield. Habitat in this district is mostly hard bottom with high-relief, rocky outcroppings, although some larger bays have mud bottoms. Depths are typically deeper than 110 m (60 fathom) and exceed 220 m (120 fathom) in some bays. In addition to tidal fluctuations, marine currents in the North Gulf District largely flow westward. The Cook Inlet District includes waters of Alaska in the Cook Inlet Management Area north of a line from Cape Douglas to Point Adam (59° 11'16" N. lat.). Habitat in this district tends to be mud or sand with occasional hard bottoms, particularly shale or coal. Depths are typically shallower than 64 m (35 fathom), although some areas exceed 165 m (90 fathom). The Cook Inlet District is subject to high current flows and tidal fluctuations to 46 m (25 ft). Waters of Kamishak Bay in the west and Kachemak Bay in the east of the district frequently contain glacial silt. Oceanic currents largely flow counterclockwise in the district.

In general, the abundant rocky habitat of the North Gulf District supports populations of pelagic shelf and demersal shelf rockfishes. In addition, slope species are found within the basins of the deeper bays. In contrast, the relatively limited amount of suitable high-relief substrate habitat in the Cook Inlet District precludes establishment of large populations of pelagic shelf and demersal shelf rockfishes. Instead, the silt and mud habitat, although not as deep as most of the continental slope, is more suitable to shallow-dwelling slope rockfish species.

Harvest Strategies

The Cook Inlet Rockfish Management Plan (state regulation 5 AAC 28.365) was adopted by the Alaska Board of Fisheries in 1992 to address increasing commercial rockfish harvests amid an absence of fishery management guidelines. The plan included three main components: (1) vessel trip limits; (2) an allowance for low-level retention of incidentally caught rockfish once the directed fishery closed; and (3) a guideline harvest level. Vessel trip limits were intended to slow the pace of the fishery and improve fishery manageability. Provisions for retention of incidentally caught rockfish (bycatch) recognized that rockfish caught incidentally in other fisheries, such as halibut or Pacific cod, embolize and suffer 100% mortality. Setting an appropriate bycatch allowances was done to discourage directed fishing on rockfish, but reduce waste of rockfish caught and killed in other fisheries. Harvest guidelines are typically based on some measure of species abundance and biology to ensure sustainability. For most groundfish, abundance is calculated from area-swept

estimates that expand trawl survey catch rates over available habitat (Gunderson 1993). However, the high-relief substrate preferred by rockfish precludes trawling, particularly in areas inhabited by pelagic and demersal shelf rockfishes (Phillips 1984). One assessment approach applied in Southeast Alaska involved conducting line transects with submersibles (O'Connell and Carlile 1994). This method, although effective in many high-relief habitats, is extremely expensive. Another approach involves setting annual harvest guidelines relative to average harvests sustained over a previous time period. This method is often used when stock assessment data is lacking, and is similar to the Tier 6 approach applied by the North Pacific Fishery Management Council in setting harvest guidelines for some groundfish fisheries in the Gulf of Alaska and Bering Sea (DiCosimo 1997). The current rockfish harvest guideline for the North Gulf District was calculated as the average commercial rockfish harvest from this area. No guideline was established for the Cook Inlet District because annual harvests have been small. Instead, directed rockfish fishing in the Cook Inlet District closes concurrently with the directed rockfish closure in the North Gulf District.

DATA COLLECTION AND ANALYSIS

Commercial harvest data from 1987-1998 were obtained from the ADF&G statewide fish ticket database. Data were summarized as round-weight equivalents by species assemblages (Table 1; Figure 1) by gear type. Because of overlaps in geographic distribution and gear susceptibility, shortspine thornyhead were included as part of the slope rockfish assemblage. Species identities in harvest records were sometime poorly documented. Species identified in historical records as unspecified pelagic, unspecified demersal, and unspecified slope rockfishes were included in pelagic, demersal, and slope rockfish assemblage summaries, respectively. Species identified as "other rockfish" and "red rockfish" were summarized as "unknown" rockfish. Gear types were pooled into jig, longline, and "other." Jig gear included hand troll as well as mechanical jig. Because 1998 rockfish harvests are still occurring, annual harvests for this report used data for 1987-1997 and the recent 5-year mean was calculated for the years 1993-1997.

Species composition and biological data were obtained by sampling commercial rockfish landed at the ports of Seward and Homer. Landings were sampled from both directed rockfish fisheries and from incidental harvests associated with fisheries for Pacific cod (*Gadus macrocephalus*), sablefish (*Anoplopoma fimbria*), lingcod (*Ophiodon elongatus*), and halibut (*Hippoglossus stenolepis*). Rockfish were also sampled during ADF&G multi-species trawl surveys (e.g., Bechtol 1998). All rockfish sampled were classified to species, measured for total length, and identified for sex. Whenever possible, sagittal otoliths were removed, cleaned, and stored for later age determination.

Rockfish data were pooled by species, management district and gear type. For each of these strata, mean total length as well as mean, maximum, and minimum age were determined. Black rockfish, yelloweye rockfish, and rougheyeye rockfish were selected as representative species for pelagic shelf, demersal shelf, and slope rockfish assemblages, respectively. For these species, size and age distributions were compiled from sample data, and mean size-at-age relationships calculated using a von Bertalanffy growth equation (Ricker 1975).

RESULTS

Black rockfish is one of the most abundant pelagic shelf rockfish species in the North Gulf District, and comprised 44-74% of annual commercial rockfish harvests during 1991-1997. Black rockfish tend to be associated with shallow, rocky reefs. They are most often caught on jig gear, but are also harvested with longline gear placed across reefs. Black rockfish lengths ranged from 240-630 mm and averaged 480 mm (n=1,429; Figure 5). Larger black rockfish tended to be caught with longline gear. Ages of black rockfish sampled ranged from 3-51 years and averaged 12.8 years among all North Gulf samples (Figure 6). Size-at-age information indicated that black rockfish growth was relatively rapid during their first 8-9 years of life, after which annual growth rates sharply declined (Figure 7).

Yelloweye rockfish have been the most commonly targeted demersal species, and comprised 3-33% of annual commercial rockfish harvests during 1991-1997. Yelloweye rockfish tend to be associated with deep, rocky substrate. They are most often caught by both jig and longline gears. Yelloweye rockfish total lengths ranged from 290-880 mm and averaged 497 mm (n=492; Figure 8). Ages of yelloweye rockfish samples ranged from 4-79 years and averaged 27.8 years among all samples (Figure 9). Size-at-age information indicated that yelloweye rockfish growth was relatively slow throughout their life (Figure 10).

Rougheye rockfish have been the most commonly harvested slope rockfish in the management area, but only comprised a maximum of 5% of annual rockfish harvests in the North Gulf District from 1991-1997. They are most often caught on longline gear incidentally during fisheries targeting halibut and sablefish. Due to their small contribution to commercial catches, relatively few rougheye rockfish were sampled. Most biological information on this species was obtained from samples collected during annual ADF&G trawl surveys on the Cook Inlet District (Figure 11). Rougheye rockfish total lengths, from samples pooled among years, areas, and gears, ranged from 70-800 mm and averaged 321 mm (n=1,084). Ages of rougheye rockfish samples ranged from 2-63 years and averaged 11.0 years (Figure 12). Size-at-age information indicated that rougheye rockfish growth was relatively rapid during their first 10 years of life (Figure 13).

Most rockfish harvests from the Cook Inlet Management Area occurred in the North Gulf District (Trowbridge 1998). Average annual landings from this district were 160,620 lb (72.9 mt) during 1987-1997 and 167,245 lb (75.9 mt) during 1993-1997. Jig gear accounted for 58% and longline gear produced 42% of all rockfish harvests during 1987-1997 (Table 5; Figure 14). Other gears did not account for more than 6% of annual rockfish harvests from the district and averaged <1% of annual harvests during 1987-1997. Pelagic shelf rockfish comprised 50% or more of all North Gulf annual harvests and averaged 65% of annual harvests during 1987-1997 and 68% during 1993-1997 (Table 6; Figure 14). Demersal shelf rockfish comprised 3%-40% of annual harvests and averaged 21% of annual harvests during 1987-1997 and 26% during 1993-1997. Slope rockfish and "unknown rockfish" averaged <7% of annual North Gulf harvests during 1993-1997.

Mean rockfish harvest in the Cook Inlet District was 2,329 lb (1.1 mt) during 1987-1997 and was 2,178 lb (1.0 mt) during 1993-1997. Longline gear accounted for 33%, jig gear for 28%, and other gears for 39% of all rockfish harvests during 1987-1997 (Tables 7; Figure 15). The large harvest by other gears were due to a relatively large catch reported in 1987; no rockfish harvests have been reported from other gears since that year. Slope rockfish averaged 38% of annual harvests during 1987-1997 and 22% during 1993-1997 (Table 8; Figure 15). Pelagic shelf rockfish averaged 25% of annual harvests during 1987-1997 and 48% during 1993-1997. Demersal shelf rockfish averaged 23% of annual harvests during 1987-1997 and 30% during 1993-1997. "Unknown rockfish" averaged <1% of annual harvests from the North Gulf District during 1987-1997.

Recreational fisheries also harvest rockfish within the Cook Inlet Management Area. During 1991-1997, an average of 40% of total annual rockfish harvests occurred in the recreational fishery (Table 9). Recreational fisheries accounted for 37% of the average annual pelagic shelf rockfish harvest, 53% of the average annual demersal shelf rockfish harvest, and 7% of the average annual slope rockfish harvest.

DISCUSSION

The species composition of rockfish harvests in the Cook Inlet Management Area differed substantially between the Cook Inlet District and North Gulf District (Figures 14 and 15). Although market conditions and alternative fishing opportunities probably affected effort and landings, species availability due to habitat, and gear probably also played a large role in determining the composition of landings. In the North Gulf District, predominance of high-relief, rocky habitat well suited to production of pelagic shelf and demersal shelf rockfishes. In addition, jig gear is better suited for targeting shallow-water, pelagic rockfish species occurring in rocky habitat than is longline gear, which has a greater likelihood of being lost on rocky substrate. In contrast, predominance of mud and sand substrate in Cook Inlet District, coupled with large tidal fluctuations of glacially-influenced water, is not well suited to rockfish production. While this type of habitat is more conducive to production of slope than pelagic shelf or demersal shelf rockfishes, the total rockfish biomass this habitat is capable of sustaining is low. Species composition of annual harvests in the Cook Inlet District has been highly variable, depending in large part upon market conditions and gears being used.

The Cook Inlet Rockfish Management Plan was adopted as a mechanism to address increasing rockfish harvests in the absence of fishery information and management guidelines. Although more biological assessment data has been collected since this plan was adopted in 1992, we lack information on stock structure and recruitment mechanisms. Because rockfish species have relatively low natural mortality, high longevity, and late sexual maturity, it is necessary to exploit this resource at lower levels than most other marine fishes to ensure sustainability. Plan modifications may be needed in response to changes in fisheries that target rockfish as well as

fisheries that catch rockfish incidentally. Since rockfish experience high mortality when caught, release of unwanted bycatch is not an effective means to decrease fishing mortality. In addition, requiring all incidentally caught rockfish to be discarded inhibits long-term management efforts because at sea discards are poorly documented. While ADF&G will continue to monitor rockfish resources by sampling landings and gleaning information from multi-species trawl surveys, no dedicated funds are available to collect information on stock structure or recruitment.

