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**Incidental Catch and Mortality of
Pacific Halibut, 1962-1986**

by

Gregg H. Williams, Cyreis C. Schmitt,
Stephen H. Hoag, and Jerald D. Berger

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PREFACE

This Technical Report presents current information collected by the staff of the International Pacific Halibut Commission on incidental catches of Pacific halibut. These data are presented in units of *pounds dressed weight (heads-off, eviscerated)*, as most investigators are familiar with halibut data in this form. Any deviation is specifically stated. To obtain *round weight*, multiply dressed weight by 1.33. Directed catches of groundfish are presented in metric tons (mt) *round weight*, whereas shellfish catches are shown in pounds *round weight*.

ABSTRACT

The International Pacific Halibut Commission (IPHC) annually compiles estimates of the amount of Pacific halibut (*Hippoglossus stenolepis*) incidentally caught in fisheries directed at shellfish and other groundfish. Incidental catches in foreign and joint venture fisheries off Alaska are estimated by the U.S. National Marine Fisheries Service, whereas IPHC estimates incidental catches in all other fisheries. For fisheries which receive at-sea monitoring, halibut incidence data extrapolated to the fishery provide a reliable estimate of incidental catch. Estimates based on incidence data collected during infrequent observer programs or observed on research surveys are considered less reliable and, in some cases, only indicate the general magnitude of the incidental catch. The combined estimates for all fisheries show that incidental catch peaked at 26 million pounds (*net weight*) in 1962. Incidental catch has generally declined since the early 1960s when estimates were first available, although there have been periodic increases in the early 1970s and 1980s when effort expanded in specific areas. By 1986, incidental catch declined to 10 million pounds. Based on mortality rates of 100 percent in the foreign trawl, joint venture, U.S. crab pot and shrimp trawl fisheries, 50 percent in U.S. and Canadian trawl fisheries for groundfish, and 25 percent on foreign setline operations, the actual loss was estimated at 25 million pounds in 1962, but has since declined to 7 million pounds in 1986, the lowest since the early 1960s. By comparison, the directed commercial and sport fishery for halibut harvested 73.1 million pounds in 1986.

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Gregg H. Williams, Cyreis C. Schmitt¹, Stephen H. Hoag and Jerald D. Berger²

INTRODUCTION

Pacific halibut (*Hippoglossus stenolepis*) are caught in many fisheries other than the directed commercial and sport halibut fishery. Regulations of the International Pacific Halibut Commission (IPHC) prohibit Canadian and United States fishermen from retaining halibut captured with gear other than hook and line. Further, foreign fishermen are prohibited by federal regulation from retaining halibut regardless of gear type. These regulations are designed to prevent fisheries other than the directed halibut fishery from targeting fishing effort toward halibut. However, halibut are often caught incidentally in other fisheries, and released fish may not survive injuries received during capture. Thus, the incidental catch represents a source of mortality and earlier estimates by Hoag (1976) indicate that the yield loss to the directed fishery may be substantial.

Information on the magnitude of the incidental catch is lacking or meager for some fisheries, making it difficult to precisely assess the effects of incidental catches on the halibut resource. IPHC conducted several studies to estimate incidental catch (Hoag 1971, Williams et al. 1982), but does not have the resources to monitor these fisheries on an annual basis. Rather, IPHC relies largely on information collected by other agencies. The most reliable information on incidental catch is from observer programs where scientists sample the catch at sea. These programs are expensive and require cooperation from the fishing industry. Only foreign and joint venture fisheries have been extensively monitored by observers. Information on incidental catches in domestic fisheries, i.e. those with U.S. or Canadian shoreside or at-sea processing, is obtained from limited observer programs or research operations and generally is not sufficient to provide precise annual estimates.

Incidental catch and loss due to mortality are estimated each year by IPHC, but several of the estimation techniques have not been published. In addition, the information about halibut captured in minor fisheries, such as the U.S. fishery for shrimp, has not been previously presented. The objective of this report is to review all data concerning the incidental catch of halibut and to briefly describe the techniques used by IPHC to estimate incidental catch and mortality.

OVERVIEW OF POPULATION REMOVALS

Incidental catch becomes an increasingly significant source of mortality as it becomes a larger proportion of the overall removals from the resource. Figure 1 depicts total removals from 1962 through 1986 and illustrates the amount of incidental mortality that is estimated

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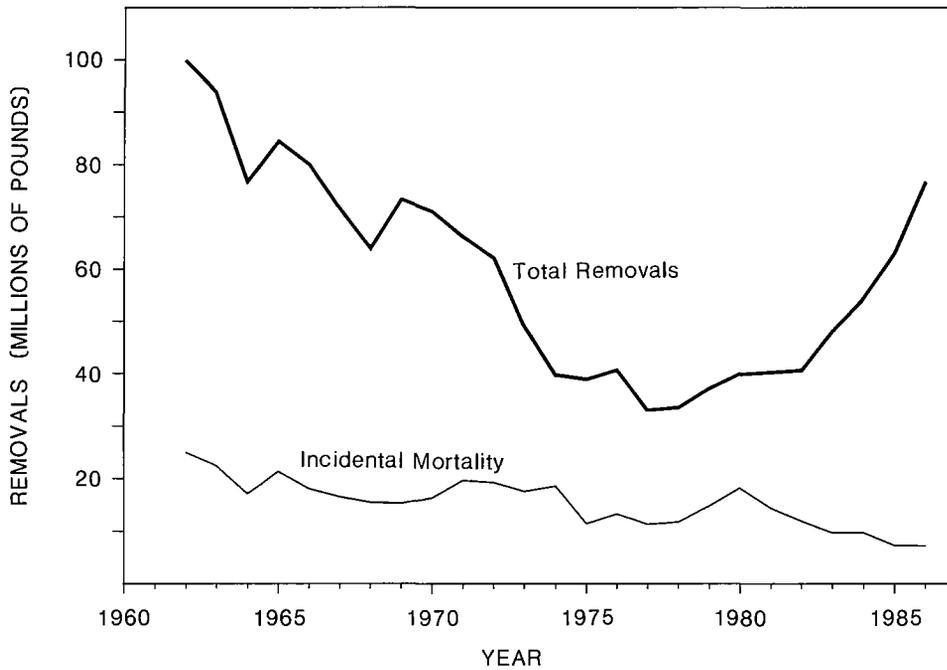


Figure 1. Incidental mortality from 1962 through 1986 as a portion of total removals from the Pacific halibut population.

to have occurred during this period. Total removals ranged from 65 to 100 million pounds during the 1960s, with incidental mortality estimated to have ranged from a high of 25 million pounds in 1962 to a low of 15 million pounds in 1969. Total removals subsequently declined primarily due to the reduced quotas allowed by IPHC, which was in response to a decline in the abundance of halibut. However, incidental mortality remained high due to a lack of regulation and became an increasingly larger share of the total removals through the 1970s.

Halibut abundance stabilized during the mid-1970s and total removals from the resource ranged from 35 to 40 million pounds during 1974 to 1982. Incidental mortality declined to a low of 12 million pounds, but increased to 18 million pounds in 1980, partly as a result of increased foreign fishing effort (IPHC 1987). Incidental mortality has since declined as foreign fisheries operating off Alaska have been curtailed and were eliminated in the Gulf of Alaska in 1986. Total removals have increased significantly during the 1980s as a result of increasing halibut abundance and reduced incidental mortality (IPHC 1988). Total removals reached nearly 80 million pounds in 1986, whereas incidental mortality declined to 7 million pounds, the lowest since 1962.

FOREIGN AND JOINT VENTURE FISHERIES FOR GROUND FISH

Description

The historical development of the foreign groundfish fishery in the Bering Sea and the northeast Pacific Ocean (Figure 2) has been described by Chitwood (1969), Forrester et al.

(1978), and Bakkala et al. (1979). Japan began to fish commercially for groundfish in 1933 when a mothership operation for yellowfin sole (*Limanda aspera*) was initiated in the Bering Sea. Japan terminated this fishery at the start of World War II and did not resume fishing until 1954. The U.S.S.R. began fishing in the Bering Sea in 1959 for flounders, and both the Japanese and Soviet fisheries expanded greatly during the 1960s and 1970s in terms of fishing effort, areas, and diversity of groundfish species in the catch. Other nations, including the Republic of Korea, the Republic of China, East Germany, and Poland, also began fishing groundfish during the 1970s.

Table 1 provides a summary of annual foreign groundfish catches by area from 1933 through 1986. Catches increased from less than 50,000 mt prior to 1958 to a peak of 2.7 million mt in 1972. Since then, catches declined to a level of about 1.5 million mt in the late 1970s and early 1980s. The majority of the groundfish catch has been taken in the eastern Bering Sea (81 percent in 1986). Foreign groundfish catches off British Columbia and Washington, Oregon, and California (WOC) have been relatively minor since the mid-1970s, although catches have increased substantially since 1984.

Table 2 shows the estimated 1986 foreign catch by species and nation in the Bering Sea and northeast Pacific Ocean. Pollock (*Theragra chalcogramma*) was the dominant species in the Bering Sea, comprising 74 percent of the catch, respectively. Foreign fishing in the Gulf of Alaska in 1986 was limited to a Japanese longline fishery for Pacific cod (*Gadus macrocephalus*), which took small catches of other species. Pacific whiting (*Merluccius productus*) was the major fishery off British Columbia and WOC in 1986. Among nations,

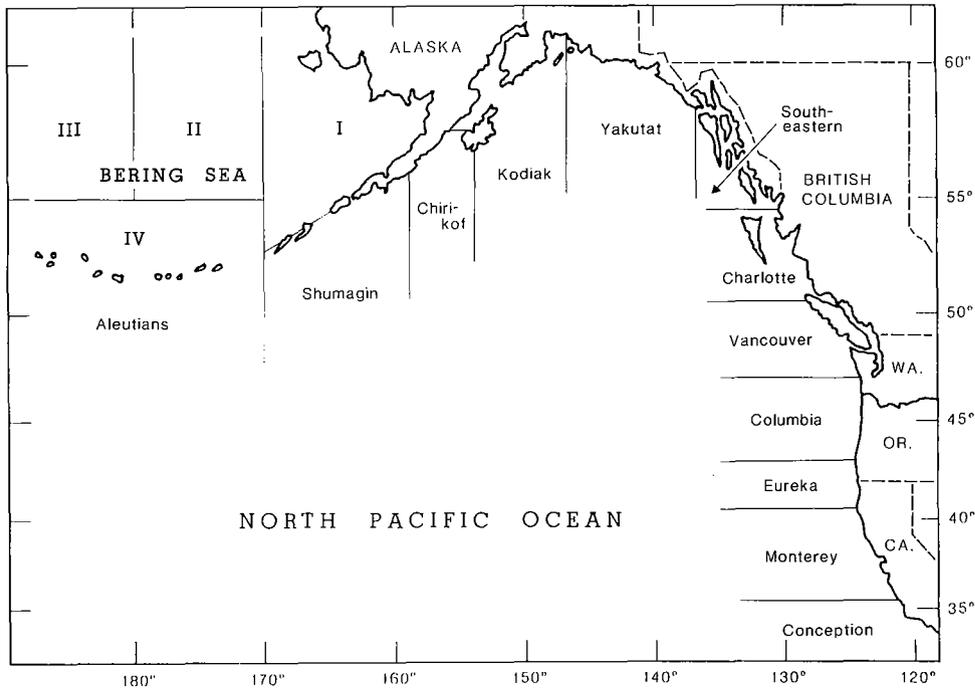


Figure 2. U.S. groundfish management regions of the northeast Pacific Ocean and Bering Sea.

Table 1. Foreign groundfish catches (000's mt) in the northeast Pacific Ocean and eastern Bering Sea. From Berger et al. (1982, 1984, 1985, 1986, 1987), Forrester et al. (1978), Forrester et al. (1983), French et al. (1980, 1981), Leaman (1984, 1985, 1986), Leaman and Stanley (1987), Nelson et al. (1981), K. Rutherford (CDFO, personal communication) and Wall et al. (1981).

| Year | Washington, Oregon, California | British Columbia | Gulf of Alaska | Bering Sea/ Aleutians | Total |
|------|--------------------------------------|---------------------|-------------------|--------------------------|-------|
| 1933 | 0 | 0 | 0 | 3 | 3 |
| 1934 | 0 | 0 | 0 | 15 | 15 |
| 1935 | 0 | 0 | 0 | 29 | 29 |
| 1936 | 0 | 0 | 0 | 27 | 27 |
| 1937 | 0 | 0 | 0 | 43 | 43 |
| 1938 | 0 | 0 | 0 | 0 | 0 |
| 1939 | 0 | 0 | 0 | 0 | 0 |
| 1940 | 0 | 0 | 0 | 10 | 10 |
| 1941 | 0 | 0 | 0 | 13 | 13 |
| 1942 | 0 | 0 | 0 | 0 | 0 |
| 1943 | 0 | 0 | 0 | 0 | 0 |
| 1944 | 0 | 0 | 0 | 0 | 0 |
| 1945 | 0 | 0 | 0 | 0 | 0 |
| 1946 | 0 | 0 | 0 | 0 | 0 |
| 1947 | 0 | 0 | 0 | 0 | 0 |
| 1948 | 0 | 0 | 0 | 0 | 0 |
| 1949 | 0 | 0 | 0 | 0 | 0 |
| 1950 | 0 | 0 | 0 | 0 | 0 |
| 1951 | 0 | 0 | 0 | 0 | 0 |
| 1952 | 0 | 0 | 0 | 0 | 0 |
| 1953 | 0 | 0 | 0 | 0 | 0 |
| 1954 | 0 | 0 | 0 | 13 | 13 |
| 1955 | 0 | 0 | 0 | 15 | 15 |
| 1956 | 0 | 0 | 0 | 25 | 25 |
| 1957 | 0 | 0 | 0 | 24 | 24 |
| 1958 | 0 | 0 | 0 | 52 | 52 |
| 1959 | 0 | 0 | 0 | 222 | 222 |
| 1960 | 0 | 0 | 0 | 550 | 550 |
| 1961 | 0 | 0 | 0 | 715 | 715 |
| 1962 | 0 | 0 | N.A. | 606 | 606 |
| 1963 | 0 | 0 | 11 | 343 | 364 |
| 1964 | 0 | 0 | 247 | 722 | 969 |
| 1965 | 0 | 0 | 394 | 503 | 897 |
| 1966 | 169 | 38 | 172 | 543 | 922 |
| 1967 | 247 | 40 | 155 | 954 | 1,396 |
| 1968 | 97 | 77 | 144 | 1,092 | 1,410 |
| 1969 | 116 | 93 | 118 | 1,402 | 1,729 |
| 1970 | 213 | 40 | 95 | 1,867 | 2,215 |
| 1971 | 154 | 15 | 118 | 2,256 | 2,543 |
| 1972 | 125 | 27 | 186 | 2,394 | 2,732 |
| 1973 | 163 | 32 | 178 | 2,144 | 2,517 |
| 1974 | 226 | 31 | 195 | 2,027 | 2,479 |
| 1975 | 222 | 20 | 203 | 1,668 | 2,113 |
| 1976 | 254 | 17 | 207 | 1,625 | 2,103 |
| 1977 | 130 | 12 | 199 | 1,289 | 1,630 |
| 1978 | 99 | 7 | 165 | 1,386 | 1,657 |
| 1979 | 117 | 9 | 163 | 1,289 | 1,578 |
| 1980 | 48 | 6 | 208 | 1,295 | 1,557 |
| 1981 | 71 | 4 | 233 | 1,273 | 1,581 |
| 1982 | 7 | 13 | 154 | 1,188 | 1,362 |
| 1983 | 0 | 14 | 147 | 1,126 | 1,287 |
| 1984 | 15 | 14 | 124 | 1,193 | 1,346 |
| 1985 | 50 | 11 | 41 | 1,035 | 1,137 |
| 1986 | 71 | 24 | 16 | 476 | 586 |

Note: For 1977-1986, data for U.S. areas are blend estimates and include squid and herring.

Table 2. Estimated foreign catch (mt) by nation and species in the northeast Pacific Ocean and Bering Sea groundfish fisheries in 1986. From Berger et al. (1987) and Leaman and Stanley (1987).

| Bering Sea/Aleutian Islands | | | | | | |
|------------------------------------|----------------|--------------------------|---------------|--------------------------|----------------|----------------|
| Species | Japan | Republic of Korea | Poland | Republic of China | Total | Percent |
| Squid | 819 | 4 | 7 | 0 | 830 | 0.2 |
| Yellowfin sole | 49,318 | 7,632 | 0 | 247 | 57,197 | 12.0 |
| Arrowtooth fl. | 2,591 | 861 | 1 | 10 | 3,463 | 0.7 |
| Greenland turbot | 6,879 | 14 | <1 | 0 | 6,893 | 1.4 |
| Other flatfish | 8,013 | 2,289 | 4 | 107 | 10,413 | 2.2 |
| Pollock | 262,423 | 81,632 | 6,831 | 1,443 | 352,329 | 74.1 |
| Pacific cod | 35,616 | 4,053 | 8 | 182 | 39,859 | 8.4 |
| Sablefish | 73 | 36 | <1 | <1 | 109 | <0.1 |
| Atka mackerel | 1 | 5 | <1 | <1 | 6 | <0.1 |
| Ocean perch spp. | 24 | 7 | <1 | 0 | 31 | <0.1 |
| Other rockfish | 4 | 0 | <1 | <1 | 4 | <0.1 |
| Pacific herring | 199 | 52 | 2 | <1 | 253 | 0.1 |
| Other fish | 3,230 | 801 | 1 | 12 | 4,044 | 0.8 |
| Snails | 493 | 0 | 0 | 0 | 493 | 0.1 |
| Total | 369,683 | 97,386 | 6,854 | 2,001 | 475,924 | 100.0 |

| Species | Gulf of Alaska | | | Washington-Oregon-California | | |
|------------------|-----------------------|---------------|----------------|-------------------------------------|---------------|----------------|
| | Japan | Total | Percent | Poland | Total | Percent |
| Flounders | 71 | 71 | 0.5 | 2 | 2 | <0.1 |
| Pollock | 114 | 114 | 0.7 | 0 | 0 | 0.0 |
| Pacific whiting | 0 | 0 | 0.0 | 69,861 | 69,861 | 98.7 |
| Pacific cod | 15,211 | 15,211 | 97.8 | 0 | 0 | 0.0 |
| Sablefish | 1 | 1 | <0.1 | 7 | 7 | <0.1 |
| Atka mackerel | <1 | <1 | <0.1 | 0 | 0 | 0.0 |
| Jack mackerel | 0 | 0 | 0.0 | 549 | 549 | 0.8 |
| Ocean perch spp. | 2 | 2 | <0.1 | 1 | 1 | <0.1 |
| Other rockfish | 3 | 3 | <0.1 | 194 | 194 | 0.3 |
| Other fish | 146 | 146 | 0.9 | 138 | 138 | 0.2 |
| Total | 15,547 | 15,547 | 100.0 | 70,752 | 70,752 | 100.0 |

| British Columbia | | | | |
|-------------------------|---------------|--------------|---------------|----------------|
| Species | Poland | USSR | Total | Percent |
| Pollock | 14 | 1 | 15 | 0.1 |
| Pacific whiting | 15,605 | 8,137 | 23,742 | 98.9 |
| Pacific ocean perch | 6 | 32 | 38 | 0.2 |
| Other rockfish | 132 | 72 | 204 | 0.9 |
| Other fish | 1 | <1 | 1 | <0.1 |
| Total | 15,758 | 8,242 | 24,000 | 100.0 |

Japan accounted for 78 percent of the total catch in the Bering Sea and all of the catch in the Gulf of Alaska. Poland and the U.S.S.R. were the most active nations in fisheries off British Columbia and WOC in 1986.

The foreign groundfish fleet involved a variety of vessel types (Nelson et al. 1981, Wall et al. 1981). During the 1970s and 1980s, the Japanese fishery in the Bering Sea included motherships accompanied by varying numbers of pair trawlers, Danish seiners, and stern trawlers. In addition, independent vessels included trawlers, ranging from about 50 m to 102 m in length, and longline vessels, typically 50-52 m in length. The fleet in the Gulf of Alaska included independent trawlers and longline vessels, but no motherships. Trawlers from Japan, Korea, and Taiwan tended to fish on the bottom, and their catch generally included 10-20 percent flounders. In contrast, trawlers from West Germany and, prior to 1981, trawlers from Poland and the U.S.S.R. fished off the bottom at times, and the proportion of flounders in their catch was relatively low (R. Nelson, NMFS, personal communication).

Joint venture fisheries include those where both foreign and domestic fishermen or processors are involved; the most common type of joint venture involved domestic fishermen delivering to a foreign processor. Joint ventures began in the late 1970s in all areas of the coast, and expanded sharply in the early 1980s. The groundfish catch by joint ventures was highest off Alaska (Table 3), but the proportion of the combined foreign and joint venture groundfish catch taken by joint ventures was highest off WOC. Pacific whiting is the primary species in joint venture fisheries in the WOC and British Columbia regions. The species composition of the catch in the Gulf of Alaska and Bering Sea is more diverse than in other regions and the 1986 catch by species is given for all regions in Table 4. Pollock was the

Table 3. Joint venture groundfish catches (000's mt) in the northeast Pacific Ocean and eastern Bering Sea. Catches for the Washington-Oregon-California region represent retained catches only. From Berger et al. (1987), Leaman (1984, 1985, 1986), Leaman and Stanley (1987) and K. Rutherford (CDFO, personal communication).

| Year | Washington, Oregon, California | British Columbia | Gulf of Alaska | Bering Sea/ Aleutians | Total |
|------|--------------------------------------|---------------------|-------------------|--------------------------|-------|
| 1978 | 1 | 2 | < 1 | 0 | 3 |
| 1979 | 9 | 4 | 2 | 0 | 15 |
| 1980 | 28 | 13 | 2 | 33 | 76 |
| 1981 | 44 | 18 | 17 | 79 | 158 |
| 1982 | 67 | 20 | 74 | 109 | 270 |
| 1983 | 72 | 28 | 143 | 211 | 454 |
| 1984 | 79 | 29 | 220 | 359 | 687 |
| 1985 | 32 | 13 | 247 | 639 | 931 |
| 1986 | 82 | 30 | 65 | 1,160 | 1,337 |

major species in the total joint venture catch, constituting 67 percent of the total catch for all areas, and 96 percent of the Gulf of Alaska catch. Yellowfin sole and 'other flounders' also were important species in the Bering Sea, representing 13 percent and 6 percent of the catch, respectively. Vessels targeting on pollock tend to use off-bottom trawls, whereas those targeting on flounders and Pacific cod use on-bottom trawls.

Table 4. Estimated joint venture catch (mt) by species group in the northeast Pacific Ocean and Bering Sea groundfish fisheries, 1986. From Berger et al. (1987) and Leaman and Stanley (1987).

| Species | Bering Sea/ Aleutians | | Gulf of Alaska | |
|------------------|--------------------------|--------------|----------------|--------------|
| | mt | percent | mt | percent |
| Squid | 34 | <0.1 | 7 | <0.1 |
| Yellowfin sole | 151,400 | 13.0 | 0 | 0.0 |
| Arrowtooth fl. | 3,375 | 0.3 | 0 | 0.0 |
| Greenland turbot | 36 | <0.1 | 0 | 0.0 |
| Other flatfish | 62,043 | 5.3 | 961* | 1.5 |
| Pollock | 835,103 | 72.0 | 62,591 | 95.9 |
| Pacific cod | 63,942 | 5.5 | 1,357 | 2.1 |
| Sablefish | 430 | <0.1 | 45 | 0.1 |
| Atka mackerel | 31,984 | 2.8 | 4 | <0.1 |
| Ocean perch spp. | 518 | <0.1 | 49 | 0.1 |
| Thornyheads | 0 | 0.0 | 1 | <0.1 |
| Other rockfish | 27 | <0.1 | 16 | <0.1 |
| Pacific herring | 3,764 | 0.3 | 0 | 0.0 |
| Other fish | 7,557 | 0.7 | 255 | 0.4 |
| Total | 1,160,213 | 100.0 | 65,287 | 100.0 |

| Species | British Columbia | | Washington/Oregon/ California | |
|-----------------|---------------------|--------------|----------------------------------|--------------|
| | mt | percent | mt | percent |
| Flatfish | 0 | 0.0 | <1 | <0.1 |
| Pollock | 82 | 0.3 | 0 | 0.0 |
| Pacific whiting | 30,136 | 99.6 | 81,640 | 99.7 |
| Sablefish | 0 | 0.0 | 6 | <0.1 |
| Jack mackerel | 0 | 0.0 | <1 | <0.1 |
| Other rockfish | 40 | 0.1 | 165 | 0.2 |
| Other fish | <1 | <0.1 | 44 | 0.1 |
| Total | 30,258 | 100.0 | 81,855 | 100.0 |

*Includes all flounders

Observer Program

The U.S. National Marine Fisheries Service (NMFS) has collected information on the composition of the foreign and joint venture fishery catches since the 1960s from observers who sample the catch at sea. This information is the basis for estimates of incidental catch. The observer program before 1977 was sporadic and data on incidental catch rates were relatively meager. In 1977, the U.S. enacted the Magnuson Fisheries Conservation and Management Act (MFCMA) and the observer program was greatly expanded. During 1978, observers monitored 9 and 14 percent of the foreign vessel fishing days conducted in the Bering Sea and the Gulf of Alaska, respectively (Nelson et al. 1981, Wall et al., 1981). By 1986, observer coverage for all fisheries and areas, including off WOC, was 94 percent. Although

coverage in 1986 was highest in the Gulf of Alaska, most of the observer days occurred in the Bering Sea fisheries (Table 5).

As a result of passage of extended jurisdiction legislation by Canada, the Canadian Department of Fisheries and Oceans (CDFO, formerly the Canadian Department of Fisheries and the Environment) began placing observers aboard foreign fishing vessels operating off British Columbia in 1977. Trawl fisheries were conducted for rockfish, Pacific whiting, and dogfish (*Squalus acanthias*), and setline and pot/trap fisheries targeted on sablefish (*Anoplopoma fimbria*). Observer coverage of foreign fleets was 16 percent of the total number of vessel days in 1977, 33 percent in 1978 and 29 percent in 1979. Fisheries for rockfish and dogfish received the greatest coverage (Leaman et al. 1978), whereas observer effort in 1978 and 1979 was highest on Japanese longline vessels targeting on sablefish (Leaman et al. 1980, 1981).

Table 5. Observer coverage of foreign and joint venture processing vessels operating in U.S. waters in 1986. From Berger et al. (1987).

| | Bering Sea/ Aleutians | Gulf of Alaska | Washington/ Oregon/California | Total |
|-----------------------------------|--------------------------|-------------------|----------------------------------|--------|
| Vessel Coverage | | | | |
| No. of Vessel Days | 14,866 | 1,248 | 3,192 | 19,306 |
| No. of Observer Days | 13,898 | 1,224 | 3,036 | 18,158 |
| Percent Coverage | 93.5 | 98.1 | 95.1 | 94.1 |
| Sampling Coverage | | | | |
| No. of Foreign Fishing Vessels | 196 | 66 | 37 | 299 |
| No. of Vessels With Observers | 196 | 65 | 37 | 298 |
| Percent Sampled | 100.0 | 98.5 | 100.0 | 99.7 |

Incidence and Average Weight of Halibut

The incidence of halibut in foreign and joint venture groundfish fisheries has commonly been expressed as the number of fish per mt of groundfish. Hoag and French (1976) summarized data on incidence and average weight from observers during the 1960s and early 1970s in the Bering Sea and the northeast Pacific Ocean by IPHC statistical region (Figure 3). Their results, in numbers of halibut per mt and in **kg, round weight**, are given in Tables 6 and 7. More recent information on incidence is given in Tables 8 through 10, and on average weight, in **pounds, net weight** and **kg, round weight**, in Table 11.

The incidence rates in recent years (Tables 8, 9, and 10) do not show any major change since the 1960s. For most area-month strata, rates range from about 0.5 to 5.0 fish per mt in the trawl fishery. Rates tend to be higher in the Gulf of Alaska than in the Bering Sea, particularly for foreign setlines fishing at depths less than 500 m where rates of over 100 fish per mt were observed. Joint venture rates tend to be higher than foreign rates. Observed incidence rates in the foreign and joint venture fisheries in the WOC region are usually small,

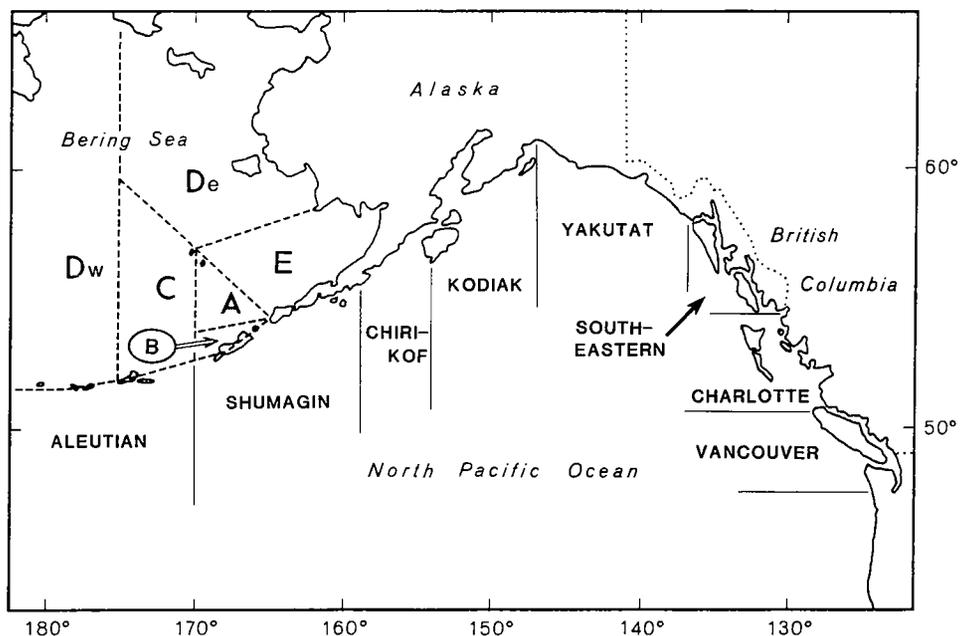


Figure 3. IPHC statistical regions in the Bering Sea and the northeast Pacific Ocean during the 1970's. From Hoag and French (1976).

less than or equal to 0.001 halibut per mt. The average net weight of halibut in the Gulf of Alaska foreign trawl fishery increased from about 8 to 20 pounds during the late 1970s for unknown reasons. The weight of halibut tends to be smaller in the Bering Sea, averaging about 6 pounds (net).

Length frequencies of halibut measured by observers of the foreign trawl, foreign setline, and joint venture fisheries during 1977-1986 are summarized by 5 cm length intervals and fishery for the Bering Sea, Gulf of Alaska, and WOC regions, in Tables 12-14, respectively. Appendix Table 4 provides length frequency data by 5 cm intervals for each U.S. statistical area (see Figure 2) and fishery for 1986.

Information on halibut incidence in foreign and joint venture fisheries operating off British Columbia is limited. Leaman et al. (1978) reported that the incidence of halibut averaged less than two percent of the total catch of target species in foreign trawl and longline fisheries observed in 1977.

Incidental Catch

Estimates of the incidental catch of halibut by foreign and joint venture fisheries were compiled from several sources. Data for 1962-1974 were reported by Hoag (1976). IPHC estimated the 1975 and 1976 incidental catches in U.S. waters from limited observer data collected by NMFS (R. French, NMFS, personal communication). Nelson et al. (1981a) also estimated the incidental catch by foreign trawlers in the Bering Sea during 1975 and 1976; their estimates were significantly lower than IPHC estimates³ and were not used by IPHC in

³NMFS and IPHC used different methodologies to aggregate observer data across time and area blocks.

compiling annual totals of incidental catch. Incidental catches of halibut by the foreign fisheries in U.S. waters in 1977 were reported by Nelson et al. (1981a), Wall et al. (1981a), and French et al. (1981a). Estimates for more recent years and for joint venture fisheries were reported by Berger et al. (1982, 1983, 1984, 1985, 1986, 1987), French et al. (1980) and (1981b), Nelson et al. (1980, 1981b, 1982, 1983), and Wall et al. (1980, 1981b, 1982). Incidental catches by foreign fisheries off British Columbia in 1975 and 1976 were taken from documents submitted to the International North Pacific Fisheries Commission (INPFC) and incidental catches for 1977-1979 were extracted from Leaman et al. (1978, 1980, 1981).

