INTERNATIONAL PACIFIC HALIBUT COMMISSION

75TH ANNUAL MEETING

Contents

INTERNATIONAL PACIFIC HALIBUT COMMISSION
SEVENTY-FIFTH ANNUAL MEETING
The Crest Hotel, Prince Rupert, B.C.
January 25 – 28, 1999

Schedule of Sessions

Monday - January 25

a.m. -	11:00 - 12:00	IPHC Administrative Session	Harbour Room
p.m. -	1:00 - 6:00	Public Session	British Columbia Room
	7:00 - 9:00	Reception	British Columbia Room

Tuesday - January 26

a.m. -	8:30 - 5:00	IPHC Administrative Session	Harbour Room
	8:30 - 5:00	Conference Board	British Columbia Room
	8:30 - 5:00	Processor Advisory Group	Skeena Room
p.m. -	7:30 -	City of Prince Rupert Reception	Arts Centre

Wednesday - January 27

a.m. -	8:30 - 9:30	IPHC, CB, and PAG Joint Session	British Columbia Room
	9:30 - 5:00	IPHC Administrative Session	Harbour Room

Thursday - January 28

a.m. -	8:30 - 9:30	IPHC Administrative Session	British Columbia Room
	10:00 - 12:00	IPHC Meeting (public welcome)	British Columbia Room
p.m. -	1:30 - 5:00	IPHC Administrative Session	Harbour Room

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*The IPHC office is located in the Boardroom.
*There is an extra room available for group meetings - contact the IPHC office
*The British Columbia and Skeena Rooms are available on Wednesday - contact IPHC office

INTERNATIONAL PACIFIC HALIBUT COMMISSION
SEVENTY-FIFTH ANNUAL MEETING
The Crest Hotel, Prince Rupert, B.C.
January 25 – 28, 1999

Public Session – January 25, 1999
British Columbia Room

1:00 p.m.	**WELCOME FROM THE CITY OF PRINCE RUPERT**	
		Mayor Jack Mussallem
1:15 p.m.	**OPENING OF MEETING**	
		Chairman's Opening Remarks

		Introductions
		  Commissioners
		  Commission Staff
		  Distinguished Guests

1:30	**DIRECTOR'S REMARKS**	
1:35	**STAFF PRESENTATIONS**	
		Review of IPHC Finances Special Experiments: 1998 Fisheries Oceanography Research The Pacific Halibut Fishery, 1998 Population Assessment: 1998 Maximum Size Limits Staff Regulatory Proposals: 1999
2:30	**COFFEE**	
3:00	**STAFF PRESENTATIONS (CONT.)**	
4:30	**QUESTIONS AND DISCUSSIONS**	
6:00	**ANNOUNCEMENTS AND ADJOURNMENT**	
7:00	**IPHC RECEPTION (No Host) – British Columbia Room**	

NOTES

Commission Finances

by

Bruce M. Leaman

BACKGROUND

The Commission was established by the two governments in 1923, at the request of halibut harvesters, to address problems of the halibut stock. The mandate for the Commission as specified by the Halibut Convention is that:

> *The Commission shall make such investigations as are necessary into the life history of the halibut and may conduct or authorize fishing operations to carry out such investigations...for the purpose of developing the stocks of halibut of the Northern Pacific Ocean and Bering Sea to levels which will permit the optimum yield from that fishery, and of maintaining the stocks at those levels...*

The mandate of the Commission is therefore the scientific, monitoring, assessment, and survey activities necessary for the continued health of the halibut resource. The funding for these activities traditionally came from the appropriations by the two governments, on a shared basis, and to a lesser extent from revenue generated by sales of fish taken during Commission research cruises.

In 1991, the funding for the Commission was increased from $1.59M (U.S.) to $1.67M. However, in 1994, the funding was reduced to $1.6M and has since been fixed at this level. Figure 1 shows the history of government appropriations as well as the effects of inflation on the purchasing power of the Commission's funding. A projection of the Commission's 1985 funding indicates a value of $2.1M, if funding had kept pace with inflation.

Several cumulative and recent developments have compounded the effects of inflation on the financial health of the Commission. The first of these developments was the transition to Individual Quota (IQ) harvesting frameworks in both Canada and the U.S. Prior to IQ programs, the fishery had been conducted via a progressively shorter set of derby-style openings, often with an entire season compressed into a total fishing time of only one or two weeks. While these intense derby openings had significant drawbacks, they did allow the Commission to mobilize its Seattle-based staff into the ports for the short periods of the openings. With the transition to IQ fisheries, the season length went from as little as 10 days to a present season of 245 days. This extended season meant that the Commission incurred the expense of full-time port samplers for the entire length of the season.

The second development was the combination of first a decreased and then a fixed level of appropriations from the two governments over the past decade. Governments have been faced with the very difficult task of reducing deficits and international commissions have been included in the spending reductions invoked to achieve this goal. However, during this same period fishery management agencies in the two countries also created the new IQ harvesting frameworks, with their associated increases in costs for the Commission.

The third development affecting the Commission's finances was the requirement to re-establish a large program of fishery-independent stock surveys. This requirement was generated both by biological changes in the stock (recruitment and growth changes) and in the fishery (IQ effects on catch statistics). These changes created considerable uncertainty in the understanding of stock dynamics based on fishery-dependent data alone. To provide independent indices of relative stock abundance, the Commission re-instituted standardized setline surveys. Although halibut that are caught during the surveys are sold, the revenue generated from fish sales is often insufficient to cover all survey costs including administration. These surveys are very costly in Areas 2A and 4, which are areas of either low abundance or at great distances from landing ports. While surveys in the central portion of the halibut range are usually revenue positive, losses in these other areas are substantial.

A final and recent development was the impact of large harvests and associated over-winter holdings on ex-vessel fish prices. The season-average ex-vessel price for fish from IPHC surveys dropped from $2.10/lb (U.S.) in 1997 to approximately $1.10/lb in 1998, a decline of almost 50%. The financial health of the IPHC followed this decline.

An overview of Commission operations for 1998 reveals the following:

Government appropriations		$1.600M
Personnel and administration costs (without surveys)		$1.672M
Catch statistics and port sampling		$0.379M
Research programs		$0.288M
	Sub-total	$2.339M
NET BALANCE		***-$0.739M***

The drop in the price for fish in 1998 affected the Commission and the industry in the same manner. The Commission initially undertook several measures to offset the deficit created by this drop. Staff levels were reduced, including not re-staffing the Commission's primary assessment scientist, who left for an academic position. Operations and research travel was restricted and other components of operations spending were reduced.