LITERATURE CITED

- Anderson, T.W. 1983. Identification and development of nearshore juvenile rockfishes (genus *Sebastes*) in central California kelp forests. M.S. thesis. Calif. State Univ., Fresno. 216 p.
- Archibald, C.P., W. Shaw, and B.M. Leaman. 1981. Growth and mortality estimates of rockfishes (*Scorpaenidae*) from B.C. coastal waters, 1977-1979. Can. Tech. Rep. Fish. Aquat. Sci. 1048. 57 p.
- Bechtol, W.R. 1992. Review of the 1987-1992 Central Region rockfish fisheries: Report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A92-22, Anchorage, 29 p.
- Bechtol, W.R. 1995. Commercial groundfish fisheries in the Cook Inlet and North Gulf Management Areas: 1995 report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A95-42, Anchorage, 20 p.
- Bechtol, W.R. 1998. A bottom trawl survey for crabs in the Southern, Kamishak, and Barren Islands Districts of the Cook Inlet Management Area, 20-23 June and 17-20 August 1996. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A98-04, Anchorage, 43 p.
- Boehlert, G.W. 1977. Timing of the surface-to-benthic migration in juvenile rockfish, *Sebastes diploproa*, off southern California. U.S. Natl. Mar. Fish. Serv., Fish. Bull. 75:887-890.
- _____, M. Kusakari, and J. Yamada. 1987. Reproductive mode and energy costs of reproduction in the genus *Sebastes*. pp. 143-152 In: Melteff, B.R. [ed]. Proc. International Rockfish Symposium. Univ. of Ak, Alaska Sea Grant Rep. 87-2.
- Carlson, H.R., and R.E. Haight. 1972. Evidence for a home site and homing of adult yellowtail rockfish, *Sebastes flavidus*. J. Fish. Res. Bd. Can. 29:1011-1014.
- _____, and R. E. Haight. 1976. Juvenile life of Pacific ocean perch, *Sebastes alutus*, in coastal fjords of southeastern Alaska: Their environment, growth, food habits, and schooling behavior. Trans. Am. Fish. Soc. 105:191-201.
- Clausen, D.M., and J. Heifetz. 1997. Pelagic shelf rockfish In Stock assessment and fishery evaluation (SAFE) report for the groundfish resources of the Gulf of Alaska, pp. 289-308. North Pacific Fisheries Management Council, Anchorage.
- DiCosimo, J. 1997. Summary of the Gulf of Alaska Groundfish Fishery Management Plan. North Pacific Fisheries Management Council, Anchorage.

- Eschmeyer, W.M., E.S. Herald, and H. Hammann. 1984. A field guide to Pacific coast fishes of North America from the Gulf of California to Baja California. Houghton Mifflin Company, Boston, 336 p.
- Gotshall, D.W. 1964. Increasing tagged rockfish (genus *Sebastes*) survival by deflating the swim bladder. *Calif. Fish and Game* 50:253-260.
- Gunderson, D.R. 1993. Surveys of fish resources. John Wiley and Sons, Inc., New York, 248 p.
- Heifetz, J., J.N. Ianelli, and D.M. Clausen. 1997. Slope rockfish. In Stock assessment and fishery evaluation (SAFE) report for the groundfish resources of the Gulf of Alaska, pp. 247-288. North Pacific Fisheries Management Council, Anchorage.
- Hempel, G. 1979. Early life history of marine fish: the egg stage. Univ. of Washington Press, Seattle.
- Ianelli, J.N., D.H. Ito, and M. Martin. 1997. Thornyheads (*Sebastolobus sp.*). In Stock assessment and fishery evaluation (SAFE) report for the groundfish resources of the Gulf of Alaska, pp. 325-358. North Pacific Fisheries Management Council, Anchorage.
- Kendall, A.W., and W.H. Lenarz. 1987. Status of early life history studies of northeast Pacific rockfishes. pp. 99-128. In: Melteff, B.R. [ed]. Proc. International Rockfish Symposium. Univ. of Ak, Alaska Sea Grant Rep. 87-2.
- Kramer, D.E., and V.M. O'Connell. 1995. Guide to the northeast Pacific rockfishes, Genera *Sebastes* and *Sebastolobus*, 1995 edition. Univ. of Alaska Sea Grant, Mar. Adv. Bull. 25, 78 p.
- Matarese, A.C., A.W. Kendall, Jr., D.M. Blood, and B.M. Vinter. 1989. Laboratory guide to early life history stages of northeast Pacific fishes. U.S. Dept. Comm., NOAA Tech. Rep. NMFS 80. 651 p.
- O'Connell, V.M., and F.C. Funk. 1986. Age and growth of yelloweye rockfish (*Sebastes ruberrimus*) landed in southeastern Alaska. pp. 171-186 In: Melteff, B.R. [ed]. Proc. International Rockfish Symposium. Univ. of Ak, Alaska Sea Grant Rep. 87-2.
- O'Connell, V.M. 1987. Reproductive seasons for some *Sebastes* species in Southeastern Alaska. Alaska Department of Fish and Game, Informational Leaflet 263, Juneau, 21 p.
- O'Connell, V., and D.W. Carlile. 1994. Comparison of remotely operated vehicle and a submersible for estimating abundance of demersal shelf rockfishes in the eastern Gulf of Alaska. *N. Am. J. Fish. Mgt.* 14:196-201.
- O'Connell, V., D. Carlile, and C. Brylinsky. 1997. Demersal shelf rockfish. In Stock assessment and fishery evaluation (SAFE) report for the groundfish resources of the Gulf of Alaska, pp. 309-324. North Pacific Fisheries Management Council, Anchorage.

- Phillips, S., editor. 1984. Report of the nearshore rockfish management workshop. Pacific States Marine Fisheries Commission, Gladstone, Oregon, 32 p.
- Pikitch, E.K. 1987. Impacts of management regulations on the catch and utilization of rockfish in Oregon. pp. 369-382 In: Melteff, B.R. [ed]. Proc. International Rockfish Symposium. Univ. of Ak, Alaska Sea Grant Rep. 87-2.
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fish. Res. Bd. Can., Bull. 191:382 p.
- Trowbridge, C. 1996. Central Region annual groundfish management report, 1995. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A96-42, Anchorage, 33 p.
- Trowbridge, C. 1998. Cook Inlet Area groundfish report to the Alaska Board of Fisheries, 1998. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A98-37, Anchorage, 17 p.
- Wyllie Echeverria, T. 1987. Thirty-four species of California rockfishes: Maturity and seasonality of reproduction. Fish. Bull. 85:229-250.

Table 1. Some species and assemblage names applied in Central Region rockfish management.

<u>ADF&G Species Code</u>	<u>Common Name</u>	<u>Scientific Name</u>
<u>Pelagic Shelf Rockfish</u>		
142	Black Rockfish	<i>Sebastes melanops</i>
154	Dusky Rockfish	<i>Sebastes ciliatus</i>
155	Yellowtail Rockfish	<i>Sebastes flavidus</i>
<u>Demersal Shelf Rockfish</u>		
138	Copper Rockfish	<i>Sebastes caurinus</i>
145	Yelloweye Rockfish	<i>Sebastes ruberrimus</i>
146	Canary Rockfish	<i>Sebastes pinniger</i>
147	Quillback Rockfish	<i>Sebastes maliger</i>
148	Tiger Rockfish	<i>Sebastes nigrocinctus</i>
149	China Rockfish	<i>Sebastes nebulosus</i>
150	Rosethorn Rockfish	<i>Sebastes helvomaculatus</i>
<u>Slope Rockfish</u>		
136	Northern Rockfish	<i>Sebastes polyspinis</i>
137	Bocaccio Rockfish	<i>Sebastes paucispinis</i>
141	Pacific Ocean Perch	<i>Sebastes alutus</i>
151	Rougheye Rockfish	<i>Sebastes aleutianus</i>
152	Shortraker Rockfish	<i>Sebastes borealis</i>
153	Redbanded Rockfish	<i>Sebastes babcocki</i>
157	Silvergray Rockfish	<i>Sebastes brevispinis</i>
158	Redstripe Rockfish	<i>Sebastes proriger</i>
159	Darkblotched Rockfish	<i>Sebastes crameri</i>
166	Sharpchin Rockfish	<i>Sebastes zacentrus</i>
NA	Splitnose Rockfish	<i>Sebastes diploproa</i>
NA	Harlequin Rockfish	<i>Sebastes variegatus</i>
<u>Thornyhead Rockfish</u>		
143	Shortspine Thornyhead	<i>Sebastolobus alascanus</i>

Table 2. Months of parturition for some female rockfish occurring in the northern Pacific Ocean.

Common Name	<u>Month of Documented Spawning Condition</u>											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<u>Pelagic Shelf Rockfish</u>												
Black Rockfish	*		?	?								
Dusky Rockfish			*	*	*	*						
Yellowtail Rockfish	*		?	?								
<u>Demersal Shelf Rockfish</u>												
Copper Rockfish			*	*	*	?	*					
Yelloweye Rockfish	*	*	*	*	*	*	*	*	*			
Canary Rockfish	*	*										
Quillback Rockfish			*	*	*	*	*					
Tiger Rockfish	*	*	*	*	*	*						
China Rockfish			*	*	*	*	*					
Rosethorn Rockfish	*	*	*	*	*	*	*	*	*			
<u>Slope Rockfish</u>												
Northern Rockfish												
Bocaccio Rockfish	*		?	?								
Pacific Ocean Perch				*	*							
Rougheye Rockfish				*								
Shortraker Rockfish				*								
Redbanded Rockfish				*	*							
Silvergray Rockfish					*	*	*					
Redstripe Rockfish					*	*						
Darkblotched Rockfish					*	?						
Sharpchin Rockfish						*	?					
Splitnose Rockfish							*					
Harlequin Rockfish												
<u>Thornyhead Rockfish</u>												
Shortspine Thornyhead												

Source: O'Connell 1987; Wyllie Echeverria 1987.

Table 3. Month in which some male rockfish that occur in the northern Pacific Ocean have been observed in a ripe spawning condition.

Common Name	<u>Month of Documented Spawning Condition</u>											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Black Rockfish		*						*	*	*	*	*
Dusky Rockfish												
Yellowtail Rockfish	*	*	*						*			
Widow Rockfish												
Blue Rockfish	*		*									
Copper Rockfish		*	*	*	*							
Yelloweye Rockfish	*	*	*	*	*						*	*
Canary Rockfish	*	*	*	*	*			*	*	*	*	*
Quillback Rockfish	*	*	*	*	*		*					
Tiger Rockfish	*	*	*		*						*	
China Rockfish			*			*						
Rosethorn Rockfish		*	*	*	*	*	*		*			
Northern Rockfish												
Bocaccio Rockfish		*	*									
Pacific Ocean Perch												
Rougheye Rockfish												
Shortraker Rockfish										*		
Redbanded Rockfish	*	*							*	*		
Silvergray Rockfish	*	*	*	*								
Redstripe Rockfish					*							
Darkblotched Rockfish												
Sharpchin Rockfish												
Splitnose Rockfish												
Harlequin Rockfish												
<u>Thornyhead Rockfish</u>												
Shortspine Thornyhead												

All listings from O'Connell 1987.

Table 4. Biological parameters for some rockfishes found in Gulf of Alaska fisheries.