In general, estimates of incidental catch occurring prior to 1977 may be less accurate than those in later years due to the lack of a comprehensive observer program at that time. The estimates were made from limited data and incidence rates were assumed to be similar in fisheries which had not been observed. However, Hoag and French (1976) believed the potential errors to be offsetting, despite the weakness of the assumptions employed. Since

Table 6. The average incidence and weight (kg., round weight) of halibut in Japanese trawls in the Bering Sea, by month and area, 1969-1974. From Hoag and French (1976).

| Month | Area | | | | | |
|-----------|--|-------|-------|-------|-------|--------|
| | A | B | C | De | Dw | E |
| | Incidence (Number per metric ton) | | | | | |
| January | — | — | 0.054 | — | 0.070 | 25.437 |
| February | 0.163 | — | 2.787 | — | 0.196 | 2.629 |
| March | 5.779 | 4.930 | 0.476 | — | 0.720 | 8.073 |
| April | 2.935 | 1.341 | 1.465 | — | 0.012 | 2.516 |
| May | 7.145 | 6.976 | 1.022 | — | 0.131 | 3.062 |
| June | — | 0.000 | 1.155 | — | 1.114 | 1.987 |
| July | — | — | 0.040 | 0.013 | 0.066 | 0.000 |
| August | 0.021 | — | 0.157 | 0.013 | 0.103 | — |
| September | 0.008 | 0.000 | 0.187 | — | 0.007 | — |
| October | 0.018 | 0.000 | 0.023 | — | 0.037 | 0.022 |
| November | 0.064 | — | — | — | 0.049 | 1.266 |
| December | 0.014 | — | 0.249 | — | 0.074 | 27.643 |
| | Weight | | | | | |
| January | — | — | 3.20 | — | 2.28 | 0.39 |
| February | 0.69 | — | 1.14 | — | 5.90 | 1.07 |
| March | 0.90 | 0.81 | 1.46 | — | 2.66 | 0.48 |
| April | 0.93 | 0.80 | 1.00 | — | 0.68 | 1.33 |
| May | 0.64 | 0.41 | 1.22 | — | 1.59 | 1.13 |
| June | — | — | 2.76 | — | 6.11 | 1.94 |
| July | — | — | 3.01 | 3.50 | 7.45 | — |
| August | 17.73 | — | 7.42 | 3.50 | 2.03 | — |
| September | 7.30 | — | 3.68 | — | 4.44 | — |
| October | 3.55 | — | 8.70 | — | 4.70 | 2.38 |
| November | 1.33 | — | — | — | 5.15 | 2.17 |
| December | 0.66 | — | 5.37 | — | 2.57 | 0.85 |

Table 7. The average incidence and weight (kg., round weight) of halibut in Japanese trawls in the north-east Pacific by month, INPFC area, and trawl type, 1963-1969. From Hoag and French (1976).

| INPFC Areas — | | Month | | | | | | | | |
|---------------------------|--------|--|--------|--------|--------|-------|-------|-------|-------|--|
| Trawl Type and Area | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | |
| Groundfish Trawls | | Incidence (Number per metric ton) | | | | | | | | |
| Shumagin | 0.404 | 10.932 | 4.724 | 2.235 | 0.300 | 1.038 | — | — | 3.750 | |
| Chirikof | 22.142 | 1.200 | 22.680 | 2.010 | 0.354 | 0.181 | 0.902 | 1.035 | 0.128 | |
| Kodiak | 3.138 | 4.566 | 6.729 | 8.411 | 0.601 | 0.255 | 0.228 | 0.526 | 2.337 | |
| Yakutat | — | — | 14.250 | — | — | 0.841 | 0.460 | 0.237 | — | |
| Southeastern | — | — | — | — | — | 0.174 | 0.056 | — | — | |
| Charlotte | — | — | — | 1.188 | 1.391 | 0.068 | 0.044 | — | — | |
| Vancouver | — | — | — | 0.000 | — | — | 0.000 | — | — | |
| Shrimp Trawls | | | | | | | | | | |
| Shumagin | — | — | — | 8.906 | 5.083 | 3.500 | — | — | — | |
| Chirikof | 7.500 | — | — | — | 8.388 | 2.165 | 4.884 | — | — | |
| Kodiak | 11.249 | — | 37.127 | 36.475 | 29.300 | — | 4.455 | 3.019 | — | |
| Groundfish Trawls* | | Weight (kg) | | | | | | | | |
| Shumagin | 3.55 | 2.00 | 2.18 | 1.98 | 2.10 | 2.50 | — | — | 1.86 | |
| Chirikof | 8.45 | 8.41 | 2.04 | 5.22 | 2.60 | 13.36 | 13.90 | — | — | |
| Kodiak | 2.77 | 1.81 | 2.59 | 2.61 | 7.09 | 15.56 | 6.69 | 4.87 | 3.05 | |
| Yakutat | — | — | 3.41 | — | — | 9.20 | 13.45 | 12.10 | — | |
| Southeastern | — | — | — | — | — | 13.50 | — | — | — | |
| Shrimp Trawls | | | | | | | | | | |
| Shumagin | — | — | — | 2.40 | 2.40 | 2.40 | — | — | — | |
| Chirikof | 5.20 | — | — | — | 1.10 | 4.89 | 5.61 | — | — | |
| Kodiak | 4.54 | — | 0.93 | 2.50 | 3.18 | — | 3.30 | 2.84 | — | |

*Data not available in Charlotte-Vancouver areas.

1977, observer programs have been widely used to provide information on incidental catch. Estimates from such programs appear reasonable and have likely increased in accuracy as coverage has expanded across the various target fisheries, areas and months.

Estimates of incidental catches by the foreign and joint venture fisheries are listed by fishery, area, and year in Table 15 in **pounds, net weight**. (More detailed information on the estimated incidental catch of halibut in **mt, round weight**, in those fisheries operating in U.S. waters for 1977-1986 is given by vessel-class, nation, region, and year in Appendix Tables 1 through 3.) The catch of halibut taken incidentally by the foreign fisheries rose rapidly during the early 1960s to a peak of about 16 million pounds in 1965. Catches declined to about 11 million pounds during the late 1960s, but again increased to over 15 million pounds in 1971 and 1972. Incidental catches dropped substantially in 1975 and averaged about 8 million pounds in the early 1980s, and declined to about 6 million pounds in 1986.

Incidental catches of halibut during the 1960s usually were highest in the Gulf of Alaska, reaching 14 million pounds in 1965. Catches in the Bering Sea declined to about one million pounds in 1963, but increased dramatically to more than 12 million pounds by 1971. During the late 1960s and early 1970s, incidental catches in the Gulf of Alaska declined to approx-

Table 8. The average incidence of halibut (no. per mt) in foreign and joint venture fisheries in the Bering Sea and Aleutian Islands by month, statistical area, and fishery, 1977-1986. Dashes indicate no fishing activity.

| Fishery and Area | Month | | | | | | | | | | | |
|---------------------------------------|--------|--------|-------|--------|--------|-------|-------|-------|--------|---------------------|--------|--------|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
| Foreign Trawl | | | | | | | | | | | | |
| I | 0.672 | 1.852 | 0.693 | 2.444 | 1.520 | 0.231 | 0.238 | 0.125 | 0.132 | 0.193 | 0.578 | 0.978 |
| II | 0.396 | 0.178 | 0.155 | 0.567 | 0.690 | 0.215 | 0.032 | 0.020 | 0.018 | 0.083 | 0.324 | 0.177 |
| III | 0.000 | 0.000 | — | — | — | — | — | — | — | — | — | 0.000 |
| IV | 0.187 | 0.121 | 0.282 | 0.193 | 0.261 | 0.186 | 0.257 | 0.327 | 0.259 | 0.234 | 0.338 | 0.049 |
| Foreign Setline (< 500 m) | | | | | | | | | | | | |
| I | 14.116 | 12.503 | 7.231 | 13.047 | 6.904 | 4.513 | 1.991 | 0.303 | 3.591 | 3.622 | 5.704 | 14.461 |
| II | 8.529 | 6.072 | 6.023 | 5.634 | 4.529 | 6.468 | 3.266 | 5.209 | 3.265 | 2.872 | 5.741 | 6.318 |
| III | — | — | — | — | — | — | — | — | — | — | — | — |
| IV | 2.733 | 0.000 | 3.018 | 9.363 | 13.757 | 9.955 | 7.044 | 7.823 | 17.624 | 11.142 | 24.994 | 17.946 |
| Foreign Setline (> 500 m) | | | | | | | | | | | | |
| I | 0.000 | 1.360 | 0.301 | 0.636 | 0.240 | 0.455 | 0.322 | 0.000 | 0.295 | 0.479 | 0.559 | 0.433 |
| II | — | 3.464 | 9.400 | 2.523 | 0.733 | 1.019 | 0.238 | 0.114 | 0.328 | 0.457 | 2.133 | 0.143 |
| III | — | — | — | — | — | — | — | — | — | — | — | — |
| IV | — | 0.000 | 0.704 | 4.949 | 0.025 | 0.254 | 0.097 | 0.105 | 0.021 | 0.000 | 0.158 | 2.937 |
| Joint Venture | | | | | | | | | | | | |
| I | 4.585 | 2.398 | 0.690 | 0.573 | 1.150 | 0.946 | 0.936 | 1.537 | 0.947 | 1.116 | 0.919 | 0.487 |
| II | 0.000 | — | 4.714 | 0.000 | — | 0.049 | 0.035 | 0.024 | 0.006 | 50.952 ¹ | — | — |
| III | — | — | — | — | — | — | — | — | — | — | — | — |
| IV | — | 0.000 | 1.765 | 0.834 | 0.691 | 0.711 | 0.979 | 1.130 | 3.824 | — | — | — |

¹Based on only one sampled haul during 1977-1986.

Table 9. The average incidence of halibut (no. per mt) in foreign and joint venture fisheries in the Gulf of Alaska by month, statistical area, and fishery, 1977-1986. Dashes indicate no fishing activity.

| Fishery and Area | Month | | | | | | | | | | | |
|---------------------------------------|---------|--------|--------|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
| Foreign Trawl | | | | | | | | | | | | |
| Shumagin | 0.000 | 0.543 | 0.000 | 5.765 | 3.865 | 1.811 | 0.489 | 0.330 | 0.413 | 0.691 | 0.488 | 0.174 |
| Chirikof | 0.012 | 4.357 | — | 0.518 | 0.840 | 0.553 | 0.948 | 0.704 | 0.311 | 0.911 | 0.706 | 0.006 |
| Kodiak | — | 7.845 | — | — | 3.223 | 0.925 | 0.671 | 0.546 | 0.428 | 1.535 | 1.972 | 0.000 |
| Yakutat | — | 6.400 | 3.351 | 2.666 | 2.365 | 0.892 | 0.927 | 1.534 | 1.952 | 3.388 | 2.159 | — |
| Southeasten | — | 5.416 | — | 1.391 | 0.942 | 0.914 | 0.930 | 0.723 | 0.978 | 2.606 | 3.889 | — |
| Foreign Setline (< 500 m) | | | | | | | | | | | | |
| Shumagin | 19.035 | 8.908 | 6.994 | 23.369 | 25.964 | 20.873 | 10.603 | 12.357 | 11.972 | 22.723 | 17.400 | 13.097 |
| Chirikof | 8.105 | 13.965 | 11.211 | 27.233 | 26.402 | 14.033 | 15.967 | 11.550 | 11.049 | 31.245 | 25.538 | 26.954 |
| Kodiak | 169.388 | 39.082 | 24.107 | 33.483 | 27.649 | — | — | 12.891 | 11.973 | 46.422 | 18.993 | 27.206 |
| Yakutat | — | — | — | 112.000 | — | — | — | — | 16.360 | — | 6.818 | 26.893 |
| Southeastern | — | — | — | — | — | — | — | — | — | — | — | — |
| Foreign Setline (> 500 m) | | | | | | | | | | | | |
| Shumagin | 1.609 | — | 0.955 | 0.180 | 4.513 | 0.679 | 0.000 | 0.000 | 0.036 | 0.703 | 0.537 | 11.352 |
| Chirikof | 0.000 | — | 1.302 | 0.447 | 0.120 | 0.000 | 0.319 | 0.000 | 0.000 | 0.000 | 1.799 | 6.039 |
| Kodiak | 0.000 | 17.910 | 4.855 | 0.174 | 0.105 | 0.000 | 0.000 | 0.022 | 0.000 | 1.347 | 1.091 | 8.297 |
| Yakutat | 0.000 | — | 0.556 | 0.859 | 3.049 | 0.067 | 0.238 | 0.000 | 0.057 | 2.369 | 1.402 | 2.820 |
| Southeastern | — | — | — | — | — | — | — | — | 0.000 | 0.000 | — | — |
| Joint Venture | | | | | | | | | | | | |
| Shumagin | 27.143 | 2.116 | 2.690 | 6.369 | 7.484 | 4.182 | 8.532 | 11.693 | 0.471 | 1.438 | 2.113 | 3.749 |
| Chirikof | 0.136 | 0.007 | 0.001 | 0.232 | 10.484 | 6.097 | 3.670 | 13.325 | 16.766 | 15.566 | 3.622 | 0.102 |
| Kodiak | 11.401 | 0.416 | 1.444 | 1.426 | 10.584 | 10.176 | 4.379 | 10.332 | 6.169 | 3.807 | 4.765 | 6.785 |
| Yakutat | — | — | — | 19.277 ¹ | 0.248 | — | — | 0.000 | — | — | — | — |
| Southeastern | — | — | — | — | — | — | — | 0.581 | — | — | — | — |

¹Based on only one sampled haul during 1977-1986

Table 10. The average incidence of halibut (no. per mt) in foreign and joint venture fisheries off Washington-Oregon-California by month, statistical area, and fishery, 1977-1986. Dashes indicate no fishing activity

| Fishery and Area | Month | | | | | | | | | | | |
|----------------------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|------|------|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
| Foreign Trawl | | | | | | | | | | | | |
| Vancouver | — | — | — | — | — | — | 0.000 | — | — | 0.000 | — | — |
| Columbia | — | — | — | — | — | 0.005 | 0.001 | 0.000 | 0.000 | 0.000 | — | — |
| Eureka | — | — | — | — | — | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | — | — |
| Monterey | — | — | — | — | — | 0.000 | 0.000 | 0.000 | — | — | — | — |
| Joint Venture | | | | | | | | | | | | |
| Vancouver | — | — | — | — | 0.000 | 0.002 | 0.002 | 0.001 | 0.001 | 0.000 | — | — |
| Columbia | — | — | — | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | — | — |
| Eureka | — | — | — | 0.000 | 0.000 | 0.000 | 0.003 | 0.001 | 0.000 | 0.000 | — | — |
| Monterey | — | — | — | 0.000 | 0.000 | 0.000 | — | 0.000 | 0.000 | 0.000 | — | — |

Table 11. Average weight of halibut in the foreign and joint venture fisheries, by year and fishery. From Berger et al. (1982, 1984, 1985, 1986, 1987), French et al. (1980, 1981a, 1981b), Nelson et al. (1980, 1981a, 1981b, 1982, 1983), and Wall et al. (1980, 1981a, 1981b, 1982).

| Area/Year | lbs, net weight | | | | kg, round weight | | | |
|-----------------------|-----------------|---------|-------|------------------|------------------|---------|-------|------------------|
| | Foreign | | | Joint Venture | Foreign | | | Joint Venture |
| | Trawl | Setline | Total | | Trawl | Setline | Total | |
| Bering Sea | | | | | | | | |
| 1977 | 6.98 | * | 6.98 | NF | 4.21 | * | 4.21 | NF |
| 1978 | 8.06 | 6.31 | 7.88 | NF | 4.86 | 3.81 | 4.76 | NF |
| 1979 | 8.25 | 6.22 | 8.13 | NF | 4.98 | 3.75 | 4.90 | NF |
| 1980 | 7.47 | 6.15 | 7.45 | 2.31 | 4.51 | 3.71 | 4.49 | 1.40 |
| 1981 | 4.49 | 5.48 | 4.53 | 3.71 | 2.71 | 3.30 | 2.73 | 2.24 |
| 1982 | 6.28 | 6.70 | 6.30 | 2.26 | 3.79 | 4.04 | 3.80 | 1.37 |
| 1983 | 5.82 | 6.05 | 6.02 | 2.65 | 3.51 | 3.65 | 3.63 | 1.60 |
| 1984 | 7.46 | 5.59 | 6.81 | 4.03 | 4.50 | 3.37 | 4.11 | 2.43 |
| 1985 | 7.28 | 5.03 | 6.11 | 3.80 | 4.40 | 3.04 | 3.69 | 2.30 |
| 1986 | 7.22 | 6.30 | 6.67 | 4.78 | 4.36 | 3.81 | 4.03 | 2.89 |
| Gulf of Alaska | | | | | | | | |
| 1977 | 8.83 | 12.27 | 8.83 | NF | 5.33 | 7.40 | 5.33 | NF |
| 1978 | 7.34 | 6.32 | 7.28 | NF | 4.43 | 3.81 | 4.39 | NF |
| 1979 | 20.81 | 5.69 | 17.10 | 6.95 | 12.56 | 3.43 | 10.32 | 4.19 |
| 1980 | 19.16 | 5.60 | 10.39 | 4.16 | 11.55 | 3.38 | 6.27 | 2.51 |
| 1981 | 19.35 | 6.87 | 9.93 | 29.10 | 11.67 | 4.15 | 5.99 | 17.55 |
| 1982 | 15.22 | 5.78 | 7.93 | 2.52 | 9.18 | 3.49 | 4.78 | 1.52 |
| 1983 | 12.93 | 6.91 | 7.77 | 6.00 | 7.80 | 4.17 | 4.69 | 3.62 |
| 1984 | 14.04 | 5.45 | 6.90 | 5.90 | 8.47 | 3.29 | 4.16 | 3.56 |
| 1985 | 6.17 | 3.04 | 3.20 | 6.34 | 3.73 | 1.84 | 1.93 | 3.83 |
| 1986 | NF | 5.48 | 5.48 | 5.39 | NF | 3.31 | 3.31 | 3.26 |

*Not estimated because of meager observer data
 NF = no fishing

imately 5 million pounds but catches in the Bering Sea increased to an average of 8 million pounds. After 1974, catches averaged approximately 4 million pounds in each area. Foreign and joint venture fisheries did not operate off the coast of British Columbia until 1966. Incidental catches off British Columbia were taken only by the foreign trawl fishery and averaged 0.3 million pounds annually until the late 1970s. Little foreign fishing for non-pelagic species occurred off British Columbia after 1979.

Most of the incidental catch of halibut was taken in the foreign trawl fishery, so trends in total incidental catches over time and among areas reflect trends in halibut catches by this fishery. Incidental catches by the foreign setline fishery during the 1960s and 1970s were estimated to be less than 0.2 million pounds in each area and year. During the early 1980s, halibut catches by the foreign setline fishery in the Bering Sea remained at low levels whereas catches in the Gulf of Alaska rose sharply to 4 million pounds, exceeding the incidental catch by foreign trawls. Joint venture fisheries began operation in the Gulf of Alaska in 1979 and in the Bering Sea in 1980. Joint venture catches of halibut were less than 0.1 million pounds annually in the Gulf of Alaska through 1982, increased to almost 1 million pounds by 1984, and declined to less than 0.2 million pounds in 1986. In the Bering Sea, joint venture inciden-

Table 12. Length frequency of halibut measures by observers of the foreign and joint venture fisheries in the Bering Sea/Aleutian region, by fishery and 5 cm interval, 1977-1986.

| 5 cm Length Interval | Foreign Trawl | | Foreign Setline | | Joint Venture | |
|----------------------|----------------|--------------|-----------------|--------------|----------------|--------------|
| | Number | Percent | Number | Percent | Number | Percent |
| 0-4 | — | — | — | — | — | — |
| 5-9 | 1 | 0.0 | — | — | 3 | 0.0 |
| 10-14 | 16 | 0.0 | — | — | 21 | 0.0 |
| 15-19 | 94 | 0.0 | 3 | 0.0 | 554 | 0.2 |
| 20-24 | 359 | 0.1 | 3 | 0.0 | 1,496 | 0.4 |
| 25-29 | 1,472 | 0.3 | 2 | 0.0 | 1,845 | 0.5 |
| 30-34 | 6,535 | 1.5 | 10 | 0.0 | 8,818 | 2.4 |
| 35-39 | 18,282 | 4.3 | 56 | 0.1 | 27,226 | 7.5 |
| 40-44 | 27,546 | 6.5 | 582 | 0.5 | 42,120 | 11.6 |
| 45-49 | 35,727 | 8.4 | 3,053 | 2.8 | 50,517 | 13.9 |
| 50-54 | 46,258 | 10.9 | 10,428 | 9.4 | 45,387 | 12.5 |
| 55-59 | 50,559 | 11.9 | 19,217 | 17.3 | 43,492 | 12.0 |
| 60-64 | 51,253 | 12.1 | 20,455 | 18.4 | 40,743 | 11.2 |
| 65-69 | 43,930 | 10.4 | 20,708 | 18.7 | 32,123 | 8.8 |
| 70-74 | 34,982 | 8.3 | 15,323 | 13.8 | 23,153 | 6.4 |
| 75-79 | 25,338 | 6.0 | 9,909 | 8.9 | 14,378 | 4.0 |
| 80-84 | 20,275 | 4.8 | 5,685 | 5.1 | 9,891 | 2.7 |
| 85-89 | 14,018 | 3.3 | 2,985 | 2.7 | 6,482 | 1.8 |
| 90-94 | 10,777 | 2.5 | 1,440 | 1.3 | 4,709 | 1.3 |
| 95-99 | 7,488 | 1.8 | 684 | 0.6 | 3,071 | 0.8 |
| 100-104 | 6,237 | 1.5 | 272 | 0.2 | 2,266 | 0.6 |
| 105-109 | 4,495 | 1.1 | 112 | 0.1 | 1,547 | 0.4 |
| 110-114 | 3,605 | 0.9 | 52 | 0.0 | 1,104 | 0.3 |
| 115-119 | 2,706 | 0.6 | 18 | 0.0 | 684 | 0.2 |
| 120-124 | 2,608 | 0.6 | 11 | 0.0 | 556 | 0.2 |
| 125-129 | 1,708 | 0.4 | 1 | 0.0 | 355 | 0.1 |
| 130-134 | 1,520 | 0.4 | — | — | 280 | 0.1 |
| 135-139 | 1,126 | 0.3 | — | — | 197 | 0.1 |
| 140-144 | 1,096 | 0.3 | 2 | 0.0 | 175 | 0.0 |
| 145-149 | 811 | 0.2 | 1 | 0.0 | 78 | 0.0 |
| 150-154 | 754 | 0.2 | 1 | 0.0 | 101 | 0.0 |
| 155-159 | 549 | 0.1 | — | — | 66 | 0.0 |
| 160-164 | 491 | 0.1 | — | — | 61 | 0.0 |
| 165-169 | 319 | 0.1 | — | — | 30 | 0.0 |
| 170-174 | 279 | 0.1 | — | — | 41 | 0.0 |
| 175-179 | 198 | 0.0 | — | — | 19 | 0.0 |
| 180-184 | 168 | 0.0 | — | — | 27 | 0.0 |
| 185-189 | 103 | 0.0 | — | — | 14 | 0.0 |
| 190-194 | 116 | 0.0 | — | — | 13 | 0.0 |
| 195-199 | 60 | 0.0 | — | — | 5 | 0.0 |
| 200+ | 56 | 0.0 | — | — | 11 | 0.0 |
| Total | 423,915 | 100.0 | 111,013 | 100.0 | 363,659 | 100.0 |
| Mean Length | 65.5 | | 65.8 | | 57.2 | |

Table 13. Length frequency of halibut measured by observers of the foreign and joint venture fisheries in the Gulf of Alaska, by fishery and 5 cm interval, 1977-1986.

| 5 cm Length Interval | Foreign Trawl | | Foreign Setline | | Joint Venture | |
|----------------------|----------------|--------------|-----------------|--------------|----------------|--------------|
| | Number | Percent | Number | Percent | Number | Percent |
| 0-4 | 2 | 0.0 | — | — | — | — |
| 5-9 | 1 | 0.0 | — | — | — | — |
| 10-14 | 3 | 0.0 | — | — | 1 | 0.0 |
| 15-19 | 4 | 0.0 | — | — | 4 | 0.0 |
| 20-24 | 30 | 0.0 | 13 | 0.0 | 33 | 0.0 |
| 25-29 | 69 | 0.1 | 7 | 0.0 | 237 | 0.2 |
| 30-34 | 161 | 0.2 | 85 | 0.1 | 1,945 | 1.6 |
| 35-39 | 878 | 0.8 | 597 | 0.4 | 6,485 | 5.3 |
| 40-44 | 3,222 | 3.1 | 4,204 | 2.5 | 10,402 | 8.5 |
| 45-49 | 6,152 | 5.9 | 12,340 | 7.3 | 12,072 | 9.9 |
| 50-54 | 8,238 | 7.9 | 23,141 | 13.7 | 13,797 | 11.3 |
| 55-59 | 8,612 | 8.2 | 29,878 | 17.7 | 14,259 | 11.7 |
| 60-64 | 9,045 | 8.6 | 29,422 | 17.4 | 13,979 | 11.5 |
| 65-69 | 7,876 | 7.5 | 23,128 | 13.7 | 11,539 | 9.5 |
| 70-74 | 7,569 | 7.2 | 17,307 | 10.3 | 9,005 | 7.4 |
| 75-79 | 6,637 | 6.3 | 11,462 | 6.8 | 6,112 | 5.0 |
| 80-84 | 6,759 | 6.4 | 7,511 | 4.4 | 5,093 | 4.2 |
| 85-89 | 6,036 | 5.8 | 4,400 | 2.6 | 3,970 | 3.3 |
| 90-94 | 5,790 | 5.5 | 2,711 | 1.6 | 3,402 | 2.8 |
| 95-99 | 5,011 | 4.8 | 1,343 | 0.8 | 2,469 | 2.0 |
| 100-104 | 4,736 | 4.5 | 712 | 0.4 | 2,053 | 1.7 |
| 105-109 | 3,524 | 3.4 | 264 | 0.2 | 1,358 | 1.1 |
| 110-114 | 2,955 | 2.8 | 140 | 0.1 | 960 | 0.8 |
| 115-119 | 1,928 | 1.8 | 53 | 0.0 | 601 | 0.5 |
| 120-124 | 1,841 | 1.8 | 54 | 0.0 | 510 | 0.4 |
| 125-129 | 1,301 | 1.2 | 13 | 0.0 | 302 | 0.2 |
| 130-134 | 1,203 | 1.1 | 5 | 0.0 | 254 | 0.2 |
| 135-139 | 901 | 0.9 | — | — | 176 | 0.1 |
| 140-144 | 924 | 0.9 | 12 | 0.0 | 170 | 0.1 |
| 145-149 | 667 | 0.6 | — | — | 121 | 0.1 |
| 150-154 | 624 | 0.6 | — | — | 132 | 0.1 |
| 155-159 | 532 | 0.5 | — | — | 88 | 0.1 |
| 160-164 | 479 | 0.5 | — | — | 71 | 0.1 |
| 165-169 | 304 | 0.3 | — | — | 56 | 0.0 |
| 170-174 | 258 | 0.2 | — | — | 52 | 0.0 |
| 175-179 | 181 | 0.2 | — | — | 26 | 0.0 |
| 180-184 | 153 | 0.1 | — | — | 23 | 0.0 |
| 185-189 | 106 | 0.1 | — | — | 11 | 0.0 |
| 190-194 | 99 | 0.1 | — | — | 13 | 0.0 |
| 195-199 | 62 | 0.1 | — | — | 3 | 0.0 |
| 200+ | 35 | 0.0 | — | — | 13 | 0.0 |
| Total | 104,908 | 100.0 | 168,802 | 100.0 | 121,797 | 100.0 |
| Mean Length | 80.2 | | 63.4 | | 63.4 | |

Table 14. Length frequency of halibut measured by observers of the foreign and joint venture fisheries off the Washington-Oregon-California coast, by fishery and 5 cm interval, 1977-1986. No measurements of halibut caught by setlines.

| 5 cm Length Interval | Foreign Trawl | | Joint Venture | |
|----------------------|---------------|---------|---------------|---------|
| | Number | Percent | Number | Percent |
| 0-4 | — | — | — | — |
| 5-9 | — | — | — | — |
| 10-14 | — | — | — | — |
| 15-19 | — | — | — | — |
| 20-24 | — | — | — | — |
| 25-29 | 1 | 1.4 | 3 | 2.2 |
| 30-34 | 2 | 2.7 | 10 | 7.4 |
| 35-39 | 5 | 6.8 | 9 | 6.7 |
| 40-44 | 8 | 11.0 | 2 | 1.5 |
| 45-49 | 3 | 4.1 | 2 | 1.5 |
| 50-54 | 5 | 6.8 | 1 | 0.7 |
| 55-59 | 5 | 6.8 | 9 | 6.7 |
| 60-64 | 6 | 8.2 | 14 | 10.4 |
| 65-69 | 8 | 11.0 | 18 | 13.3 |
| 70-74 | 3 | 4.1 | 21 | 15.6 |
| 75-79 | 2 | 2.7 | 12 | 8.9 |
| 80-84 | 2 | 2.7 | 6 | 4.4 |
| 85-89 | — | — | 5 | 3.7 |
| 90-94 | 1 | 1.4 | 8 | 5.9 |
| 95-99 | 4 | 5.5 | 3 | 2.2 |
| 100-104 | 2 | 2.7 | 1 | 0.7 |
| 105-109 | 1 | 1.4 | 2 | 1.5 |
| 110-114 | — | — | 2 | 1.5 |
| 115-119 | 1 | 1.4 | 1 | 0.7 |
| 120-124 | 6 | 8.2 | 1 | 0.7 |
| 125-129 | — | — | — | — |
| 130-134 | 1 | 1.4 | 2 | 1.5 |
| 135-139 | 2 | 2.7 | 1 | 0.7 |
| 140-144 | 3 | 4.1 | 2 | 1.5 |
| 145-149 | 1 | 1.4 | — | — |
| 150-154 | — | — | — | — |
| 155-159 | — | — | — | — |
| 160-164 | — | — | — | — |
| 165-169 | — | — | — | — |
| 170-174 | — | — | — | — |
| 175-179 | — | — | — | — |
| 180-184 | 1 | 1.4 | — | — |
| 185-189 | — | — | — | — |
| 190-194 | — | — | — | — |
| 195-199 | — | — | — | — |
| 200+ | — | — | — | — |
| Total | 73 | 100.0 | 135 | 100.0 |
| Mean Length | 75.7 | | 69.8 | |

Table 15. Estimated incidental catch¹ (000's lbs., net weight) of halibut in the foreign and joint venture fisheries, by region and year, 1962-1986.

| Year | BERING SEA/ALEUTIANS | | | | | GULF OF ALASKA ² | | | | | BRITISH COL. ³ | GRAND TOTAL |
|------|----------------------|----------------------|--------|---------------|--------|-----------------------------|----------------------|--------|---------------|--------|---------------------------|-------------|
| | Foreign | | | Joint Venture | Total | Foreign | | | Joint Venture | Total | Foreign Trawl | |
| | Trawl | Setline ⁴ | Total | | | Trawl | Setline ⁴ | Total | | | | |
| 1962 | 3,741 | Trace | 3,741 | 0 | 3,741 | 2,138 | 0 | 2,138 | 0 | 2,138 | 0 | 5,879 |
| 1963 | 1,127 | Trace | 1,127 | 0 | 1,127 | 4,933 | Trace | 4,933 | 0 | 4,933 | 0 | 6,060 |
| 1964 | 1,666 | Trace | 1,666 | 0 | 1,666 | 9,985 | Trace | 9,985 | 0 | 9,985 | 0 | 11,651 |
| 1965 | 2,128 | Trace | 2,128 | 0 | 2,128 | 14,220 | Trace | 14,220 | 0 | 14,220 | 0 | 16,348 |
| 1966 | 2,336 | Trace | 2,336 | 0 | 2,336 | 9,389 | Trace | 9,389 | 0 | 9,389 | 159 | 11,884 |
| 1967 | 3,522 | Trace | 3,522 | 0 | 3,522 | 6,587 | Trace | 6,587 | 0 | 6,587 | 340 | 10,449 |
| 1968 | 4,671 | Trace | 4,671 | 0 | 4,671 | 5,387 | 200 | 5,587 | 0 | 5,587 | 416 | 10,674 |
| 1969 | 6,264 | Trace | 6,264 | 0 | 6,264 | 3,226 | 200 | 3,426 | 0 | 3,426 | 360 | 10,050 |
| 1970 | 6,710 | Trace | 6,710 | 0 | 6,710 | 4,099 | 200 | 4,299 | 0 | 4,299 | 36 | 11,045 |
| 1971 | 12,540 | Trace | 12,540 | 0 | 12,540 | 2,579 | 200 | 2,779 | 0 | 2,779 | 45 | 15,364 |
| 1972 | 8,808 | Trace | 8,808 | 0 | 8,808 | 5,341 | 200 | 5,541 | 0 | 5,541 | 288 | 14,637 |
| 1973 | 7,211 | Trace | 7,211 | 0 | 7,211 | 4,732 | 200 | 4,932 | 0 | 4,932 | 313 | 12,456 |
| 1974 | 6,919 | Trace | 6,919 | 0 | 6,919 | 5,631 | 200 | 5,831 | 0 | 5,831 | 491 | 13,241 |
| 1975 | 3,084 ⁵ | Trace | 3,084 | 0 | 3,084 | 3,175 | 200 | 3,375 | 0 | 3,375 | 365 | 6,824 |
| 1976 | 4,050 ⁶ | Trace | 4,050 | 0 | 4,050 | 2,770 | 200 | 2,970 | 0 | 2,970 | 325 | 7,345 |
| 1977 | 2,481 | Trace | 2,481 | 0 | 2,481 | 3,791 | 200 | 3,991 | 0 | 3,991 | 86 ⁷ | 6,558 |
| 1978 | 4,344 | 382 | 4,726 | 0 | 4,726 | 1,942 | 119 | 2,061 | 0 | 2,061 | Trace | 6,787 |
| 1979 | 4,520 | 225 | 4,745 | 0 | 4,745 | 3,401 | 348 | 3,749 | 36 | 3,785 | Trace | 8,530 |
| 1980 | 7,010 | 113 | 7,123 | 472 | 7,595 | 3,242 | 1,855 | 5,097 | 80 | 5,177 | Trace | 12,772 |
| 1981 | 4,267 | 215 | 4,482 | 385 | 4,867 | 1,780 | 2,166 | 3,946 | 8 | 3,954 | Trace | 8,821 |
| 1982 | 2,519 | 141 | 2,660 | 933 | 3,593 | 1,948 | 2,511 | 4,459 | 6 | 4,465 | Trace | 8,058 |
| 1983 | 2,677 | 426 | 3,103 | 726 | 3,829 | 1,280 | 4,083 | 5,363 | 591 | 5,954 | Trace | 9,783 |
| 1984 | 2,520 | 1,008 | 3,528 | 1,023 | 4,551 | 857 | 1,640 | 2,497 | 977 | 3,474 | Trace | 8,025 |
| 1985 | 1,692 | 1,273 | 2,965 | 1,701 | 4,666 | 40 | 359 | 399 | 498 | 897 | Trace | 5,563 |
| 1986 | 849 | 1,127 | 1,976 | 2,837 | 4,813 | 0 | 637 | 637 | 148 | 785 | Trace | 5,598 |

¹Estimates for 1962-1974 are from Hoag (1976); estimates for 1975 and 1976 are from IPHC (unpublished); estimates for U.S. regions for 1977-1986 are from Berger et al. (1987); estimates for the Canadian region for 1977-1986 are guesses due to a lack of data.