However, these responses alone were insufficient to prevent a deficit on operations. The Commission was forced to undertake extraordinary measures to offset this drop in revenue, including cancelling survey coverage in Areas 2A, southern 2B, and Area 4D. In addition, several charters were conducted to perform experiments providing information on the effects of fishing gear and bait on survey and commercial CPUE. These experimental charters were directed to areas where catch rates were sufficient so that the cruises would be revenue-positive. The total catches from surveys (approx. 1.9 Mlb) and experimental fishing (1.0 Mlb) were almost 3 Mlb. Despite a carryover of $663,000 from the previous fiscal year and the addition of extra revenue from the experimental charters, Commission activities in 1997/98 lost approximately $425,000 resulting in a net balance of approximately $238,000 for the fiscal year. In addition, some experimental fishing is occurring in the winter and spring of 1998-99.

IMPLICATIONS OF FIXED $1.6M APPROPRIATIONS

There are several implications to the present funding arrangement for the Commission. Chief among these is that the Commission's economic health is increasingly dependent on that of the halibut resource, and less on the appropriations from governments. The funding for the Commission to execute its mandate is therefore precarious. Costs of operations will continue to escalate and the only means of achieving cost reductions of the magnitude needed to offset shortfalls on appropriations will be reductions in both full-time and temporary staff. However, these reductions will significantly reduce the ability of the Commission to produce high-quality research and assessment recommendations.

At the request of the Commissioners, the Staff has produced a budget for Commission operations that incorporates only the $1.6M government appropriations. This budget permits only the assessment and commercial fishery sampling activities of Commission operations but does not contain sufficient resources to generate standardized setline surveys. It also contains a reduction in personnel costs equivalent to 7.5 positions. While some research would still be done (see the Appendix to this book), a substantial body of necessary research could not be conducted. The lack of the setline surveys, in particular, would have serious effects on our ability to understand stock dynamics. Recommended yields from the resource will become more conservative as uncertainty about its status increases.

FUTURE ACTIONS

The Staff has kept the two governments well informed about the financial status of the Commission. The Commissioners have responded positively and initiated measures through the U.S. State Department and the Canadian Department of Fisheries and Oceans to draw attention to the situation. However, the IPHC is only one of many agencies to which governments provide some funding and we must continue to seek outside research funds.

A number of alternatives to address Commission needs can be considered.

1. The Commission could reduce staff and expenditures to meet target spending of only $1.6M. This implies an immediate and substantial staff reduction as well as continual reductions in personnel and research costs to maintain fishery monitoring and assessment. The implications to our long-term understanding and management of the resource are substantial and serious. The Commission would eventually become only a catch monitoring agency.

2. The appropriations to the Commission from governments could be increased to offset the shortfall in operations expenses and permit surveys, in conjunction with Commission cost savings and some survey revenue.

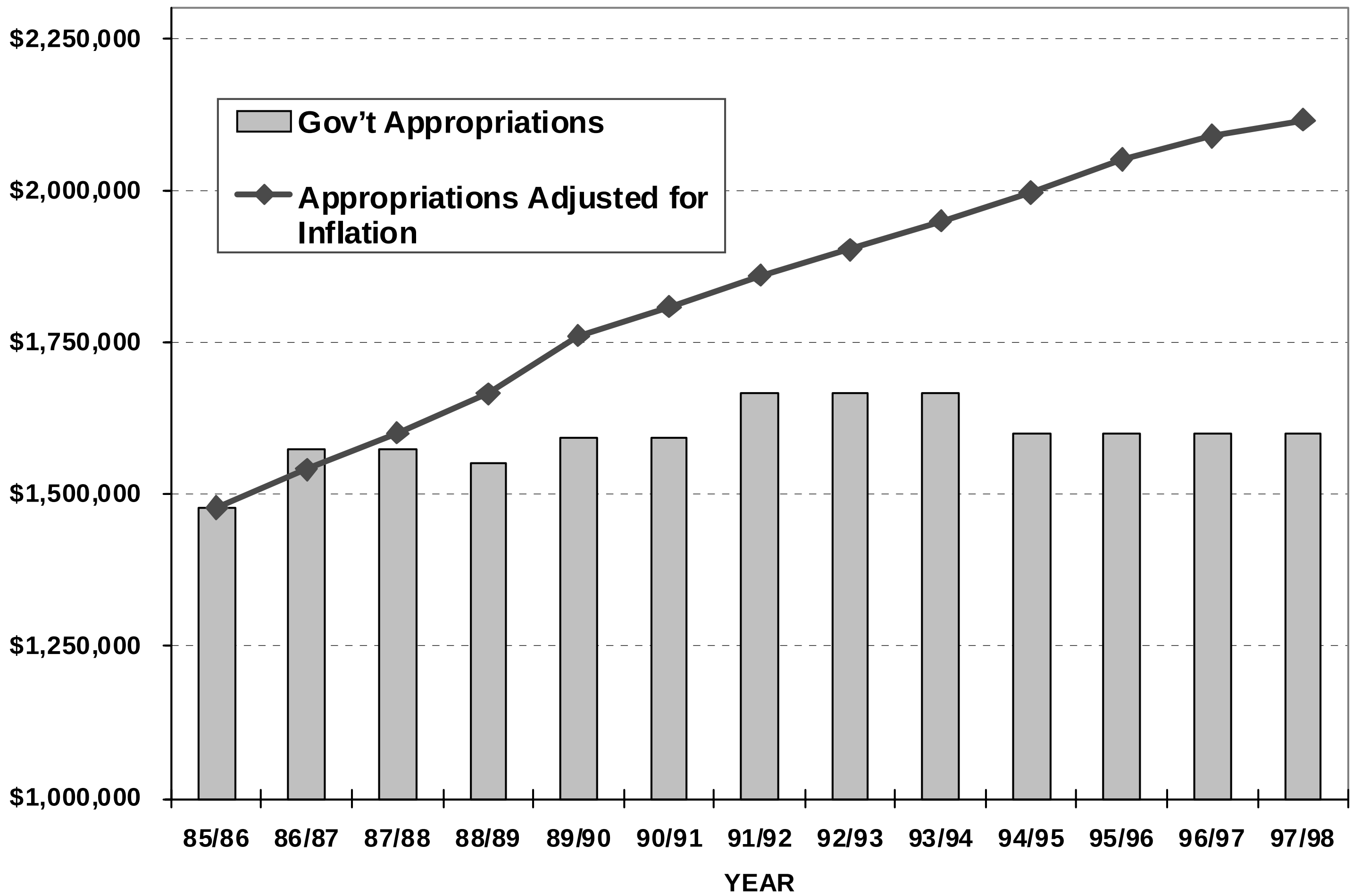
3. The Commission could recover operations shortfalls from survey revenues in conjunction with additional field experiments that are revenue positive. This alternative also contemplates the creation of a fund, based on survey revenues, that could be used as an ongoing reserve. This reserve fund would be replenished with revenue from survey or experimental fishing, to provide the annual basis for generation

of survey and/or research programs. It could also act as a reserve to buffer the effects of lower yields and fish available to surveys, when stock levels are lower.