Common Name	Maturity			Inst. Natural Mortality	Source
	Length at 50% (cm)	Age at 50%	Maximum Age		
<u>Pelagic Shelf Rockfish</u>					
Black Rockfish	38-42	6-8	51	0.12-0.26	14, 18
Dusky Rockfish	43	13	67	0.09	5, 14
Yellowtail Rockfish	35-36 ^c	6-7 ^c	42-53	0.06-0.14	14, 15, 16
<u>Demersal Shelf Rockfish</u>					
Copper Rockfish	32-34 ^c	4-6 ^c	50		14, 16
Yelloweye Rockfish	45-50	21-23	114	0.02	3, 4, 17
Canary Rockfish	40-44 ^c	7-9 ^c	23-58	0.03-0.17	14, 15, 16
Quillback Rockfish	22-26 ^c	4-6 ^c	74		14, 16
Tiger Rockfish			84		14,
China Rockfish	27 ^c	4 ^c	56		14, 16
Rosethorn Rockfish	22-23 ^c	7-8 ^c	71		14 16
<u>Slope Rockfish</u>					
Northern Rockfish	36	13	49	0.06	8, 9
Bocaccio Rockfish	42-48 ^c	3-4 ^c			16
Pacific Ocean Perch	36	10	79-98	0.02-0.08	8, 10
Rougheye Rockfish	45-47		95-140	0.01-0.04	11, 12, 19
Shortraker Rockfish	47		120	0.03-0.04	13, 19
Redbanded Rockfish	31-34 ^c	4 ^c			16
Silvergray Rockfish	44-46	14	80	0.01-0.07	15, 19
Redstripe Rockfish	29-30	8	41	0.09-0.10	15, 19
Darkblotched Rockfish	27 ^c	4 ^c	48	0.07	15, 16
Sharpchin Rockfish	27	10	46	0.05-0.07	8, 15
Splitnose Rockfish	19-22 ^c	7-9 ^c			16
Harlequin Rockfish	23-24		43		19
<u>Thornyhead Rockfish</u>					
Shortspine Thornyhead		11	62 (50-100)	0.07-0.08	1,2

^c – indicates data from California stocks

1 - Ianelli et al. 1997

2 - Miller 1985

3 - O'Connell et al 1997

4 - O'Connell and Funk 1986

5 - Clausen and Heifetz 1997

6 - Meyer 1992

7 - Urban and Phillips

8 - Heifetz and Ianelli

9 - Clausen and Heifetz 1991

10 - Heifetz et al. 1994

11 - Nelson and Quinn 1987

12 - Nelson 1986

13 - McDermott 1994

14 - Meyer personal communication

15 - Archibald et al. 1981

16 - Wyllie Echeverria 1987

17 - O'Connell and Funk 1987

18 - Wallace and Tagart 1994.

19 - Haldorson and Love 1991.

Table 5. Commercial harvests of rockfish assemblage by gear type in the North Gulf District, 1987-1998.

Year ^a	Round Weight (lb)					Percent of all Gears
	Pelagic	Demersal	Slope	Unknown	Total	
			Jig			
1987	34,937	887	0	32,010	67,834	40.4%
1988	31,175	799	0	23,141	55,115	36.8%
1989	4,683	18	163	0	4,864	21.4%
1990	16,946	15	1,638	0	18,599	62.4%
1991	188,691	4,943	13,019	0	206,653	92.7%
1992	100,081	2,578	1,675	0	104,334	30.9%
1993	28,252	2,724	2,863	0	33,839	49.7%
1994	119,988	10,878	3,114	0	133,980	65.3%
1995	211,533	7,324	4,249	0	223,106	83.2%
1996	58,354	3,031	405	0	61,790	53.6%
1997	102,286	7,189	811	0	110,286	61.4%
1998	32,688	927	900	0	34,515	54.7%
Average	81,539	3,671	3,104	27,576	92,764	57.8%
			Longline			
1987	49,033	8,817	828	41,486	100,164	59.6%
1988	55,809	4,167	87	34,699	94,762	63.2%
1989	6,102	10,334	731	740	17,907	78.6%
1990	4,381	990	5,612	60	11,043	37.1%
1991	666	2,162	13,010	0	15,838	7.1%
1992	96,934	123,698	11,896	0	232,528	68.9%
1993	6,572	24,631	2,751	0	33,954	49.9%
1994	37,721	24,075	9,372	0	71,168	34.7%
1995	11,545	27,441	5,235	0	44,221	16.5%
1996	14,542	27,919	4,388	0	46,849	40.7%
1997	14,065	41,706	13,230	33	69,034	38.4%
1998	3,374	19,422	5,507	0	28,303	44.9%
Average	27,034	26,904	6,104	15,404	67,043	41.7%
			Other Gears			
1987	0	0	0	0	0	0.0%
1988	0	0	0	0	0	0.0%
1989	0	0	0	0	0	0.0%
1990	49	0	59	44	152	0.5%
1991	238	0	139	36	413	0.2%
1992	63	68	0	13	144	0.0%
1993	0	40	73	120	233	0.3%
1994	0	0	0	0	0	0.0%
1995	266	182	414	0	862	0.3%
1996	26	25	250	6,254	6,555	5.7%
1997	105	0	243	0	348	0.2%
1998	6	0	246	0	252	0.4%
Average	108	63	203	1,078	747	0.5%

^a - Average includes years 1987-1997; 1998 data is preliminary through 26 October 1998.

Table 6. Annual rockfish commercial catch by all gear types in the North Gulf District, 1987-1998.

<u>Year^a</u>	<u>Pelagic</u>	<u>Demersal</u>	<u>Slope</u>	<u>Unknown</u>	<u>Total</u>	<u>Closure Date</u>
<u>Round Weight (lb)</u>						
1987	83,970	9,704	828	73,496	167,998	December 31
1988	86,984	4,966	87	57,840	149,877	December 31
1989	10,785	10,352	894	740	22,771	July 10 - F
1990	21,376	1,005	7,353	60	29,794	July 20 - F
1991	189,595	7,141	26,168	0	222,904	June 21 - F
1992	197,078	126,589	13,580	0	337,247	July 10 - F
1993	34,824	27,395	5,687	120	68,026	December 31
1994	157,709	34,953	12,486	0	205,148	May 28
1995	223,344	34,947	9,898	0	268,189	June 1
1996	72,922	37,229	5,043	0	115,194	May 6
1997	116,456	48,896	14,284	33	179,669	May 4
1998	36,068	20,349	6,653	0	63,070	April 7
<u>Average Annual Harvest Weight (lb)</u>						
1987-1997	108,640	31,198	8,755	12,026	160,620	
1993-1997	121,051	36,684	9,480	31	167,245	
<u>Percent of Total Annual Harvest</u>						
<u>Year^a</u>	<u>Pelagic</u>	<u>Demersal</u>	<u>Slope</u>	<u>Unknown</u>	<u>Total lb</u>	
1987	50.0%	5.8%	0.5%	43.7%	167,998	
1988	58.0%	3.3%	0.1%	38.6%	149,877	
1989	47.4%	45.5%	3.9%	3.2%	22,771	
1990	71.7%	3.4%	24.7%	0.2%	29,794	
1991	85.1%	3.2%	11.7%	0.0%	222,904	
1992	58.4%	37.5%	4.0%	0.0%	337,247	
1993	51.2%	40.3%	8.4%	0.2%	68,026	
1994	76.9%	17.0%	6.1%	0.0%	205,148	
1995	83.3%	13.0%	3.7%	0.0%	268,189	
1996	63.3%	32.3%	4.4%	0.0%	115,194	
1997	64.8%	27.2%	8.0%	0.0%	179,669	
1998	57.2%	32.3%	10.5%	0.0%	63,070	
<u>Average Percent Composition Among Years</u>						
1987-1997	64.6%	20.8%	6.9%	7.8%	160,620	
1993-1997	67.9%	26.0%	6.1%	0.0%	167,245	

^a - Data for 1998 is preliminary through 26 October 1998.

^b - F denotes some portion of the rockfish fishery was closed to coincide with management actions in adjacent federal waters.

Table 7. Commercial harvests by gear and rockfish assemblage in the Cook Inlet District, 1987-1998.

Year ^a	Round Weight (lb)					Percent of all Gears
	Pelagic	Demersal	Slope	Unknown	Total	
Jig						
1987	0	0	0	0	0	0.0%
1988	587	0	0	0	587	20.4%
1989	0	0	0	0	0	0.0%
1990	0	0	0	0	0	0.0%
1991	0	0	0	0	0	0.0%
1992	0	0	0	0	0	0.0%
1993	2,329	0	0	0	2,329	88.3%
1994	0	0	0	0	0	0.0%
1995	1,949	0	0	0	1,949	46.6%
1996	0	0	0	0	0	0.0%
1997	2,276	94	2	0	2,372	72.7%
1998	0	0	0	0	0	0.0%
Average	649	9	0	0	658	28.3%
Longline						
1987	0	46	0	882	928	8.6%
1988	0	567	641	1,089	2,297	79.6%
1989	0	0	0	0	0	0.0%
1990	0	246	153	0	399	100.0%
1991	43	47	176	0	266	100.0%
1992	0	0	328	0	328	100.0%
1993	3	305	0	0	308	11.7%
1994	0	0	109	0	109	100.0%
1995	245	1,882	105	0	2,232	53.4%
1996	210	468	18	0	696	100.0%
1997	15	731	129	16	891	27.3%
1998	0	10	0	0	10	100.0%
Average	47	390	151	181	769	33.0%
Other Gears						
1987	0	0	8,750	1,172	9,922	91.4%
1988	0	0	0	0	0	0.0%
1989	0	0	0	0	0	0.0%
1990	0	0	0	0	0	0.0%
1991	0	0	0	0	0	0.0%
1992	0	0	0	0	0	0.0%
1993	0	0	0	0	0	0.0%
1994	0	0	0	0	0	0.0%
1995	2	0	0	0	2	0.0%
1996	0	0	0	0	0	0.0%
1997	0	0	0	0	0	0.0%
1998	0	0	0	0	0	0.0%
Average	0	0	795	107	902	38.7%

^a - Average includes years 1987-1997; 1998 data is preliminary through 26 October 1998.

Table 8. Annual rockfish commercial catch by all gear types in the Cook Inlet District, 1987-1998.

<u>Year^a</u>	<u>Pelagic</u>	<u>Demersal</u>	<u>Slope</u>	<u>Unknown</u>	<u>Total</u>	<u>Closure Date</u>
<u>Round Weight (lb)</u>						
1987	0	46	8,750	2,054	10,850	December 31
1988	587	567	641	1,089	2,884	December 31
1989	0	0	0	0	0	December 31
1990	0	246	153	0	399	December 31
1991	43	47	176	0	266	June 21 - F
1992	0	0	328	0	328	July 10 - F
1993	2,332	305	0	0	2,637	December 31
1994	0	0	109	0	109	June 11
1995	2,196	1,882	105	0	4,183	June 1
1996	210	468	18	0	696	May 6
1997	2,291	825	131	16	3,263	May 4
1998	0	10	0	0	10	April 7
<u>Average Annual Harvest Weight (lb)</u>						
1987-1997	696	399	946	287	2,329	
1993-1997	1,406	696	73	3	2,178	
<u>Year^a</u>	<u>Pelagic</u>	<u>Demersal</u>	<u>Slope</u>	<u>Unknown</u>	<u>Total lb</u>	
<u>Percent of Total Annual Harvest</u>						
1987	0.0%	0.4%	80.6%	18.9%	10,850	
1988	20.4%	19.7%	22.2%	37.8%	2,884	
1989	No Harvest				0	
1990	0.0%	61.7%	38.3%	0.0%	399	
1991	16.2%	17.7%	66.2%	0.0%	266	
1992	0.0%	0.0%	100.0%	0.0%	328	
1993	88.4%	11.6%	0.0%	0.0%	2,637	
1994	0.0%	0.0%	100.0%	0.0%	109	
1995	52.5%	45.0%	2.5%	0.0%	4,183	
1996	30.2%	67.2%	2.6%	0.0%	696	
1997	70.2%	25.3%	4.0%	0.5%	3,263	
1998	0.0%	100.0%	0.0%	0.0%	10	
<u>Average Percent Composition Among Years</u>						
1987-1997	25.3%	22.6%	37.9%	5.2%	2,329	
1993-1997	48.3%	29.8%	21.8%	0.1%	2,178	

^a - Data for 1998 is preliminary through 26 October 1998.

^b - F denotes some portion of the rockfish fishery was closed to coincide with management actions in adjacent federal waters.

Table 9. Commercial and recreational harvests of rockfish assemblages from the Cook Inlet Management Area, 1991-1997.