²May include some catches in the Aleutian region prior to 1975.

³Only trace amounts of halibut have been taken in the foreign setline and joint venture fisheries in this region.

⁴Guesses until 1978 because of a lack of data.

⁵Estimated at 1.9 million pounds (1165.1 mt) by Nelson et al. (1981).

⁶Estimated at 2.0 million pounds (1211.5 mt) by Nelson et al. (1981).

⁷Includes a small amount of halibut caught on setline gear (Leaman et al. 1978).

tal catches have been on an increasing trend since 1980 and approached 3 million pounds in 1986. Joint venture fisheries operating in the British Columbia and WOC regions target on Pacific whiting using midwater trawl gear and catch very minor amounts of halibut. In 1986, joint venture fisheries were responsible for 53 percent of the total coast-wide incidental catch.

Mortality and Condition

Not all halibut caught incidentally survive the injuries received during capture. The mortality of halibut caught in foreign trawls is believed to be near 100 percent, due to the large groundfish catches usually present in the trawl codends and to the lengthy sorting process (Hoag 1976). Mortality of 100 percent is also likely in the joint venture fishery, where catching and processing conditions are similar to those described for foreign trawling. Addi-

Table 16. Condition of halibut and probability of sea lion predation observed in 1982 on the foreign and joint venture fisheries (R. Nelson, NMFS, personal communication).

| Region and Vessel Type | | Condition | | | Predation | | |
|-------------------------------------|---------|-----------|-------|--------|-----------|------|------|
| | | Excellent | Poor | Dead | None | Some | High |
| Bering Sea/Aleutians | | | | | | | |
| Foreign | Percent | 71.9 | 23.6 | 4.5 | 89.4 | 6.7 | 3.9 |
| Setline | No. | 1,062 | 348 | 67 | — | — | — |
| Joint Venture | Percent | 1.2 | 3.4 | 95.5 | 98.7 | 1.1 | 0.2 |
| Motherships | No. | 381 | 1,074 | 30,625 | — | — | — |
| Foreign | Percent | 9.2 | 15.7 | 75.1 | 96.9 | 2.6 | 0.6 |
| Motherships | No. | 195 | 335 | 1,600 | — | — | — |
| Foreign | Percent | 32.4 | 24.6 | 43.0 | 90.4 | 3.7 | 5.9 |
| Trawlers | No. | 11,247 | 8,533 | 14,893 | — | — | — |
| Gulf of Alaska | | | | | | | |
| Foreign | Percent | 69.9 | 21.6 | 8.6 | 75.2 | 6.1 | 18.8 |
| Setline | No. | 4,065 | 1,255 | 500 | — | — | — |
| Joint Venture | Percent | 0.7 | 39.9 | 59.5 | 64.3 | 3.6 | 32.1 |
| Motherships | No. | 1 | 61 | 91 | — | — | — |
| Foreign | Percent | — | — | — | — | — | — |
| Motherships | No. | — | — | — | — | — | — |
| Foreign | Percent | 56.5 | 21.4 | 22.1 | 83.8 | 7.3 | 9.0 |
| Trawlers | No. | 14,477 | 5,492 | 5,670 | — | — | — |
| Washington-Oregon-California | | | | | | | |
| Joint Venture | Percent | 10.0 | 7.0 | 83.0 | 100.0 | — | — |
| Motherships | No. | 3 | 2 | 24 | — | — | — |
| Foreign | Percent | 100.0 | — | — | 100.0 | — | — |
| Trawlers | No. | 1 | — | — | — | — | — |

Nationalities: Motherships: Japan
Setline: Japan, Korea
Trawlers: Bulgaria, Taiwan, West Germany
Joint Venture Motherships: U.S./U.S.S.R., U.S./Korea, U.S./Poland, U.S./Japan,
U.S./Bulgaria, U.S./West Germany

tionally, the transfer of the codend to the foreign processing ship probably increases mortality. For halibut caught in the foreign setline fisheries, a mortality rate of 50 percent had been conservatively estimated by Myhre (1974). Terry and Hoag (1983) examined incidental mortality and used a range of mortality rates for foreign trawl (50 to 100 percent) and setline (10 to 50 percent), due to the difficulty in assessing mortality in the varied conditions in which halibut are incidentally caught.

Data on the condition of over 100,000 halibut caught by the foreign and joint venture fisheries were collected by NMFS observers in 1982. Halibut were judged to be dead or in excellent or poor condition by the observers and the results are given for each vessel type and area in Table 16. Also, the probability of sea lion predation (none, some, or high) was estimated and summarized in Table 16.

The NMFS observations indicate that halibut released from setline vessels have the highest survival potential: 71 percent were judged to be in excellent condition. The highest mortality probably occurred on joint venture motherships, where only one percent were judged excellent. Condition of halibut caught by foreign motherships and independent trawlers was somewhat better than on joint venture motherships but worse than on setline vessels: fish in excellent condition were 9 percent of the foreign mothership catch and 32 percent of the foreign trawl catch. Sea lion predation on released fish was observed less than 10 percent of the time. Additional discussion of these data can be found in Natural Resources Consultants (1984).

Estimates of incidental mortality of halibut for foreign and joint venture fisheries in 1962-1986 are shown in Table 17 in **pounds, net weight**. These estimates are based on the estimates of incidental catch presented earlier in Table 6 and mortality rates of 100 percent for foreign trawl and joint venture fisheries and 25 percent for foreign setline operations. The results indicate a cyclical pattern in incidental mortality during 1962-1986, with mortality highest in 1965 and 1971 at 15 to 17 million pounds and in 1980 at 12 million pounds. In 1986, incidental mortality in the foreign and joint venture fisheries was the lowest since 1962, approximately 4 million pounds.

CANADIAN AND U.S. FISHERIES FOR GROUND FISH

Canadian and U.S. groundfish fisheries which deliver catches to a foreign processing ship operating within Canadian or U.S. national waters are termed joint ventures, but are considered domestic harvests. If the catch is delivered to a domestic processor, either shore-based or floating, the fishery is considered fully domestic. This section of the report covers fisheries of the latter type, i.e. fisheries with domestic processing.

Description

The historical development and catch statistics of the U.S. and Canadian fisheries for groundfish in the Bering Sea and northeast Pacific Ocean have been documented most completely by Forrester et al. (1978, 1983) and Van Houten Lynde (unpublished⁴). Annual groundfish landings (mt) by the U.S. and Canadian groundfish fleets during 1920-1986 are

⁴Van Houten Lynde, Marcelle. 1986. This Historical Annotated Landings (HAL) Database: Documentation of annual harvest of groundfish from the northeast Pacific and eastern Bering Sea from 1956 to 1980. NOAA Tech. Memo. NMFS F/NWC-103. 197 p.

Table 17. Estimated incidental mortality (000's lbs., net weight) of halibut in the foreign and joint venture fisheries, by region and year, 1962-1986.

| Year | Bering Sea/Aleutians | | | | | Gulf of Alaska ¹ | | | | | British Columbia | GRAND TOTAL |
|------|----------------------|---------|--------|---------------|--------|-----------------------------|---------|--------|---------------|--------|------------------|-------------|
| | Foreign | | | Joint Venture | Total | Foreign | | | Joint Venture | Total | Foreign Trawl | |
| | Trawl | Setline | Total | | | Trawl | Setline | Total | | | | |
| 1962 | 3,741 | Trace | 3,741 | 0 | 3,741 | 2,138 | 0 | 2,138 | 0 | 2,138 | 0 | 5,879 |
| 1963 | 1,127 | Trace | 1,127 | 0 | 1,127 | 4,933 | Trace | 4,933 | 0 | 4,933 | 0 | 6,060 |
| 1964 | 1,666 | Trace | 1,666 | 0 | 1,666 | 9,985 | Trace | 9,985 | 0 | 9,985 | 0 | 11,651 |
| 1965 | 2,128 | Trace | 2,128 | 0 | 2,128 | 14,220 | Trace | 14,220 | 0 | 14,220 | 0 | 16,348 |
| 1966 | 2,336 | Trace | 2,336 | 0 | 2,336 | 9,389 | Trace | 9,389 | 0 | 9,389 | 159 | 11,884 |
| 1967 | 3,522 | Trace | 3,522 | 0 | 3,522 | 6,587 | Trace | 6,587 | 0 | 6,587 | 340 | 10,449 |
| 1968 | 4,671 | Trace | 4,671 | 0 | 4,671 | 5,387 | 50 | 5,437 | 0 | 5,437 | 416 | 10,524 |
| 1969 | 6,264 | Trace | 6,264 | 0 | 6,264 | 3,226 | 50 | 3,276 | 0 | 3,276 | 360 | 9,900 |
| 1970 | 6,710 | Trace | 6,710 | 0 | 6,710 | 4,099 | 50 | 4,149 | 0 | 4,149 | 36 | 10,895 |
| 1971 | 12,540 | Trace | 12,540 | 0 | 12,540 | 2,579 | 50 | 2,629 | 0 | 2,629 | 45 | 15,214 |
| 1972 | 8,808 | Trace | 8,808 | 0 | 8,808 | 5,341 | 50 | 5,391 | 0 | 5,391 | 288 | 14,487 |
| 1973 | 7,211 | Trace | 7,211 | 0 | 7,211 | 4,732 | 50 | 4,782 | 0 | 4,782 | 313 | 12,306 |
| 1974 | 6,919 | Trace | 6,919 | 0 | 6,919 | 5,631 | 50 | 5,681 | 0 | 5,681 | 491 | 13,091 |
| 1975 | 3,084 | Trace | 3,084 | 0 | 3,084 | 3,175 | 50 | 3,225 | 0 | 3,225 | 365 | 6,674 |
| 1976 | 4,050 | Trace | 4,050 | 0 | 4,050 | 2,770 | 50 | 2,820 | 0 | 2,820 | 325 | 7,195 |
| 1977 | 2,481 | Trace | 2,481 | 0 | 2,481 | 3,791 | 50 | 3,841 | 0 | 3,841 | 86 | 6,408 |
| 1978 | 4,344 | 96 | 4,440 | 0 | 4,440 | 1,942 | 30 | 1,972 | 0 | 1,972 | Trace | 6,411 |
| 1979 | 4,520 | 56 | 4,576 | 0 | 4,576 | 3,401 | 87 | 3,488 | 36 | 3,524 | Trace | 8,100 |
| 1980 | 7,010 | 28 | 7,038 | 472 | 7,510 | 3,242 | 464 | 3,706 | 80 | 3,786 | Trace | 11,296 |
| 1981 | 4,267 | 54 | 4,321 | 385 | 4,706 | 1,780 | 542 | 2,322 | 8 | 2,330 | Trace | 7,035 |
| 1982 | 2,519 | 35 | 2,554 | 933 | 3,487 | 1,948 | 628 | 2,576 | 6 | 2,582 | Trace | 6,069 |
| 1983 | 2,677 | 107 | 2,784 | 726 | 3,510 | 1,280 | 1,021 | 2,301 | 591 | 2,892 | Trace | 6,401 |
| 1984 | 2,520 | 252 | 2,772 | 1,023 | 3,795 | 857 | 410 | 1,267 | 977 | 2,244 | Trace | 6,039 |
| 1985 | 1,692 | 318 | 2,010 | 1,701 | 3,711 | 40 | 90 | 130 | 498 | 628 | Trace | 4,339 |
| 1986 | 849 | 282 | 1,131 | 2,837 | 3,968 | 0 | 159 | 159 | 148 | 307 | Trace | 4,275 |

¹May include mortality in the Aleutian region prior to 1975.

Table 18. United States and Canadian catches (mt) of groundfish (excluding halibut) in the northeast Pacific Ocean, 1920-1955. From Forrester, et. al. (1978).

| Year | U.S. | Canada | Total | Year | U.S. | Canada | Total |
|------|--------|--------|--------|------|--------|--------|---------|
| 1920 | 7,179 | 5,328 | 12,507 | 1940 | 27,871 | 12,416 | 40,287 |
| 1921 | 7,351 | 5,827 | 13,178 | 1941 | 40,182 | 19,737 | 59,919 |
| 1922 | 7,334 | 5,640 | 12,974 | 1942 | 39,185 | 22,439 | 61,624 |
| 1923 | 9,174 | 5,538 | 14,712 | 1943 | 53,560 | 29,408 | 82,968 |
| 1924 | 9,613 | 7,671 | 17,284 | 1944 | 62,930 | 43,767 | 106,967 |
| 1925 | 11,094 | 6,857 | 17,951 | 1945 | 70,356 | 36,558 | 106,914 |
| 1926 | 10,994 | 7,247 | 18,241 | 1946 | 65,036 | 26,327 | 91,363 |
| 1927 | 12,143 | 10,359 | 22,502 | 1947 | 43,654 | 23,139 | 66,793 |
| 1928 | 11,368 | 15,322 | 26,690 | 1948 | 58,033 | 25,591 | 83,624 |
| 1929 | 12,448 | 16,872 | 29,320 | 1949 | 51,140 | 28,084 | 79,224 |
| 1930 | 23,142 | 9,613 | 32,755 | 1950 | 53,893 | 14,231 | 68,124 |
| 1931 | 17,037 | 9,436 | 26,473 | 1951 | 59,308 | 16,675 | 75,983 |
| 1932 | 16,247 | 4,943 | 21,190 | 1952 | 47,433 | 17,344 | 64,777 |
| 1933 | 17,572 | 7,389 | 24,961 | 1953 | 38,949 | 12,046 | 50,995 |
| 1934 | 19,842 | 10,172 | 30,014 | 1954 | 50,912 | 12,983 | 63,895 |
| 1935 | 20,880 | 9,844 | 30,724 | 1955 | 48,909 | 14,204 | 63,113 |
| 1936 | 20,342 | 11,436 | 31,778 | | | | |
| 1937 | 21,968 | 10,623 | 32,591 | | | | |
| 1938 | 18,223 | 13,644 | 31,867 | | | | |
| 1939 | 25,820 | 10,622 | 36,442 | | | | |

shown in Tables 18 and 19 and have been extracted from Forrester et al. (1978), Van Houten Lynde (*op cit.*), and W. Daspit (PacFIN, personal communication). Halibut, herring (*Clupea harengus pallasi*), and shrimp were excluded from these statistics. These data represent catches by trawl, longline, handline, troll, net, and pot gear.

Prior to World War I, Canadian and U.S. commercial exploitation of groundfish species was sporadic and often experimental. Most were small-scale fisheries operating close to ports of delivery, although a Canadian company conducted a short-lived hook and line fishery for Pacific cod in the Bering Sea during the early 1900s.

During World War I, demand for fish protein to replace meat being shipped to Europe caused rapid expansion of Canadian otter trawl fisheries for sablefish, lingcod (*Ophiodon elongatus*), and flatfish. Groundfish catches in the U.S. were minor during the war years. Combined Canadian and U.S. landings usually averaged less than 10,000 mt prior to 1920. Subsequent to World War I, Canadian production of sablefish and flatfish declined to a low level, but a handline fishery for lingcod and an otter trawl fishery for dogfish to supply oil, meal, and fertilizer continued for many years.

World War II precipitated another rapid expansion of trawl fisheries off Canada and the United States. Wartime demand and improved fish processing techniques prompted market expansion. Total groundfish landings by Canadian and U.S. fleets exceeded 100,000 mt during 1944. Flatfish landings reached a war years' peak of 18,000 mt, most of which was taken by U.S. trawlers. Dogfish also was in great demand as a source of vitamin A and Canadian landings of dogfish peaked at 32,000 mt in 1944. Soupfin shark (*Galeorhinus zyopterus*), sablefish, and lingcod were heavily fished by the U.S. for their vitamin A content and catches of these species totalled 38,000 mt in 1944.

Table 19. United States and Canadian groundfish (excluding halibut) catches (mt) by area¹ in the northeast Pacific Ocean and Bering Sea, 1956-1986. Data sources are listed below table.

| Year | Washington, Oregon, California | British Columbia | Gulf of Alaska | Bering Sea/ Aleutians | Total |
|------|--------------------------------------|---------------------|-------------------|--------------------------|---------|
| 1956 | 27,923 | 29,886 | 142 | 0 | 57,951 |
| 1957 | 29,526 | 24,030 | 79 | 0 | 53,635 |
| 1958 | 23,541 | 25,016 | 21 | 0 | 48,557 |
| 1959 | 26,100 | 28,754 | 44 | 0 | 54,898 |
| 1960 | 26,721 | 27,137 | 2,191 | 0 | 56,049 |
| 1961 | 31,717 | 27,656 | 1,060 | 0 | 60,433 |
| 1962 | 28,927 | 28,763 | 88 | 0 | 57,778 |
| 1963 | 29,079 | 30,618 | 143 | 0 | 59,840 |
| 1964 | 27,815 | 31,899 | 420 | 0 | 60,134 |
| 1965 | 31,055 | 35,167 | 210 | 0 | 66,432 |
| 1966 | 28,090 | 40,498 | 342 | 0 | 68,930 |
| 1967 | 32,864 | 39,189 | 230 | 0 | 72,283 |
| 1968 | 24,633 | 38,413 | 177 | 0 | 63,223 |
| 1969 | 26,941 | 37,277 | 105 | 0 | 64,312 |
| 1970 | 26,667 | 30,996 | 4,458 | 0 | 62,121 |
| 1971 | 28,981 | 26,411 | 456 | 0 | 55,848 |
| 1972 | 37,427 | 28,668 | 184 | 0 | 66,279 |
| 1973 | 31,138 | 31,577 | 260 | 0 | 62,975 |
| 1974 | 35,600 | 31,169 | 1,602 | 0 | 68,371 |
| 1975 | 38,367 | 34,749 | 1,979 | 0 | 75,095 |
| 1976 | 53,510 | 38,385 | 2,180 | 0 | 94,075 |
| 1977 | 46,003 | 39,068 | 2,782 | 19 | 87,872 |
| 1978 | 66,677 | 37,775 | 4,971 | 63 | 109,486 |
| 1979 | 86,764 | 42,939 | 7,746 | 658 | 138,107 |
| 1980 | 79,261 | 43,328 | 4,985 | 5,740 | 133,313 |
| 1981 | 114,174 | 37,337 | 4,505 | 14,398 | 170,414 |
| 1982 | 130,620 | 35,877 | 8,023 | 25,242 | 199,762 |
| 1983 | 108,275 | 36,537 | 9,056 | 46,485 | 200,353 |
| 1984 | 98,524 | 38,335 | 13,079 | 57,528 | 207,466 |
| 1985 | 91,313 | 45,159 | 40,863 | 92,379 | 269,714 |
| 1986 | 82,238 | 52,182 | 60,897 | 106,413 | 301,730 |

Data Sources: (1) 1956-1980: Van Houten Lynde, M. 1986. The Historical Annotated Landings (HAL) data base: Documentation of annual harvest of groundfish from the northeast Pacific and eastern Bering Sea from 1956 to 1980. NOAA Technical Memorandum NMFS F/NWC-103, 197 pp.; (2) 1981-1986 U.S. catches: W. Daspit, PacFIN, personal communication; (3) 1981-1986 Canadian catches: Leaman (1982, 1983, 1984, 1985, 1986), Leaman and Stanley (1987).

¹**Area definitions:** (1) Washington-Oregon-California is Conception through Columbia regions, except that for 1981-1986, includes U.S. portion of Vancouver region; (2) British Columbia is Vancouver and Charlotte regions and excludes Puget Sound and the Strait of Georgia, except that for 1981-1986, includes only the Canadian portion of the Vancouver region; (3) Gulf of Alaska is Southeastern through Shumagin regions; (4) Bering Sea is Bering Sea I through Bering Sea IV (Aleutian).

The anticipated decline in groundfish production after World War II did not materialize. The high demand for fish and frozen fillets of various flatfish, lingcod, and other species was sustained, and previously unwanted species, such as Pacific cod, Dover sole (*Microstomus pacificus*), and some rockfish gained market acceptance. Domestic trawl catches of groundfish averaged 62,000 mt during 1950-1970. More than half was taken from Canadian waters. Catches in the Gulf of Alaska were minor, usually totalling less than 200 mt annually, and

originated primarily from the Southeastern region. Domestic trawl fleets did not operate in the Bering Sea during these years. The total Canadian trawl catch rose from 7,600 mt in 1945 to a peak of 24,700 mt in 1966 and averaged 15,000 mt during the 1950-1970 period. More than half the Canadian trawl catch was taken from the Charlotte region and approximately one third came from the Vancouver region. Species composition of the trawl catch varied, but Pacific cod and rock sole (*Lepidopsetta bilineata*) were dominant. Dogfish production declined significantly after the war because it was no longer needed as a source of vitamin A. The U.S. trawl catch of all groundfish averaged 50,000 mt during 1950-1970 and most came from waters south of Alaska, mainly the Charlotte, Vancouver, and Columbia regions. Flatfish, especially Dover and English soles (*Parophrys vetulus*), were the principal target species. Pacific ocean perch (*Sebastes alutus*) was important by 1954, peaked at 13,000 mt in 1965, but declined thereafter as stocks were depleted and catch restrictions were imposed. Other rockfish also were prominent in U.S. trawl landings after 1960. Data on U.S. longline catches are not available, but Canadian longline fisheries for sablefish operated in the Southeastern, Charlotte, and Vancouver regions and catches totalled less than 1,000 mt.

During 1971-1976, groundfish landings by domestic trawl fleets averaged 74,000 mt, half of which was caught in the WOC region and half off British Columbia. Trawl fisheries in the Gulf of Alaska were small and sporadic; catches exceeded 1,500 mt only after 1970. Canadian catches of groundfish in the northeast Pacific averaged 21,000 mt, and were taken primarily by the trawl fishery in the Charlotte and Vancouver regions. Species composition of the landings (by all gears) during this period was 39 percent Pacific cod, 22 percent flatfish, 15 percent rockfish, and 10 percent lingcod. U.S. trawl catches of groundfish in the northeast Pacific Ocean were larger than Canadian catches during 1971-1976, averaging 33,000 mt during this period. The catches were about equally divided among the Charlotte through Monterey regions. Species composition of U.S. catches (by all gears) was 39 percent flatfish, 31 percent rockfish, 11 percent sablefish, 7 percent Pacific cod, and 5 percent lingcod.

Since 1976, groundfish catches have steadily increased, reaching 302,000 mt in 1986. These increases have occurred primarily in the trawl fisheries for rockfish and Pacific whiting in the WOC region, longline and pot fisheries for sablefish in all areas, and trawl fisheries for Pacific cod and pollock in the Bering Sea. U.S. trawl fisheries for pollock, Pacific cod, and flatfish began operation in the Gulf of Alaska and Bering Sea in the late 1970s. The expansion of U.S. fisheries for groundfish partially resulted from implementation of the MFCMA in 1976, which favored domestic fisheries over foreign fisheries. In addition, the decline in the trawl fishery for shrimp off Alaska caused much of the shrimp fleet to turn to other fisheries, particularly the trawl fisheries for groundfish. Also as a result of extended jurisdiction, reciprocal fishing privileges between the U.S. and Canada were terminated after 1981, and this shifted a large portion of the U.S. trawl fleet from Canadian to U.S. waters, especially into the WOC region. Since the early 1980s, the Canadian trawl fleet has shifted much of its effort from flatfish to rockfish (Leaman and Stanley 1987).

Observer Programs

Estimates of the incidental catch of halibut by domestic trawl fisheries off British Columbia and Alaska are based on data collected by observers who sample the catch at sea. Several agencies have been involved with the observer programs and the level of fleet coverage has varied considerably over the years.

IPHC conducted an observer program to obtain incidence rates of halibut in the domestic trawl fishery off British Columbia in the 1960s. Between 1962 and 1970, 3,031 hauls

were sampled during 120 commercial trips on 32 trawlers (Hoag 1971). These observations covered approximately two percent of the fishing effort (hours) by the fleet. Observer coverage of this fishery was discontinued until 1978, when the Canadian Department of Fisheries and Oceans began an observer program to monitor species composition and discard rates (Ketchen 1981a). Information on the incidence of halibut also was collected. Twenty-four commercial trips, representing approximately five percent coverage of the fleet, were observed during 1978-1979. In 1979, IPHC also observed one commercial trip, and in 1980 IPHC participated in the CDFO observer program. During 33 trips in 1981-1982, 1.5 percent of the fleet's catch was observed (Stanley 1984). An additional six trips were observed during 1983, but these data have not been summarized.

The Alaska Department of Fish and Game (ADF&G), under contract to the U.S. North Pacific Fishery Management Council (NPFMC), began placing observers aboard U.S. trawlers fishing off Alaska in 1978; longline vessels were included in 1984. During 1978-1984, a total of 58 trips in the Gulf of Alaska and 30 trips in the Bering Sea were observed (Blackburn 1986). Data were also collected in 1985-1986 (P. Craig, ADF&G, personal communication), but the coverage has been sporadic.

Incidence and Average Length of Halibut

Two measures of the incidence of halibut in the domestic trawl fisheries off Canada are available for various years, areas, and target species groupings. These measures are (1) CPUE in pounds of halibut per hour trawled, and (2) a catch ratio in weight of halibut per weight of total catch. Hoag (1971) presented incidence rates for 1962-1969, Ketchen (1981a, 1981b) summarized the incidence of halibut observed in 1978-1980, and Stanley (1984) presented the incidence data for 1981-1982. These authors have presented their data for different target species groupings because of changes in the trawl fishery over time. Incidence rates measured as CPUE for the various target species are given in Table 20 and as a catch ratio in Table 21.

The incidence of halibut was highest, exceeding 100 pounds per hour, during the summer (May through August) in most areas and years when fishing for species other than Pacific ocean perch. The major exception has Hecate Strait in 1981-1982, when incidence rates averaged 71 pounds per hour during the summer. Incidence rates observed during the winter (September through April) are much more variable, ranging between 13 and 96 pounds per hour for the various categories. Incidence rates when fishing for Pacific ocean perch are very low, less than 10 pounds per hour in most areas, seasons, and years.

Observed incidence rates have varied over the years. In general, incidence rates observed in Hecate Strait and Queen Charlotte Sound during 1978-1979 were much lower than observations collected in other years. Ketchen (1981a) suggested this was due to decreased abundance of juvenile halibut off British Columbia. Incidence rate data collected during 1980 and 1981-1982 were similar to catch ratios observed by Hoag (1971) during 1962-1969. This led Ketchen (1981b) to propose that the 1978-1979 data may not have been representative of the fishery. When fishing for species other than Pacific ocean perch, the observed incidence (CPUE method) of halibut was lower during the summer in 1981-1982 than in 1962-1969 or 1980.

Incidental catches by the trawl fishery off British Columbia are estimated using incidence rates for the 1962-1969 period, Hoag's (1971) catch ratio method, and annual trawl landing statistics. These incidence rates are used because time, area, and fleet monitoring by observers is much less extensive in recent years. Also, rates observed in 1981-1982 are similar

Table 20. CPUE (pounds [net] per hour) of Pacific halibut by area, target species, season, and year in the Canadian trawl fishery. From Hoag (1971), Ketchen (1981a, 1981b), and Stanley (1984).

| Area-Year | Target Species and Season | | | | | | | | | | | | | | | |
|--|---|--------|---------------------|--------|------------------|--------|----------------|--------|-----------------------|--------|-----------------------|--------|----------------------|--------|--------|--------|
| | Hoag (1971), Ketchen (1981a, 1981b), Stanley (1984) | | | | | | Stanley (1984) | | | | | | | | | |
| | Flatfish | | Pacific Ocean Perch | | Other Groundfish | | Pacific Cod | | Turbot and Dover Sole | | English and Rock Sole | | Rockfish (excl. POP) | | Others | |
| | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer |
| West Coast of Vancouver Island | | | | | | | | | | | | | | | | |
| 1962-1969 | 21 | 102 | 6 | 4 | 18 | 136 | — | — | — | — | — | — | — | — | — | — |
| 1980 | — | 24 | — | — | — | 83 | — | — | — | — | — | — | — | — | — | — |
| Queen Charlotte Sound | | | | | | | | | | | | | | | | |
| 1962-1969 | 13 | 84 | 7 | 7 | 35 | 221 | — | — | — | — | — | — | — | — | — | — |
| 1978-1979 | — | 28 | — | 2 | 3 | 73 | — | — | — | — | — | — | — | — | — | — |
| 1981-1982 | 96 | 105 | — | 2 | 78 | 48 | 57 | 27 | 157 | 3 | 60 | 163 | 95 | 41 | 97 | 66 |
| Hecate Strait | | | | | | | | | | | | | | | | |
| 1962-1969 | 63 | 165 | 37 | 28 | 35 | 249 | — | — | — | — | — | — | — | — | — | — |
| 1978-1979 | 13 | 60 | — | 1 | 29 | 68 | — | — | — | — | — | — | — | — | — | — |
| 1980 | — | 149 | — | 1 | — | 143 | — | — | — | — | — | — | — | — | — | — |
| 1981-1982 | 78 | 72 | — | 8 | 90 | 70 | 102 | 73 | 51 | 80 | 80 | 69 | 52 | 70 | 71 | 86 |
| West Coast of Queen Charlotte Islands | | | | | | | | | | | | | | | | |
| 1978-1979 | — | 0 | 14 | 7 | 9 | 6 | — | — | — | — | — | — | — | — | — | — |
| 1980 | — | — | — | 17 | — | — | — | — | — | — | — | — | — | — | — | — |

Table 21. Catch ratios (weight of halibut per weight of total catch) of Pacific halibut by target species, season, and year in the Canadian trawl fishery. From Hoag (1971), Ketchen (1981a, 1981b), and Stanley (1984).

| Area-Year | Target Species and Season | | | | | | | | | | | | | | | |
|--|---|--------------------|---------------------|--------|--------------------|--------------------|----------------|--------|-----------------------|--------|-----------------------|--------|----------------------|--------|--------|--------|
| | Hoag (1971), Ketchen (1981a, 1981b), Stanley (1984) | | | | | | Stanley (1984) | | | | | | | | | |
| | Flatfish | | Pacific Ocean Perch | | Other Groundfish | | Pacific Cod | | Turbot and Dover Sole | | English and Rock Sole | | Rockfish (excl. POP) | | Others | |
| | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer |
| West Coast of Vancouver Island | | | | | | | | | | | | | | | | |
| 1962-1969 | 0.013 | 0.175 | 0.003 | 0.003 | 0.009 | 0.019 | — | — | — | — | — | — | — | — | — | — |
| 1980 | — | 0.011 | — | — | — | 0.079 | — | — | — | — | — | — | — | — | — | — |
| Queen Charlotte Sound | | | | | | | | | | | | | | | | |
| 1962-1969 | 0.019 | 0.063 | 0.003 | 0.003 | 0.030 | 0.138 | — | — | — | — | — | — | — | — | — | — |
| 1978-1979 | — | 0.018 | — | 0.001 | 0.005 | 0.040 | — | — | — | — | — | — | — | — | — | — |
| 1981-1982 | 0.040 ¹ | 0.098 ¹ | 0.001 | 0.001 | 0.069 ² | 0.047 ² | 0.037 | 0.022 | 0.021 | 0.001 | 0.059 | 0.195 | 0.034 | 0.030 | 0.137 | 0.090 |
| Hecate Strait | | | | | | | | | | | | | | | | |
| 1962-1969 | 0.064 | 0.060 | 0.045 | 0.008 | 0.015 | 0.060 | — | — | — | — | — | — | — | — | — | — |
| 1978-1979 | 0.013 | 0.024 | — | <0.001 | 0.137 | 0.032 | — | — | — | — | — | — | — | — | — | — |
| 1980 | — | 0.107 | — | 0.001 | — | 0.057 | — | — | — | — | — | — | — | — | — | — |
| 1981-1982 | 0.060 ¹ | 0.065 ¹ | 0.004 | 0.004 | 0.063 ² | 0.104 | 0.082 | 0.061 | 0.025 | 0.056 | 0.095 | 0.074 | 0.047 | 0.061 | 0.060 | 0.191 |
| West Coast of Queen Charlotte Islands | | | | | | | | | | | | | | | | |
| 1978-1979 | — | 0.000 | 0.004 | 0.001 | 0.011 | 0.001 | — | — | — | — | — | — | — | — | — | — |
| 1980 | — | — | — | 0.003 | — | — | — | — | — | — | — | — | — | — | — | — |

¹Mean of catch ratios for turbot, Dover sole, English sole, and Rock sole categories

²Mean of catch ratios for Pacific cod, rockfish (excluding Pacific ocean perch), and other groundfish categories

to those observed during 1962-1969 in common strata (Stanley 1984), suggesting the earlier data remain valid.