4. The Commission could receive funds directly from industry. These funds could be specified for general operations and ongoing or specific projects. Direct funding could be a valuable component of the Commission's financial plan although it should be evaluated in the context of the Commission's continuing costs.

Staff believes that the Commission, governments, and industry need to address the basis for the long-term funding of necessary Commission activities. The halibut resource has an unmatched history of sound management that has been based on high-quality sampling and scientific programs. Commission staff have reduced costs and increased revenue where possible, but our ability to continue this history is endangered. A concerted effort to create the financial stability that is necessary for the Commission's programs is required. Over the next year, staff will be working with all participants to achieve this goal and welcomes any suggestions for means to do so.

IPHC BUDGET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YEAR

Special IPHC Experiments, 1998-1999

by

Robert J. Trumble

During the summer of 1998, the IPHC staff conducted special experiments in association with the stock assessment surveys. The extra fishing was designed to answer questions regarding gear effectiveness. The experiments helped offset lost revenue from the surveys that occurred as a result of the drop in halibut prices. The staff is currently conducting a winter experiment that spans December 1998, January, and February 1999. The winter experiments build on the results of the summer work, and emphasize bait comparisons.

SUMMER EXPERIMENTS

During the 1998 charter season, the IPHC created opportunities for vessels on stock assessment charters to conduct research fishing in addition to that required by the original charter. We selected vessels on charter because these vessels were already geared up to fish for the Commission and had IPHC staff on board, which minimized the cost and logistics of the operation.

Units of gear were either full (1500- or 1800-foot) skates or half (750- or 900-foot) skates rigged similarly in terms of hook spacing, gangion length, and hook type. Gear was fished in pairs. Each experiment was intended to compare two gear treatments. The order of treatments in each set usually alternated from day to day to help minimize variation due to changes in habitat or fish abundance.

In all cases, the special experiments were designed to evaluate sources of variability in the calculation of catch per unit effort (CPUE) for the stock assessment surveys or for the commercial fishery. IPHC staff worked with owners or operators of vessels chartered for the experiments to select the specific experiments. We tried to balance the gear and interests of the vessel with the need to obtain adequate samples for each type of experiment. The experiments examined effects of:

1. Hook size (standard large hooks versus small hooks on conventional gear);
2. Gear type (conventional halibut gear versus cod-style gear);
3. Bait size (standard size versus smaller or larger size baits);
4. Bait quality (standard #2 semi-brite versus dark chum, or semi-brite chum from different sources);
5. Bait type (standard #2 semi-brite chum versus other bait types).

Over 2,000 pairs of skates from almost 400 sets by 10 vessels were fished (Table 1) and over 20,000 halibut were caught. The data from these experiments has not yet been processed into a form for computer retrieval. However, tallies of catch by treatment for each set were prepared in the field and are available for comparison. The sum total of fish landed during the special experiments was 1,068,088 pounds, which yielded approximately $1,430,000 at an average price of $1.33

per pound. The IPHC paid charter vessels 50 percent of revenue from the special experiments, and divided the cost of the experiments 50-50 with the vessels.

Bait size

Bait size was examined during eight separate vessel trips. Four-ounce chum salmon baits were chosen as the standard against which other sizes would be compared. Sizes of bait compared to this standard were 2, 3, 6, 7, and 8 oz. On average for any trip, the CPUE for smaller baits was less than that for the 4-oz. bait, and the CPUE for larger baits averaged higher (Fig. 1).

Hook size

Four different trials compared standard 16/0 hooks with smaller hooks on standard 18-foot halibut gear, three with 14/0 hooks and one with 13/0 hooks. In three of the four trials, the larger hooks resulted in a larger overall CPUE of halibut (Fig. 2). Generally, the smaller hooks tended to catch more sublegal halibut and halibut in the 10 to 20 pound market category, and larger hooks caught more halibut over 40 pounds.

Bait quality

In most cases, one bait out-fished the other (Fig. 3), but the best bait was not necessarily the better grade bait. In five trials, dark chum salmon out-fished semi-brite chum. In two cases, the average catch for either bait was about the same. In both cases that semi-brite salmon out-fished dark salmon, we purchased dark and semi-brite salmon from the same run fresh from a seiner. In another trial, two batches of semi-brite salmon were compared against each other. One batch consistently produced lower catches than the other, averaging 80% of the higher catch. In another trial that compared two batches of silver-brite salmon, the catch rate of one batch averaged about 75% of the other.

Bait type and gear type

Summer experiments compared black cod gear (short spacing, short gangions) with standard halibut gear, and Pacific cod and squid with standard chum salmon. These experiments have not yet been summarized by set. Results will be available from the IPHC office when analyses are complete.

WINTER EXPERIMENTS

As the special summer experiments came to an end, the IPHC staff reviewed the effectiveness of the experiments in providing data and revenue. The success on both counts led to a recommendation for future special experiments. The decision to pursue the experiments during the winter came from four considerations:

1. Winter charters would cause lower staff demand than during summer, because of the high intensity efforts to conduct summer stock assessment surveys;

2. A higher price of halibut anticipated in winter would bring in higher revenues;
3. Winter landings would not compete in the market place with commercial landings of fresh halibut, but would provide some information on marketing fresh halibut during the winter closure; and
4. Collection of DNA samples in winter when halibut concentrate near the spawning grounds is needed to evaluate genetic stock structure and compare with summer samples when halibut disperse to the feeding grounds.

The experiments are taking place near Seward, Alaska using one vessel and near Prince Rupert, British Columbia using two vessels. Harvest will be limited to approximately 300,000 pounds from each area.

The staff selected bait experiments as the emphasis of the winter experiment. Specifically, we wanted to find out if readily-available baits could substitute for the #2 semi-brite chum salmon that we use as the standard bait on our stock assessment surveys. Chum salmon may not always be available, or not available at a reasonable price, so comparable alternative bait gives us a back-up to keep surveys going. Therefore, we chose two sizes of two different, readily-available baits (herring and squid) to test as possible alternatives to the standard chum salmon. The bait comparison studies use a statistical design that requires all five bait types to be fished on separate skates in a random order for each set. To minimize variations caused by differences within a bait type, all vessels used baits from the same sources.

In addition, we are collecting tissue samples for DNA analysis, and otoliths to help determine the timing of annular ring formation. Determination of genetic variability is needed during winter when halibut congregate on the spawning grounds, as well as when they are dispersed during summer. Halibut begin depositing annual rings that mark the start of summer growth during the spring, and begin depositing rings that mark the winter growth during the fall.

The Commission staff is experimenting with a unique arrangement with two companies to broker sales of the halibut caught during the winter charters. Rather than sell each load individually on the open market, the companies will sell the halibut to end users, subtract designated costs and commissions, and remit the remainder to the Commission. One company brokered the fish sales in Seward, and the other brokered sales in Prince Rupert. Because of the short time from the decision to conduct winter charters and the start of the cruises, the staff solicited bids from companies that bought substantial amounts of halibut from the IPHC during the summer surveys. If the marketing experiment proves successful, we will consider public tenders for brokering of fish from other IPHC surveys or special experiments.