<u>Year</u>	<u>Round Weight (lb)</u>			<u>Total</u>
	<u>Pelagic Shelf</u>	<u>Demersal Shelf</u>	<u>Slope</u>	
Commercial Harvests				
1991	189,638	7,188	26,344	223,170
1992	197,078	126,589	13,908	337,575
1993	37,156	27,700	5,807	70,663
1994	157,709	34,953	12,595	205,257
1995	225,540	36,829	10,003	272,372
1996	73,132	37,697	5,061	115,890
<u>1997</u>	<u>118,747</u>	<u>49,721</u>	<u>14,464</u>	<u>182,932</u>
Average	142,714	45,811	12,597	201,123
Recreational Harvests				
1991	62,573	53,799	1,091	117,463
1992	94,010	50,375	1,427	145,812
1993	86,552	50,879	1,342	138,773
1994	100,536	52,777	1,070	154,383
1995	68,190	36,409	822	105,421
1996	96,472	40,940	293	137,705
<u>1997</u>	<u>82,785</u>	<u>74,275</u>	<u>794</u>	<u>157,854</u>
Average	84,445	51,351	977	136,773
Pooled Commercial and Recreational Harvests				
1991	252,211	60,987	27,435	340,633
1992	291,088	176,964	15,335	483,387
1993	123,708	78,579	7,149	209,436
1994	258,245	87,730	13,665	359,640
1995	293,730	73,238	10,825	377,793
1996	169,604	78,637	5,354	253,595
<u>1997</u>	<u>201,532</u>	<u>123,996</u>	<u>15,258</u>	<u>340,786</u>
Average	227,160	97,162	13,574	337,896

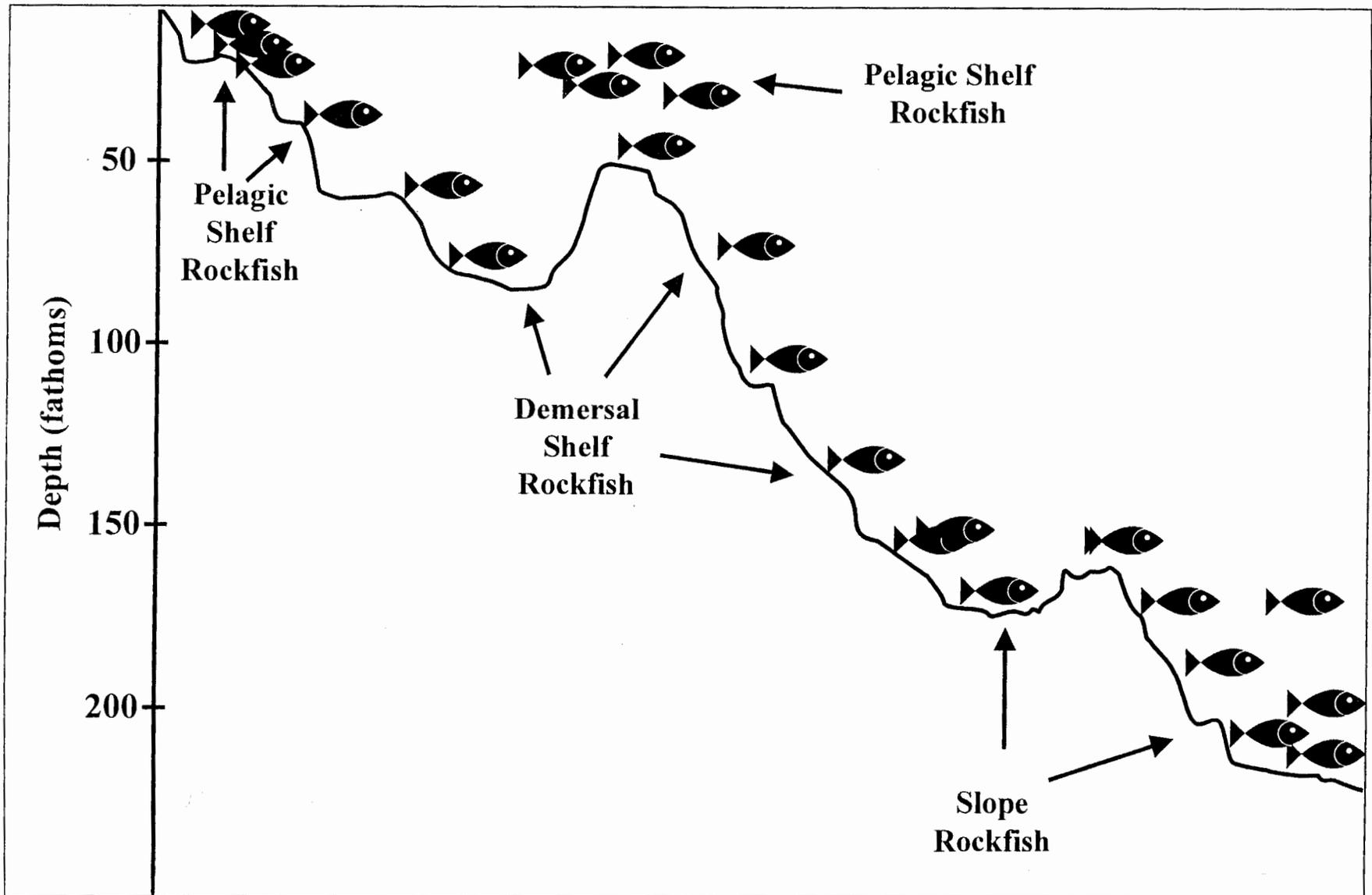


Figure 1. Typical habitat distribution of rockfish species assemblages.

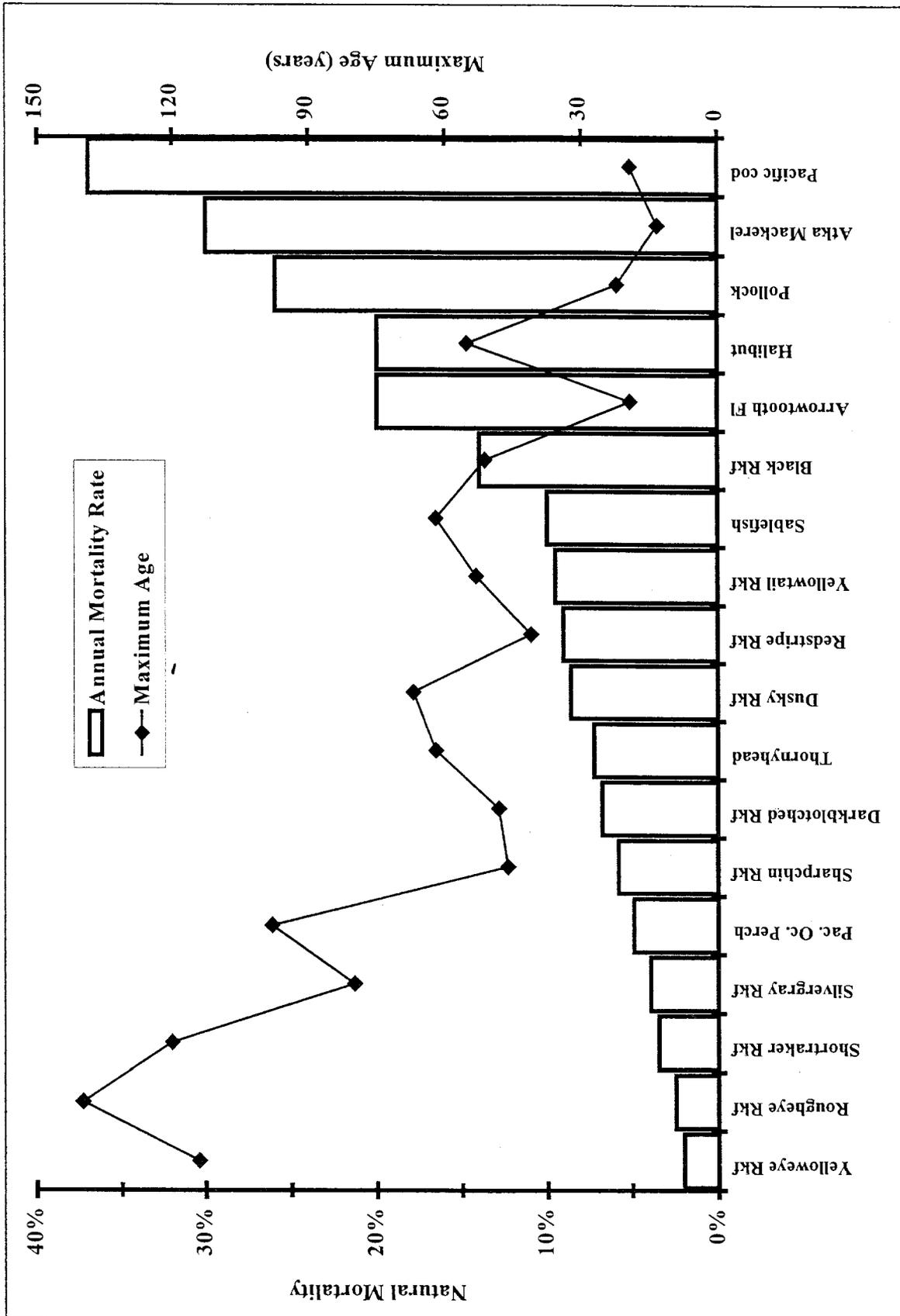


Figure 2. Comparisons of natural mortality rates to longevity for a variety of marine species.

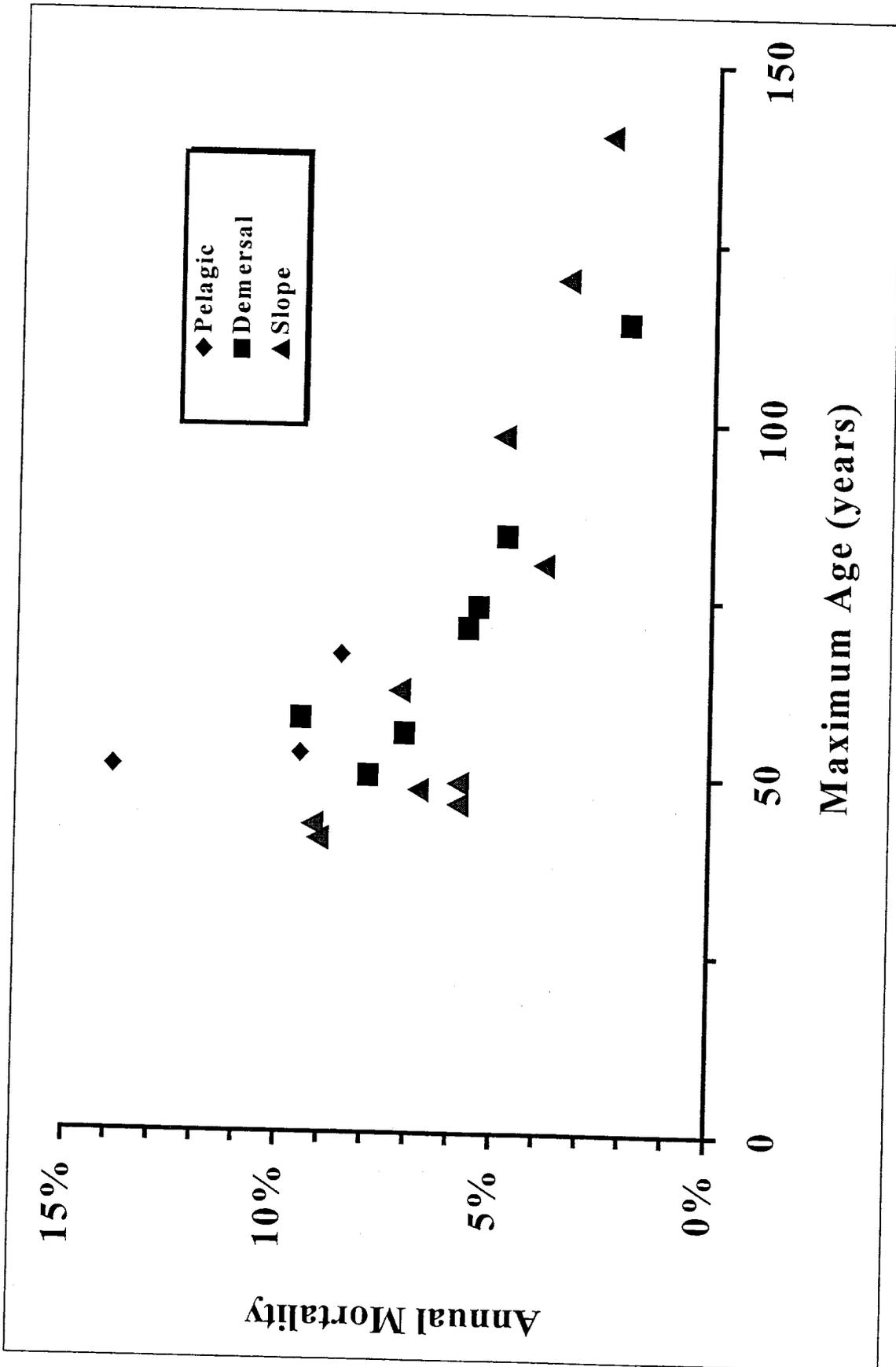


Figure 3. Distribution of rockfish longevity and natural mortality by species assemblage.