Information on the size of halibut caught by the domestic trawl fishery off British Columbia has been collected during all observer programs, but has not been summarized for the 1978-1979 period. Data collected during the other years showed that the size composition varied by area, season, target species, and time period. Hoag (1971) reported that most halibut were less than 100 cm, with 32.5 percent less than 65 cm. Halibut also were largest in the most southern area, off the west coast of Vancouver Island, and decreased progressively in size from south to north. In Queen Charlotte Sound and Hecate Strait (Figure 4), halibut were smaller in the winter than in the summer. The seasonal length distribution of halibut observed during 1962-1969 is shown in Figure 5 (adapted from Hoag 1971). Ketchen (1981b) reported that the size composition of halibut in Hecate Strait during the summer in 1980 was similar to that reported by Hoag (1971). As shown in Figure 6 (adapted from Ketchen 1981b), the percentage of halibut caught between 50 and 65 cm was slightly higher in 1980 than in 1962-1969, but the percentage less than 50 cm was much lower in 1980. Stanley (1984) reported that the incidental catch during 1981-1982 was comprised of much smaller fish than in 1962-1969, except when the target species was Pacific ocean perch: in 1981-1982, 34 percent were less than 65 cm compared to 22 percent during 1962-1969. Mean length of halibut by area, season, and target species observed during 1981-1982 is given in Table 22.

The incidence of halibut observed in the U.S. trawl fisheries off Alaska (Table 23) varies greatly with the month and area of operation. The incidence was highest, 156 pounds per hour, in the Kodiak area during October-December, 1984, in a trawl fishery for Pacific cod and flounders. Incidence rates were generally higher in the Gulf of Alaska than in the Bering Sea. Within the Gulf, incidence rates were similar among regions during 1978-1979, between 21 and 26 pounds per hour except in Southeast, where rates were lower, 7.1 pounds per hour. Fisheries observed during this period included a winter trawl fishery for Pacific cod to supply bait to the Tanner crab fisheries near Dutch Harbor and Kodiak, and in Prince William Sound and Cook Inlet. In addition to the bait fishery, a winter fishery operated out of Kodiak and Petersburg to supply bottomfish for human consumption. Pacific cod and pollock were the primary species taken off Kodiak and the Petersburg fleet fished for starry flounder (*Platichthys stellatus*) and pollock. Catches observed in the Yakutat area were portions of trips that were part of an Alaska Department of Commerce and Economic Development study. Pacific ocean perch was the main target species. Incidence rates observed in 1982 were similar to those in 1978-1979. Rates were much higher in 1984 in the Kodiak area, as fisheries for Pacific cod and flounders were developing at that time.

Most halibut caught incidentally by the U.S. trawl fisheries off Alaska were smaller than 80 cm. Observer data for 1978-1979 show that halibut caught in the eastern Bering Sea were smaller, on average, than those in the Gulf of Alaska. Mean lengths were 38 cm in the Bering Sea, 59 cm in the Chirikof region, 57 cm in the Kodiak region, and 48 cm in the Southeast region (Blackburn and Rigby, unpublished⁵). Halibut averaged 50 cm in length in data col-

⁵Blackburn, James E. and Philip Rigby. An observer program for the domestic groundfish fishery in the Gulf of Alaska. Final report on Contract No. 77-5 for September, 1977 through December, 1979 to the North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, AK, 99510.

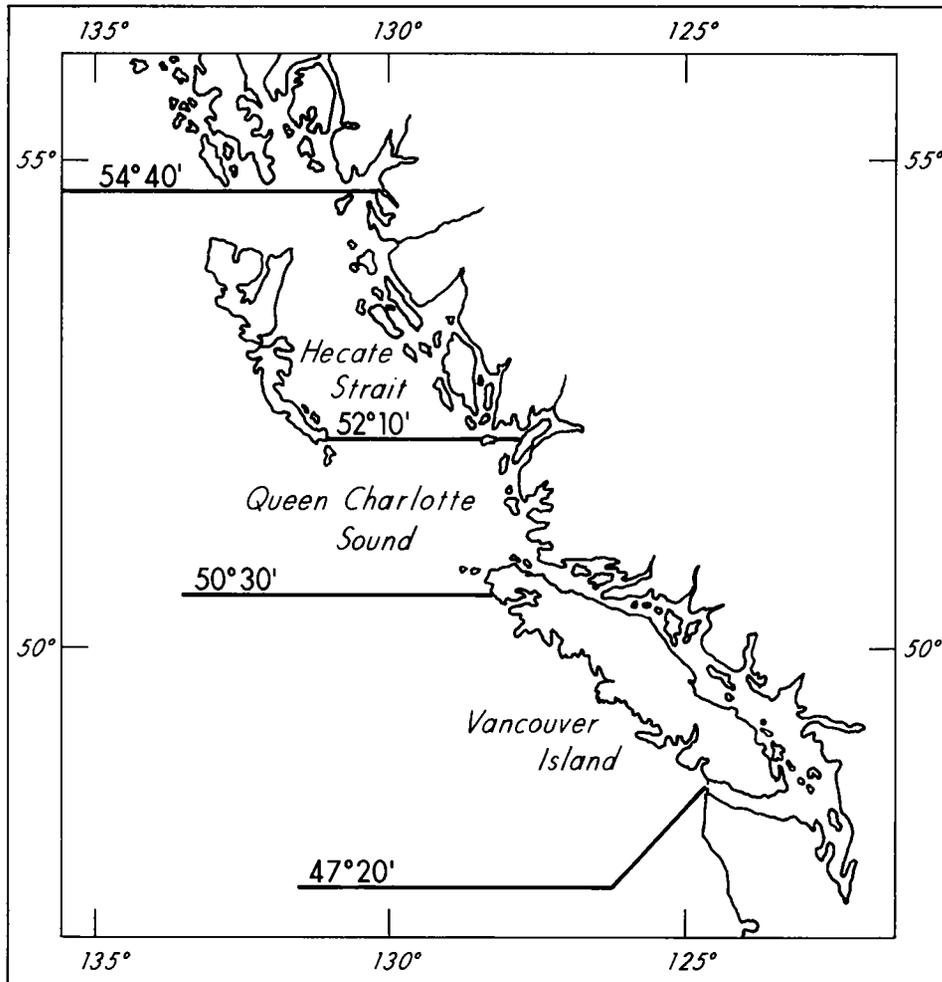


Figure 4. British Columbia sampling areas used by Hoag (1971).

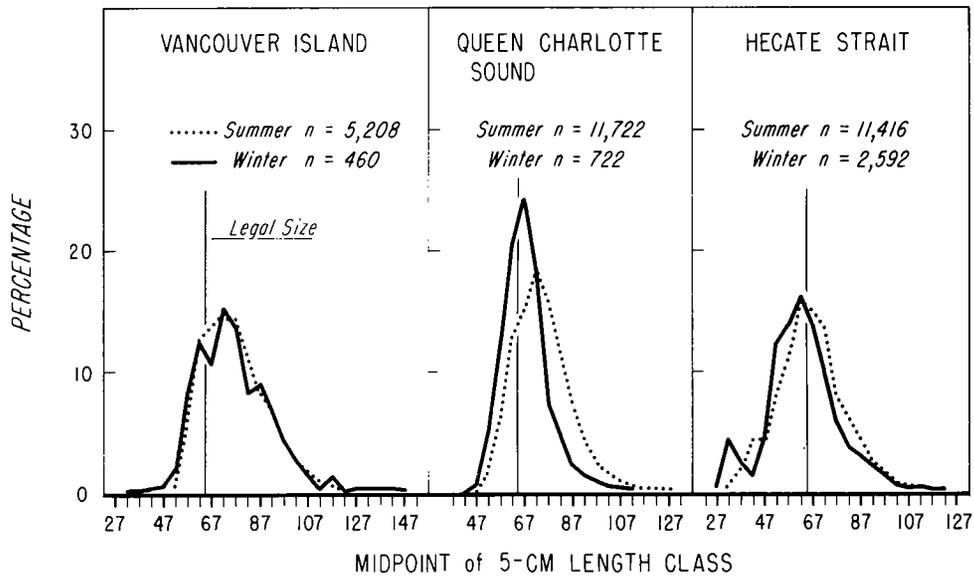


Figure 5. Areal and seasonal length distributions of halibut caught by commercial trawlers fishing off the B.C. coast during 1962-1969. From Hoag (1971).

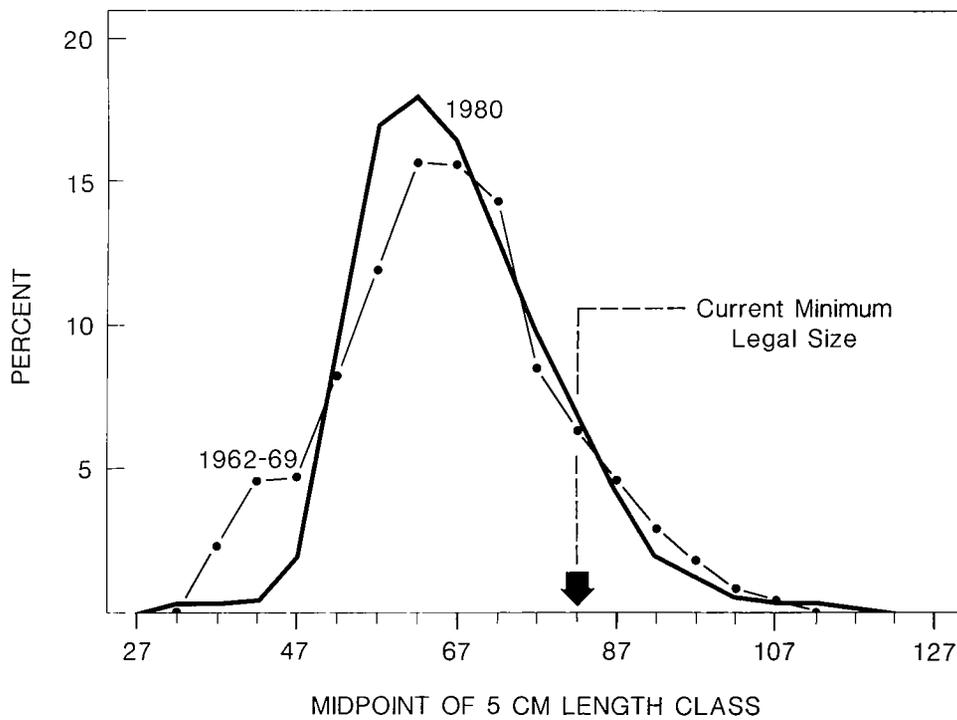


Figure 6. Length distributions of halibut caught by commercial trawlers during the summer of 1980 in Hecate Strait and during 1962-1969 off Canada. From Ketchen (1981b).

Table 22. Mean length and percent by number of halibut less than 65 cm and 82 cm by area, season, and target species in the Canadian trawl fishery, 1981-1982. From Stanley (1984).

| Target Species | Queen Charlotte Sound | | Hecate Strait | | TOTAL |
|------------------------------|-----------------------|--------|---------------|--------|-------|
| | Summer | Winter | Summer | Winter | |
| Pacific cod | | | | | |
| Number of halibut | 38 | 321 | 1589 | 421 | 2369 |
| Mean length | 69.9 | 63.7 | 58.6 | 58.5 | 59.4 |
| Percent < 65 cm | 36.8 | 60.7 | 72.4 | 76.5 | 71.0 |
| Percent < 82 cm | 92.1 | 95.0 | 97.2 | 95.7 | 96.5 |
| Rockfish | | | | | |
| Number of halibut | 81 | 36 | 141 | 130 | 388 |
| Mean length | 74.4 | 65.0 | 64.3 | 60.7 | 65.3 |
| Percent < 65 cm | 16.0 | 50.0 | 55.3 | 65.4 | 49.0 |
| Percent < 82 cm | 81.5 | 94.4 | 88.7 | 96.2 | 90.2 |
| Pacific ocean perch | | | | | |
| Number of halibut | — | — | 9 | — | 9 |
| Mean length | — | — | 67.4 | — | 67.4 |
| Percent < 65 cm | — | — | 44.4 | — | 44.4 |
| Percent < 82 cm | — | — | 77.8 | — | 77.8 |
| Turbot and Dover sole | | | | | |
| Number of halibut | — | — | 548 | 264 | 812 |
| Mean length | — | — | 65.1 | 64.3 | 64.9 |
| Percent < 65 cm | — | — | 49.1 | 56.4 | 51.5 |
| Percent < 82 cm | — | — | 94.5 | 80.7 | 90.0 |
| English and Rock sole | | | | | |
| Number of halibut | 121 | — | 648 | 409 | 1178 |
| Mean length | 60.2 | — | 58.4 | 58.2 | 58.5 |
| Percent < 65 cm | 57.0 | — | 71.1 | 81.4 | 73.3 |
| Percent < 82 cm | 93.4 | — | 90.4 | 97.6 | 93.2 |
| Others | | | | | |
| Number of halibut | 238 | 44 | 235 | 230 | 747 |
| Mean length | 64.0 | 64.7 | 62.6 | 58.0 | 61.7 |
| Percent < 65 cm | 47.5 | 56.8 | 62.6 | 72.2 | 62.5 |
| Percent < 82 cm | 91.2 | 97.7 | 95.3 | 93.0 | 95.6 |
| TOTAL | | | | | |
| Number of halibut | 478 | 401 | 3170 | 1454 | 5503 |
| Mean length | 65.3 | 63.9 | 60.2 | 59.6 | 60.8 |
| Percent < 65 cm | 43.7 | 59.4 | 66.6 | 72.3 | 65.6 |
| Percent < 82 cm | 90.2 | 95.3 | 94.8 | 93.1 | 94.0 |

lected during 1980 in the Bering Sea (Blackburn and Owen, unpublished⁶). Observer data collected in 1984 showed that halibut averaged 54 cm in the Bering Sea and 57 cm in the Kodiak region on trawl operations, and 121 cm on longline operations for sablefish in the Kodiak region (Figure 7).

⁶Blackburn, James E. and David L. Owen. An observer program for the comestic groundfish fishery in the Gulf of Alaska; southern Bering Sea observation in 1980. Final report on Contract No. 77-5 for January, 1980 through September, 1980 to the North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, AK, 99510.

Table 23. Halibut incidence rates (CPUE: pounds [*net weight*] per hour for trawl, pounds [*net weight*] per 1000 hooks for longline; Catch Ratio: weight of halibut per weight of total catch; and number of halibut per mt of target species) observed in the U.S. trawl and longline fisheries off Alaska. From Blackburn (1986), Blackburn (unpublished), Blackburn and Owen (unpublished), Blackburn and Rigby (unpublished), and P. Craig (ADF&G, personal communication).

| | Region | | | | |
|--------------------------|-----------------------------|----------|--------|---------|-----------|
| | Bering Sea (Bristol Bay) | Chirikof | Kodiak | Yakutat | Southeast |
| TRAWL | | | | | |
| 1978-1979 | | | | | |
| January-December | | | | | |
| CPUE | 3.1 | 26.5 | 25.4 | 21.8 | 7.1 |
| Catch Ratio | 0.003 | 0.021 | 0.010 | 0.005 | 0.001 |
| 1980 | | | | | |
| January-March | | | | | |
| CPUE | 52.9 | — | — | — | — |
| Catch Ratio | 0.009 | — | — | — | — |
| 1982 | | | | | |
| January-March | | | | | |
| CPUE | 10.6 | — | 30.2 | — | — |
| Catch Ratio | 0.003 | — | 0.007 | — | — |
| April-June | | | | | |
| CPUE | 9.0 | — | 14.1 | — | — |
| Catch Ratio | 0.002 | — | 0.006 | — | — |
| 1984 | | | | | |
| January-March | | | | | |
| CPUE | 100.5 | — | 66.6 | — | — |
| Catch Ratio | 0.047 | — | 0.01 | — | — |
| April-June | | | | | |
| CPUE | — | — | 135.4 | — | — |
| Catch Ratio | — | — | 0.055 | — | — |
| October-December | | | | | |
| CPUE | 147.2 | — | 155.8 | — | — |
| Catch Ratio | 0.029 | — | 0.018 | — | — |
| 1986-1987 | | | | | |
| September-January | | | | | |
| No. per mt landed | — | — | 12.0 | — | — |
| LONGLINE | | | | | |
| 1984 | | | | | |
| January-December | | | | | |
| CPUE | — | — | 8.1 | — | — |
| Catch Ratio | — | — | 0.009 | — | — |
| 1986-1987 | | | | | |
| September-March | | | | | |
| No./mt sablefish | — | — | 20.6 | — | — |
| No./mt Pacific cod | — | — | 79.8 | — | — |

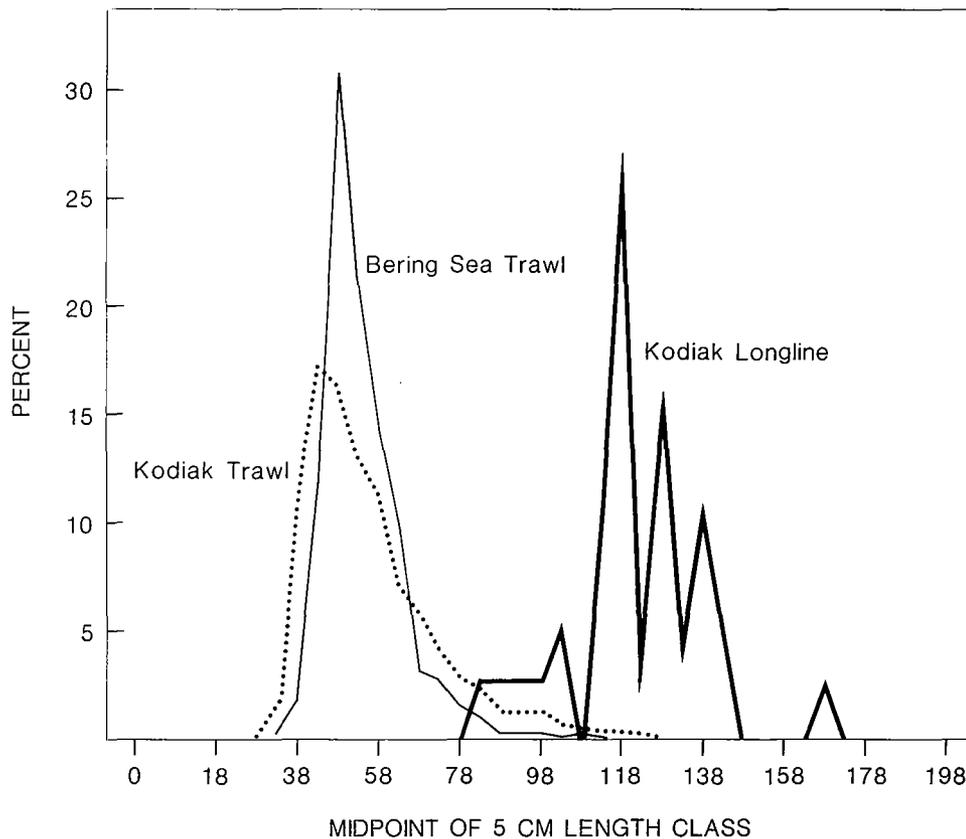


Figure 7. Length distribution of halibut caught incidentally in trawl and longline fisheries off Alaska in 1984. From Blackburn (1986).

Incidental Catch

Estimates of the incidental catch of halibut in the domestic fisheries are generally based on limited data and are considered less reliable than recent estimates for the foreign and joint venture fisheries. As described in the previous section, estimates of the incidental catch off British Columbia are based on incidence rates observed during the 1960s because recent observer coverage has been limited in area, season, and target species. Also, U.S. trawl fisheries off Alaska have been highly variable in area, season, and target species, and observations have been few in number.

Annual estimates of the incidental catch of halibut are available only for the trawl fisheries for groundfish operating off British Columbia and are summarized in Table 24 in **pounds, net weight**. Estimates of incidental catch in the newly-developed U.S. trawl and longline fisheries for groundfish in the Gulf of Alaska and Bering Sea are only available sporadically because of infrequent observer monitoring. Halibut caught incidentally by all fisheries totalled slightly more than three million pounds annually, most of which was caught off British Columbia. Hoag (1981) reported that approximately 3.2 million pounds of halibut were caught annually by the domestic trawl fleets off British Columbia during 1962-1969. Updated estimates by Hoag (1976) indicate that incidental catches off British Col-

Table 24. Estimated incidental catch and mortality (000's lbs., net weight) of halibut by Canadian and U.S. trawl fisheries for groundfish, 1962-1986. Estimates of incidental catch from ADF&G (unpublished), Blackburn (1986), Hoag (1976), IPHC (unpublished), and P. Rigby (ADF&G, personal communication). Estimates of mortality based on a mortality rate of 50 percent (see text for further explanation).

| Year | Bering Sea/ Aleutians | | Gulf of Alaska | | British Columbia | | Total | |
|------|--------------------------|-----------|----------------|-----------|------------------|-----------|-------|-----------|
| | Catch | Mortality | Catch | Mortality | Catch | Mortality | Catch | Mortality |
| 1962 | 0 | 0 | 0 | 0 | 2,351 | 1,176 | 2,351 | 1,176 |
| 1963 | 0 | 0 | 0 | 0 | 2,153 | 1,077 | 2,153 | 1,077 |
| 1964 | 0 | 0 | 0 | 0 | 2,210 | 1,105 | 2,210 | 1,105 |
| 1965 | 0 | 0 | 0 | 0 | 2,870 | 1,435 | 2,870 | 1,435 |
| 1966 | 0 | 0 | 0 | 0 | 3,014 | 1,507 | 3,014 | 1,507 |
| 1967 | 0 | 0 | 0 | 0 | 2,623 | 1,312 | 2,623 | 1,312 |
| 1968 | 0 | 0 | 0 | 0 | 3,094 | 1,547 | 3,094 | 1,547 |
| 1969 | 0 | 0 | 0 | 0 | 3,646 | 1,823 | 3,646 | 1,823 |
| 1970 | 0 | 0 | 0 | 0 | 2,867 | 1,434 | 2,867 | 1,434 |
| 1971 | 0 | 0 | 0 | 0 | 3,399 | 1,700 | 3,399 | 1,700 |
| 1972 | 0 | 0 | 0 | 0 | 2,924 | 1,462 | 2,924 | 1,462 |
| 1973 | 0 | 0 | 0 | 0 | 2,392 | 1,196 | 2,392 | 1,196 |
| 1974 | 0 | 0 | 0 | 0 | 2,475 | 1,238 | 2,475 | 1,238 |
| 1975 | 0 | 0 | 0 | 0 | 3,088 | 1,544 | 3,088 | 1,544 |
| 1976 | 0 | 0 | 0 | 0 | 3,478 | 1,739 | 3,478 | 1,739 |
| 1977 | 0 | 0 | 0 | 0 | 3,461 | 1,731 | 3,461 | 1,731 |
| 1978 | 0 | 0 | 25 | 13 | 3,941 | 1,471 | 2,966 | 1,484 |
| 1979 | 0 | 0 | 73 | 37 | 3,703 | 1,852 | 3,776 | 1,889 |
| 1980 | 44 | 22 | 42 | 21 | 2,744 | 1,372 | 2,830 | 1,415 |
| 1981 | 199 | 100 | 102 | 51 | 2,375 | 1,188 | 2,676 | 1,339 |
| 1982 | 40 | 20 | 21 | 11 | 1,734 | 867 | 1,795 | 898 |
| 1983 | N.A. | N.A. | N.A. | N.A. | 1,885 | 943 | 1,885 | 943 |
| 1984 | 585 | 293 | 119 | 60 | 2,148 | 1,074 | 2,852 | 1,427 |
| 1985 | N.A. | N.A. | N.A. | N.A. | 2,279 | 1,140 | 2,279 | 1,140 |
| 1986 | N.A. | N.A. | N.A. | N.A. | 2,321 | 1,161 | 2,321 | 1,161 |

N.A. = not available

umbia remained at that level during the 1970s, averaging 3.1 million pounds annually. Incidental catches in the Canadian trawl fishery began a decline during the early 1980s, from 3.9 million pounds in 1978 to 1.7 million pounds in 1982, but increased to 2.1 million pounds by 1984. The reduction in the early 1980s primarily resulted from a shift in target species to rockfish, which is associated with a relatively low incidence rate of halibut, and the removal of the U.S. fleet from Canadian waters in 1981.

U.S. fleets began trawling off Alaska in the mid-1970s and incidental catches in this developing fishery are probably small, but will likely increase as these fisheries expand. Prior to 1981, incidental catches were less than 100,000 pounds and were taken in the Gulf of Alaska. Since then, trawl fisheries for flounders and Pacific cod have been initiated and incidental catches have been estimated to be as high of 0.7 million pounds in the Bering Sea/Gulf of Alaska in 1984.

Estimates of the incidental catch of halibut are not available for other domestic fisheries for groundfish, but their catches probably are minor. Incidental catches of halibut in all

domestic fisheries off the WOC coast and in the Strait of Georgia are not monitored, but they probably are negligible because these areas are not productive halibut grounds. Fisheries using midwater trawls for species such as pollock, Pacific whiting, or dogfish, also probably catch few halibut.

Mortality and Condition

No new information has been collected on the mortality or condition of halibut caught by the trawl fishery off British Columbia since Hoag (1985), which is summarized below.

The physical condition of over 2,000 halibut caught and released by domestic trawlers was categorized into five levels based on their external injuries and physical activity. Condition was positively correlated with length of fish and negatively correlated with time on deck and the weight of the total catch. Most of the halibut were tagged, and the recovery rate declined with poorer condition. The criteria for judging condition were meaningful, although not entirely accurate as some of the fish that were considered dead were subsequently recovered.

The survival of fish was estimated from the recovery rate of tags and expected rates of fishing mortality and other losses. The average survival of halibut in all conditions was 28 percent for those less than 80 cm to 55 percent for those greater than 80 cm. The survival, however, for fish less than 80 cm was probably underestimated, and Hoag (1975) concluded that survival for all sizes was about 50 percent. Several ways of reducing this loss were suggested, including modifications of the trawl fishery to reduce the incidental catch and allowance of halibut retention by the trawl fishery to convert some of the loss into production. These alternatives were believed to be impractical, however, due to social, economic, and enforcement problems.

For the U.S. trawl fisheries off Alaska, halibut condition was reported only from observer trips conducted in the winter halibut savings area in the Bering Sea during 1980. Fifty-eight percent were judged to be in excellent condition, 32 percent were in good condition, and 9 percent appeared to be dead.

The estimated incidental mortality of halibut by the U.S. and Canadian trawl fisheries for groundfish is shown in Table 24 in **pounds, net weight**. These estimates are based on a mortality rate of 50 percent, as determined by Hoag's (1975) study. The estimates indicate that incidental mortality averaged 1.5 million pounds annually during 1962-1977 and was entirely caused by the trawl fishery off British Columbia. Incidental mortality in the Canadian trawl fishery has since declined. Incidental mortality in the Alaskan trawl groundfish fishery was less than 50,000 pounds prior to 1981, but increased to 350,000 pounds by 1984, accounting for 25 percent of the incidental mortality in domestic groundfish fisheries from all areas that year. Estimates for 1985-1986 were not available.

Motherships and catcher-processors have been introduced into the U.S. fisheries in recent years. Fishing by these types of operations is characterized by long hauls, transferred codends and lengthy sorting processes similar to that observed in the foreign and joint venture fisheries. Under these conditions, mortality of halibut will be higher, approaching 100 percent.

U.S. FISHERIES FOR KING AND TANNER CRAB

Description

Development of the U.S. king and Tanner crab fisheries has been described by the North Pacific Fishery Management Council (1978, 1981). Fishing for king crab was sporadic prior to World War II and limited to a small Bering Sea trawl fishery after the war. When trawling for crab was prohibited in 1960, vessels moved into the developing pot fishery around Kodiak Island in the Gulf of Alaska. The success at fishing with pots encouraged fisheries in other areas of the Gulf and in the Bering Sea. By the late 1970s, king and Tanner crab were being harvested along the entire Alaskan coast to depths of 300 fathoms. Five species of crab are currently harvested: red king crab (*Paralithodes camtschatica*), blue king crab (*P. platypus*), golden or brown king crab (*Lithodes aequispina*), and two species of Tanner crab (*Chionoecetes bairdi* and *C. opilio*).

Catches of all species of king and Tanner crab from 1960 through 1986 are shown in Table 25 in thousands of pounds. King crab catches increased from less than 29 million

Table 25. United States catch (000's lbs.) of king and Tanner crab in the Gulf of Alaska and Bering Sea, 1960-1986. From ADF&G Catch and Production Statistical Leaflets, 1960-1985 and E. Anderson (ADF&G, personal communication).

| Year | King Crab | | | Tanner Crab | | |
|------|----------------|----------------------|---------|----------------|----------------------|---------|
| | Gulf of Alaska | Bering Sea/Aleutians | Total | Gulf of Alaska | Bering Sea/Aleutians | Total |
| 1960 | — | — | 28,570 | — | — | — |
| 1961 | — | — | 43,412 | — | — | 7 |
| 1962 | — | — | 52,782 | — | — | 11 |
| 1963 | — | — | 78,740 | — | — | — |
| 1964 | — | — | 86,721 | — | — | 14 |
| 1965 | 96,812 | 36,296 | 133,108 | — | — | — |
| 1966 | 117,822 | 41,473 | 159,295 | — | — | < 1 |
| 1967 | 84,050 | 44,810 | 128,860 | 118 | — | 118 |
| 1968 | 39,797 | 42,120 | 81,917 | 3,212 | 31 | 3,243 |
| 1969 | 22,170 | 35,560 | 57,730 | 10,151 | 1,056 | 11,207 |
| 1970 | 20,165 | 31,896 | 52,061 | 13,009 | 1,464 | 14,473 |
| 1971 | 20,918 | 49,785 | 70,703 | 12,714 | 166 | 12,880 |
| 1972 | 25,674 | 48,752 | 74,426 | 30,017 | 118 | 30,135 |
| 1973 | 24,485 | 52,339 | 76,824 | 61,190 | 529 | 61,719 |
| 1974 | 32,705 | 62,509 | 95,214 | 58,293 | 5,613 | 63,906 |
| 1975 | 30,104 | 67,525 | 97,629 | 39,748 | 7,109 | 46,857 |
| 1976 | 23,636 | 82,263 | 105,899 | 57,833 | 22,938 | 80,771 |
| 1977 | 16,398 | 82,001 | 98,399 | 45,286 | 53,178 | 98,464 |
| 1978 | 17,079 | 104,396 | 121,475 | 58,863 | 70,693 | 129,556 |
| 1979 | 21,472 | 128,188 | 149,660 | 55,429 | 75,160 | 130,589 |
| 1980 | 27,730 | 157,989 | 185,719 | 44,525 | 77,141 | 121,666 |
| 1981 | 29,722 | 58,906 | 88,628 | 26,957 | 72,002 | 98,959 |
| 1982 | 14,575 | 25,173 | 39,748 | 29,679 | 40,987 | 70,666 |
| 1983 | 1,330 | 25,526 | 26,856 | 30,173 | 31,112 | 61,285 |
| 1984 | 1,716 | 16,901 | 18,617 | 22,010 | 27,652 | 49,662 |
| 1985 | 666 | 15,522 | 16,188 | 18,379 | 68,481 | 86,860 |
| 1986 | 1,021 | 26,205 | 27,226 | 14,617 | 95,613 | 110,230 |

pounds in 1960 to over 159 million pounds in 1966, due primarily to catches in the Gulf of Alaska around Kodiak Island. Catches fell to 52 million pounds by 1970 and vessels were forced to look for new areas to fish. Many vessels began fishing the Bering Sea, which had not been fished by the U.S. fleet since the 1950s. King crab catches gradually increased through the 1970s, peaking in 1980 with over 185 million pounds landed, about 85 percent of which was caught in the Bering Sea. Catches of Tanner crab were incidental to the king crab fishery until the mid-1970s, when directed fisheries developed. Tanner crab catches peaked in 1979 at over 130 million pounds, with the catch from the Bering Sea slightly more than 75 million pounds. Catches of both king and Tanner crab have dropped sharply since 1980 in response to severe declines in population levels. Several theories have been proposed for the cause of the decline of the red king crab population, which include: (1) egg clutch disease; (2) handling mortality of females and sublegal males; and (3) increased predation on juveniles by Pacific cod and halibut (Otto et al. 1983).