The staff also solicited applications from vessels to conduct the winter charters. Payment for the charters is 50 percent of the revenue from fish sales minus 50 percent of the cost of fishing. The IPHC considered only those captains who have a history of commercial halibut fishing, with a crew capable of fishing 50 or 60 skates of gear per day and handling large quantities of halibut in adverse weather conditions. The IPHC evaluated vessels primarily on the experience and production of captain and crew with longline fishing, on the safety features of the vessel, operating costs, and suitable space for two IPHC employees.

SUMMARY

The preliminary research results from the summer experiments have given us some insights into the causes of variability in halibut catch rates, which will help us standardize our methodology and interpret changes in CPUE from our surveys and the commercial fishery. The tendency for larger bait to catch more halibut shows that we need to maintain consistency in bait size during stock assessment surveys. Dark chum sometimes outfished semi-brite chum, semi-brite sometimes outfished dark, and batches of semi-brite chum from different sources had different catch rates. These results suggest that we need to further evaluate bait quality effects on survey CPUE. We expect more information as we complete the analyses. The winter experiment will help us assure consistency in our summer stock assessment surveys if we can find alternative bait that fishes the same as the standard chum salmon currently used. The winter charter operations will collect halibut DNA samples to complete collections from winter grounds for use in further DNA stock identification work. This information will help evaluate the genetic composition of the halibut stock. We will use the otoliths collected to determine when during the year the halibut deposit annual growth rings, to improve reliability of the age determination for Pacific halibut. The results from these experiments will not answer all questions that we have asked, but will help us develop more specific experiments for future special charters.

Table 1. Summary of special experiments conducted during summer and fall 1998.

Experiment type	Number of sets	Number of skate pairs	Description
Bait size	101	498	Comparing 2, 3, 6, 7, and 8 oz. pieces against standard 4 oz. pieces of #2 semi-brite chum salmon
Hook size	89	404	Comparing 13/0 (125 pairs) and 14/0 (279 pairs) against standard 16/0 hook
Bait quality	116	703	Holding bait size to 4 oz., comparing dark salmon to semi-brite (428 pairs), two different batches of semi-brite (134 pairs) and two batches of silver-brite chum salmon (141 pairs)
Bait type	57	206	Comparing Pacific cod (149 pairs) or octopus (5 pairs) to semi-brite chum and pollock to squid (52 pairs)
Gear type	28	171	Blackcod gear to halibut gear, with same or differently sized chum baits, or with chum on halibut gear and herring on blackcod gear.

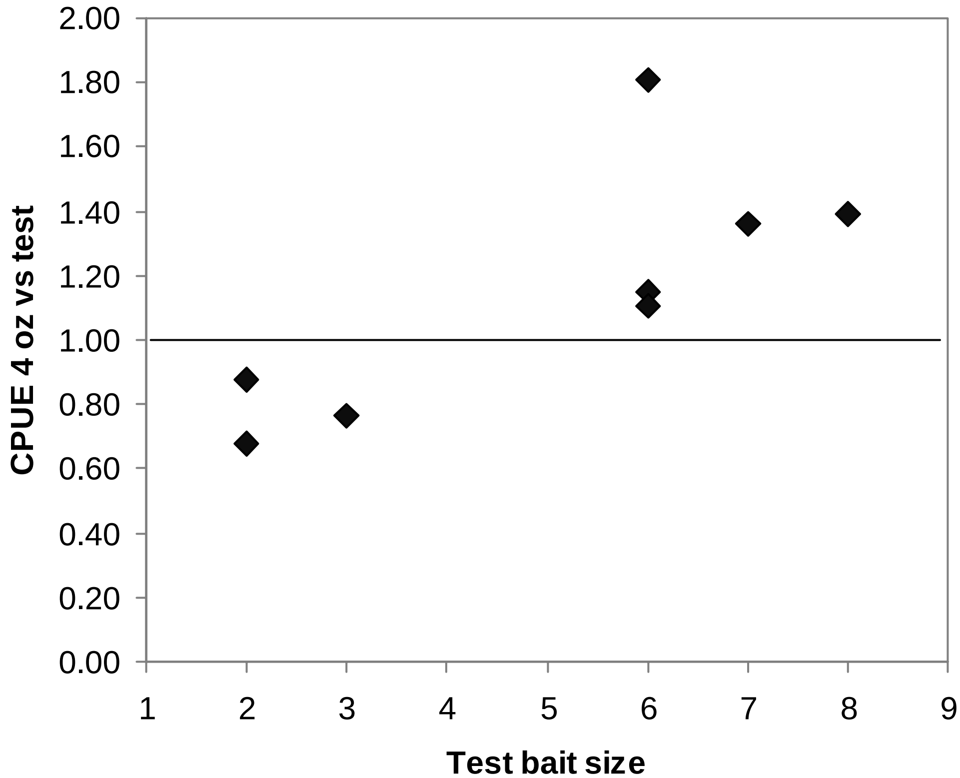

Figure 1. **Ratio of catch in pounds of legal-sized halibut on 4-oz baits versus test baits.**

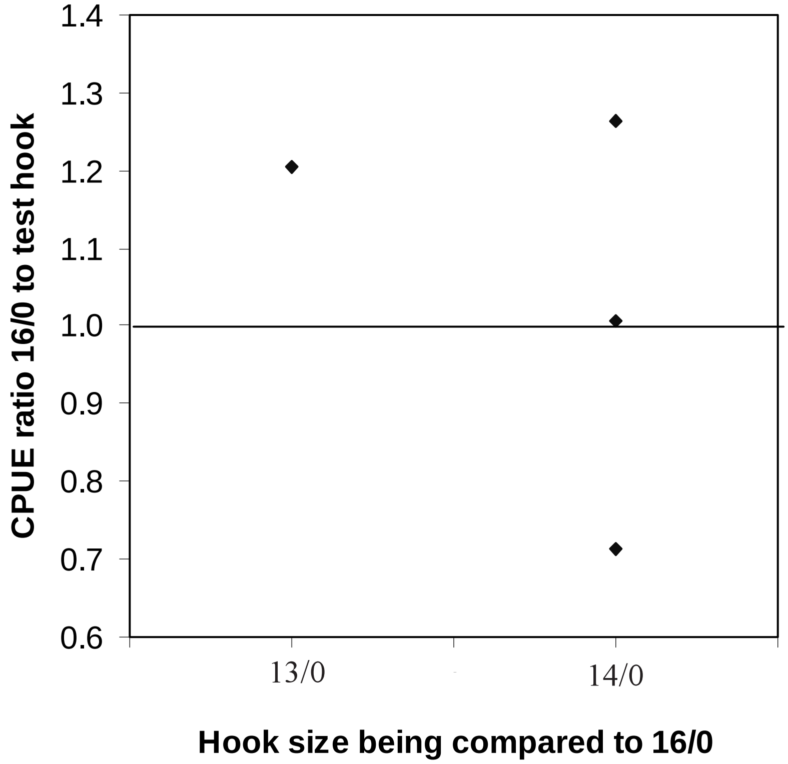

Figure 2. Ratio of CPUE of legal-sized halibut caught on skates with 16/0 hooks compared to test hook sizes.