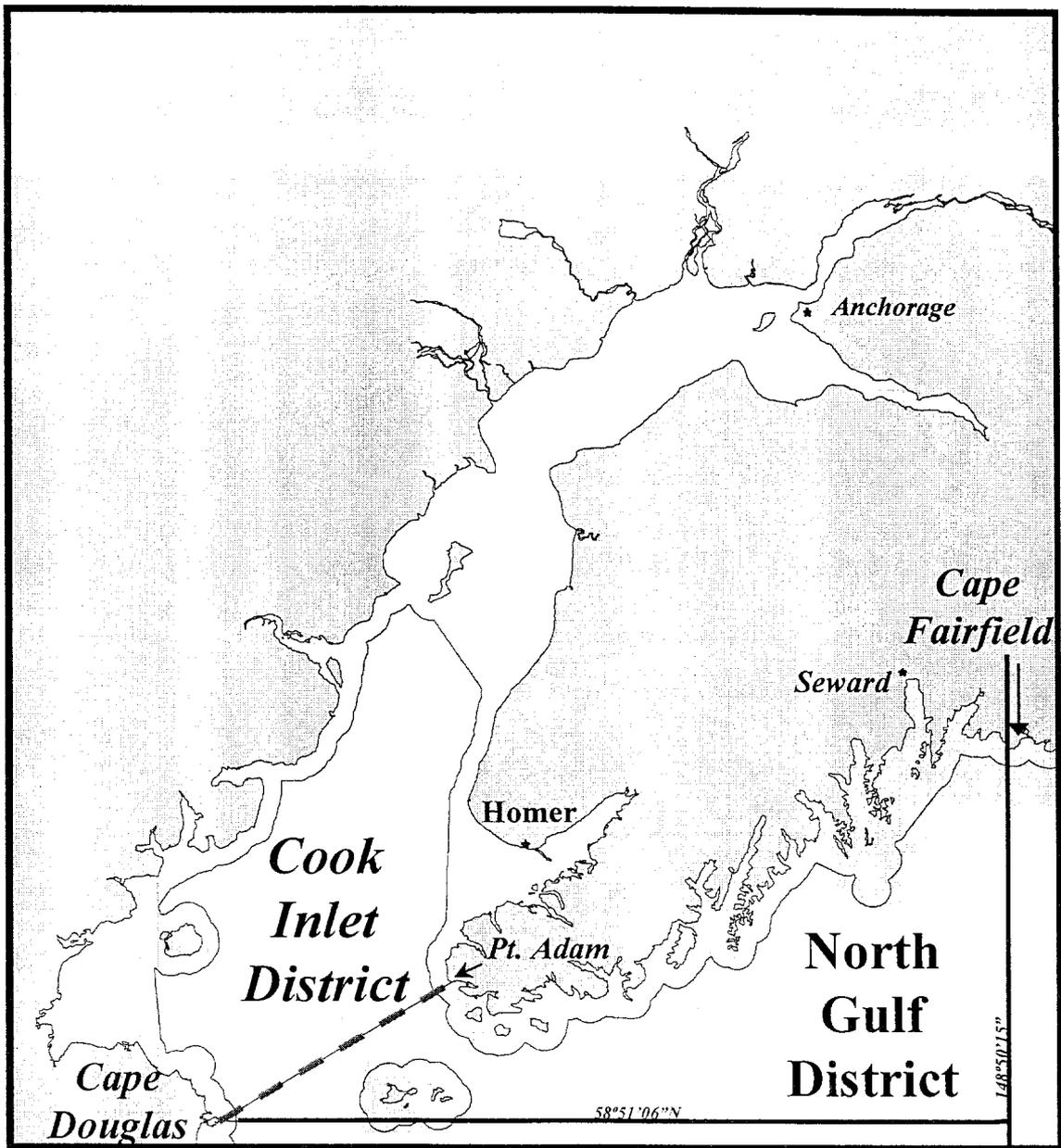


Figure 4. Groundfish fishery districts of the Cook Inlet Management Area.

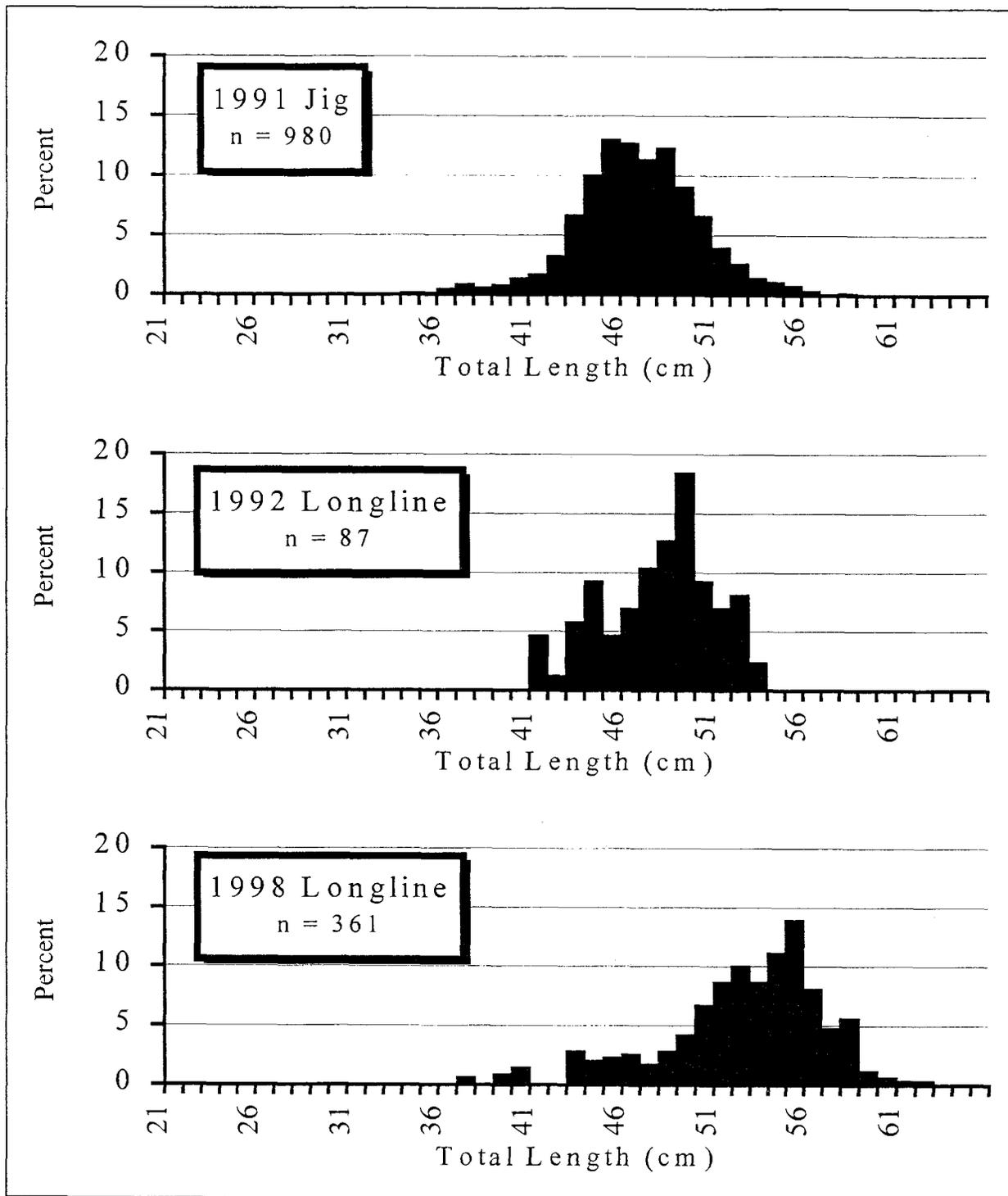


Figure 5. Size distribution of black rockfish sampled from the North Gulf District in 1991, 1992, and 1998.

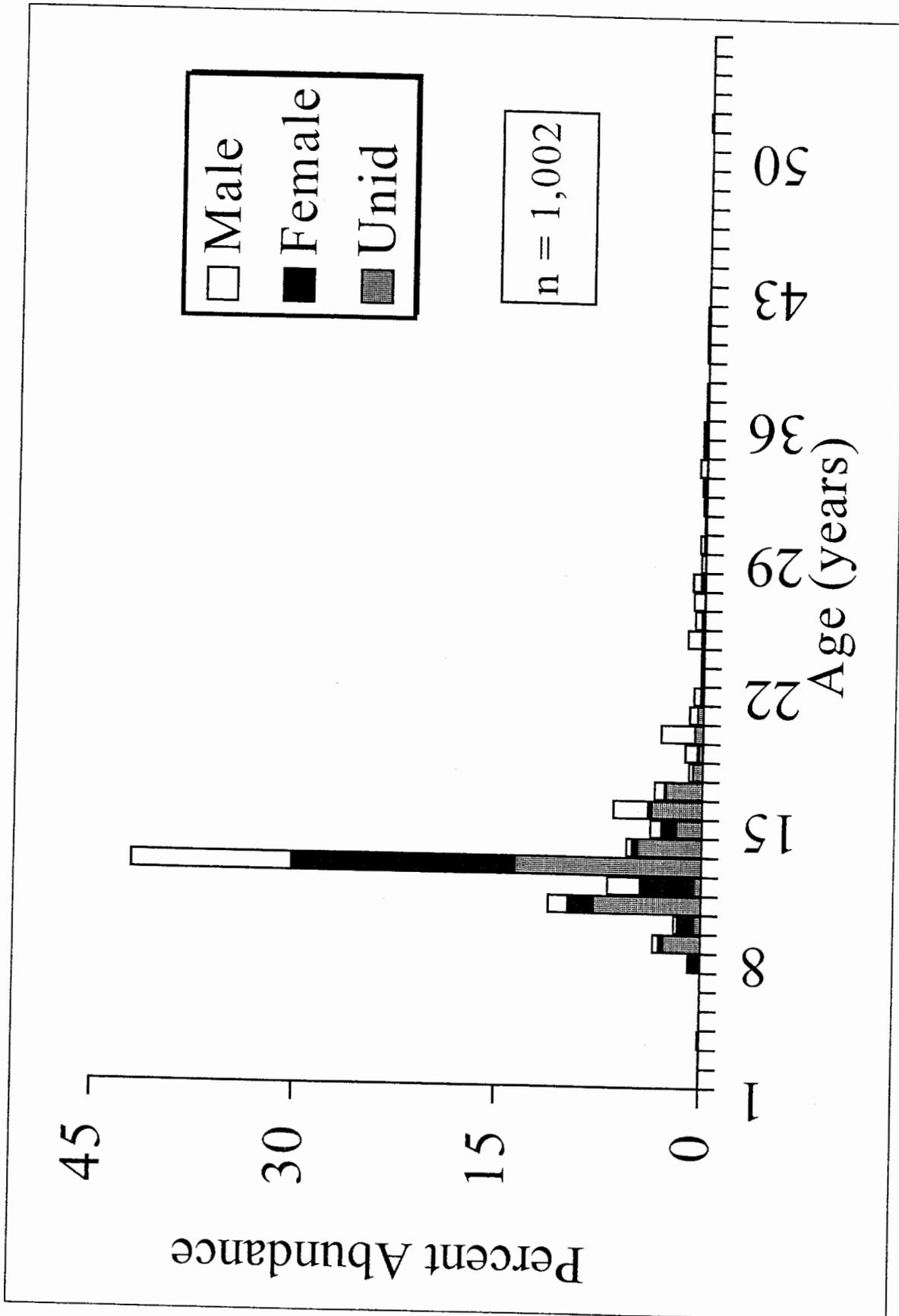


Figure 6. Age distribution of black rockfish sampled from the North Gulf District, 1991-1993.