In the early days of the fishery, vessels used trawls and tangle nets. The nonselective properties of these gears, e.g., significant mortality of softshell and undersize male and female crab, have resulted in their prohibition since 1960. Pots are currently the predominant gear type in use today, although ring nets and diving gear are also allowed. Table 26 shows the various types and sizes of pots used in the 1979-1980 Kodiak king crab season. Side-entry, or rectangular, pots are most commonly used in the offshore crab fisheries which occur from Kodiak westward. In other areas, top-entry pots are more frequently used and usually comprise a large portion of the gear fished. In the Tanner crab fishery, current regulations restrict the tunnel opening size in side-entry pots, so fishermen reduce the tunnel openings by fastening a wooden or plastic panel, i.e. Tanner boards, across the tunnels.

Table 26. Gear composition of the Kodiak king crab fleet for the 1979-1980 season.

| | No. of Pots | Percent |
|---------------------------------|---------------|--------------|
| Top-Entry | | |
| Conical | 60 | 0.4 |
| Collapsible | 70 | 0.4 |
| Pyramid | 175 | 1.1 |
| Total | 305 | 1.9 |
| Side-Entry (Rectangular) | | |
| 5' x 5' | 426 | 2.6 |
| 5½' x 5½' | 260 | 1.6 |
| 6' x 6' | 6,300 | 38.9 |
| 6½' x 6½' | 3,395 | 20.9 |
| 7' x 7' | 4,747 | 29.3 |
| 7½' x 7½' | 336 | 2.1 |
| 8' x 8' | 415 | 2.6 |
| Total | 15,879 | 98.1 |
| GRAND TOTAL | 16,184 | 100.0 |

Source: Alaska Department of Fish and Game, Westward Region Shellfish Report to the Alaska Board of Fisheries, March, 1980, Table 15, p. 49

Observer Program

Scientific observers have occasionally collected catch data onboard commercial crab vessels, but there has been no formal observer program for the domestic crab fisheries. In 1981, ADF&G placed observers on several vessels fishing Tanner crab in the Yakutat area to investigate differences in halibut and Tanner crab catch rates between top-entry and side-entry crab pots (Bracken and Seibel, unpublished⁷). During the 1984/1985 Bristol Bay red king crab season, ADF&G again placed observers aboard vessels to monitor the catch of female and undersize male king crab and to collect in-season catch information. No record was kept of the incidental catch of fish, including halibut (D. Dunaway, ADF&G, personal communication).

Research Program

Information on halibut in crab pots has been collected on ADF&G crab assessment surveys in the Gulf of Alaska and Aleutian Islands and NMFS tagging cruises in the Bering Sea. These programs were generally conducted annually in each fishery management region (Figure 8), although a few regions had been surveyed only intermittently. Also, in recent years ADF&G survey effort has been reduced due to the decline of crab populations and the lack of several regional fisheries. Specific dates and locations of these programs through 1984 are shown in Table 27.

Initially, the ADF&G surveys were designed to provide assessment data on red king crab. As the fishery for Tanner crab developed, the surveys were expanded to collect data on Tanner crab populations. In the Bering Sea, NMFS survey effort was primarily directed at blue king crab populations around the Pribilof Islands and Tanner crab in Bristol Bay.

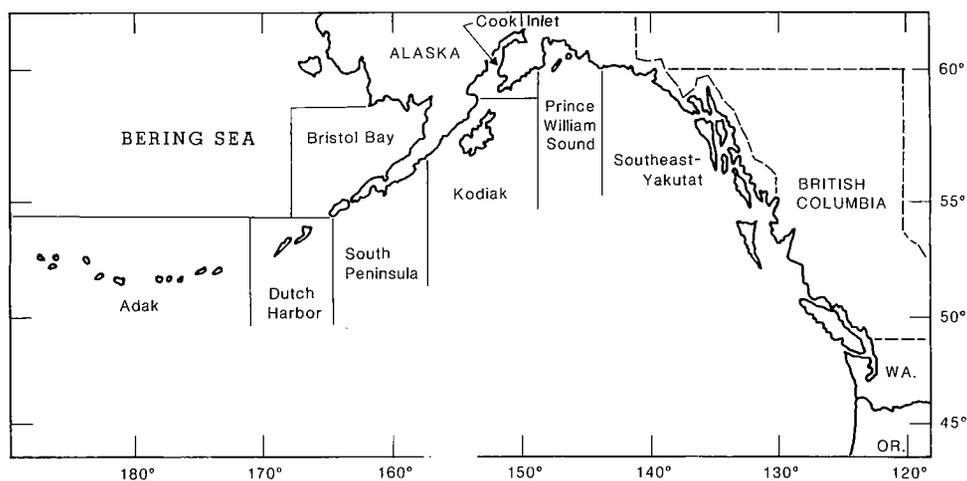


Figure 8. King and Tanner crab fishery management regions off Alaska in 1985.

⁷Bracken, B.E. and M.C. Seibel. 1981. Special report to the Board of Fisheries: Yakutat Tanner crab fishery onboard observer program, January-March, 1981. Alaska Dept. of Fish and Game, Comm. Fish. Div., unpublished report.

Table 27. Summary of crab research cruises conducted by ADF&G and NMFS in the Gulf of Alaska and Bering Sea through 1984.

| Region/Area | Years | Months | Target Species | Depths Fished (fathoms) | Pot Type Used |
|--------------------------------------|------------------|----------------|--------------------------|-------------------------|---------------|
| Gulf of Alaska | | | | | |
| Southeast-Yakutat | 1978-1984 | June-July | Red king crab | 10-150 | side-entry |
| Prince William Sd. | 1977-1984 | June-July | Tanner (<i>bairdi</i>) | 20-150 | top-entry |
| Cook Inlet | 1974-1984 | May-July | Red king crab | 10-60 | side-entry |
| Kodiak | 1971-1984 | June-August | Red king crab | 10-150 | side-entry |
| South Peninsula | 1974-1984 | July-August | Red king crab | 8-165 | side-entry |
| Bering Sea/Aleutians | | | | | |
| Dutch Harbor | 1975-1981, 1983 | July-September | Red king crab | 10-160 | side-entry |
| Adak | 1970, 1975-1977 | June-October | Red king crab | 10-215 | side-entry |
| Bristol Bay | 1973, 1976, 1981 | May-July | Red king crab | 26-65 | side-entry |
| | 1978-1979 | May-August | Tanner (<i>bairdi</i>) | 28-91 | *side-entry |
| | 1980 | May-June | Tanner (<i>opilio</i>) | 40-45 | *side-entry |
| Pribilof Islands | 1978-1982 | May-August | Blue king crab | 28-48 | side-entry |
| St. Matthew Isl. | 1982-1983 | June-July | Blue king crab | 13-45 | side-entry |
| Norton Sound | 1980, 1982 | July | Red king crab | 7-18 | side-entry |
| Zhemchug and Pribilof Canyons | 1983 | July | Brown king crab | 150-210 | side-entry |
| Bowers and Petral Banks, Amukta Pass | 1984 | June-July | Brown king crab | 69-260 | side-entry |

*Pots had Tanner boards installed

Incidence and Average Weight of Halibut

Without actual fishery observations, the only source of information about halibut in crab pots is research surveys. Most halibut caught on the surveys were measured and the weight was calculated using a previously established length/weight relationship (Hoag et al. 1980). The incidence of halibut is expressed as the number of halibut per survey potlift. These incidence and average weight data (**pounds, net weight**) were summarized by region in Table 28.

In most regions, halibut incidence was less than 0.5 halibut per survey potlift. Rates were lowest in the Bering Sea, where the surveys and fisheries are conducted in primarily juvenile halibut areas and halibut are widely dispersed. Southeast-Yakutat exhibits the highest halibut incidence rate, which may be due to a survey design that concentrated stations in bays and channels of the inside waters of southeastern Alaska. Survey incidence rates were similar among the regions in the central and western Gulf and the Aleutian Islands, ranging from 0.21 to 0.38 halibut per survey potlift. Incidence on the Cook Inlet surveys was somewhat higher than that observed in westward regions. Prince William Sound survey incidence rates were quite low, reflecting the use of top-entry pots for survey work. Fishermen have maintained that halibut catches in top-entry pots are substantially lower than catches

Table 28. The average incidence and weight (lbs., *net weight*) of halibut caught in crab pots on ADF&G and NMFS crab research cruises during 1970-1982. From Williams (unpublished).

| Region | No. of Halibut per Survey Potlift | Average Weight |
|------------------------|-----------------------------------|----------------|
| Southeast-Yakutat | 1.29 | 11.2 |
| Prince William Sound | 0.13 | 14.6 |
| Cook Inlet | 0.42 | 11.0 |
| Kodiak | 0.33 | 18.4 |
| South Peninsula | 0.21 | 20.5 |
| East Aleutians | 0.22 | 23.4 |
| West Aleutians | 0.38 | 21.5 |
| Bering Sea — king crab | 0.012 | 11.9 |
| Tanner crab | 0.003 | 11.9 |

observed in side-entry pots and the Prince William Sound data lend support to this contention.

Williams et al. (1982) tested side-entry and top-entry crab pots for differences in catch rates of halibut and Tanner crab and also examined the effects of Tanner boards on halibut catch rates. The results, shown in Table 29, indicate that top-entry pots have much lower halibut catch rates than side-entry pots. Additionally, halibut caught in top-entry pots during the study were small in size, although the sample size was small and the data not conclusive. Using Tanner boards in side-entry pots reduced the halibut catch by 63 percent and almost eliminated the catch of halibut over 90 cm in length.

Information collected from the commercial fisheries is limited to an observer program conducted by ADF&G in 1981 in the Yakutat Tanner crab fishery. Although only a few vessels were involved, the results (Table 30) indicated that halibut incidence rates were substantially lower in top-entry pots (Bracken and Seibel, unpublished⁸).

The average size of halibut caught on the crab research cruises is summarized in Table 28 in **pounds, net weight**. In the western Gulf of Alaska, halibut ranged from 18.4 to 23.4 pounds. Halibut were smallest, averaging about 11 pounds, on the Southeast, Cook Inlet, and Bering Sea surveys. The length frequency of halibut caught in all areas and years is shown in Figure 9. Over 40 percent of the fish are below 81 cm, the current legal minimum size in the commercial fishery for halibut.

Incidental Catch

Williams (unpublished⁹) estimates the incidental catch of halibut in crab pots based on data collected on the ADF&G and NMFS research surveys. These survey data may not reflect actual conditions in the commercial crab fisheries. Consequently, estimates of incidental catch in the crab fisheries are not considered precise, but probably represent the

⁸Bracken, B.E. and M.C. Seibel. 1981. Special report to the Board of Fisheries: Yakutat Tanner crab fishery onboard observer program, January-March, 1981. Alaska Dept. of Fish and Game, Comm. Fish. Div., unpublished report.

⁹Williams, Gregg H. The catch of halibut in crab pots. International Pacific Halibut Commission, Seattle, Washington. Unpublished report.

Table 29. Summary of data collected during pot comparison studies. Halibut weight is in net pounds and length is fork length in cm. From Williams et al. (1982).

| | Experiment I | | Experiment II | |
|----------------------------|--------------|-----------|------------------------|---------------------------|
| | Side-Entry | Top-Entry | Side-Entry with Boards | Side-Entry without Boards |
| Number of potlifts* | 98 | 100 | 30 | 29 |
| No. halibut per legal crab | 1.89 | 0.06 | 0.26 | 0.72 |
| Halibut | | | | |
| Number caught | 140 | 4 | .18 | 47 |
| Catch per potlift | 1.43 | 0.04 | 0.60 | 1.62 |
| Average weight | 16.1 | 6.0 | 10.6 | 15.8 |
| Average length | 88.5 | 65.5 | 79.2 | 88.4 |
| Tanner Crab | | | | |
| Number caught | 377 | 278 | 466 | 300 |
| Crab per potlift | 3.85 | 2.78 | 15.53 | 10.34 |
| Number of legal crab | 74 | 68 | 69 | 65 |
| Legal crab per potlift | 0.76 | 0.68 | 2.30 | 2.24 |

*Excludes lost and unbaited pots

Table 30. Data collected on 1981 ADF&G Tanner crab fishery observer program in the Yakutat area. From Bracken and Siebel (unpublished).

| | Top-Entry | Side-Entry with Tanner Boards | Side-Entry without Tanner Boards | Total |
|-----------------|-----------|-------------------------------|----------------------------------|-------|
| No. of Potlifts | 743 | 220 | 34 | 997 |
| No. of Halibut | 3 | 78 | 33 | 114 |
| No. per Potlift | 0.004 | 0.335 | 0.971 | 0.114 |

general magnitude of the incidental catch. Williams (*ibid.*) estimated incidental catches in the king crab fishery by applying the halibut incidence rate (number of halibut per potlift) from the regional research surveys to the number of crab pots fished annually in each region.

Side-entry pots used in the Tanner crab fishery are required to have a smaller tunnel opening in order to reduce the incidental capture of king crabs. Fishermen report that this also reduces the escape of Tanner crab from the pot. To meet the requirement for a reduced opening, crab fishermen typically place a wood board across the upper portion of the tunnel opening. These Tanner boards also reduce the halibut incidence rate (Williams et al. 1982).

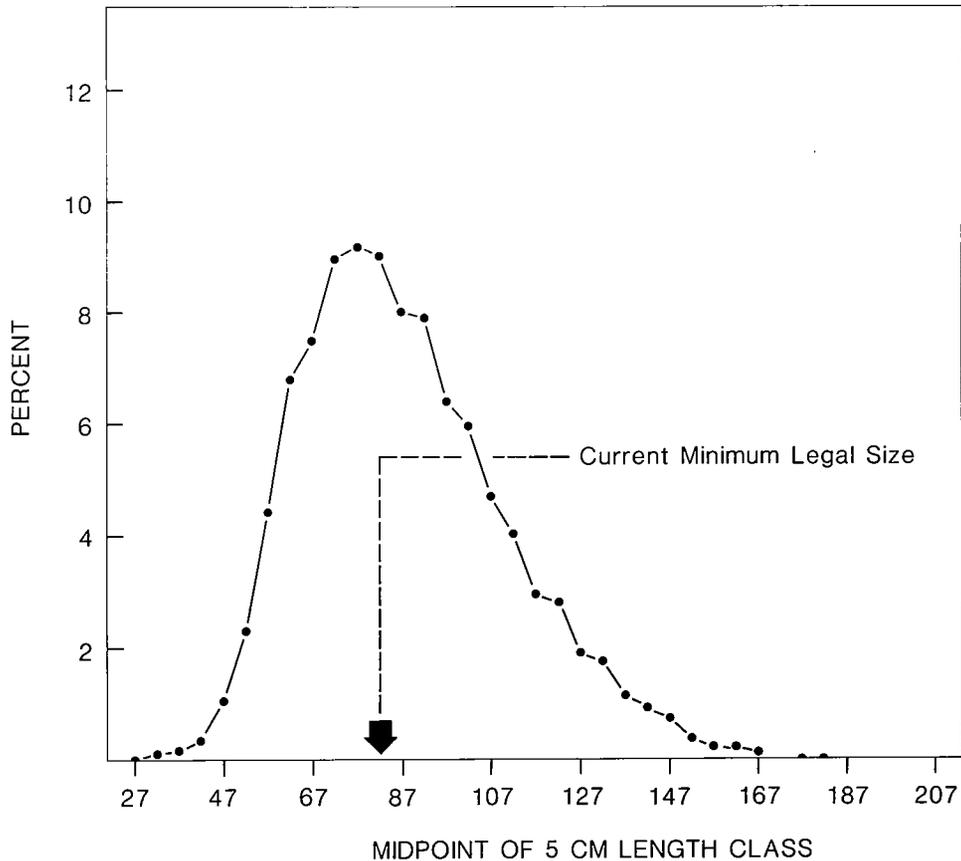


Figure 9. Length distribution of halibut caught in crab pots on crab research cruises conducted by ADF&G and NMFS during 1970-1982.

Therefore, Williams (*op. cit.*) reduced the survey incidence rates in order to estimate incidental catch in the Tanner crab fishery. Subsequent steps in the estimation procedure were identical to those followed for estimation of the king crab fishery incidental catch.

A weakness in the approach to estimating incidental catch in the Tanner crab fishery is the implicit assumption that all fishing for Tanner crab is conducted with side-entry pots with Tanner boards. Top-entry pots have been shown to have very low halibut incidence rates (Williams et al. 1982), so that any significant effort by top-entry pots in the fisheries for Tanner crab would result in lower bycatches than otherwise estimated. However, fishery statistics are not reported by gear type, so the proportion of total effort composed of top-entry pots is unknown. The data in Table 26 suggests that the amount of effort by top-entry is small, so the likelihood of overestimating the incidental catch is probably low. Changes in gear composition since the data in Table 26 were collected will obviously have a bearing on this conclusion.

King and Tanner crab fishery effort was not available for the Southwest-Yakutat, Prince William Sound, and Cook Inlet regions, precluding direct estimation of halibut incidental catch in these regions. Rather, incidental catch was estimated by assuming fishery catch rates

of crab in these regions were the same as in the western Gulf, thereby approximating effort levels. The regional survey incidence rates were then applied to the effort to estimate incidental catch. These imprecise estimates indicated halibut incidental catch was likely relatively low in these regions, i.e. less than 200,000 pounds per region annually. Crab fisheries in these regions produce small harvests and were therefore considered to have a minor impact on halibut.

The results indicate that the incidental catch, shown in Table 31 in **pounds, net weight**, by the crab fisheries has been cyclic, reaching a peak of 3.6 million pounds in 1966 and 5.7 million pounds in 1981. The highest catches were estimated for fisheries operating in the Gulf of Alaska, which reached 4.1 million pounds in 1981. Incidental catches in the Bering Sea/Aleutian Islands crab fisheries were much lower, averaging 0.9 million pounds in 1962-1986. Although not shown in Table 31, most of the incidental catch in the Bering Sea/Aleutian Islands region was taken in fisheries operating in the Aleutian Islands, as Bering Sea incidental catch rarely exceeded 0.1 million pounds. Fisheries for Tanner crab developed around 1970 in the Gulf of Alaska and incidental catches increased to 1.9 million pounds in 1983.

Table 31. Estimated incidental catch and mortality (000's lbs., net weight) of halibut in the king and Tanner crab fisheries, 1962-1986. From Williams (unpublished).

| Year | Gulf of Alaska | | | Bering Sea/Aleutians | | | GRAND TOTAL |
|------|-------------------|---------------------|-------|----------------------|---------------------|-------|-------------|
| | King Crab Fishery | Tanner Crab Fishery | Total | King Crab Fishery | Tanner Crab Fishery | Total | |
| 1962 | 1,091 | 0 | 1,091 | 402 | 0 | 402 | 1,493 |
| 1963 | 1,319 | 0 | 1,319 | 911 | 0 | 911 | 2,230 |
| 1964 | 1,564 | 0 | 1,564 | 1,299 | 0 | 1,299 | 2,863 |
| 1965 | 2,002 | 0 | 2,002 | 1,054 | 0 | 1,054 | 3,056 |
| 1966 | 2,531 | 0 | 2,531 | 1,064 | 0 | 1,064 | 3,595 |
| 1967 | 2,253 | 0 | 2,253 | 1,196 | 0 | 1,196 | 3,449 |
| 1968 | 1,495 | 0 | 1,495 | 1,014 | 0 | 1,014 | 2,509 |
| 1969 | 1,159 | 250 | 1,409 | 1,335 | 0 | 1,335 | 2,744 |
| 1970 | 1,242 | 520 | 1,762 | 1,318 | 0 | 1,318 | 3,080 |
| 1971 | 932 | 370 | 1,302 | 555 | 0 | 555 | 1,857 |
| 1972 | 928 | 506 | 1,434 | 867 | 0 | 867 | 2,301 |
| 1973 | 1,054 | 1,118 | 2,172 | 816 | 0 | 816 | 2,988 |
| 1974 | 1,214 | 1,634 | 2,848 | 673 | 8 | 681 | 3,529 |
| 1975 | 1,192 | 805 | 1,997 | 547 | 16 | 563 | 2,560 |
| 1976 | 1,220 | 1,296 | 2,516 | 484 | 17 | 501 | 3,017 |
| 1977 | 1,281 | 1,172 | 2,453 | 383 | 35 | 418 | 2,871 |
| 1978 | 1,560 | 1,449 | 3,009 | 467 | 95 | 562 | 3,571 |
| 1979 | 1,793 | 1,524 | 3,317 | 763 | 69 | 832 | 4,149 |
| 1980 | 1,807 | 1,635 | 3,442 | 1,622 | 73 | 1,695 | 5,137 |
| 1981 | 2,933 | 1,202 | 4,135 | 1,503 | 92 | 1,595 | 5,730 |
| 1982 | 2,206 | 1,427 | 3,633 | 1,136 | 112 | 1,248 | 4,881 |
| 1983 | 402 | 1,877 | 2,279 | 682 | 77 | 759 | 3,038 |
| 1984 | 212 | 1,413 | 1,625 | 567 | 37 | 604 | 2,229 |
| 1985 | 216 | 1,023 | 1,239 | 465 | 31 | 496 | 1,735 |
| 1986 | 233 | 994 | 1,227 | 459 | 46 | 505 | 1,732 |

Since the early 1980s, incidental catches have been declining, primarily in response to the rapid decrease in fishing for crab. Since 1982, fisheries for red king crab have been closed in the Cook Inlet, Kodiak, and Chignik-South Peninsula regions. In 1986, incidental catches in king crab fisheries were less than one million pounds. In contrast, fisheries for Tanner crab have slowly declined and incidental catches have fluctuated between one and two million pounds since 1973. Incidental catches in all crab fisheries were estimated at 1.7 million pounds in 1986, the lowest level since the early 1960s.

Mortality and Condition

Data on the condition of halibut caught in crab pots have been collected by ADF&G since 1974. The number of halibut caught and the percent determined to be dead are given by

Table 32. Mortality of halibut captured in crab pots on ADF&G crab surveys. Only surveys when observations were taken are shown. From Williams (unpublished).

| Year | Southeast-Yakutat | | Cook Inlet | | Kodiak | |
|-------------|-------------------|--------|------------------|--------|------------------|--------|
| | Total No. Caught | % Dead | Total No. Caught | % Dead | Total No. Caught | % Dead |
| 1974 | — | — | 48 | 75.0 | — | — |
| 1975 | — | — | — | — | — | — |
| 1976 | — | — | 137* | 16.1 | — | — |
| 1977 | — | — | 312 | 20.2 | — | — |
| 1978 | — | — | 215 | 42.3 | — | — |
| 1979 | — | — | 153 | 24.8 | — | — |
| 1980 | 370 | 4.1 | 196 | 44.4 | 1,315 | 62.0 |
| 1981 | 573 | 3.8 | 242 | 47.5 | 1,048 | 35.9 |
| 1982 | 849 | 5.4 | 179 | 32.4 | 1,026 | 21.6 |
| 1983 | 623 | 5.9 | — | — | 1,685 | 13.3 |
| 1984 | 779 | 3.0 | — | — | 2,167 | 9.6 |
| Mean | — | 4.2 | — | 34.7 | — | 28.5 |

| Year | South Peninsula | | East Aleutians | |
|-------------|------------------|--------|------------------|--------|
| | Total No. Caught | % Dead | Total No. Caught | % Dead |
| 1974 | — | — | — | — |
| 1975 | — | — | — | — |
| 1976 | — | — | — | — |
| 1977 | — | — | — | — |
| 1978 | — | — | — | — |
| 1979 | 26 | 15.4 | — | — |
| 1980 | — | — | — | — |
| 1981 | 458 | 16.6 | 443 | 32.1 |
| 1982 | 306 | 7.5 | — | — |
| 1983 | 206 | 4.4 | 38 | 21.1 |
| 1984 | — | — | — | — |
| Mean | — | 11.0 | — | 26.6 |

*Mortality data not collected on the entire survey. Data are for only that portion of the survey when halibut mortality was recorded.

region and year in Table 32. Halibut mortality rates were quite variable between areas and years, although they were lowest on the Southeast-Yakutat surveys and highest on the Cook Inlet and Kodiak surveys. Mortality rates of halibut in crab pots are likely dependent upon the amount of crab in the pot, the length of soak, and the amount of struggling by the fish in the pot. Pot soak times on the research surveys were generally less than 24 hours. Williams et al. (1982) estimated mortalities of 13 percent during a 1980 IPHC-ADF&G pot comparison study, where soak times averaged 19 hours. In the 1981 ADF&G Yakutat observer program, 45 percent of the 114 halibut captured were dead. Soak times were generally 24 hours, although some pots were left soaking 48 to 72 hours.

In the commercial crab fisheries, soak times are usually longer than 24 hours and may approach 72 hours. Also, crab catches are likely higher in the commercial fisheries than on the research surveys, contributing to higher mortality to fish trapped in the pots. These factors suggest a higher mortality in the commercial fisheries. In addition, fishermen reportedly use incidentally-caught halibut for bait in their pots, further increasing the loss. For these reasons, we consider that mortality of halibut caught in commercial crab pots may approach 100 percent, and suggest that the estimates of incidental catch shown in Table 31 be viewed as the incidental mortality incurred in the king and Tanner crab fisheries.

CANADIAN AND U.S. FISHERIES FOR SHRIMP

Description

The early development of the Canadian and U.S. shrimp fisheries on the Pacific coast has been described by Forrester et al. (1978). The following description of these fisheries is based on catch statistics compiled from Forrester et al. (1983), annual ADF&G Statistical Leaflets and INPFC Statistical Yearbooks, and NMFS (PacFIN). Shrimp catches by area and year, 1953-1986, are listed in Table 33 in mt.

Commercial fishing for shrimp began in inshore waters along the west coasts of Canada and the conterminous U.S. before the turn of the century. These fisheries remained small until the 1950s when commercial concentrations of shrimp were discovered in offshore waters along the Washington and Oregon coasts. The introduction of shrimp peeling machines and increased market demand for shrimp encouraged expansion of the shrimp fisheries northward to waters around Kodiak Island by the late 1950s.

Shrimp landings, especially from the Gulf of Alaska, increased steadily during the 1960s and early 1970s. Total landings rose from approximately 3,000 mt in 1957 to nearly 78,000 mt by 1976. More than 56,000 mt (73 percent) was caught in the Gulf of Alaska in 1976. Landings from WOC also increased, from nearly 1,000 mt in 1957 to almost 15,000 mt by 1976. Shrimp catches in Canadian waters were relatively stable during this period and averaged less than 1,000 mt per year. The shrimp fishery also moved into the Bering Sea in 1972, but catches have been relatively small in this area.

Shrimp abundance off Alaska declined sharply during the late 1970s and has remained low. Landings from the Gulf fell from 57,000 mt in 1976 to less than 2,000 mt by 1985. Fishing had nearly ceased in the Bering Sea by 1983. Landings off WOC and British Columbia also declined in the early 1980s, but have steadily increased since 1984.

Most of the shrimp caught in Alaskan waters are northern shrimp (*Pandalus borealis*), whereas the principle species caught off British Columbia and WOC is ocean shrimp (*P. jordani*). Several other species are taken, but landings of these species are small.

Shrimp off Alaska are caught primarily with otter trawl gear, although beam trawls are also used in southeast Alaska and pots are utilized to a small degree throughout Alaska. In Canadian waters, pots are commonly used for prawns, whereas trawls are used for shrimp. About half the catch off WOC is taken in double-trawls and half in other types of trawls. Landings by area and gear type in 1984 are shown in Appendix Table 5.

Table 33. United States and Canadian trawl and pot catches (mt) of shrimp in the Bering Sea and northeast Pacific Ocean. Data for Alaska from ADF&G Catch and Production Statistical Leaflets, 1960-1985 and from E. Anderson (ADF&G, personal communication); data for other areas from Boutillier (1983), Forrester et al. (1978, 1983), Fulton (1985, 1986, 1987), Head (1984), 1977-1980 INPFC Statistical Yearbooks, and from W. Daspit (PacFIN, personal communication).

| Year | Bering Sea/ Aleutians | Gulf of Alaska | British Columbia | Washington, Oregon, California | Total |
|------|--------------------------|-------------------|---------------------|--------------------------------------|--------|
| 1953 | — | 787 | N.A. | N.A. | 787 |
| 1954 | — | 659 | N.A. | N.A. | 659 |
| 1955 | — | 829 | N.A. | N.A. | 829 |
| 1956 | — | 1,381 | 552 | N.A. | 1,933 |
| 1957 | — | 1,080 | 725 | 934 | 2,739 |
| 1958 | — | 3,566 | 866 | 993 | 5,425 |
| 1959 | — | 5,920 | 473 | 3,467 | 9,860 |
| 1960 | — | 3,373 | 761 | 2,271 | 6,405 |
| 1961 | — | 7,249 | 547 | 2,256 | 10,052 |
| 1962 | — | 7,685 | 754 | 2,727 | 11,166 |
| 1963 | — | 6,861 | 973 | 2,587 | 10,421 |
| 1964 | — | 3,505 | 471 | 2,865 | 6,841 |
| 1965 | — | 7,629 | 793 | 1,120 | 9,542 |
| 1966 | — | 12,788 | 763 | 2,283 | 15,834 |
| 1967 | — | 18,966 | 771 | 5,130 | 24,867 |
| 1968 | — | 19,062 | 711 | 6,424 | 26,197 |
| 1969 | — | 21,705 | 1,064 | 6,634 | 29,403 |
| 1970 | — | 33,683 | 969 | 8,213 | 42,865 |
| 1971 | — | 43,043 | 359 | 5,890 | 49,292 |
| 1972 | 43 | 37,982 | 365 | 11,300 | 49,690 |
| 1973 | 207 | 54,208 | 794 | 14,050 | 69,259 |
| 1974 | 2,608 | 46,717 | 4,093 | 10,850 | 64,268 |
| 1975 | 406 | 44,944 | 1,780 | 16,578 | 63,708 |
| 1976 | 1,665 | 56,705 | 4,458 | 14,773 | 77,601 |
| 1977 | 2,087 | 50,569 | 2,796 | 34,624 | 90,076 |
| 1978 | 3,022 | 30,246 | 1,569 | 37,403 | 72,240 |
| 1979 | 1,603 | 21,355 | 712 | 21,369 | 45,039 |
| 1980 | 1,125 | 22,602 | 685 | 19,009 | 43,421 |
| 1981 | 1,090 | 11,573 | 939 | 18,009 | 31,575 |
| 1982 | 155 | 7,631 | 687 | 12,678 | 21,151 |
| 1983 | 3 | 3,422 | 738 | 6,221 | 10,384 |
| 1984 | — | 4,674 | 914 | 4,439 | 10,027 |
| 1985 | — | 1,947 | 1,193 | 12,353 | 15,493 |
| 1986 | — | 2,186 | 1,297 | 25,898 | 29,831 |

Observer Program

Only one commercial fishing trip to obtain data on the incidence of halibut has been monitored at sea. During July 1981, IPHC placed an observer aboard a shrimp trawler which fished in Kachemak Bay, near Homer, Alaska. Eleven hauls, averaging 90 minutes in duration, were observed on the two-day trip. Detailed data collected during this trip are given in Appendix Table 6.

Research Program

The incidental catch of halibut in shrimp fisheries off Alaska was estimated from data collected on NMFS research cruises because of the lack of observer data. Estimates of incidental catch based on research cruise data are considered less reliable than those based on observer data because research objectives and operations differ greatly from commercial fishing trips. Therefore, estimates of the incidental catch of halibut in the domestic shrimp fisheries are only considered indicative of the general magnitude of the catch.

Seasonal incidence rates and average weights of halibut were calculated by Hoag (unpublished¹⁰) from data collected on NMFS shrimp research cruises conducted during 1950-1976. Data for more than 600 trawl hauls targeting on shrimp (greater than 1,000 pounds per hour trawled) were obtained. These data covered all months and areas in the Gulf of Alaska and Bering Sea. Additional research data on the incidence and size of halibut caught in shrimp trawls have been sporadically collected by ADF&G during their shrimp assessment cruises. Most of these data are not readily available and none have been utilized to estimate the incidental catch of halibut.

Incidence and Average Weight of Halibut

The incidence of halibut in NMFS shrimp research surveys, estimated by Hoag (ibid.), is expressed as the number of halibut per mt of shrimp. These data indicate that halibut incidence is much higher during the winter (January-April and October-December) than in the summer (May-September). In the winter, 4.7 halibut per mt of shrimp were caught, whereas 2.1 halibut per mt of shrimp were caught during the summer. The incidence observed on the aforementioned commercial fishing trip during July, 1981 was nearly the same as that on the summer research cruises: for the eleven commercial hauls, an average of 2.3 halibut per mt of shrimp were caught. In addition, the incidence of halibut during an ADF&G shrimp assessment cruise in Yakutat Bay during August, 1981 was monitored by an IPHC representative; incidence averaged 1.8 halibut per hour trawled. In comparison, the incidence was much higher on the commercial trip in Kachemak Bay, nearly 3.5 halibut per hour trawled.