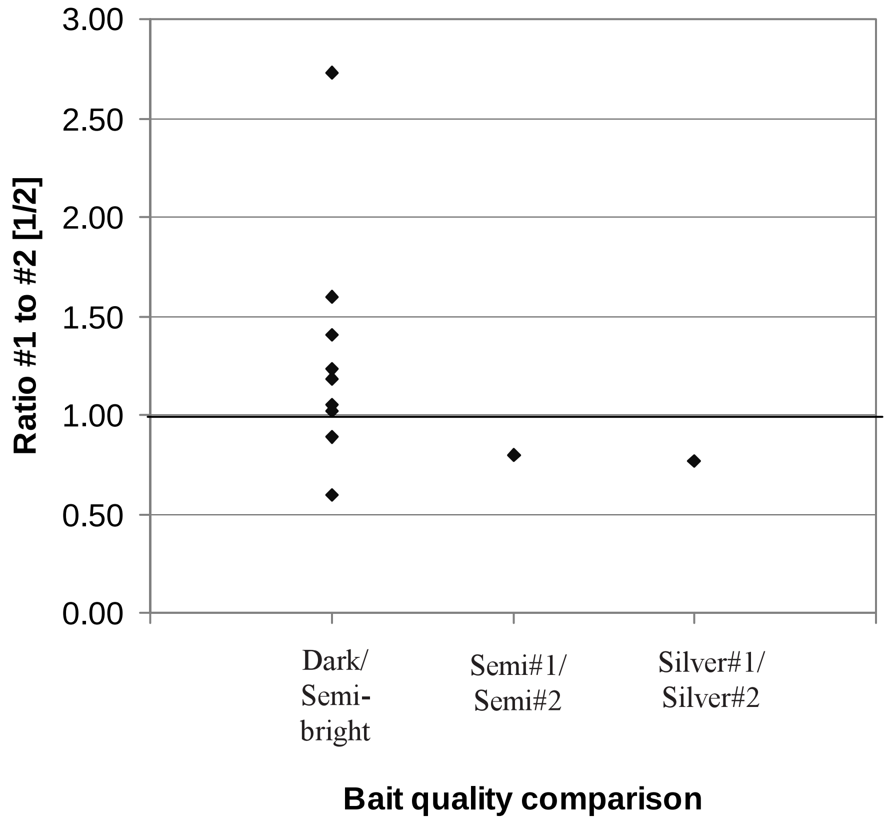

Figure 3. **Comparison of the ratio of CPUE for bait group 1 versus bait group 2 for 11 bait quality experiments. All baits were dark chum, semi-brite chum or silver-brite chum salmon.**

Halibut, Climate, and Fisheries Oceanography

by

Steven R. Hare

BACKGROUND

In 1997, the IPHC embarked upon a three year fisheries oceanography project to examine the influence of climate variability on Pacific halibut biology, particularly growth and recruitment. Beyond better understanding the factors that influence halibut population dynamics, the ultimate goal of the project is to integrate the fisheries oceanography research more closely with the stock assessment, hoping to expand it beyond a single-species environment-free model. During the first two years of the project, a number of research activities were conducted, reaching varying levels of completion. A few of these are summarized below.

EL NIÑO-SOUTHERN OSCILLATION AND PACIFIC DECADAL OSCILLATION

In 1997 and 1998, a wide array of unusual climatic and ecosystem anomalies were observed in the Bering Sea, from record warm sea surface temperatures and eerily calm atmospheric conditions to extensive die-offs of seabirds, salmon run "collapses" and previously undocumented coccolithophore blooms. In many ways, the strength of the 1997/98 El Niño and 1998/99 La Niña (collectively termed ENSO events) and the widespread ecosystem response reawakened much of the fisheries community to the tremendous impact climate variability can have on natural resources.

Recent research, much conducted here at the IPHC, has shown that there is a second major atmospheric-oceanic oscillation that influences climate over the north Pacific. Termed the "Pacific Decadal Oscillation" (PDO), it resembles ENSO but with two major differences (Fig. 1). First, unlike ENSO, the strongest impacts of the PDO are in the north Pacific Ocean with relatively modest impacts in the equatorial Pacific and essentially no impacts outside the Pacific Basin. ENSO, on the other hand, has well-recognized effects not only in the tropics but around the world. Secondly, the time scales of variability are distinctly different between the two oscillations. ENSO events tend to occur every 3-7 years though the frequency appears to have increased in the 1990s. During the course of the 20th century, the PDO has alternated between "positive" and "negative" phases every 20-30 years. There was an abrupt shift from a negative to a positive phase in the winter of 1977. The question of whether a reversal from positive to negative occurred sometime in the 1990s is an open question. The PDO index, for winter months only, shows a change in sign but the annual index has remained positive. The 1999 PICES annual meeting in Vladivostok, with the author as co-convenor, has made this question the topic of the Science Board Symposium.

HALIBUT GROWTH CHANGES OVER TIME

Over the past 15 years, there has been a remarkable decrease in the weight-at-age of halibut in commercial (Fig. 2) and survey catches (Fig. 3). The decline in weight-at-age differs among areas and age classes but the following generalizations hold:

- Fish from all IPHC regions showed declines in weight-at-age with the largest decreases occurring in Areas 3A and 3B; the smallest decreases were in Area 2A.
- Decrease in weight-at-age increased with age. In Area 3A, the decline in weight-at-age for 13 year old fish was 50% between the mid-1970s and mid-1990s. The decline was 60% for age 17 fish and 70% for age 20 fish. In Area 2B, the declines were 30%, 50% and 60% for age 13, 17 and 20 fish, respectively.
- The steepest declines in weight at age occurred between the early 1980s and early 1990s for fish older than age 15. In Areas 3A and 3B, for a given age, fish from successive year classes weighed 6-8 pounds less each year during this period.
- There appears to be a slight increase in size-at-age among the younger age classes beginning in the mid-1990s.

The cause(s) of the change in growth rates that led to the observed decline in size-at-age is unknown but is likely related to either density-dependent or environmental factors. The declines coincided with an enormous increase in the biomass of total groundfish in the Gulf of Alaska (GOA) that began in the mid-1970s (Fig. 4). Even though its biomass has doubled over the past 20 years, halibut constitute less than 2% of the total GOA groundfish biomass. Certainly, halibut from year classes after the mid-1970s have faced increased competition in terms of absolute numbers of fish though it has been shown that productivity within the GOA also doubled during that time.