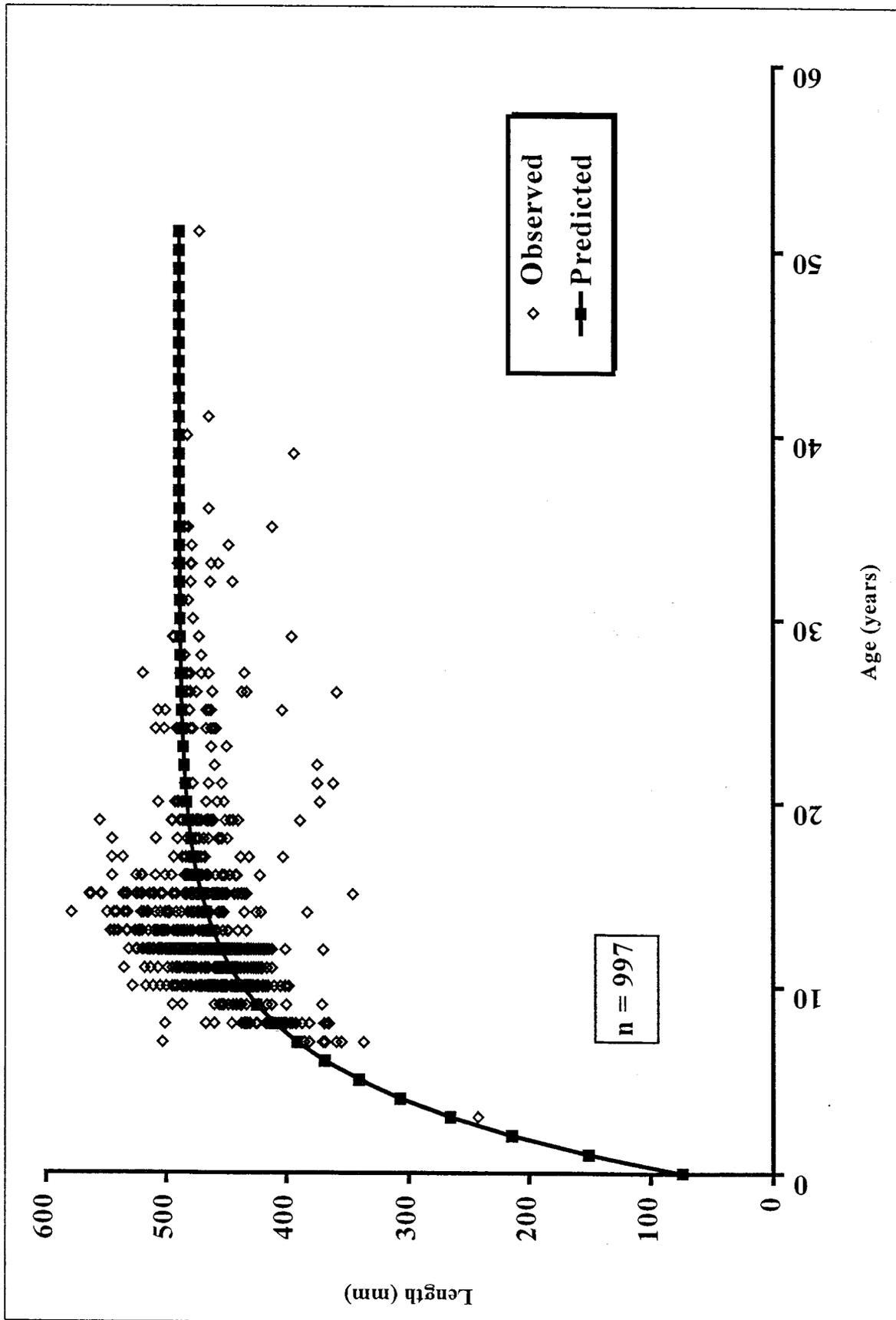


Figure 7. Size-at-age of black rockfish caught in the North Gulf District, 1991-1992.

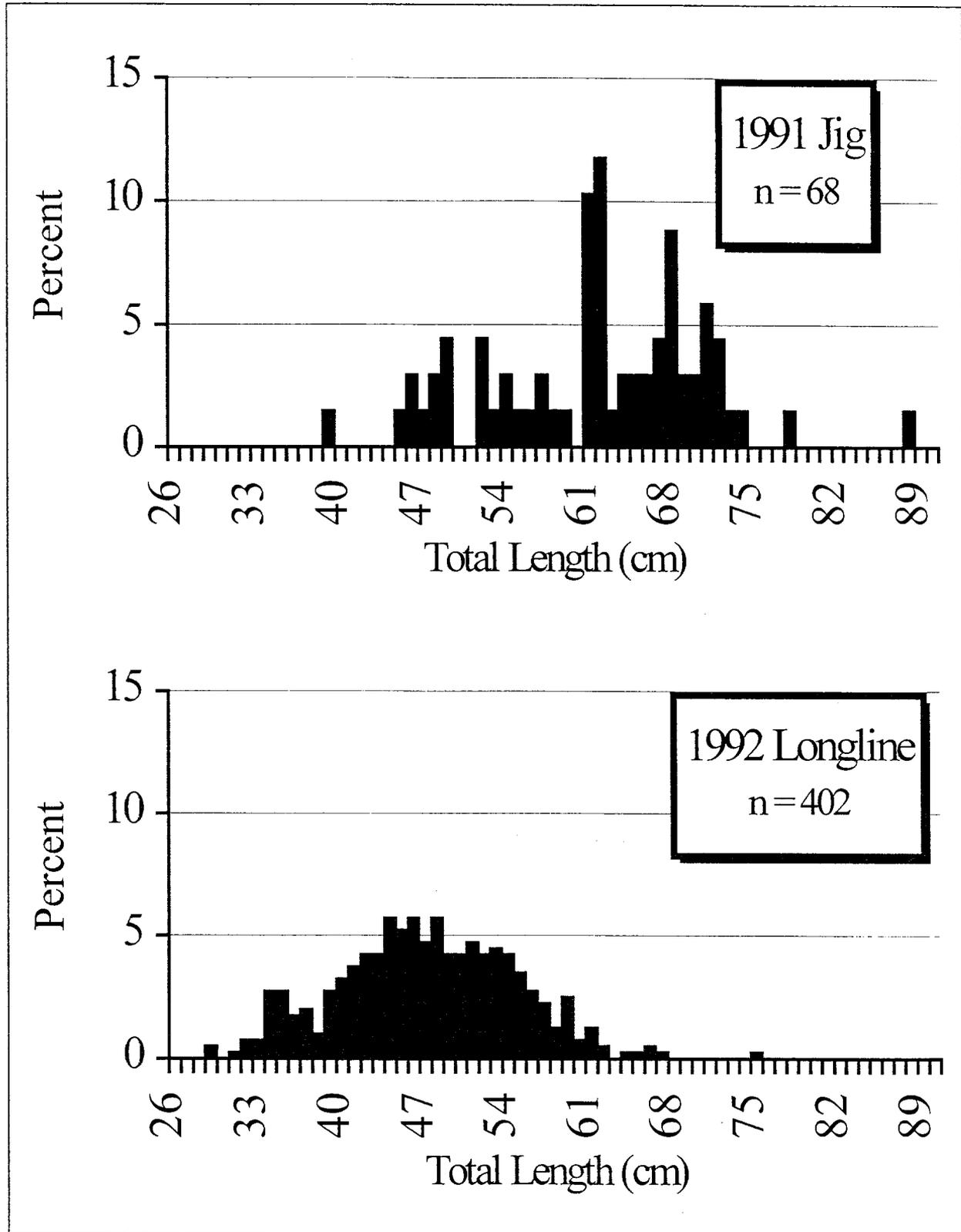


Figure 8. Size composition of yelloweye rockfish caught from commercial deliveries in the North Gulf District, 1991 and 1992.

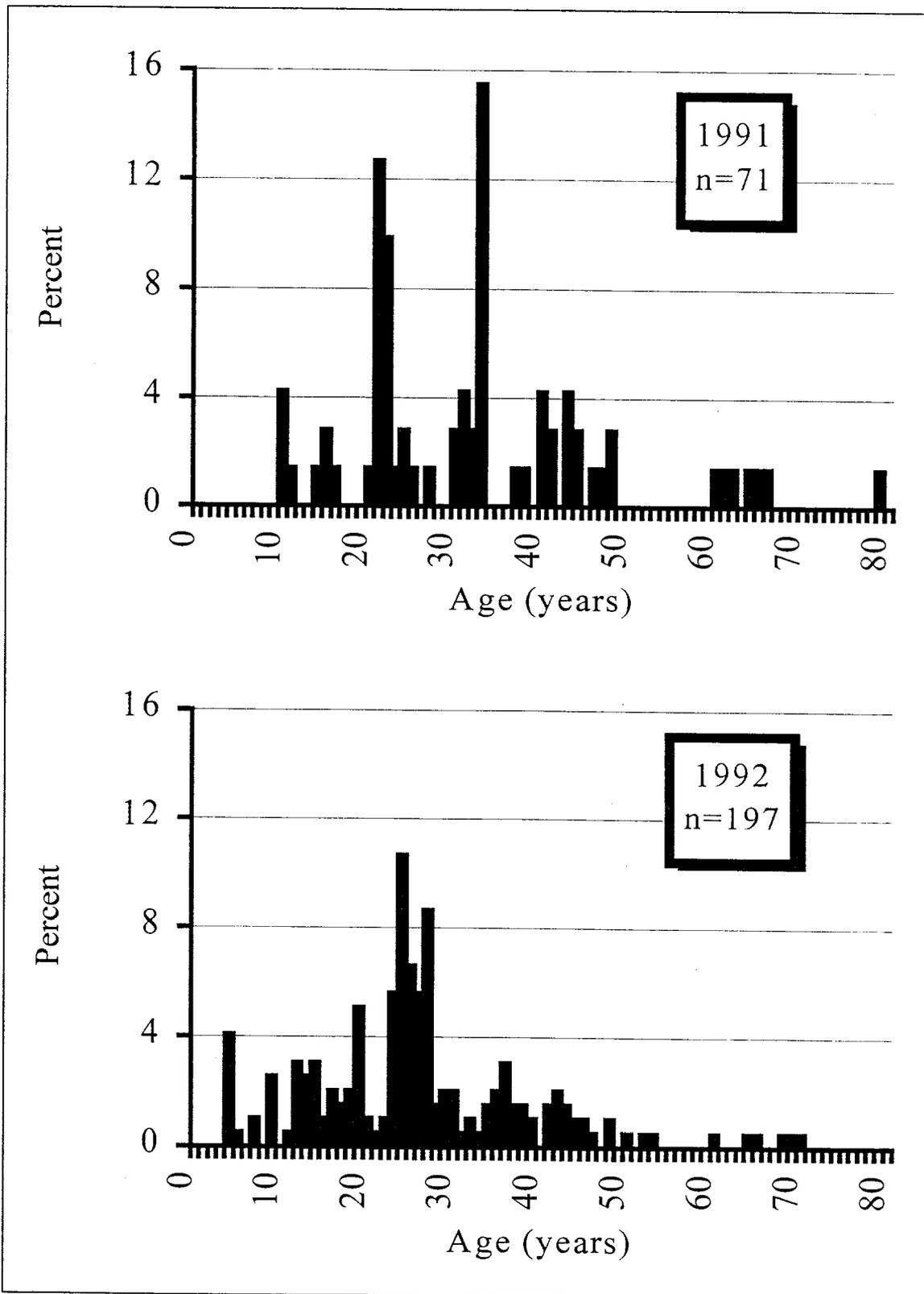


Figure 9. Age composition of yelloweye rockfish sampled from commercial deliveries in the North Gulf District, 1991 and 1992