The average weight of halibut on the NMFS research cruises was higher during the summer, 3.0 pounds, than during the winter, 1.7 pounds. Average weight observed on the summer commercial trip was even higher, 4.3 pounds, but the highest average weight, 7.0 pounds was recorded on the ADF&G research cruise in Yakutat Bay.

Incidental Catch

The incidental catch of halibut in the shrimp fisheries off Alaska was estimated using incidence and average weight data from the NMFS surveys. Estimates of the incidental

¹⁰Hoag, S.H. 1979. The incidental catch of halibut in shrimp trawls. International Pacific Halibut Commission, Seattle, WA. Unpublished report.

catch in the Gulf of Alaska and Bering Sea shrimp trawl fisheries were obtained by multiplying the seasonal incidence rates and average weights by the monthly shrimp landings reported in annual ADF&G Statistical Leaflets.

The incidental catch of halibut in shrimp fisheries in other areas was not estimated, but it was probably minor. The shrimp fishery off British Columbia is relatively small and much of the fishery is conducted with pots; therefore, the incidental catch also probably is small. The incidental catch of halibut off the WOC coast probably is low because the abundance of halibut in this area is low compared to other areas (Hoag et al. 1983.)

Estimates of the incidental catch in shrimp fisheries are summarized in Table 34 in **pounds, net weight**. The estimated incidental catch of halibut off Alaska was small until the early 1960s. Catches first exceeded 0.1 million pounds in 1967 and continued to increase during the next decade. A peak of 0.4 million pounds reached in 1976 was followed by a rapid decline, as shrimp population levels and fisheries declined. By 1981, the estimated incidental catch was again at its former 0.1 million pound level. Nearly all of this catch was taken in the Gulf of Alaska. Incidental catches in the shrimp fishery in the Bering Sea peaked at 21,000 pounds in 1978 and declined to only a trace amount in 1983.

Mortality and Condition

Little information on the condition of halibut caught incidentally in the domestic shrimp trawl fisheries off Alaska was available. Condition was monitored only on one commercial fishing trip, where 79 percent of the 56 halibut caught appeared to be dead (IPHC 1982). Most of these died from injuries or suffocation received during capture. Similar data from the NMFS surveys were not available.

Although some survival is possible in the shrimp fisheries, we assume the mortality of halibut caught in shrimp trawls to be 100 percent, primarily because of the long tows that characterize shrimp trawling and that the halibut captured in this fishery are usually small and therefore easily injured. Accordingly, the estimates of incidental catch shown in Table 34 should also be considered as estimates of incidental mortality.

Table 34. Estimated incidental catch and mortality (000's lbs., net weight) of halibut in the U.S. shrimp fishery in the Gulf of Alaska and Bering Sea, 1962-1986. From IPHC (unpublished).

| Year | Bering Sea/ Aleutians | Gulf of Alaska | Total | Year | Bering Sea/ Aleutians | Gulf of Alaska | Total |
|------|--------------------------|-------------------|-------|------|--------------------------|-------------------|-------|
| 1962 | 0 | 61 | 61 | 1975 | 3 | 311 | 314 |
| 1963 | 0 | 54 | 54 | 1976 | 13 | 391 | 404 |
| 1964 | 0 | 28 | 28 | 1977 | 15 | 338 | 353 |
| 1965 | 0 | 54 | 54 | 1978 | 21 | 201 | 222 |
| 1966 | 0 | 87 | 87 | 1979 | 11 | 140 | 151 |
| 1967 | 0 | 132 | 132 | 1980 | 8 | 53 | 161 |
| 1968 | 0 | 133 | 133 | 1981 | 8 | 77 | 85 |
| 1969 | 0 | 154 | 154 | 1982 | 1 | 50 | 51 |
| 1970 | 0 | 237 | 237 | 1983 | Trace | 24 | 24 |
| 1971 | 0 | 300 | 300 | 1984 | 0 | 32 | 32 |
| 1972 | Trace | 264 | 264 | 1985 | 0 | 13 | 13 |
| 1973 | 2 | 381 | 383 | 1986 | 0 | 13 | 13 |
| 1974 | 19 | 328 | 347 | | | | |

OTHER FISHERIES

Halibut are caught incidentally in fisheries other than the groundfish and shellfish fisheries, but data were not available to estimate catches. Salmon troll fisheries may take significant catches of halibut, but mortality of released fish probably is low (Bell 1956). Catches in seine fisheries for herring or salmon probably are negligible. Observations of halibut occurrence in experimental setnet fisheries for sablefish have been collected and these data are provided. In addition, catch information for a Japanese directed setline fishery for halibut in the Bering Sea during the late 1950s and 1960s is summarized.

Setnet Fishery for Sablefish off Washington and Oregon

An experimental fishery for sablefish using sunken gillnets, or setnets, operated off the northern Pacific coast from 1982 through 1985. Setnets have been prohibited north of 38° north latitude on the Pacific coast by the coastal states and the Pacific Fishery Management Council (PFMC) due to concerns about gear conflicts with other fisheries, incidental catch of prohibited species, and the effects of "ghost fishing" from lost gear. However, data were not available to address these concerns, so an experimental setnet fishery was designed to obtain these data. As an experimental fishery, vessels could participate only under the terms of an NMFS permit, which controlled area and depth of fishing, gear use, and also required NMFS observers to be on board collecting data from the operation and taking biological samples from the catch. The fishery operated from May through October and consisted of one vessel in 1982, two vessels in 1983, three vessels in 1984, and 12 vessels in 1985. The fishery was eliminated by PFMC in 1986.

Although the vessels could fish anywhere north of 38° north latitude to the U.S.-Canadian border, fishing effort was concentrated off the northern Washington coast. During 1982-1984, fishing was conducted at depths of 80 to 90 fathoms. However, data were lacking from depths greater than 90 fathoms so in 1985, vessel effort was allocated to include fishing in the deeper waters. Fishermen were required to use a mesh size greater than 5-7/8 inches; 6 inch and 6-1/2 inch mesh sizes were routinely fished. The permits also stipulated that a smaller test net be fished and these nets were 5, 5-1/4, and 5-1/2 inch mesh.

Observers monitored the fishery during 1983-1985 and data collected on the occurrence of halibut in the setnets are summarized in Table 35. In general, the incidence of halibut was low, averaging about 7 pounds per 100 fathoms of net fished for all years. The halibut catch was quite variable with respect to area and depth, but incidence tended to be highest in the most northerly locations in less than 90 fathoms. Halibut incidence was five times higher in

Table 35. Summary of incidental halibut catch data¹ from an experimental setnet fishery for sablefish off the Washington and northern Oregon coasts. From Klein (unpublished).

| Year | Number of Halibut | Weight (lbs. net) | Average Weight (lbs.) | Catch Rate (lbs./100 fm net) | Percent of Catch (wt.) |
|------|-------------------|-------------------|-----------------------|------------------------------|------------------------|
| 1983 | 237 | 4,518 | 19.1 | 11.9 | 0.77 |
| 1984 | 607 | 10,511 | 17.6 | 7.7 | 0.60 |
| 1985 | 665 | 10,125 | 15.2 | 2.7 | 0.53 |

¹For 1983, data shown are actual observed catches. For 1984 and 1985, observer data has been extrapolated to total catch and are therefore estimates of the total halibut catch.

the 6-inch mesh than in the 5-1/4 inch mesh. During 1984 and 1985, halibut bycatches were about 10,000 pounds annually, representing less than one percent of the total experimental fishery catch. Halibut averaged about 17 pounds in size, well above the current minimum commercial size.

Observers also recorded the condition (excellent, poor, or dead) of the setnet-caught halibut. Klein (unpublished¹¹) stated that survival ranged from 31 to 64 percent in 1983 and concluded that survival probably tended towards the lower end of the range. These data equate to mortality rates of 36 to 69 percent, with the actual mortality rate approaching 69 percent. No difference was observed in these rates between 1983 and 1984. Similar data for 1985 have not been reported.

Japanese Directed Fishery in the Bering Sea

Although not an incidental removal, the catch by a Japanese directed setline fishery for halibut in the Bering Sea during the late 1950s and 1960s is included in this report because it is not considered part of the regular North American commercial landings. Data for this fishery were obtained from documents submitted by Japan to INPFC and were previously presented by Hoag (1976).

Japan's fishery occurred throughout the Bering Sea, but principally west of 175° west longitude; annual catches, in **thousands of pounds, net weight**, are shown by area in Table 36. The fishery began in 1958 in the western portion of the area and did not extend into the

Table 36. Halibut catch and mortality (000's lbs., net weight) by the directed Japanese setline fishery by area within the Bering Sea. From Hoag (1976).

| Year | Halibut Catch West of 175° | Halibut Catch East of 175° |
|--------------|-------------------------------|-------------------------------|
| 1958 | 2,107 | 0 |
| 1959 | 3,713 | 0 |
| 1960 | 11,489 | 0 |
| 1961 | 18,467 | 0 |
| 1962 | 16,407 | 0 |
| 1963 | 8,086 | 5,008 |
| 1964 | 772 | 403 |
| 1965 | 23 | 3 |
| 1966 | 354 | 2 |
| 1967 | 80 | 58 |
| 1968 | 278 | 0 |
| 1969 | 20 | 0 |
| 1970 | 8 | 0 |
| Total | 61,804 | 5,474 |

¹¹Klein, Steve J. 1985. Review of the set-net fishery off the Washington coast, 1982-1984. U.S. Dept. of Commerce, NOAA, NMFS, NWAFC Processed Report 85-06. 52 p.

eastern Bering Sea until 1963, when INPFC removed halibut from its abstention list. Previously, Japan had abstained from fishing stocks of North American halibut that were fully utilized, which included those in the eastern Bering Sea. This was in accordance with the terms of the INPFC Convention. During the early 1960s, INPFC concluded that Bering Sea stocks were not being fully exploited, contrary to the position of IPHC. Halibut was removed from the abstention list in 1963 and the Japanese fishery in the eastern Bering Sea began that year.

Reported catches were highest in the western Bering Sea, reaching a peak of over 18 million pounds in 1961. Effort shifted to the eastern portion in 1963 and catches were over 5 million pounds in the first year. In subsequent years, catches were much lower, never exceeding 0.5 million pounds after 1964. The fishery was discontinued after 1969.

Due to the directed nature of the fishery, mortality was 100 percent. Data shown in Table 36 indicate complete removals.

SUMMARY

Halibut are caught in many fisheries other than the directed commercial and sport halibut fisheries. Although IPHC regulations require that incidentally caught halibut be returned to the sea, many released fish may not survive injuries received during capture. Thus, the incidental catch represents a significant source of mortality, and yield loss to the directed halibut fisheries is substantial.

Although IPHC estimates the incidental catch annually, these estimates change periodically as new data become available. This report reviews and updates historical information on incidental catches and mortality.

Prior to the 1960s, domestic trawl fisheries off WOC and British Columbia were the largest, in terms of fleet size and total landings, in the northeast Pacific Ocean and Bering Sea. Domestic groundfish catches averaged 60,000 mt during the 1950s and continued to increase into the 1980s. Most of the increase occurred off WOC, but trawl fisheries in the Gulf of Alaska and Bering Sea developed during the 1980s. Foreign trawl fisheries in the Bering Sea and Gulf of Alaska expanded rapidly during the late 1950s and 1960s; in 1959, foreign groundfish catches nearly equalled domestic landings. Catches by foreign fisheries peaked during the early 1970s at 2.7 million mt, approximately 35 times larger than domestic landings. Extended jurisdiction in 1976 resulted in a decline in foreign fisheries, an increase in domestic fisheries, and prompted the development of joint venture fisheries. Joint venture catches surpassed domestic landings in 1982 and increased significantly in recent years. In 1986, foreign groundfish catches were 0.6 million mt, joint venture catches were 1.4 million mt, and domestic groundfish catches were 0.3 million mt. Foreign fisheries were prohibited in the Gulf of Alaska after 1986.

Pot fisheries for king crab developed during the late 1950s in the Gulf of Alaska. Catches have peaked twice since then. First in 1966, king crab landings totalled 159 million pounds, most of which was caught in the Gulf. The second peak occurred in 1980 and reached 186 million pounds, most of which was taken from the Bering Sea. By 1986, king crab stocks in both areas were depleted, and catches plummeted to 27 million pounds. Catches of Tanner crab were incidental to the king crab fishery until the early 1970s, when directed fisheries developed. Tanner crab catches peaked in 1979 at over 130 million pounds, of which slightly more than half came from the Bering Sea. Catches had fallen to 50 million pounds by 1984, but increased to 110 million pounds in 1986.

Trawl fisheries for shrimp were small until the late 1950s, when populations were discovered off WOC. Combined catches from all areas surpassed 2,000 mt in 1957 and increased steadily to a peak of 90,000 mt in 1977. Catches were largest in the Gulf of Alaska, where landings peaked at 57,000 mt in 1976. Shrimp catches off Alaska have since declined. Off British Columbia, shrimp catches peaked in 1976 at 4,500 mt, although historically catches have generally ranged from 500 to 1,000 mt. In 1986, the coast-wide catch of shrimp was 29,381 mt.

The most reliable information on incidental catch is from observer programs where the catch is sampled at sea. In recent years, only the foreign and joint venture fisheries in the WOC region, Gulf of Alaska and Bering Sea have been extensively monitored by observers. In 1986, observer coverage for all these fisheries averaged 94 percent. Monitoring of the foreign fishery operating off B.C. occurred in 1977-1979, with the greatest coverage taking place in 1978 at 33 percent. Observer coverage of the domestic trawl fishery off British Columbia was extensive during the 1960s, but coverage since then has been limited to relatively few observations collected during 1978-1982. Also, the developing domestic trawl and long-line fisheries off Alaska for groundfish have received sporadic coverage since 1977. Shrimp trawlers fishing off Alaska have been monitored at sea only once and observations of the commercial crab fisheries have not been made.

Several government agencies conduct research surveys of groundfish and shellfish stocks in the northeast Pacific Ocean and Bering Sea. Although research surveys are not directly comparable to commercial fisheries, survey information provides an indication of the general magnitude of incidental catches of halibut in the commercial fishery. IPHC relied on data from ADF&G and NMFS pot surveys in the Gulf of Alaska and Bering Sea to estimate incidental catches of halibut in the commercial crab fisheries because observer data were not available. Similarly, incidental catches by the shrimp trawl fishery off Alaska were based on NMFS trawl surveys of shrimp stocks in the Gulf.

Incidence rates vary greatly among fisheries, areas, seasons, and years. In general, incidence of halibut is higher during the winter, when halibut are more concentrated, than during the summer. Incidence rates in foreign groundfish fisheries range from about 0.5 to 5.0 halibut per mt and tend to be higher in the Gulf of Alaska than in the Bering Sea. Joint venture fisheries often have slightly higher incidence rates than foreign trawl fisheries. For foreign setline fisheries fishing at depths less than 500 m, incidence rates generally range between 10 and 30 halibut per mt in the Gulf and between 1 and 10 halibut per mt in the Bering Sea. In deeper waters, incidence rates are frequently less than one halibut per mt.

Incidence rates in the domestic trawl fishery off British Columbia are lowest in fisheries targeting on Pacific ocean perch and highest in fisheries targeting on flatfish and other groundfish. Rates in Pacific ocean perch fisheries are generally less than 0.0004 (catch ratio¹²) during all seasons. Rates in flatfish and other groundfish fisheries range from 0.01 to 0.07 (catch ratio¹²) in the winter to 0.2 to 0.10 (catch ratio¹²) in the summer.

Incidence rates in the U.S. trawl fisheries for groundfish off Alaska were highly variable, but usually range between 0.0003 and 0.020 (catch ratio¹²). In NMFS shrimp trawl surveys off Alaska, incidence was 2 halibut per mt of shrimp in the summer and 5 halibut per mt of shrimp in the winter. Incidence rates in ADF&G and NMFS pot surveys for crab off Alaska ranged from 0.2 to 0.4 halibut per potlift in the Gulf of Alaska. Incidence is much lower in the Bering Sea, generally 0.01 halibut per potlift or less.

¹²weight of halibut per weight of total catch

Average size of incidentally-caught halibut also varies among fisheries, areas, seasons, and years. The average weight of halibut caught by the foreign trawl fisheries is about 15 pounds in the Gulf of Alaska and 7 pounds in the Bering Sea. Halibut caught on foreign setlines average about 6 pounds. The size of halibut caught in joint venture fisheries usually is smaller, about 5 pounds in the Gulf of Alaska and 3 pounds in the Bering Sea. Halibut caught on NMFS shrimp research cruises average slightly more than 2 pounds in size, whereas halibut average about 17 pounds in ADF&G pot surveys for crab off Alaska. In British Columbia, the average weight of halibut in the domestic trawl fisheries is about 8 pounds (**net weight**).

Estimates of incidental catch, in **thousand of pounds, net weight**, are summarized by area in Table 37. Incidental catches of halibut were relatively small until the early 1960s, then increased rapidly. The total incidental catch, including removals attributed to the Japanese-directed fishery in the Bering Sea, peaked in 1962 at 26 million pounds and declined to approximately 18 million pounds in the late 1960s. Catches increased to 21 million pounds in 1971, but subsequently dropped to 13 million pounds by 1975. Incidental catches increased again during the late 1970s, reaching 21 million pounds in 1980. Thereafter, incidental catches declined and fell below 10 million pounds in 1986.

Table 37. Summary of estimates of incidental catch and mortality (000's lbs., net weight) by region of the coast.

| Year | British Columbia | | Gulf of Alaska | | Bering Sea and Aleutians | | GRAND TOTAL | | Japanese Directed Fishery |
|------|------------------|-----------|----------------|-----------|--------------------------|-----------|-------------|-----------|---------------------------|
| | Catch | Mortality | Catch | Mortality | Catch | Mortality | Catch | Mortality | |
| 1962 | 2,351 | 1,176 | 3,290 | 3,290 | 4,143 | 4,143 | 9,784 | 8,609 | 16,407 |
| 1963 | 2,153 | 1,077 | 6,306 | 6,306 | 2,038 | 2,038 | 10,497 | 9,421 | 13,094 |
| 1964 | 2,210 | 1,105 | 11,577 | 11,577 | 2,965 | 2,965 | 16,752 | 15,647 | 1,175 |
| 1965 | 2,870 | 1,435 | 16,276 | 16,276 | 3,182 | 3,182 | 22,328 | 20,893 | 26 |
| 1966 | 3,173 | 1,666 | 12,007 | 12,007 | 3,400 | 3,400 | 18,580 | 17,073 | 356 |
| 1967 | 2,963 | 1,652 | 8,972 | 8,972 | 4,718 | 4,718 | 16,653 | 15,342 | 138 |
| 1968 | 3,510 | 1,963 | 7,215 | 7,065 | 5,685 | 5,685 | 16,410 | 14,713 | 278 |
| 1969 | 4,006 | 2,183 | 4,989 | 4,839 | 7,599 | 7,599 | 16,594 | 14,621 | 20 |
| 1970 | 2,903 | 1,470 | 6,298 | 6,148 | 8,028 | 8,028 | 17,229 | 15,646 | 8 |
| 1971 | 3,444 | 1,745 | 4,381 | 4,231 | 13,095 | 13,095 | 20,920 | 19,071 | 0 |
| 1972 | 3,212 | 1,750 | 7,329 | 7,089 | 9,675 | 9,675 | 20,126 | 18,514 | 0 |
| 1973 | 2,705 | 1,509 | 7,485 | 7,335 | 8,029 | 8,029 | 18,219 | 16,873 | 0 |
| 1974 | 2,966 | 1,729 | 9,007 | 8,857 | 7,619 | 7,619 | 19,592 | 18,205 | 0 |
| 1975 | 3,453 | 1,909 | 5,683 | 5,533 | 3,650 | 3,650 | 12,786 | 11,092 | 0 |
| 1976 | 3,803 | 2,064 | 5,877 | 5,727 | 4,564 | 4,564 | 14,244 | 12,355 | 0 |
| 1977 | 4,328 | 1,817 | 6,782 | 6,632 | 2,914 | 2,914 | 14,024 | 11,363 | 0 |
| 1978 | 2,941 | 1,471 | 5,296 | 5,195 | 5,309 | 5,023 | 13,546 | 11,689 | 0 |
| 1979 | 3,703 | 1,852 | 7,315 | 7,018 | 5,588 | 5,419 | 16,606 | 14,289 | 0 |
| 1980 | 2,744 | 1,372 | 8,814 | 7,402 | 9,342 | 9,235 | 20,900 | 18,009 | 0 |
| 1981 | 2,375 | 1,188 | 8,268 | 6,593 | 6,669 | 6,409 | 17,312 | 14,190 | 0 |
| 1982 | 1,734 | 867 | 8,169 | 6,276 | 4,882 | 4,756 | 14,785 | 11,899 | 0 |
| 1983 | 1,885 | 943 | 8,257 | 5,195 | 4,588 | 4,269 | 14,730 | 10,407 | 0 |
| 1984 | 2,148 | 1,074 | 5,250 | 3,961 | 5,740 | 4,692 | 13,138 | 9,727 | 0 |
| 1985 | 2,279 | 1,140 | 2,149 | 1,880 | 5,162 | 4,207 | 9,490 | 7,227 | 0 |
| 1986 | 2,321 | 1,161 | 2,025 | 1,547 | 5,318 | 4,473 | 9,664 | 7,181 | 0 |

The majority of incidental catch was taken by foreign fisheries in the Gulf of Alaska and Bering Sea. At times, incidental catches by the domestic crab fisheries in these areas were also quite high, but they have been reduced in recent years as these fisheries have declined. Incidental catch in the joint venture fisheries has increased significantly in recent years, as these fisheries replace the foreign fleets. As these fisheries expand further, incidental catch will probably increase and could surpass historic levels of incidental catch in the foreign fisheries. Incidental catches by domestic trawl fisheries have been relatively constant and these fisheries were the primary source of incidental catch off British Columbia. The incidental catch of halibut in the shrimp fishery off Alaska is probably minor.

Many incidentally-caught halibut die from injuries or suffocation during capture, but little information on mortality was available. In general, halibut released from foreign and domestic setline vessels have the highest survival potential: approximately 70 percent are in excellent condition when released. Approximately half the halibut caught by domestic trawl fisheries, characterized by short tows and quick sorting, probably survive. Only 10 to 30 percent of halibut caught by foreign trawlers, with long tows and slow sorting, are in excellent condition and survival potential is even lower, close to one percent for halibut caught by joint venture fisheries, which utilize codend transfers. Few halibut probably survive capture in the crab and shrimp fisheries.

A summary of IPHC's estimates of halibut mortality is shown in Table 37. These estimates are based on mortality rates of 100 percent in foreign trawl fisheries, joint venture fisheries, and crab and shrimp fisheries, 50 percent in domestic groundfish trawl fisheries, and 25 percent in foreign setline fisheries. The estimates indicate that incidental mortality was highest in 1965, 1971, and 1980 at 18-21 million pounds. Figure 10 illustrates the trends in mortality by region of the coast (top) and fishery (bottom). Although remaining relatively stable off British Columbia, incidental mortality has been declining off Alaska. However, fisheries off Alaska remain the largest source of mortality, particularly those operating in recent years in the Bering Sea/Aleutian Island region. In 1986, incidental mortality is estimated at about 7 million pounds, the lowest since the early 1960s.

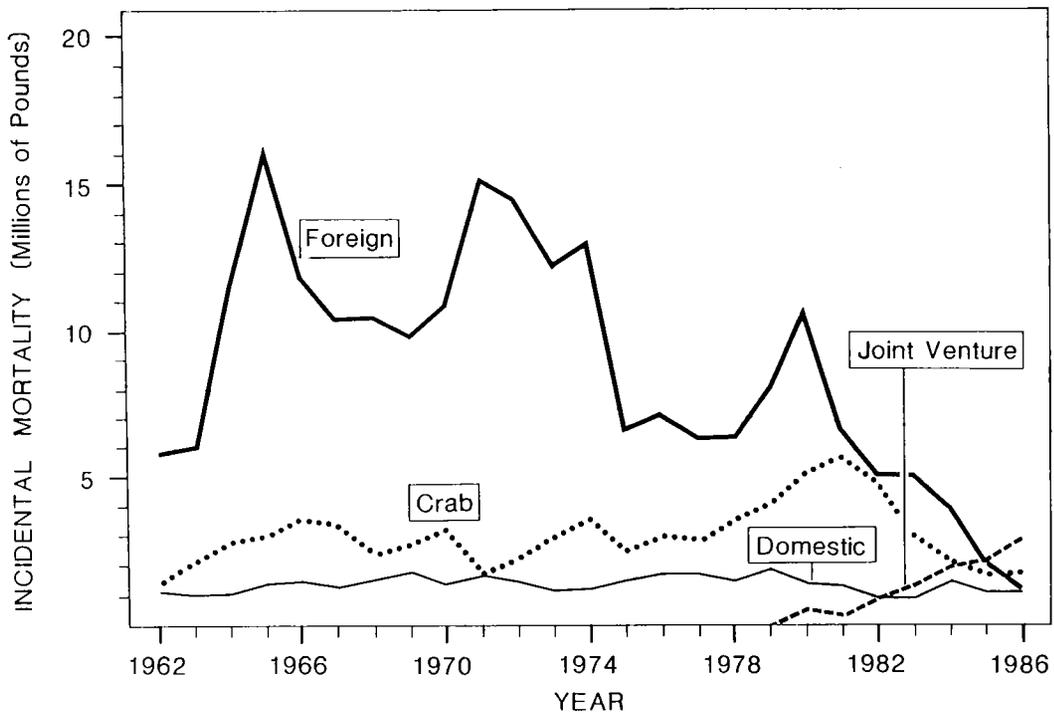
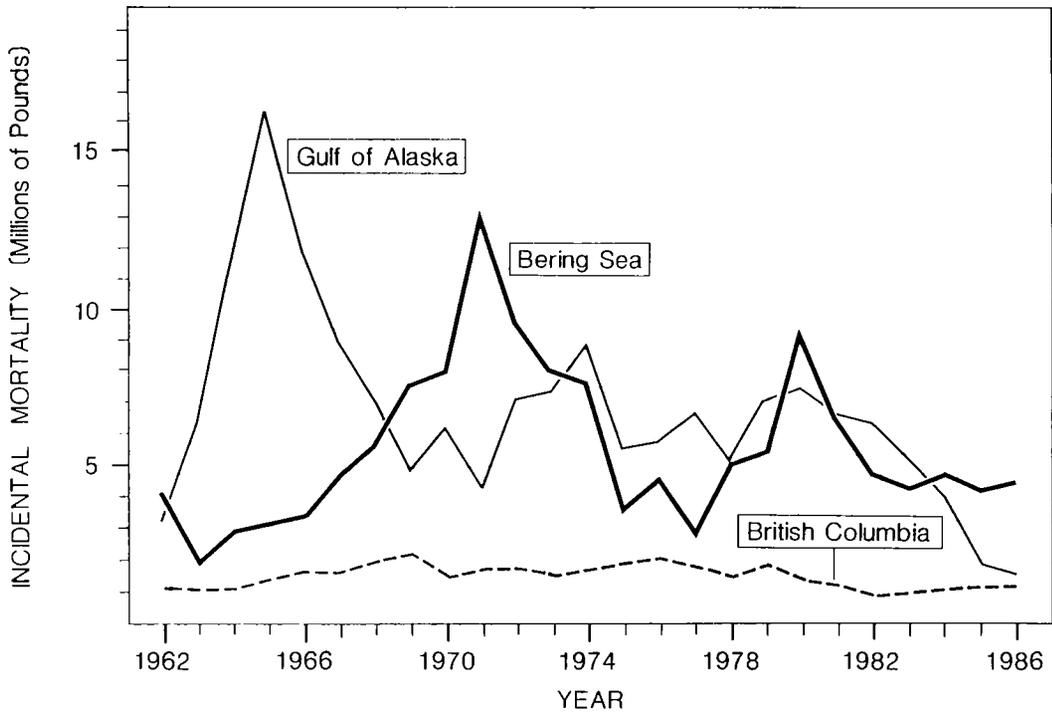


Figure 10. Pacific halibut incidental mortality by region of the coast (top) and by fishery (bottom), 1962-1986.

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APPENDIX

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, *round weight*) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign groundfish fishery during 1977, by nation, vessel class, and area. From Nelson et al. (1981a).

| Nation/Vessel Class | Areas I - III | | Area IV | | TOTAL | |
|------------------------------------|----------------|----------------|---------------|--------------|----------------|----------------|
| | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | |
| Japan | | | | | | |
| Mothership | 105,111 | 229.1 | — | — | 105,111 | 229.1 |
| Small stern trawler | 81,965 | 683.8 | 17,945 | 313.1 | 99,910 | 996.9 |
| Large stern trawler | 131,551 | 176.8 | 664 | 11.9 | 132,215 | 188.7 |
| Longline ¹ | — | — | — | — | — | — |
| U.S.S.R. | | | | | | |
| Large stern trawler | 31 | 0.4 | 354 | 14.5 | 385 | 14.9 |
| Republic of Korea | | | | | | |
| Large stern trawler | 5,999 | 11.4 | 160 | 2.7 | 6,159 | 14.1 |
| Longline ¹ | — | — | — | — | — | — |
| Taiwan | | | | | | |
| Small stern trawler | 1,193 | 9.6 | — | — | 1,193 | 9.6 |
| ALL-NATION TOTAL | 325,850 | 1,111.1 | 19,123 | 342.2 | 344,973 | 1,453.3 |
| Percent | 94.46 | 76.45 | 5.54 | 23.55 | | |

¹U.S. observers did not sample foreign longline vessel catches in 1977 and therefore incidental catch was not estimated.