PACIFIC BASIN CLIMATE VARIABILITY AND PATTERNS OF NORTHEAST PACIFIC MARINE FISH PRODUCTION

In collaboration with scientists from NOAA and the UW, two analyses were conducted on recruitment trends for the major salmon, pelagic and groundfish species and their relationship to the major climate signals in the northeast Pacific. The two climate signals we used were the Pacific Decadal Oscillation and “Nino North”. Niño North was defined from an analysis of sea surface temperature data and yielded an index that differed from traditional El Niño indices in that it indexed events based on the strength of their northern (as opposed to equatorial) impacts. We found that recruitment in a large fraction of the northeast Pacific marine fish stocks appears to be related to either PDO or Niño North climate forcing (Table 1). Pacific salmon stocks appear to respond to both climate signals though more strongly to the PDO. The decadal-scale nature of variability in halibut recruitment (Fig. 5) and salmon productivity, and their similarity to the PDO index, are illustrated in Fig. 6. Understanding the mechanisms behind this long-term temporal variability is expected to improve our management of the halibut resource.

THE OCEAN BOTTOM PROPERTIES DATABASE

This project involves the compilation of oceanographic data to assist our ongoing analysis of factors influencing halibut recruitment and growth. At year's end, the database consisted of nearly 145,000 observations of eight hydrographic variables (temperature, salinity, dissolved oxygen, nitrite, nitrate, phosphate, silicate and pH) measured within 15 m of the ocean bottom along the continental shelf from the Bering Strait to southern California. All of these records have been verified for accuracy. The principal additions this year were 35 years of Russian bottom-trawl temperature data and an update (through 1994) of National Oceanic Data Center hydrocasts. Several dozen data requests have been filled from outside agencies as word of this apparently unique resource has spread. A two-year proposal to expand this database with collected but undigitized data is presently being considered by NOAA's data rescue program, ESDIM (Environmental Service Data and Information Management).

FUTURE RESEARCH AND DIRECTION

The IPHC does not have the wherewithal to fund an independent full-scale fisheries oceanography research program. It does stand to benefit, however, from the significant amount of ongoing ecosystem/climate research currently being conducted in the north Pacific. The IPHC funded one research scientist and began establishing collaborative relationships with several of the agencies, organizations and initiatives engaged in research relevant to Pacific halibut biology. Plans for the next year include pursuing several lines of research.

- Continue research on nature of climate variability and, in particular, examine how ocean climate at depth differs from surface conditions.
- Analyze historical variations in halibut growth increment. We will update and extend an earlier study and look at temporal variation in halibut growth as recorded in their otoliths. This project was rescheduled from last year due to funding problems.
- Construct an environmental-based recruitment index for halibut. This is in collaboration with scientists at NOAA who are engaged in similar work for other groundfish species.
- Compare growth changes across different species of groundfish and attempt to construct an environmental growth model for halibut.
- Examine Pacific basin-wide patterns of zooplankton biomass variability. This is in collaboration with Japanese, Canadian, and U.S. scientists.
- Work on planning for two IPHC co-sponsored symposia on interdecadal variability in groundfish population dynamics.

Table 1. **North Pacific fish populations showing a significant relationship to the Pacific Decadal Oscillation (PDO) or El Niño Southern Oscillation (ENSO). Effect indicates relationship of recruitment to PDO and ENSO indices displayed in Figure 1. Region abbreviations are Eastern Bering Sea (EBS), Gulf of Alaska (GOA) and West Coast (WC).**

Region	Species	Signal	Effect
EBS	Arrowtooth flounder	PDO	+
EBS	Greenland turbot	PDO	-
GOA	Walleye pollock	ENSO	+
GOA	Pacific cod	ENSO	+
GOA	Pacific halibut	PDO	+
GOA	Arrowtooth. flounder	PDO	+
GOA	Sockeye salmon	PDO	+
GOA	Pink salmon	PDO	+
GOA	Chum salmon	PDO	+
GOA	Coho salmon	PDO	+
WC	Pacific hake	ENSO	+
WC	Coho salmon	PDO	-
WC	Chinook salmon	PDO	-

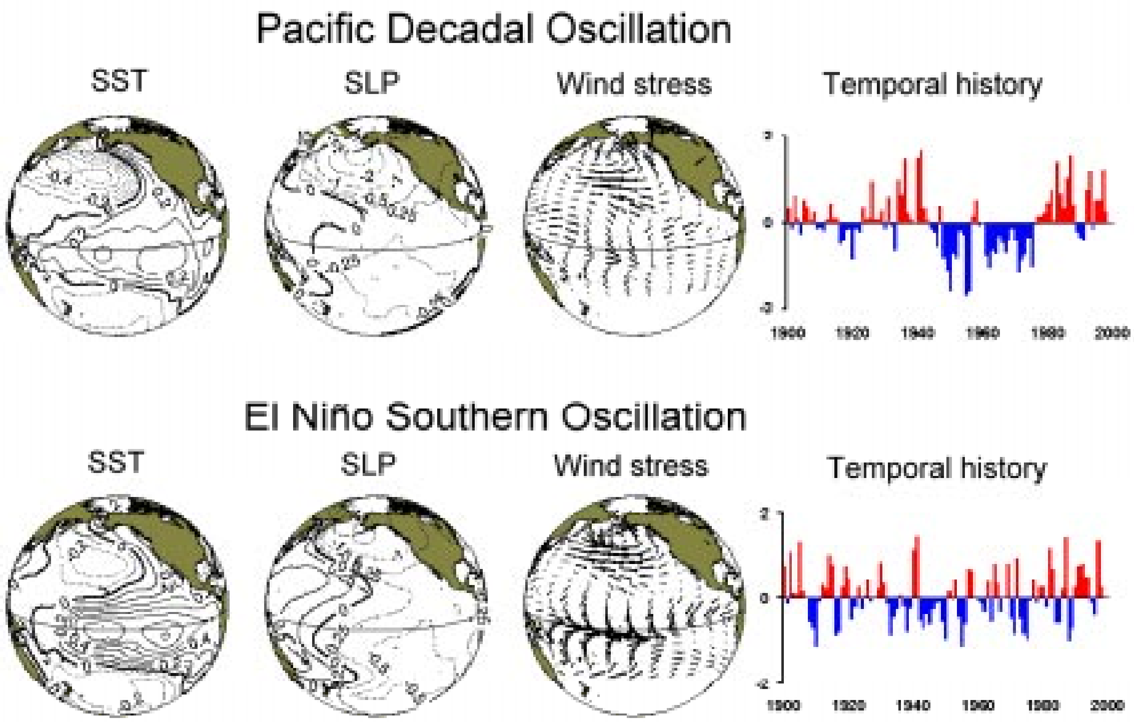

Figure 1. **A comparison of anomalous climate conditions associated with the positive phases of the Pacific Decadal Oscillation (PDO) and El Niño Southern Oscillation (ENSO). The values show °C for sea surface temperature (SST), millibars for sea level pressure (SLP) and direction and intensity of surface wind stress. The longest wind vectors represent a stress of 10 m^2/s^2. Actual anomaly values for a given year associated with the PDO and ENSO are computed by multiplying the climate anomaly with the associated temporal index.**