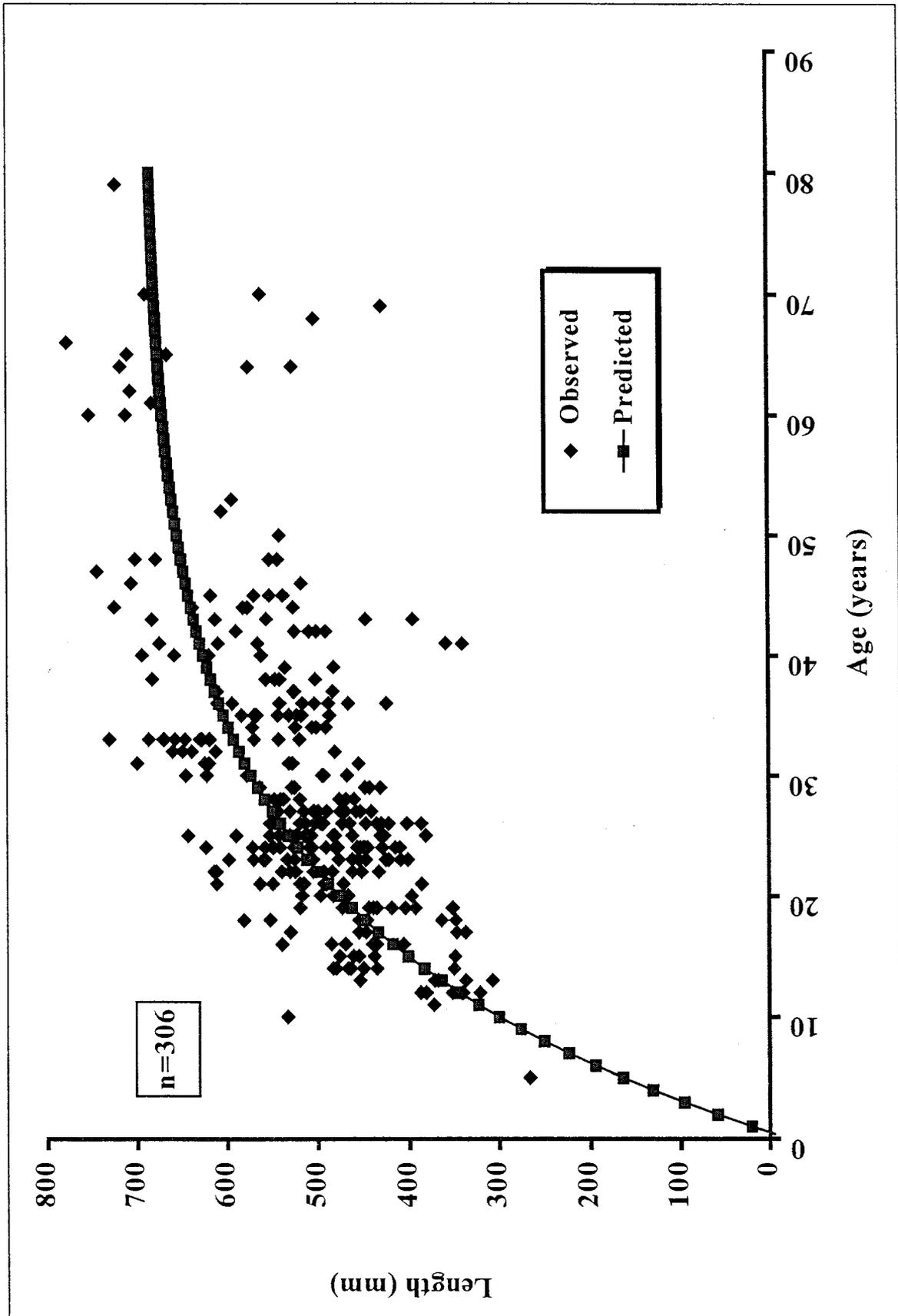


Figure 10. Size-at-age of yelloweye rockfish caught in the North Gulf District, 1991-1994.

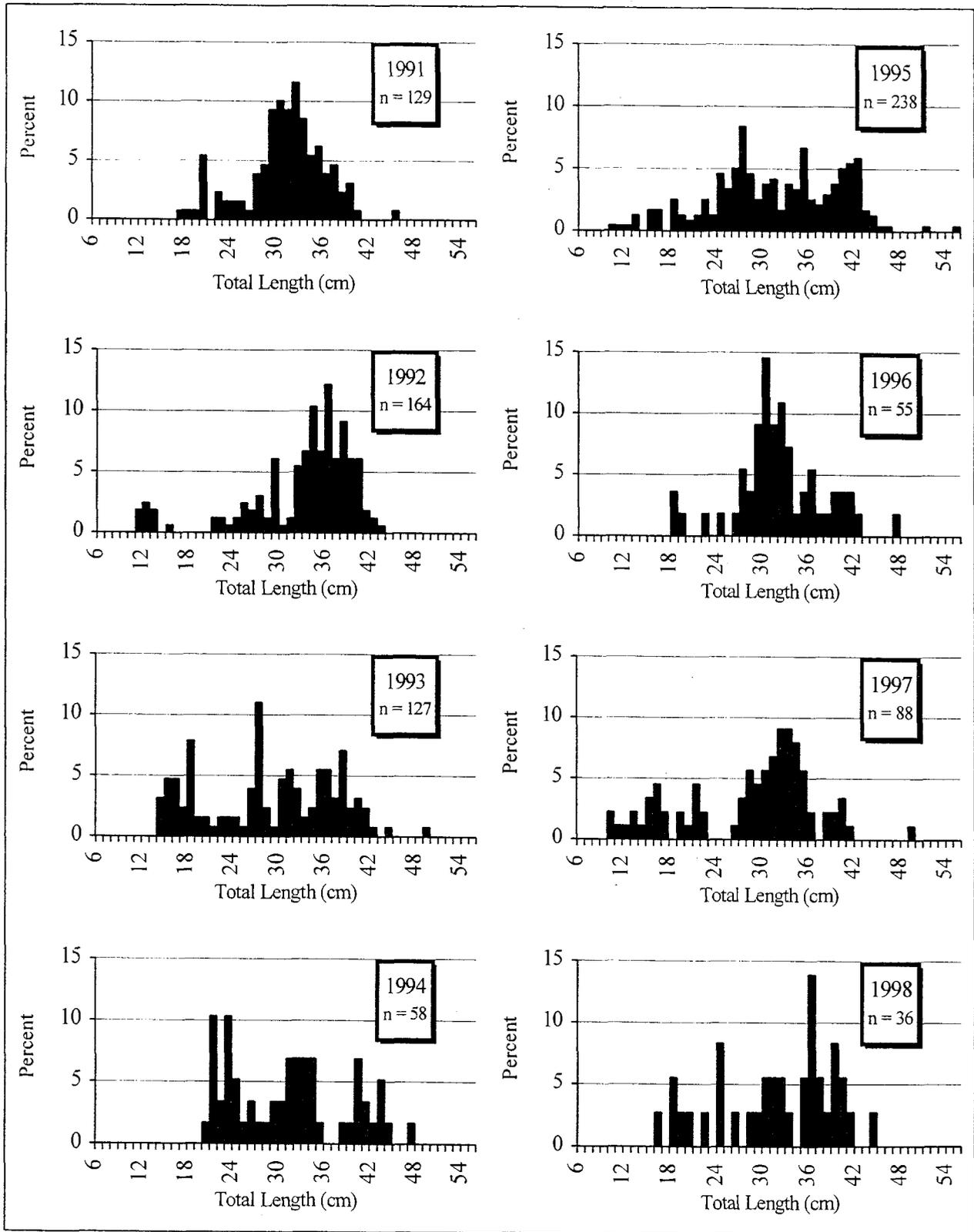


Figure 11. Size composition of roughey rockfish caught by ADF&G trawl surveys in the Cook Inlet District, 1991-1998.

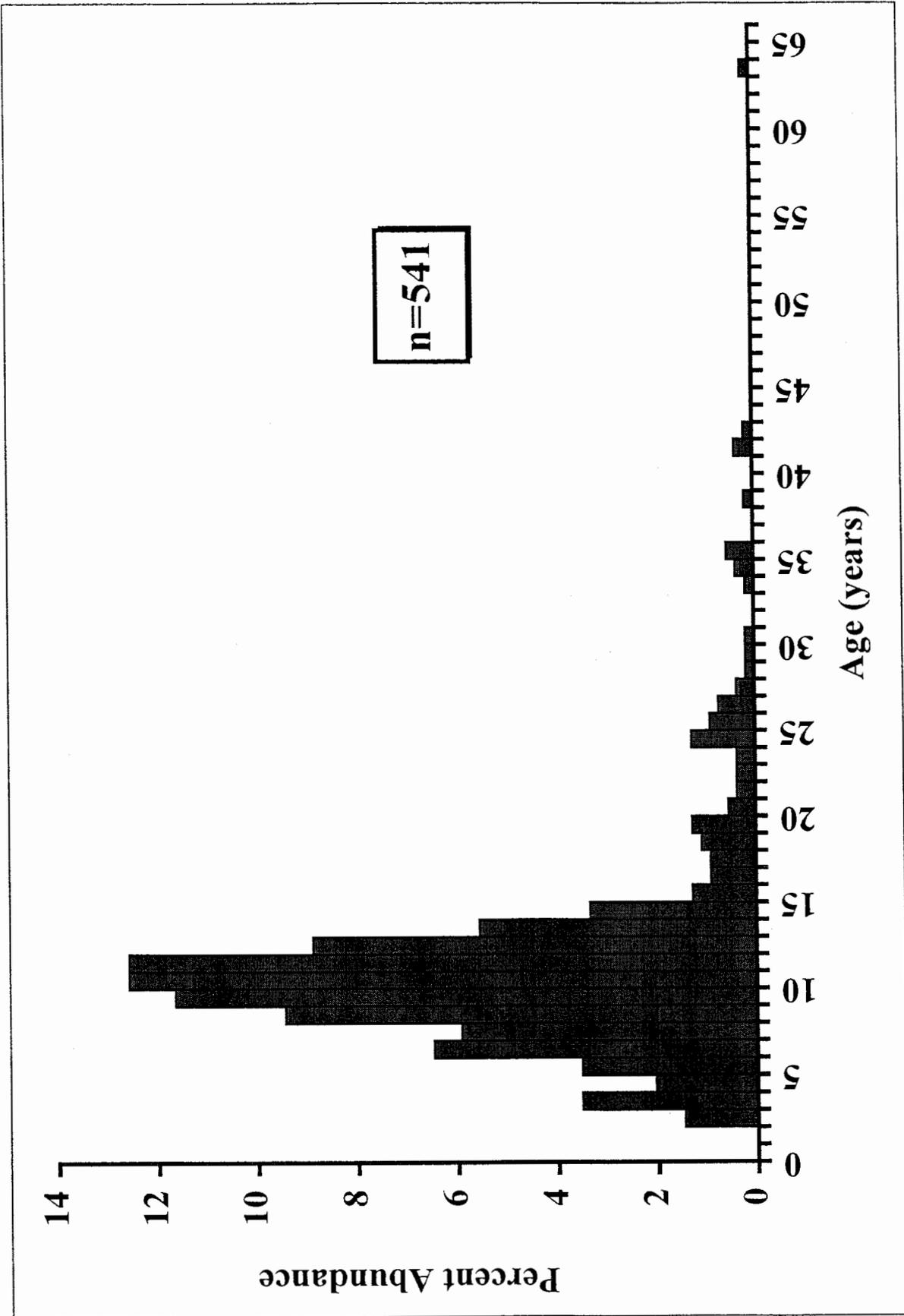


Figure 12. Age composition of rougheye rockfish sampled in the Cook Inlet Management Area, 1991-1995.