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign groundfish fishery during 1978, by nation, vessel class, and area. From Nelson et al. (1981a).

| Nation/Vessel Class | Area I | | Area II | | Area III | | Area IV | | TOTAL | |
|------------------------------------|---------|-------|---------|---------|----------|-------|---------|-------|---------|---------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | |
| Japan | | | | | | | | | | |
| Surimi mothership | 44,719 | 202.9 | 47,634 | 207.2 | — | — | — | — | 92,353 | 410.1 |
| Freezer mothership | 12,204 | 19.1 | — | — | — | — | — | — | 12,204 | 19.1 |
| Small stern trawler | 81,136 | 285.5 | 193,116 | 1,015.3 | 183 | 1.7 | 49,693 | 478.2 | 324,128 | 1,780.7 |
| Large freezer trawler | 7,034 | 16.5 | 1,268 | 1.5 | — | — | 3,229 | 30.2 | 11,531 | 48.2 |
| Large surimi trawler | 20,350 | 75.6 | 14,442 | 49.7 | — | — | — | — | 34,792 | 125.3 |
| Longliner | 46,788 | 170.9 | 5,526 | 23.1 | — | — | 8,167 | 36.2 | 60,481 | 230.2 |
| U.S.S.R. | | | | | | | | | | |
| Large freezer trawler | 11,296 | 39.5 | 465 | 33.0 | — | — | 955 | 10.5 | 12,716 | 83.0 |
| Republic of Korea | | | | | | | | | | |
| Large freezer trawler | 36,119 | 98.4 | 5,696 | 13.4 | 13 | TR | 987 | 9.2 | 42,815 | 121.0 |
| Longliner | — | — | — | — | — | — | 60 | 0.2 | 60 | 0.2 |
| Taiwan¹ | | | | | | | | | | |
| Small stern trawler | 6,540 | 21.8 | 2,232 | 13.1 | — | — | — | — | 8,772 | 34.9 |
| ALL-NATION TOTAL | 266,186 | 930.2 | 270,379 | 1,356.3 | 196 | 1.7 | 63,091 | 564.5 | 599,852 | 2,852.7 |
| Percent | 44.38 | 32.61 | 45.07 | 47.54 | 00.03 | 00.06 | 10.52 | 19.79 | | |

¹The mean incidence rates from small Japanese stern trawlers were applied to the Taiwanese catch.
TR = trace, weight less than 0.1 mt

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign groundfish fishery during 1979, by nation, vessel class, and area. From Nelson et al. (1980).

| Nation/Vessel Class | Area I | | Area II | | Area III | | Area IV | | TOTAL | |
|------------------------------------|---------|---------|---------|-------|----------|-------|---------|-------|---------|---------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | |
| Japan | | | | | | | | | | |
| Mothership | 15,512 | 69.4 | 12,404 | 40.5 | — | — | — | — | 27,916 | 109.9 |
| Freezer mothership | 1,223 | 3.6 | — | — | — | — | — | — | 1,223 | 3.6 |
| Small stern trawler | 106,152 | 670.6 | 84,306 | 613.0 | 0 | 0.0 | 39,920 | 366.1 | 230,378 | 1,649.7 |
| Large freezer trawler | 45,390 | 130.9 | 8,002 | 11.4 | — | — | 10,212 | 101.9 | 63,604 | 244.2 |
| Large surimi trawler | 29,043 | 106.6 | 22,717 | 50.2 | — | — | — | — | 51,760 | 156.8 |
| Longliner | 28,963 | 99.6 | 659 | 5.2 | 30 | 0.2 | 6,018 | 28.6 | 35,670 | 133.6 |
| U.S.S.R. | | | | | | | | | | |
| Large freezer trawler | 1,689 | 13.7 | 5,065 | 19.5 | — | — | 1,242 | 7.1 | 7,996 | 40.3 |
| Republic of Korea | | | | | | | | | | |
| Large freezer trawler | 128,867 | 403.7 | 30,051 | 61.8 | — | — | 3,719 | 37.2 | 162,637 | 502.7 |
| Longliner | 303 | 1.0 | — | — | — | — | 322 | 1.6 | 625 | 2.6 |
| Taiwan¹ | | | | | | | | | | |
| Small stern trawler | 474 | 3.0 | 1,516 | 16.4 | — | — | — | — | 1,990 | 19.4 |
| Poland | | | | | | | | | | |
| Large freezer trawler | 0 | 0.0 | 12 | TR | — | — | — | — | 12 | TR |
| ALL-NATION TOTAL | 357,616 | 1,502.1 | 164,732 | 818.0 | 30 | 0.2 | 61,433 | 542.5 | 583,811 | 2,862.8 |
| Percent | 61.26 | 52.47 | 28.22 | 28.57 | 00.01 | 00.01 | 10.52 | 18.95 | | |

¹The mean incidence rates from small Japanese stern trawlers were applied to the Taiwanese catch.
TR = trace, weight less than 0.1 mt

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign and joint venture groundfish fishery during 1980, by nation, vessel class, and area. From Nelson et al. (1981b).

| Nation/Vessel Class | Area I | | Area II | | Area III | | Area IV | | TOTAL | |
|------------------------------------|----------------|------------|----------------|--------------|--------------|-----------|----------------|--------------|----------------|--------------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | |
| Japan | | | | | | | | | | |
| Surimi mothership | 4,601 | 20 | 42,543 | 37 | — | — | — | — | 47,144 | 57 |
| Freezer mothership | 4,840 | 5 | 0 | 0 | — | — | — | — | 4,840 | 5 |
| Small stern trawler | 205,962 | 273 | 214,616 | 1,494 | 1,590 | 14 | 124,404 | 985 | 546,572 | 2,766 |
| Large freezer trawler | 26,907 | 21 | 2,073 | 3 | 0 | 0 | 6,341 | 24 | 35,321 | 48 |
| Large surimi trawler | 3,005 | 15 | 30,909 | 65 | — | — | 19,124 | 76 | 53,038 | 156 |
| Longliner | 14,823 | 50 | 2,321 | 13 | 2 | TR | 1,073 | 5 | 18,219 | 68 |
| U.S.S.R. | | | | | | | | | | |
| Large freezer trawler | 12 | TR | 0 | 0 | — | — | 0 | 0 | 12 | TR |
| Republic of Korea | | | | | | | | | | |
| Large freezer trawler | 97,045 | 560 | 75,793 | 119 | 0 | 0 | 49,707 | 390 | 222,545 | 1,069 |
| Longliner | 103 | TR | 4 | TR | — | — | 5 | TR | 112 | TR |
| Taiwan | | | | | | | | | | |
| Small & large stern trawler | 47 | 1 | 13,897 | 96 | — | — | 3 | TR | 13,947 | 97 |
| Poland | | | | | | | | | | |
| Large freezer trawler | 15,907 | 39 | 141 | TR | — | — | 1,264 | 4 | 17,312 | 43 |
| West Germany | | | | | | | | | | |
| Large freezer trawler | 497 | 2 | 3 | TR | — | — | 4 | TR | 504 | 2 |
| ALL-NATION TOTAL | 373,749 | 986 | 382,300 | 1,827 | 1,592 | 14 | 201,925 | 1,484 | 959,566 | 4,311 |
| Percent | 38.95 | 22.87 | 39.87 | 42.38 | 00.17 | 00.32 | 21.04 | 34.42 | | |
| JOINT VENTURE VESSELS | | | | | | | | | | |
| U.S.-U.S.S.R. | 160,182 | 210 | 145 | TR | 545 | 1 | — | — | 160,872 | 211 |
| U.S.-Korea | 43,998 | 75 | 5 | TR | 6 | TR | 67 | TR | 44,076 | 75 |
| JOINT VENTURE TOTAL | 204,180 | 285 | 150 | TR | 551 | 1 | 67 | TR | 204,948 | 286 |
| Percent | 99.63 | 99.65 | 00.07 | — | 00.27 | 00.35 | 00.03 | — | | |

TR = trace, weight less than 0.5 mt

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign and joint venture groundfish fishery during 1981, by nation, vessel class, and area. From Nelson et al. (1982).

| Nation/Vessel Class | Area I | | Area II | | Area III | | Area IV | | TOTAL | |
|------------------------------------|---------|-------|---------|-------|----------|-------|---------|-------|---------|-------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | |
| Japan | | | | | | | | | | |
| Surimi mothership | 40,302 | 37 | 6,613 | 6 | — | — | — | — | 46,915 | 43 |
| Freezer mothership | 2,310 | 3 | — | — | — | — | — | — | 2,310 | 3 |
| Small stern trawler | 485,762 | 469 | 65,613 | 644 | 4 | TR | 62,707 | 436 | 614,086 | 1,549 |
| Large freezer trawler | 6,983 | 16 | 41 | TR | — | — | 7,157 | 87 | 14,181 | 103 |
| Large surimi trawler | 2,600 | 18 | 2,923 | 4 | — | — | 5,607 | 84 | 11,130 | 106 |
| Longliner | 36,171 | 112 | 2,055 | 12 | — | — | 1,031 | 6 | 39,257 | 130 |
| Republic of Korea | | | | | | | | | | |
| Small stern trawler | 1,716 | 6 | 0 | 0 | — | — | 384 | 4 | 2,100 | 10 |
| Large freezer trawler | 143,532 | 313 | 82,749 | 171 | — | — | 13,017 | 202 | 239,298 | 686 |
| Longliner | 67 | TR | — | — | — | — | 17 | TR | 84 | TR |
| Taiwan | | | | | | | | | | |
| Small & large stern trawler | 1,362 | 18 | 1,907 | 20 | — | — | — | — | 3,269 | 38 |
| Poland | | | | | | | | | | |
| Large freezer trawler | 0 | 0 | 0 | 0 | — | — | 0 | 0 | 0 | 0 |
| West Germany | | | | | | | | | | |
| Large freezer trawler | 12,470 | 23 | 3,284 | 12 | — | — | 347 | 1 | 16,101 | 36 |
| ALL-NATION TOTAL | 733,275 | 1,015 | 165,185 | 869 | 4 | TR | 90,267 | 820 | 988,731 | 2,704 |
| Percent | 74.16 | 37.54 | 16.71 | 32.14 | 00.00 | 00.00 | 9.23 | 30.33 | | |
| JOINT VENTURE VESSELS | | | | | | | | | | |
| U.S.-U.S.S.R. | 88,645 | 170 | 0 | 0 | — | — | 8,476 | 37 | 97,121 | 207 |
| U.S.-Korea | 1,923 | 6 | 210 | 1 | — | — | — | — | 2,133 | 7 |
| U.S.-Japan | 486 | 1 | — | — | — | — | — | — | 486 | 1 |
| U.S.-W. Germany | 0 | 0 | — | — | — | — | 3,876 | 17 | 0 | 17 |
| U.S.-Poland | 0 | 0 | — | — | — | — | — | — | 0 | 0 |
| JOINT VENTURE TOTAL | 91,054 | 177 | 210 | 1 | — | — | 12,352 | 54 | 103,616 | 232 |
| Percent | 87.88 | 76.29 | 00.20 | 00.43 | — | — | 11.92 | 23.28 | | |

TR = trace, weight less than 0.5 mt

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign and joint venture groundfish fishery during 1982, by nation, vessel class, and area. From Nelson et al. (1983).

| Nation/Vessel Class | Area I | | Area II | | Area III | | Area IV | | TOTAL | |
|------------------------------------|---------|--------|---------|--------|----------|------|---------|--------|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | |
| Japan | | | | | | | | | | |
| Surimi mothership | 5,657 | 14.63 | 971 | 1.68 | — | — | — | — | 6,628 | 16.31 |
| Freezer mothership | 13,697 | 21.94 | — | — | — | — | — | — | 13,697 | 21.94 |
| Small stern trawler | 52,869 | 221.73 | 55,483 | 510.36 | 369 | 3.53 | 62,564 | 150.55 | 171,285 | 886.17 |
| Large freezer trawler | 9,613 | 33.63 | 2 | 0.01 | — | — | 113 | 1.94 | 9,728 | 35.58 |
| Large surimi trawler | 5,823 | 37.26 | 5,620 | 20.03 | — | — | 1,140 | 19.53 | 12,583 | 76.82 |
| Longliner | 5,231 | 19.39 | 7,640 | 32.62 | — | — | 7,228 | 27.35 | 20,099 | 79.36 |
| Republic of Korea | | | | | | | | | | |
| Small stern trawler | 22,604 | 43.23 | 162 | 0.32 | — | — | 589 | 24.12 | 23,355 | 67.67 |
| Large freezer trawler | 152,853 | 367.48 | 2,546 | 5.85 | 0 | 0 | 4,626 | 24.71 | 160,025 | 398.04 |
| Longliner | 598 | 3.82 | 415 | 2.17 | — | — | 0 | 0 | 1,013 | 5.99 |
| Taiwan | | | | | | | | | | |
| Small stern trawler | 1,087 | 9.55 | 514 | 3.35 | — | — | — | — | 1,601 | 12.90 |
| Large freezer trawler | 754 | 5.99 | 2,238 | 0.84 | — | — | — | — | 2,992 | 6.83 |
| West Germany | | | | | | | | | | |
| Large freezer trawler | 197 | 0.54 | 68 | 0.34 | — | — | 69 | 0.30 | 334 | 1.18 |
| ALL-NATION TOTAL | 270,983 | 779.19 | 75,659 | 577.57 | 369 | 3.53 | 76,329 | 248.50 | 423,340 | 1,608.79 |
| Percent | 64.01 | 48.43 | 17.87 | 35.90 | 0.09 | 0.22 | 18.03 | 15.45 | | |
| JOINT VENTURE VESSELS | | | | | | | | | | |
| U.S.-U.S.S.R. | 330,311 | 480.83 | — | — | — | — | 28,025 | 59.89 | 358,336 | 490.72 |
| U.S.-Korea | — | — | — | — | — | — | 2 | TR | 2 | TR |
| U.S.-Japan | 334 | 1.08 | 0 | 0 | — | — | — | — | 334 | 1.08 |
| U.S.-Poland | 3 | 0.03 | — | — | — | — | 0 | 0 | 3 | 0.03 |
| U.S.-Taiwan | 144 | 0.45 | — | — | — | — | — | — | 144 | 0.45 |
| U.S.-W. Germany | 52,676 | 69.87 | — | — | — | — | 620 | 0.88 | 53,296 | 70.75 |
| JOINT VENTURE TOTAL | 383,468 | 502.26 | 0 | 0 | — | — | 28,647 | 60.77 | 412,115 | 563.03 |
| Percent | 93.05 | 89.21 | 0 | 0 | — | — | 6.95 | 10.79 | | |

TR = trace, weight less than 0.005 mt

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign and joint venture groundfish fishery during 1983, by nation, vessel class, and area. From Berger et al. (1984).

| Nation/Vessel Class | Area I | | Area II | | Area III | | Area IV | | TOTAL | |
|------------------------------------|---------|----------|---------|--------|----------|------|---------|--------|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | |
| Japan | | | | | | | | | | |
| Surimi mothership | 3,134 | 14.15 | 4,007 | 15.34 | — | — | — | — | 7,141 | 29.49 |
| Freezer mothership | 29,732 | 60.55 | — | — | — | — | — | — | 29,732 | 60.55 |
| Small stern trawler | 74,826 | 324.47 | 65,262 | 491.97 | 0 | 0.00 | 53,154 | 77.13 | 193,242 | 893.47 |
| Large surimi trawler | 2,880 | 20.07 | 6,787 | 22.35 | — | — | 215 | 1.35 | 9,882 | 43.77 |
| Large freezer trawler | 15,742 | 49.23 | 0 | 0.00 | — | — | 0 | 0.00 | 15,742 | 49.23 |
| Longliner | 38,764 | 134.40 | 24,102 | 78.15 | — | — | 5,859 | 17.29 | 68,725 | 229.84 |
| Republic of Korea | | | | | | | | | | |
| Small stern trawler | 12,374 | 29.67 | 14 | 0.20 | 0 | 0.00 | 601 | 6.96 | 12,989 | 36.83 |
| Large freezer trawler | 166,978 | 419.95 | 0 | 0.00 | — | — | 6,609 | 80.68 | 173,587 | 500.63 |
| Longliner | 1,912 | 10.96 | 2,351 | 14.79 | — | — | 229 | 1.48 | 4,492 | 27.23 |
| West Germany | | | | | | | | | | |
| Large freezer trawler | 53 | 0.64 | — | — | — | — | 2 | 0.01 | 55 | 0.65 |
| ALL-NATION TOTAL | 346,395 | 1,064.09 | 102,523 | 622.80 | 0 | 0.00 | 66,669 | 184.90 | 515,587 | 1,817.79 |
| Percent | 67.18 | 56.85 | 19.88 | 33.27 | 0.00 | 0.00 | 12.93 | 9.88 | | |
| JOINT VENTURE VESSELS | | | | | | | | | | |
| U.S.-U.S.S.R. | 175,831 | 273.36 | — | — | — | — | 38,616 | 75.54 | 214,447 | 348.90 |
| U.S.-Korea | 58,669 | 85.99 | 183 | 0.27 | — | — | — | — | 58,852 | 86.26 |
| U.S.-Japan | 781 | 3.33 | — | — | — | — | — | — | 781 | 3.33 |
| JOINT VENTURE TOTAL | 235,281 | 362.68 | 182 | 0.27 | — | — | 38,616 | 75.54 | 274,080 | 438.49 |
| Percent | 85.84 | 82.71 | 0.07 | 0.06 | — | — | 14.09 | 17.23 | | |

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign and joint venture groundfish fishery during 1984, by nation, vessel class, and area. From Berger et al. (1985).

| Nation/Vessel Class | Area I | | Area II | | Area III | | Area IV | | TOTAL | |
|------------------------------------|---------|----------|---------|--------|----------|------|---------|--------|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | |
| Japan | | | | | | | | | | |
| Surimi mothership | 1,226 | 4.34 | 8,989 | 21.56 | — | — | — | — | 10,215 | 25.90 |
| Freezer mothership | 31,143 | 113.78 | — | — | — | — | — | — | 31,143 | 113.78 |
| Small stern trawler | 104,746 | 550.70 | 50,735 | 285.98 | — | — | 11,340 | 83.70 | 166,821 | 920.38 |
| Large surimi trawler | 885 | 5.66 | 3,384 | 20.43 | — | — | 527 | 2.56 | 4,796 | 28.65 |
| Large freezer trawler | 25,527 | 103.24 | 1,969 | 3.63 | 115 | 0.16 | 65 | 0.49 | 27,676 | 107.52 |
| Longliner | 41,009 | 125.89 | 126,971 | 441.26 | — | — | 12,388 | 41.10 | 180,368 | 608.25 |
| Republic of Korea | | | | | | | | | | |
| Small stern trawler | 7,714 | 26.51 | 100 | 0.35 | 0 | 0.00 | 0 | 0.00 | 7,814 | 26.86 |
| Large freezer trawler | 80,148 | 256.56 | 6,802 | 30.48 | 0 | 0.00 | 0 | 0.00 | 86,950 | 287.04 |
| Longliner | 0 | 0.00 | — | — | — | — | — | — | 0 | 0.00 |
| Poland | | | | | | | | | | |
| Large freezer trawler | 226 | 1.24 | 0 | 0.00 | 0 | 0.00 | 10 | 0.01 | 236 | 1.25 |
| U.S.S.R | | | | | | | | | | |
| Large freezer trawler | 1,274 | 5.26 | 0 | 0.00 | — | — | — | — | 1,274 | 5.26 |
| West Germany | | | | | | | | | | |
| Large freezer trawler | 7 | 0.04 | 10 | 0.09 | — | — | 4 | 0.01 | 21 | 0.14 |
| Portugal | | | | | | | | | | |
| Small stern trawler | 1,013 | 3.31 | — | — | — | — | — | — | 1,013 | 3.31 |
| ALL-NATION TOTAL | 294,918 | 1,196.53 | 198,960 | 803.78 | 115 | 0.16 | 24,334 | 127.87 | 518,327 | 2,128.34 |
| Percent | 56.90 | 56.22 | 38.29 | 37.77 | 0.02 | 0.01 | 4.69 | 6.01 | | |
| JOINT VENTURE VESSELS | | | | | | | | | | |
| U.S.-Japan | 3,202 | 12.95 | 170 | 0.99 | — | — | — | — | 3,372 | 13.94 |
| U.S.-Korea | 47,411 | 116.90 | 3 | 0.02 | — | — | 13,995 | 46.56 | 61,409 | 163.48 |
| U.S.-Poland | 957 | 3.81 | — | — | — | — | — | — | 957 | 3.81 |
| U.S.-Spain | 27,082 | 50.57 | — | — | — | — | 169 | 0.56 | 27,251 | 51.13 |
| U.S.-U.S.S.R. | 140,976 | 327.15 | 75 | 0.44 | — | — | 20,233 | 57.37 | 161,284 | 384.96 |
| U.S.-West Germany | 0 | 0.00 | — | — | — | — | — | — | 0 | 0.00 |
| JOINT VENTURE TOTAL | 219,628 | 511.38 | 248 | 1.45 | — | — | 34,397 | 104.49 | 254,273 | 617.32 |
| Percent | 86.37 | 82.84 | 0.10 | 0.23 | — | — | 13.53 | 16.93 | | |

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign and joint venture groundfish fishery during 1985, by nation, vessel class, and area. From Berger et al. (1986).

| | Area I | | Area II | | Area III | | Area IV | | TOTAL | |
|------------------------------------|---------|--------|---------|--------|----------|----|---------|-------|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | |
| Japan | | | | | | | | | | |
| Surimi mothership | 0 | 0.00 | 1,710 | 10.37 | — | — | — | — | 1,710 | 10.37 |
| Freezer mothership | 30,778 | 82.41 | — | — | — | — | — | — | 30,778 | 82.41 |
| Small stern trawler | 62,277 | 370.27 | 31,858 | 200.75 | — | — | 0 | 0.00 | 94,135 | 571.02 |
| Large surimi trawler | 3,327 | 17.62 | 2,851 | 16.56 | — | — | 0 | 0.00 | 6,178 | 37.18 |
| Large freezer trawler | 14,985 | 60.41 | 115 | 0.67 | — | — | 0 | 0.00 | 15,099 | 61.08 |
| Longliner | 41,375 | 106.16 | 192,785 | 612.17 | — | — | 18,712 | 49.39 | 252,872 | 767.72 |
| Republic of Korea | | | | | | | | | | |
| Small stern trawler | 7,855 | 29.50 | 206 | 0.56 | — | — | 0 | 0.00 | 8,061 | 30.06 |
| Large freezer trawler | 69,639 | 200.22 | 6,499 | 27.03 | — | — | 0 | 0.00 | 76,138 | 227.25 |
| Poland | | | | | | | | | | |
| Large freezer trawler | 40 | 0.04 | 5 | 0.02 | — | — | 4 | 0.02 | 49 | 0.07 |
| U.S.S.R. | | | | | | | | | | |
| Large freezer trawler | 291 | 1.55 | — | — | — | — | — | — | 291 | 1.55 |
| ALL NATION TOTAL | 230,567 | 868.18 | 236,028 | 871.13 | — | — | 18,716 | 49.47 | 485,311 | 1,788.71 |
| Percent | 47.51 | 48.54 | 48.63 | 48.77 | — | — | 3.86 | 2.76 | | |
| JOINT VENTURE VESSELS | | | | | | | | | | |
| U.S.-Japan | 108,642 | 211.00 | 727 | 1.72 | — | — | — | — | 109,369 | 212.72 |
| U.S.-Korea | 44,955 | 112.63 | 198 | 0.90 | — | — | 19,306 | 49.13 | 64,459 | 162.66 |
| U.S.-Poland | 2,786 | 5.92 | — | — | — | — | 0 | 0 | 2,786 | 5.92 |
| U.S.-Portugal | 3,497 | 5.44 | — | — | — | — | — | — | 3,497 | 5.44 |
| U.S.-Taiwan | 1,394 | 3.84 | — | — | — | — | — | — | 1,394 | 3.84 |
| U.S.-U.S.S.R. | 259,081 | 600.30 | — | — | — | — | 6,784 | 35.29 | 265,865 | 635.59 |
| JOINT VENTURE TOTAL | 420,355 | 939.13 | 925 | 2.62 | — | — | 26,090 | 84.42 | 447,370 | 1,026.17 |
| Percent | 9396 | 91.52 | 0.21 | 0.26 | — | — | 5.83 | 8.23 | | |

Appendix Table 1. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the eastern (Concluded) Bering Sea and Aleutian Islands foreign and joint venture groundfish fishery during 1986, by nation, vessel class, and area. From Berger et al. (1987).

| | Area I | | Area II | | Area III | | Area IV | | TOTAL | |
|------------------------------------|---------|----------|---------|--------|----------|----|---------|--------|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | |
| Japan | | | | | | | | | | |
| Surimi mothership | — | — | 294 | 1.14 | — | — | — | — | 294 | 1.14 |
| Freezer mothership | 36,449 | 112.20 | — | — | — | — | — | — | 36,449 | 112.20 |
| Small stern trawler | 22,595 | 131.99 | 11,894 | 60.75 | — | — | 0 | 0.00 | 34,489 | 191.99 |
| Large surimi trawler | 782 | 6.04 | 730 | 4.00 | — | — | — | — | 1,512 | 10.04 |
| Large freezer trawler | 11,493 | 62.43 | 250 | 0.65 | — | — | — | — | 11,743 | 63.08 |
| Longliner | 1,499 | 5.40 | 177,306 | 674.43 | — | — | — | — | 178,805 | 679.83 |
| Republic of Korea | | | | | | | | | | |
| Small stern trawler | 2,906 | 11.95 | 0 | 0.00 | — | — | 0 | 0.00 | 2,906 | 11.95 |
| Large freezer trawler | 26,845 | 111.93 | 27 | 0.14 | — | — | 0 | 0.00 | 26,872 | 112.07 |
| Poland | | | | | | | | | | |
| Large freezer trawler | 2 | <0.01 | — | — | — | — | 0 | 0.00 | 2 | <0.01 |
| People's Republic of China | | | | | | | | | | |
| Large freezer trawler | 3,300 | 9.81 | 0 | 0.00 | — | — | 0 | 0.00 | 3,300 | 9.81 |
| ALL NATION TOTAL | 105,871 | 451.75 | 190,501 | 740.36 | — | — | 0 | 0.00 | 296,372 | 1,192.11 |
| Percent | 35.72 | 37.89 | 64.28 | 62.11 | — | — | 0.00 | 0.00 | | |
| JOINT VENTURE VESSELS | | | | | | | | | | |
| U.S.-Japan | 99,846 | 385.75 | 1,994 | 9.19 | — | — | 123 | 0.43 | 101,963 | 395.37 |
| U.S.-Korea | 145,109 | 469.44 | 5,283 | 16.67 | — | — | 16,583 | 64.16 | 166,975 | 550.27 |
| U.S.-Poland | 5,921 | 13.45 | — | — | — | — | — | — | 5,921 | 13.45 |
| U.S.-Rep. of China | 6,397 | 13.51 | — | — | — | — | — | — | 6,397 | 13.51 |
| U.S.-U.S.S.R. | 300,654 | 684.05 | 145 | 1.34 | — | — | 11,542 | 53.59 | 312,341 | 738.89 |
| JOINT VENTURE TOTAL | 557,927 | 1,566.23 | 7,422 | 27.22 | — | — | 28,248 | 118.09 | 593,597 | 1,711.49 |
| Percent | 93.99 | 91.51 | 1.25 | 1.59 | — | — | 4.76 | 6.90 | | |

Appendix Table 2. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, by the foreign groundfish fishery in the Gulf of Alaska, 1977. From Wall et al. (1981a).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------|-------|----------|-------|---------|-------|---------|-------|--------------|------|---------|-------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Large surimi and freezer trawlers | 73,543 | 332 | 48,609 | 161 | 18,347 | 142 | 10,165 | 123 | 14,161 | 119 | 164,825 | 877 |
| Small freezer trawler | 5,093 | 23 | 1,250 | 5 | 11,027 | 100 | 9,396 | 194 | 640 | 6 | 27,406 | 328 |
| U.S.S.R. | | | | | | | | | | | | |
| Large freezer trawler | 3,247 | 42 | 27,375 | 131 | 147,914 | 596 | 3,507 | 9 | 31 | TR | 182,074 | 778 |
| Republic of Korea | | | | | | | | | | | | |
| Large freezer trawler | 34,534 | 198 | 3,387 | 13 | — | — | — | — | — | — | 37,921 | 211 |
| Poland | | | | | | | | | | | | |
| Large freezer trawler | — | — | — | — | 783 | 11 | — | — | — | — | 783 | 11 |
| ALL-NATION TOTAL | 116,417 | 595 | 80,621 | 310 | 178,071 | 849 | 23,068 | 326 | 14,832 | 125 | 413,009 | 2,200 |
| Percent | 28.19 | 27.05 | 19.52 | 14.09 | 43.12 | 38.59 | 5.59 | 14.82 | 3.59 | 5.68 | | |

TR = trace, less than 0.5 fish or 0.5 mt

Appendix Table 2. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, by the foreign groundfish fishery in the Gulf of Alaska, 1978. From Wall et al. (1981).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------|--------|----------|--------|--------|--------|---------|--------|--------------|-------|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Small freezer trawler | 6,866 | 27.84 | 996 | 4.15 | 5,141 | 58.10 | 12,811 | 144.81 | 57 | 0.50 | 25,871 | 235.40 |
| Large surimi and freezer trawlers | 23,446 | 94.76 | 14,090 | 60.65 | 8,362 | 84.92 | 5,480 | 50.87 | 5,097 | 44.63 | 56,475 | 335.83 |
| Longliner | 5,683 | 20.30 | 10,379 | 38.31 | 1,667 | 5.82 | 591 | 5.46 | — | — | 18,320 | 69.89 |
| U.S.S.R. | | | | | | | | | | | | |
| Large freezer trawler | 21,405 | 86.91 | 45,075 | 84.89 | 803 | 6.75 | 20 | 0.18 | 8 | 0.07 | 67,311 | 178.80 |
| Poland | | | | | | | | | | | | |
| Large freezer trawler | — | — | — | — | 234 | 1.97 | — | — | — | — | 234 | 1.97 |
| Republic of Korea | | | | | | | | | | | | |
| Large freezer trawler | 122,480 | 457.00 | 2,210 | 8.06 | — | — | — | — | 3 | 0.03 | 124,693 | 465.09 |
| Longliner | 280 | 1.03 | 139 | 0.52 | 51 | 0.17 | TR | TR | — | — | 470 | 1.72 |
| ALL-NATION TOTAL | 180,160 | 687.84 | 72,889 | 196.58 | 16,258 | 157.73 | 18,902 | 201.32 | 5,165 | 45.23 | 293,374 | 1,288.70 |
| Percent | 61.41 | 53.37 | 24.85 | 15.25 | 5.54 | 12.24 | 6.44 | 15.62 | 1.76 | 3.51 | | |

TR = trace, less than 0.5 fish or 0.005 mt

Appendix Table 2. Estimated incidental catch (numbers of fish and metric tons, *round weight*) of halibut, *Hippoglossus stenolepis*, by the foreign (Continued) groundfish fishery in the Gulf of Alaska, 1979. From Wall et al. (1980).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------|--------|----------|--------|--------|--------|---------|----------|--------------|--------|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Small freezer trawler | 930 | 6.52 | 2,315 | 23.00 | 12,845 | 112.01 | 4,565 | 67.16 | 2,741 | 37.68 | 23,396 | 246.37 |
| Large surimi trawler | 517 | 2.34 | 64 | 0.64 | 4,809 | 27.77 | 0 | 0 | 0 | 0 | 5,390 | 30.75 |
| Large freezer trawler | 8,051 | 39.90 | 0 | 0 | 13,316 | 135.52 | 3,535 | 35.87 | 11,033 | 105.67 | 35,935 | 316.96 |
| Longliner | 19,911 | 51.94 | 23,223 | 73.53 | 12,535 | 46.80 | 4,110 | 30.32 | — | — | 59,779 | 202.59 |
| U.S.S.R. | | | | | | | | | | | | |
| Large freezer trawler | 243 | 3.05 | 4,630 | 46.86 | 17,569 | 134.46 | 304 | 8.54 | — | — | 22,746 | 192.91 |
| Poland | | | | | | | | | | | | |
| Large freezer trawler | 278 | 3.49 | 0 | 0 | 421 | 4.46 | — | — | — | — | 699 | 7.95 |
| Republic of Korea | | | | | | | | | | | | |
| Large freezer trawler | 34,243 | 105.46 | — | — | — | — | 54,059 | 1,262.29 | 7,278 | 169.95 | 95,580 | 1,537.70 |
| Longliner | 568 | 1.42 | — | — | — | — | 862 | 5.95 | 35 | 0.24 | 1,465 | 7.61 |
| Mexico | | | | | | | | | | | | |
| All vessel classes | 151 | 4.23 | 503 | 2.99 | 3,918 | 24.42 | 79 | 1.09 | — | — | 4,651 | 32.73 |
| ALL-NATION TOTAL | 64,892 | 218.35 | 30,735 | 147.02 | 65,413 | 485.44 | 67,514 | 1,411.22 | 21,087 | 313.54 | 249,641 | 2,575.57 |
| Percent | 26.0 | 8.5 | 12.3 | 5.7 | 26.2 | 18.8 | 27.0 | 54.8 | 8.5 | 12.2 | | |

Appendix Table 2. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, by the foreign (Continued) and joint venture groundfish fishery in the Gulf of Alaska, 1980. From Wall et al. (1981).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------|--------|----------|--------|---------|----------|---------|--------|--------------|--------|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Small stern trawler | 930 | 1.03 | 1,738 | 18.12 | 27,612 | 261.32 | 15,533 | 213.65 | 388 | 4.94 | 46,201 | 499.06 |
| Large surimi trawler | 0 | 0 | 142 | 8.73 | 7,367 | 104.62 | 497 | 7.59 | 10 | 0.15 | 8,016 | 121.09 |
| Large freezer trawler | 948 | 10.33 | 887 | 2.82 | 31,258 | 476.32 | 15,810 | 207.56 | 10,901 | 125.87 | 59,804 | 822.90 |
| Longliner | 79,465 | 195.36 | 159,328 | 598.17 | 83,791 | 298.74 | 1,261 | 7.73 | — | — | 323,845 | 1,100.00 |
| U.S.S.R. | | | | | | | | | | | | |
| Large freezer trawler | 5,935 | 44.55 | 2,411 | 8.50 | 35,875 | 513.61 | — | — | — | — | 44,221 | 566.66 |
| Poland | | | | | | | | | | | | |
| Large freezer trawler | 0 | 0 | 0 | 0 | — | — | — | — | — | — | 0 | 0 |
| Republic of Korea | | | | | | | | | | | | |
| Large freezer trawler | 21,015 | 63.98 | — | — | — | — | 1,273 | 12.97 | — | — | 22,288 | 76.95 |
| Longliner | 7,005 | 17.97 | — | — | — | — | 141 | 0.86 | — | — | 7,146 | 18.83 |
| ALL-NATION TOTAL | 115,298 | 333.22 | 164,506 | 636.34 | 185,903 | 1,654.61 | 34,515 | 450.36 | 11,299 | 130.96 | 511,521 | 3,205.49 |
| Percent | 22.50 | 10.40 | 32.20 | 19.90 | 36.30 | 51.60 | 6.80 | 14.00 | 2.20 | 4.10 | | |
| JOINT VENTURE VESSELS | | | | | | | | | | | | |
| U.S.-U.S.S.R. | 1,644 | 2.63 | — | — | — | — | — | — | — | — | 1,644 | 2.63 |
| U.S.-Korea | 531 | 1.29 | 11,629 | 26.25 | 5,514 | 18.33 | — | — | — | — | 17,674 | 45.87 |
| TOTAL | 2,175 | 3.92 | 11,629 | 26.25 | 5,514 | 18.33 | — | — | — | — | 19,318 | 48.50 |
| Percent | 11.30 | 8.10 | 60.20 | 54.10 | 28.50 | 37.80 | — | — | — | — | | |