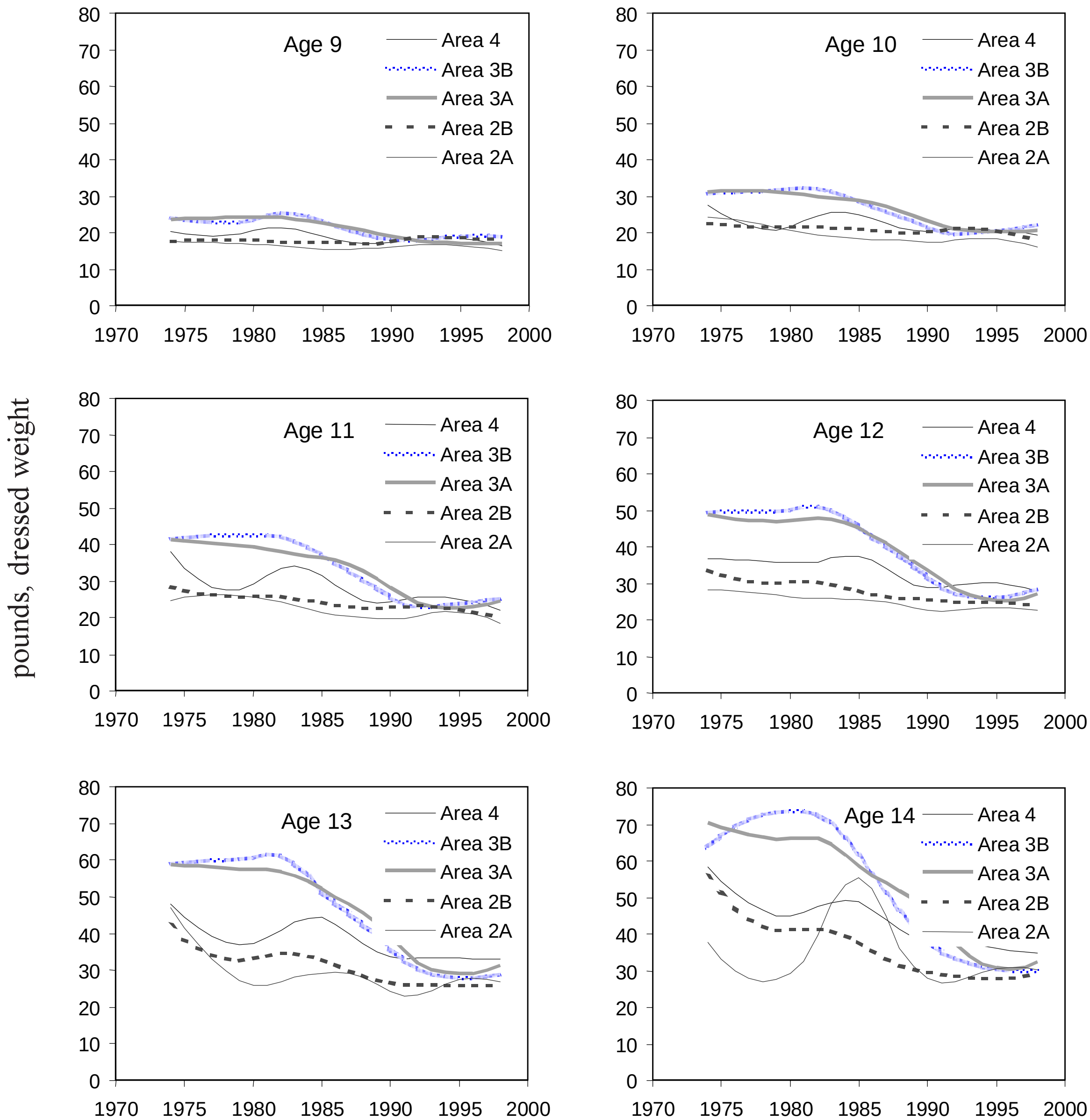

Figure 2. **Trends in weight-at-age of Pacific halibut from the major IPHC regions. Weights are computed from observed commercial length-at-age data and have been loess-smoothed using a window of 0.5.**