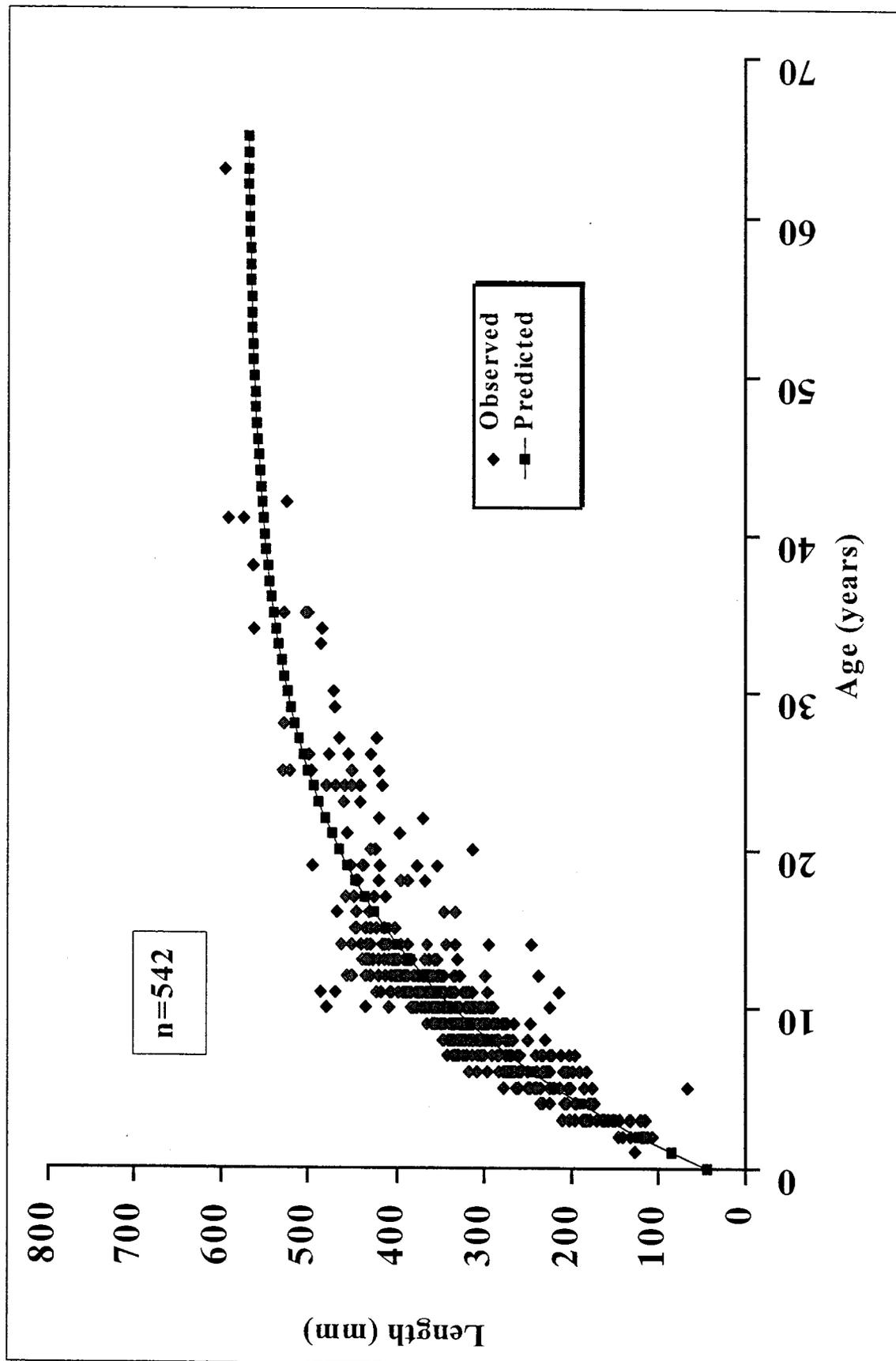


Figure 13. Size-at-age of rougheye rockfish sampled from ADF&G trawl surveys and commercial fisheries in the Cook Inlet Management Area, 1991-1995.

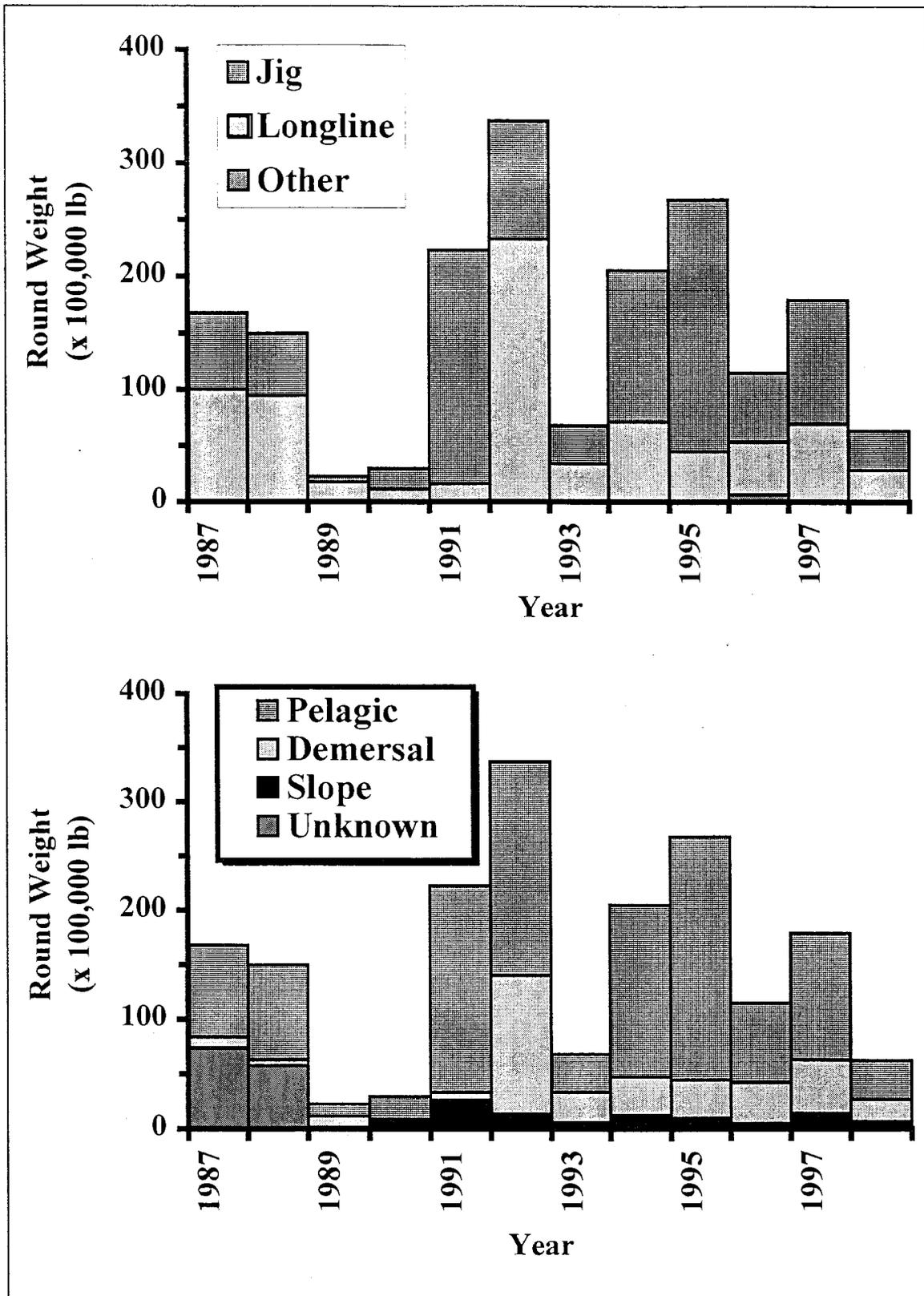


Figure 14. Rockfish harvest composition by gear and species assemblage in the North Gulf District, 1987-1998.

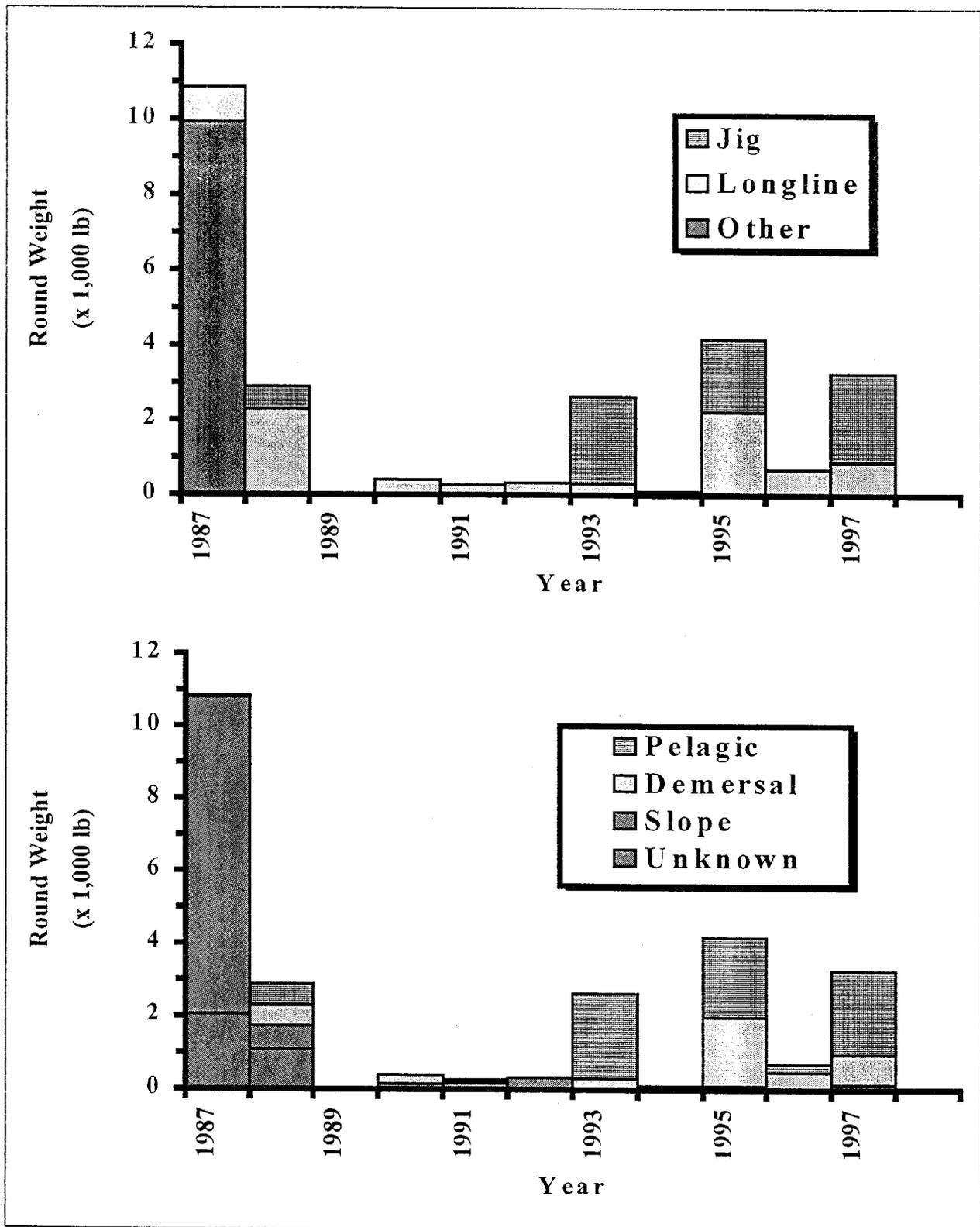


Figure 15. Rockfish harvest composition by gear and species assemblage in the Cook Inlet District, 1987-1998.

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