Appendix Table 2. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, by the foreign (Continued) and joint venture groundfish fishery in the Gulf of Alaska, 1981. From Wall et al. (1982).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------|--------|----------|----------|--------|--------|---------|--------|--------------|--------|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Small freezer trawler | 121 | 3.75 | 2,620 | 23.81 | 4,745 | 71.93 | 9,538 | 140.51 | 318 | 4.32 | 17,342 | 244.32 |
| Large surimi trawler | 1,042 | 12.63 | 3,131 | 30.88 | 6,213 | 91.51 | 302 | 5.62 | — | — | 10,688 | 140.64 |
| Large freezer trawler | 1,500 | 13.24 | 6,006 | 60.07 | 8,869 | 120.43 | 20,647 | 220.64 | 10,585 | 114.15 | 47,607 | 528.53 |
| Longliner | 105,010 | 316.42 | 164,504 | 761.90 | 24,900 | 130.16 | 14,737 | 69.51 | — | — | 309,151 | 1,277.99 |
| Poland | | | | | | | | | | | | |
| Large freezer trawler | 0 | 0 | 153 | 5.08 | — | — | 129 | 1.58 | — | — | 282 | 6.66 |
| Republic of Korea | | | | | | | | | | | | |
| Large freezer trawler | 13,282 | 69.68 | 8,478 | 104.73 | 87 | 1.45 | 0 | 0 | — | — | 21,847 | 175.86 |
| Small freezer trawler | 1,609 | 23.42 | 1,864 | 50.90 | 893 | 21.92 | 0 | 0 | — | — | 4,366 | 96.24 |
| Longliner | 1,106 | 1.79 | 524 | 2.32 | 3,566 | 21.13 | 832 | 3.92 | — | — | 6,028 | 29.16 |
| ALL-NATION TOTAL | 123,670 | 440.93 | 187,280 | 1,039.69 | 49,273 | 485.53 | 46,185 | 441.78 | 10,903 | 118.47 | 417,311 | 2,499.40 |
| Percent | 29.63 | 17.64 | 44.88 | 41.60 | 11.81 | 18.35 | 11.07 | 17.68 | 2.61 | 4.74 | | |
| JOINT VENTURE VESSELS | | | | | | | | | | | | |
| U.S.-Japan | 0 | 0.00 | — | — | — | — | — | — | — | — | 0 | 0.00 |
| U.S.-Korea | — | — | 274 | 4.81 | — | — | — | — | — | — | 274 | 4.81 |
| JOINT VENTURE TOTAL | 0 | 0.00 | 274 | 4.81 | — | — | — | — | — | — | 274 | 4.81 |
| Percent | 0.00 | 0.00 | 100.00 | 100.00 | — | — | — | — | — | — | | |

Appendix Table 2. Estimated incidental catch (numbers of fish and metric tons round weight) of halibut, *Hippoglossus stenolepis*, by foreign and (Continued) joint venture groundfish fishery in the Gulf of Alaska, 1982. From Nelson et al. (1983).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------|--------|----------|----------|---------|--------|---------|--------|--------------|----|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Small freezer trawler | 2,980 | 31.46 | 4,840 | 91.63 | 12,259 | 163.68 | 0 | 0.00 | — | — | 20,079 | 286.77 |
| Large surimi trawler | 1,881 | 17.11 | 1,446 | 10.63 | 1,782 | 8.78 | — | — | — | — | 5,109 | 36.52 |
| Large freezer trawler | 7,160 | 93.38 | 10,482 | 146.79 | 12,993 | 165.34 | — | — | — | — | 30,365 | 405.51 |
| Longliner | 53,732 | 180.48 | 200,074 | 762.95 | 102,531 | 309.50 | 65,827 | 206.26 | — | — | 422,164 | 1,459.19 |
| Republic of Korea | | | | | | | | | | | | |
| Large freezer trawler | 33,666 | 94.98 | 22,271 | 229.19 | 1,620 | 10.81 | — | — | — | — | 57,557 | 334.98 |
| Small freezer trawler | 11,368 | 72.26 | 3,044 | 37.54 | 179 | 1.82 | — | — | — | — | 14,591 | 111.62 |
| Longliner | 506 | 2.59 | 77 | 0.32 | 10,275 | 44.08 | 1,203 | 8.48 | — | — | 12,061 | 55.47 |
| ALL-NATION TOTAL | 111,293 | 492.26 | 242,234 | 1,279.05 | 141,639 | 704.01 | 67,030 | 214.74 | — | — | 562,196 | 2,690.06 |
| Percent | 19.80 | 18.30 | 43.09 | 47.55 | 25.19 | 26.17 | 11.92 | 7.98 | — | — | | |
| JOINT VENTURE VESSELS | | | | | | | | | | | | |
| U.S.-Japan | — | — | 21 | 0.23 | 0 | 0.00 | — | — | — | — | 21 | 0.23 |
| U.S.-Poland | 0 | 0.00 | 4 | 0.05 | 0 | 0.00 | — | — | — | — | 4 | 0.05 |
| U.S.-Korea | — | — | 54 | 0.51 | 0 | 0.00 | — | — | — | — | 54 | 0.51 |
| U.S.-West Germany | 2,292 | 2.81 | 0 | 0.00 | — | — | — | — | — | — | 2,292 | 2.81 |
| JOINT VENTURE TOTAL | 2,292 | 2.81 | 79 | 0.79 | 0 | 0.00 | — | — | — | — | 2,371 | 3.60 |
| Percent | 96.67 | 78.06 | 3.33 | 21.94 | 0.00 | 0.00 | — | — | — | — | | |

Appendix Table 2. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, by the foreign (Continued) and joint venture groundfish fishery in the Gulf of Alaska, 1983. From Berger et al. (1984).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------|--------|----------|----------|---------|--------|---------|--------|--------------|----|---------|----------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Small stern trawler | 2,246 | 11.54 | 6,560 | 63.10 | 10,659 | 97.71 | 9 | 0.15 | — | — | 19,474 | 172.50 |
| Large stern trawler | 689 | 8.09 | 3,394 | 31.77 | 80 | 0.63 | — | — | — | — | 4,163 | 40.49 |
| Large freezer trawler | 8,858 | 61.82 | 12,946 | 130.51 | 18,406 | 168.19 | 0 | 0.00 | — | — | 40,210 | 360.52 |
| Longliner | 131,316 | 457.73 | 281,787 | 1,151.17 | 136,687 | 662.68 | 40,700 | 189.46 | — | — | 290,490 | 2,461.04 |
| Republic of Korea | | | | | | | | | | | | |
| Large freezer trawler | 12,985 | 59.05 | 19,682 | 122.16 | — | — | — | — | — | — | 32,667 | 181.21 |
| Small stern trawler | 273 | 1.35 | 2,225 | 16.40 | — | — | — | — | — | — | 2,498 | 17.75 |
| Longliner | 0 | 0.00 | 1 | 0.01 | 5 | 0.05 | 180 | 1.81 | — | — | 186 | 1.87 |
| ALL-NATION TOTAL | 156,367 | 599.58 | 326,595 | 1,515.12 | 165,837 | 929.26 | 40,889 | 191.42 | — | — | 689,688 | 3,235.38 |
| Percent | 22.67 | 18.53 | 47.35 | 46.83 | 24.05 | 28.72 | 5.93 | 5.92 | | | | |
| JOINT VENTURE VESSELS | | | | | | | | | | | | |
| U.S.-Japan | — | — | 228 | 1.30 | 5 | 0.01 | — | — | — | — | 233 | 1.31 |
| U.S.-U.S.S.R. | — | — | 1,637 | 8.96 | 39,398 | 119.16 | — | — | — | — | 41,035 | 128.12 |
| U.S.-Korea | 15,497 | 76.18 | 163 | 1.05 | 612 | 9.72 | — | — | — | — | 16,272 | 86.95 |
| U.S.-Taiwan | — | — | 247 | 1.84 | 40,784 | 138.27 | — | — | — | — | 41,031 | 140.11 |
| JOINT VENTURE TOTAL | 15,497 | 76.18 | 2,275 | 13.15 | 80,799 | 267.16 | — | — | — | — | 98,571 | 356.49 |
| Percent | 15.72 | 21.37 | 2.31 | 3.69 | 81.97 | 74.94 | | | | | | |

Appendix Table 2. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, by the foreign (Continued) and joint venture groundfish fishery in the Gulf of Alaska, 1984. From Berger et al. (1985).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|----------|----------|--------------|----------|----------------|-----------------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Small stern trawler | 4,007 | 24.69 | 1,723 | 20.43 | 3,734 | 44.23 | — | — | — | — | 9,464 | 89.35 |
| Large stern trawler | 5,151 | 30.03 | 4,351 | 57.68 | 3,337 | 57.11 | — | — | — | — | 12,839 | 144.82 |
| Large freezer trawler | 868 | 8.27 | 2,958 | 34.50 | 2,206 | 25.64 | — | — | — | — | 6,032 | 68.41 |
| Longliner | 182,989 | 578.74 | 117,893 | 410.63 | — | — | — | — | — | — | 300,882 | 989.37 |
| Republic of Korea | | | | | | | | | | | | |
| Large freezer trawler | 6,167 | 20.49 | 24,016 | 181.56 | — | — | — | — | — | — | 30,183 | 202.05 |
| Small stern trawler | 833 | 2.22 | 1,101 | 6.17 | — | — | — | — | — | — | 1,934 | 8.39 |
| Poland | | | | | | | | | | | | |
| Large freezer trawler | — | — | 0 | 0.00 | 579 | 3.76 | — | — | — | — | 579 | 3.76 |
| ALL-NATION TOTAL | 200,015 | 664.44 | 152,042 | 710.97 | 9,856 | 130.74 | — | — | — | — | 361,913 | 1,506.15 |
| Percent | 55.27 | 44.12 | 42.01 | 47.20 | 2.72 | 8.68 | — | — | — | — | | |
| JOINT VENTURE VESSELS | | | | | | | | | | | | |
| U.S.-Japan | — | — | 65 | 0.27 | 1 | <0.01 | — | — | — | — | 66 | 0.27 |
| U.S.-Korea | 22,962 | 135.91 | 919 | 7.50 | 836 | 11.35 | — | — | — | — | 24,717 | 154.76 |
| U.S.-Poland | 69 | 0.21 | 89 | 0.33 | 14,336 | 67.18 | — | — | — | — | 14,494 | 67.72 |
| U.S.-Spain | 520 | 1.42 | — | — | 7,958 | 28.52 | — | — | — | — | 8,478 | 29.94 |
| U.S.-Taiwan | — | — | 11,283 | 37.66 | 84,431 | 260.20 | — | — | — | — | 95,714 | 297.86 |
| U.S.-U.S.S.R. | 2,149 | 5.25 | 1,157 | 1.83 | 18,931 | 32.02 | — | — | — | — | 22,237 | 39.10 |
| U.S.-West Germany | — | — | 15 | 0.01 | — | — | — | — | — | — | 15 | 0.01 |
| JOINT VENTURE TOTAL | 25,700 | 142.79 | 13,528 | 47.60 | 126,493 | 399.27 | — | — | — | — | 165,721 | 589.66 |
| Percent | 15.51 | 24.22 | 8.16 | 8.07 | 76.33 | 67.71 | | | | | | |

Appendix Table 2. Estimated incidental catch (number of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, by the foreign (Continued) and joint venture groundfish fishery in the Gulf of Alaska, 1985. From Berger et al. (1986).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------|--------|----------|-------|--------|--------|---------|----|--------------|----|---------|--------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Small stern trawler | 0 | 0.00 | — | — | 0 | 0.00 | — | — | — | — | 0 | 0.00 |
| Large stern trawler | 534 | 3.46 | 0 | 0.00 | 0 | 0.00 | — | — | — | — | 534 | 3.46 |
| Longliner | 89,503 | 133.20 | 28,783 | 83.46 | — | — | — | — | — | — | 118,286 | 216.66 |
| Republic of Korea | | | | | | | | | | | | |
| Large freezer trawler | 5,098 | 17.63 | 640 | 2.20 | — | — | — | — | — | — | 5,738 | 19.83 |
| Small stern trawler | 228 | 0.89 | 0 | 0.00 | — | — | — | — | — | — | 228 | 0.89 |
| ALL-NATION TOTAL | 95,363 | 155.18 | 29,423 | 85.66 | 0 | 0.00 | — | — | — | — | 124,786 | 240.84 |
| Percent | 76.42 | 64.43 | 23.58 | 35.57 | 0.00 | 0.00 | — | — | — | — | | |
| JOINT VENTURE VESSELS | | | | | | | | | | | | |
| U.S.-Japan | — | — | 184 | 0.30 | 3,072 | 16.92 | — | — | — | — | 3,256 | 17.22 |
| U.S.-Korea | 24,123 | 79.59 | 40 | 0.11 | 62 | 2.36 | — | — | — | — | 24,225 | 82.06 |
| U.S.-Poland | 2,301 | 5.98 | 2,452 | 9.21 | 21,057 | 79.13 | — | — | — | — | 25,810 | 94.32 |
| U.S.-Taiwan | 98 | 0.28 | 4,085 | 17.01 | 21,010 | 89.41 | — | — | — | — | 25,193 | 106.70 |
| JOINT VENTURE TOTAL | 26,522 | 85.85 | 6,761 | 26.63 | 45,201 | 187.82 | — | — | — | — | 78,484 | 300.30 |
| Percent | 33.79 | 28.59 | 8.61 | 8.87 | 27.59 | 62.54 | — | — | — | — | | |

Appendix Table 2. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, by foreign and (Concluded) joint venture groundfish fishery in the Gulf of Alaska, 1986. From Berger et al. (1987).

| Nation/Vessel Class | Shumagin | | Chirikof | | Kodiak | | Yakutat | | Southeastern | | TOTAL | |
|------------------------------------|----------|--------|----------|--------|--------|-------|---------|----|--------------|----|---------|--------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| FOREIGN GROUND FISH VESSELS | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | |
| Longliners | 61,757 | 187.58 | 54,463 | 196.81 | — | — | — | — | — | — | 116,220 | 384.39 |
| Percent | 53.14 | 48.80 | 46.86 | 51.20 | — | — | — | — | — | — | | |
| JOINT VENTURE VESSELS | | | | | | | | | | | | |
| U.S.-Japan | 4 | 0.04 | 1,483 | 3.87 | 8,125 | 22.94 | — | — | — | — | 9,612 | 26.85 |
| U.S.-Korea | 4,992 | 20.09 | 117 | 0.78 | 3 | <0.01 | — | — | — | — | 5,112 | 20.87 |
| U.S.-Poland | 34 | 0.09 | 0 | 0.00 | 1,802 | 7.29 | — | — | — | — | 1,836 | 7.38 |
| U.S.-Republic of China | 10,413 | 32.58 | — | — | 459 | 1.59 | — | — | — | — | 10,872 | 34.17 |
| JOINT VENTURE TOTAL | 15,443 | 52.80 | 1,600 | 4.65 | 10,389 | 31.82 | — | — | — | — | 27,432 | 89.27 |
| Percent | 56.31 | 59.15 | 5.83 | 5.21 | 37.87 | 35.64 | — | — | — | — | | |

Appendix Table 3. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the foreign and joint venture fishery for Pacific whiting, *Merluccius products*, off Washington, Oregon, and California, 1977-1986. From French et al. (1980, 1981a, 1981b), Berger et al. (1982, 1984, 1985, 1986, 1987) and Nelson et al. (1983).

| Year/Fishery/Nation | Monterey | | Eureka | | Columbia | | Vancouver | | TOTAL | |
|---------------------|----------|-----|--------|-----|----------|------|-----------|-----|-------|------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| 1977 | | | | | | | | | | |
| Foreign | | | | | | | | | | |
| Poland | 0 | 0.0 | 0 | 0.0 | — | — | — | — | 0 | 0.0 |
| U.S.S.R. | 0 | 0.0 | 0 | 0.0 | 66 | 1.3 | — | — | 66 | 1.3 |
| TOTAL | 0 | 0.0 | 0 | 0.0 | 66 | 1.3 | — | — | 66 | 1.3 |
| 1978 | | | | | | | | | | |
| Foreign | | | | | | | | | | |
| Poland | 0 | 0.0 | 0 | 0.0 | 9 | <0.1 | — | — | 9 | <0.1 |
| U.S.S.R. | 0 | 0.0 | 0 | 0.0 | 231 | 1.4 | — | — | 231 | 1.4 |
| Total | 0 | 0.0 | 0 | 0.0 | 140 | 1.4 | — | — | 240 | 1.4 |
| Joint Venture | | | | | | | | | | |
| U.S.-U.S.S.R. | — | — | — | — | 0 | 0.0 | — | — | 0 | 0.0 |
| TOTAL | 0 | 0.0 | 0 | 0.0 | 240 | 1.4 | — | — | 240 | 1.4 |
| 1979 | | | | | | | | | | |
| Foreign | | | | | | | | | | |
| Poland | — | — | 0 | 0.0 | 15 | 0.2 | — | — | 15 | 0.2 |
| U.S.S.R. | — | — | 0 | 0.0 | 25 | 0.3 | — | — | 25 | 0.3 |
| Total | — | — | 0 | 0.0 | 40 | 0.5 | — | — | 40 | 0.5 |
| Joint Venture | | | | | | | | | | |
| U.S.-U.S.S.R. | — | — | — | — | 0 | 0.0 | — | — | 0 | 0.0 |
| TOTAL | 0 | 0.0 | 0 | 0.0 | 40 | 0.5 | — | — | 40 | 0.5 |
| 1980 | | | | | | | | | | |
| Foreign | | | | | | | | | | |
| Poland | — | — | 0 | 0.0 | 135 | 0.7 | — | — | 135 | 0.7 |
| Joint Venture | | | | | | | | | | |
| U.S.-Poland | — | — | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| U.S.-U.S.S.R. | — | — | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | — | — | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| TOTAL | — | — | 0 | 0.0 | 135 | 0.7 | 0 | 0.0 | 135 | 0.7 |

Appendix Table 3. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the foreign and joint venture fishery for Pacific whiting, *Merluccius productus*, off Washington, Oregon, and California, 1977-1986. From French et al. (1980, 1981a, 1981b), Berger et al. (1982, 1984, 1985, 1986, 1987) and Nelson et al. (1983).

| Year/Fishery/Nation | Monterey | | Eureka | | Columbia | | Vancouver | | TOTAL | |
|---------------------|----------|----|--------|-----|----------|------|-----------|------|-------|------|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| 1981 | | | | | | | | | | |
| Foreign | | | | | | | | | | |
| Poland | — | — | 0 | 0.0 | 22 | <0.1 | — | — | 22 | <0.1 |
| Bulgaria | — | — | 0 | 0.0 | 0 | 0.0 | — | — | 0 | 0.0 |
| Total | — | — | 0 | 0.0 | 22 | <0.1 | — | — | 22 | <0.1 |
| Joint Venture | | | | | | | | | | |
| U.S.-U.S.S.R. | — | — | 0 | 0.0 | 0 | 0.0 | — | — | 0 | 0.0 |
| TOTAL | — | — | 0 | 0.0 | 22 | <0.1 | — | — | 22 | <0.1 |
| 1982 | | | | | | | | | | |
| Foreign | | | | | | | | | | |
| Bulgaria | — | — | — | — | 1 | <0.1 | — | — | 1 | <0.1 |
| Joint Venture | | | | | | | | | | |
| U.S.-U.S.S.R. | — | — | — | — | 7 | <0.1 | 30 | 0.2 | 37 | 0.2 |
| U.S.-Bulgaria | — | — | — | — | 3 | <0.1 | 3 | <0.1 | 6 | <0.1 |
| Total | — | — | — | — | 10 | <0.1 | 33 | 0.2 | 43 | 0.2 |
| TOTAL | — | — | — | — | 11 | <0.1 | 33 | 0.2 | 44 | 0.2 |
| 1983 | | | | | | | | | | |
| Joint Venture | | | | | | | | | | |
| U.S.-U.S.S.R. | — | — | — | — | — | — | 46 | 0.5 | 46 | 0.5 |
| TOTAL | — | — | — | — | — | — | 46 | 0.5 | 46 | 0.5 |
| 1984 | | | | | | | | | | |
| Foreign | | | | | | | | | | |
| Poland | — | — | — | — | 0 | 0.0 | — | — | 0 | 0.0 |
| U.S.S.R. | — | — | — | — | 0 | 0.0 | — | — | 0 | 0.0 |
| Joint Venture | | | | | | | | | | |
| U.S.-Poland | — | — | — | — | — | — | 3 | <0.1 | 3 | <0.1 |
| U.S.-U.S.S.R. | — | — | — | — | 20 | 0.2 | 3 | <0.1 | 23 | 0.2 |
| Total | — | — | — | — | 20 | 0.2 | 6 | 0.1 | 26 | 0.2 |
| TOTAL | — | — | — | — | 20 | 0.2 | 6 | <0.1 | 26 | 0.2 |

Appendix Table 3. Estimated incidental catch (numbers of fish and metric tons, round weight) of halibut, *Hippoglossus stenolepis*, in the foreign and joint venture fishery for Pacific whiting, *Merluccius productus*, off Washington, Oregon, and California, 1977-1986. From French et al. (1980, 1981a, 1981b), Berger et al. (1982, 1984, 1985, 1986, 1987) and Nelson et al. (1983).

| Year/Fishery/Nation | Monterey | | Eureka | | Columbia | | Vancouver | | TOTAL | |
|---------------------|----------|----|--------|------|----------|-----|-----------|------|-------|-----|
| | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt | Nos. | mt |
| 1985 | | | | | | | | | | |
| Foreign | | | | | | | | | | |
| Poland | — | — | — | — | 4 | 0.1 | — | — | 4 | 0.1 |
| Joint Venture | | | | | | | | | | |
| U.S.-U.S.S.R. | — | — | — | — | 24 | 0.1 | 1 | <0.1 | 25 | 0.1 |
| U.S.-Poland | — | — | — | — | 4 | 0.1 | 2 | <0.1 | 6 | 0.1 |
| Total | — | — | — | — | 28 | 0.2 | 3 | <0.1 | 31 | 0.2 |
| TOTAL | — | — | — | — | 32 | 0.3 | 3 | <0.1 | 35 | 0.3 |
| 1986 | | | | | | | | | | |
| Foreign | | | | | | | | | | |
| Poland | — | — | 0 | 0.0 | 20 | 0.1 | — | — | 20 | 0.1 |
| Joint Venture | | | | | | | | | | |
| U.S.-U.S.S.R. | — | — | 27 | <0.1 | 30 | 0.4 | 8 | <0.1 | 65 | 0.4 |
| U.S.-Poland | — | — | — | — | 16 | 0.1 | 15 | 0.1 | 31 | 0.2 |
| Total | — | — | 27 | <0.1 | 46 | 0.5 | 23 | 0.1 | 96 | 0.6 |
| TOTAL | — | — | 27 | <0.1 | 66 | 0.6 | 23 | 0.1 | 116 | 0.7 |

Appendix Table 4. Halibut length frequencies by U.S. statistical area and fishery for 1986.

| Length (cm) | EUREKA | COLUMBIA | | VAN- COUVER | KODIAK | CHIRIKOF | | SHUMAGIN | |
|----------------|------------------|------------------|------------------|------------------|------------------|--------------------|------------------|--------------------|------------------|
| | Joint Venture | Foreign Trawl | Joint Venture | Joint Venture | Joint Venture | Foreign Setline | Joint Venture | Foreign Setline | Joint Venture |
| 1-4 | — | — | — | — | — | — | — | — | — |
| 5-9 | — | — | — | — | — | — | — | — | — |
| 10-14 | — | — | — | — | 1 | — | — | — | — |
| 15-19 | — | — | — | — | — | — | — | — | — |
| 20-24 | — | — | — | — | 4 | — | — | — | — |
| 25-29 | 1 | — | 1 | — | 7 | — | 2 | — | — |
| 30-34 | 4 | — | 1 | 1 | 11 | — | 7 | 8 | — |
| 35-39 | 5 | — | 3 | 1 | 30 | 3 | 13 | 12 | 8 |
| 40-44 | — | — | — | — | 34 | 7 | 11 | 15 | 16 |
| 45-49 | — | — | — | 1 | 36 | 15 | 12 | 18 | 35 |
| 50-54 | — | — | — | — | 31 | 15 | 11 | 17 | 50 |
| 55-59 | — | — | 1 | 1 | 35 | 15 | 12 | 23 | 4 |
| 60-64 | — | 1 | 3 | 1 | 36 | 15 | 9 | 23 | 48 |
| 65-69 | 1 | 5 | 4 | 2 | 35 | 15 | 10 | 22 | 48 |
| 70-74 | 1 | 1 | 5 | 3 | 36 | 15 | 7 | 19 | 40 |
| 75-79 | — | 2 | 4 | 1 | 27 | 15 | 9 | 18 | 38 |
| 80-84 | — | 1 | — | 1 | 27 | 15 | 3 | 16 | 32 |
| 85-89 | — | — | 1 | 1 | 21 | 23 | 2 | 15 | 27 |
| 90-94 | — | 1 | 3 | 1 | 22 | 15 | 3 | 15 | 23 |
| 95-99 | — | — | — | — | 15 | 14 | 2 | 15 | 12 |
| 100-104 | — | — | 1 | — | 17 | 9 | 3 | 12 | 9 |
| 105-109 | — | — | — | — | 16 | 8 | 1 | 7 | 16 |
| 110-114 | — | — | — | 1 | 13 | 4 | 2 | 6 | 5 |
| 115-119 | — | — | — | — | 12 | 5 | 1 | 3 | 4 |
| 120-124 | — | — | — | — | 11 | 3 | — | 1 | 2 |
| 125-129 | — | — | — | — | 8 | 1 | 1 | — | 2 |
| 130-134 | — | — | — | — | 6 | — | 1 | — | 2 |
| 135-139 | — | — | — | — | 1 | — | 1 | — | 1 |
| 140-144 | — | — | — | — | 4 | — | 2 | — | 2 |
| 145-149 | — | — | — | — | 7 | — | — | — | 3 |
| 150-154 | — | — | — | — | 4 | — | — | — | 1 |
| 155-159 | — | — | — | — | 5 | — | — | — | — |
| 160-164 | — | — | — | — | 3 | — | 2 | — | 1 |
| 165-169 | — | — | — | — | 1 | — | — | — | — |
| 170-174 | — | — | — | — | 2 | — | — | — | 2 |
| 175-179 | — | — | — | — | — | — | — | — | — |
| 180-184 | — | — | — | — | 1 | — | — | — | — |
| 185-189 | — | — | — | — | 1 | — | — | — | — |
| 190-194 | — | — | — | — | — | — | — | — | — |
| 195-199 | — | — | — | — | — | — | — | — | — |
| 200+ | — | — | — | — | — | — | 1 | — | — |
| TOTAL | 12 | 11 | 27 | 15 | 520 | 202 | 129 | 265 | 474 |

Appendix Table 4. Halibut length frequencies by U.S. statistical area and fishery for 1986.
(Concluded)

| Length (cm) | BERING SEA I | | BERING SEA II | | | BERING SEA IV |
|----------------|------------------|------------------|------------------|--------------------|------------------|------------------|
| | Foreign Trawl | Joint Venture | Foreign Trawl | Foreign Setline | Joint Venture | Joint Venture |
| 1-4 | — | — | — | — | — | — |
| 5-9 | — | — | — | — | — | — |
| 10-14 | — | 5 | — | — | — | 1 |
| 15-19 | 8 | 27 | — | — | — | — |
| 20-24 | 15 | 72 | — | — | — | — |
| 25-29 | 22 | 91 | 1 | 1 | — | — |
| 30-34 | 41 | 138 | 7 | 2 | — | — |
| 35-39 | 69 | 159 | 15 | 5 | 1 | 4 |
| 40-44 | 108 | 203 | 26 | 21 | 5 | 17 |
| 45-49 | 155 | 223 | 50 | 44 | 18 | 34 |
| 50-54 | 176 | 210 | 63 | 50 | 26 | 40 |
| 55-59 | 182 | 194 | 75 | 50 | 29 | 41 |
| 60-64 | 181 | 186 | 75 | 49 | 30 | 42 |
| 65-69 | 174 | 190 | 76 | 49 | 27 | 41 |
| 70-74 | 166 | 185 | 69 | 48 | 27 | 41 |
| 75-79 | 169 | 179 | 65 | 43 | 21 | 36 |
| 80-84 | 157 | 166 | 56 | 43 | 24 | 34 |
| 85-89 | 153 | 159 | 51 | 37 | 20 | 30 |
| 90-94 | 142 | 158 | 49 | 33 | 20 | 28 |
| 95-99 | 121 | 146 | 37 | 30 | 8 | 24 |
| 100-104 | 105 | 136 | 33 | 21 | 3 | 20 |
| 105-109 | 82 | 136 | 33 | 12 | 3 | 14 |
| 110-114 | 86 | 117 | 17 | 9 | 2 | 14 |
| 115-119 | 61 | 99 | 22 | 4 | 5 | 11 |
| 120-124 | 54 | 86 | 20 | 2 | 3 | 8 |
| 125-129 | 44 | 82 | 14 | 1 | 2 | 4 |
| 130-134 | 35 | 59 | 9 | — | 4 | 6 |
| 135-139 | 39 | 51 | 14 | — | 1 | 7 |
| 140-144 | 23 | 45 | 13 | — | 1 | 4 |
| 145-149 | 22 | 28 | 9 | — | — | 4 |
| 150-154 | 18 | 30 | 13 | — | — | 5 |
| 155-159 | 9 | 20 | 5 | — | 1 | 6 |
| 160-164 | 7 | 20 | 7 | — | — | 4 |
| 165-169 | 5 | 14 | 2 | — | 1 | — |
| 170-174 | 6 | 13 | 2 | — | — | 6 |
| 175-179 | 4 | 6 | 3 | — | — | 1 |
| 180-184 | 4 | 6 | 3 | — | — | 3 |
| 185-189 | 2 | 6 | 2 | — | — | 1 |
| 190-194 | 5 | 4 | 1 | — | 1 | — |
| 195-199 | 1 | 2 | — | — | — | 1 |
| 200+ | 1 | 1 | 1 | — | — | — |
| TOTAL | 2652 | 3652 | 938 | 554 | 283 | 532 |

Appendix Table 5. Shrimp landings (mt) by area and gear type in 1984. From ADF&G (1986) and Fulton (1985).

| Gear | Gulf of Alaska | British Columbia | Washington, Oregon, California | Total |
|--------------|----------------|------------------|--------------------------------|---------------|
| Pot/Trap | 220 | 521 | — | 741 |
| Otter Trawl | 3,789 | 41 | 4,439 | 8,269 |
| Beam Trawl | 665 | 352 | — | 1,017 |
| Total | 4,674 | 914 | 4,439 | 10,027 |

Appendix Table 6. Detailed data from a 1981 observer trip on a U.S. shrimp trawler in Kachemak Bay, Alaska by IPHC personnel.

| Haul No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|----------------------|----------------|-------|----------------|----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|-------|
| Date | 7/27 | 7/27 | 7/27 | 7/27 | 7/27 | 7/27 | 7/27 | 7/27 | 7/27 | 7/27 | 7/28 |
| Time Start | 0600 | 0800 | 0915 | 1100 | 1230 | 1430 | 1705 | 1915 | 2115 | 2315 | 0100 |
| Duration (min) | 70 | 50 | 90 | 70 | 90 | 120 | 85 | 90 | 90 | 90 | 120 |
| Depth (fm) | 42 | 35 | 40 | 43 | 45 | 48 | 52 | 47 | 38 | 49 | 60 |
| Total Catch (lbs) | 7,000 | 400 | 7,000 | 5,000 | 3,500 | 15,000 | 5,000 | 9,000 | 500 | 500 | 500 |
| No. Halibut | 16 | 1 | 9 | 11 | 3 | 5 | 2 | 3 | 3 | 2 | 1 |
| Halibut Lengths (cm) | 60(D) 65(D) | 30(D) | 56(D) 28(D) | 67(D) 36(D) | 44(A) 100(A) | 38(D) 100(A) | 38(D) 81(D) | 35(D) 68(D) | 47(A) 49(D) | 25(A) 36(A) | 73(D) |
| (D) = dead | 70(D) | | 32(D) | 86(A) | 45(A) | 45(A) | | 47(D) | 72(D) | | |
| (A) = alive | 90(D) | | 26(D) | 104(A) | 67(D) | 67(D) | | | | | |
| | 46(D) | | 27(D) | 81(D) | 55(D) | | | | | | |
| | 38(D) | | 76(A) | 60(D) | | | | | | | |
| | 50(D) | | 30(D) | 60(D) | | | | | | | |
| | 40(D) | | 29(D) | 48(A) | | | | | | | |
| | 40(D) | | 45(D) | 36(D) | | | | | | | |
| | 48(D) | | | 28(D) | | | | | | | |
| | 45(D) | | | 46(D) | | | | | | | |
| | 48(D) | | | | | | | | | | |
| | 38(D) | | | | | | | | | | |
| | 40(D) | | | | | | | | | | |
| | 40(D) | | | | | | | | | | |
| | 103(D) | | | | | | | | | | |

Trip Summary:

| | |
|------------------------------|---------------|
| No. of Hauls: | 11 |
| Duration (min): | 965 |
| Depth Range (fm): | 35-60 |
| Total Shrimp Catch: | 53,400 pounds |
| Total No. Halibut: | 56 |
| Total Net Weight of Halibut: | 243 pounds |
| Percent Halibut of Total: | 0.5% |
| Percent Dead: | 79% |