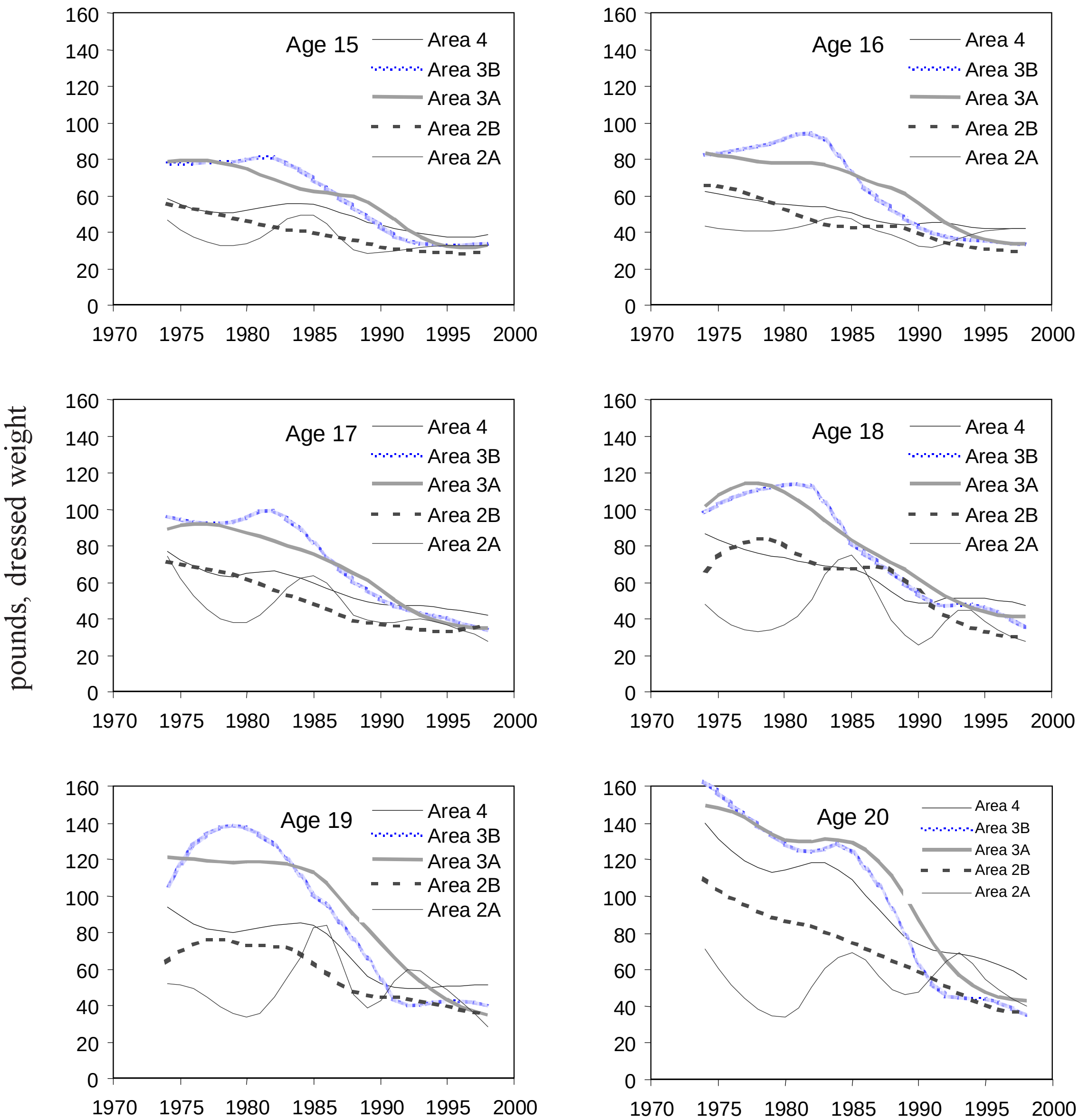

Figure 2. **(continued).**

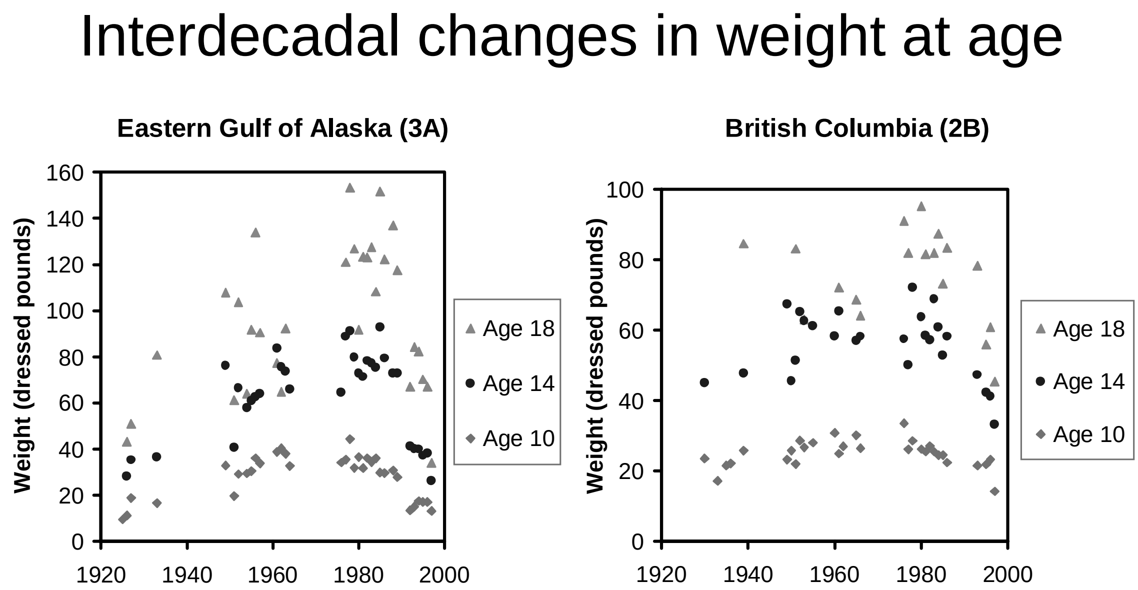

Figure 3. A comparison of historical halibut weight-at-age in survey catches for three age classes and two IPHC areas.

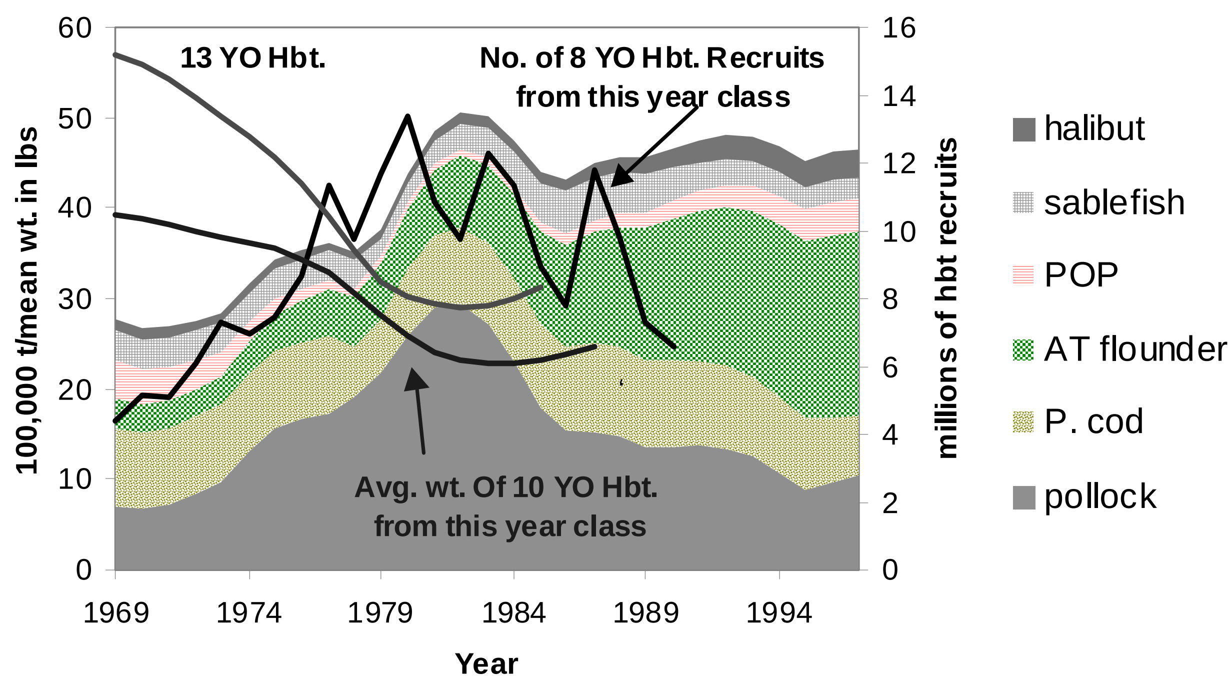

Figure 4. A comparison of trends in Gulf of Alaska groundfish biomass, weight-at-age of halibut and recruitment of 8 year old (YO) halibut. Weight-at-age and recruitment are aligned with the year of birth.

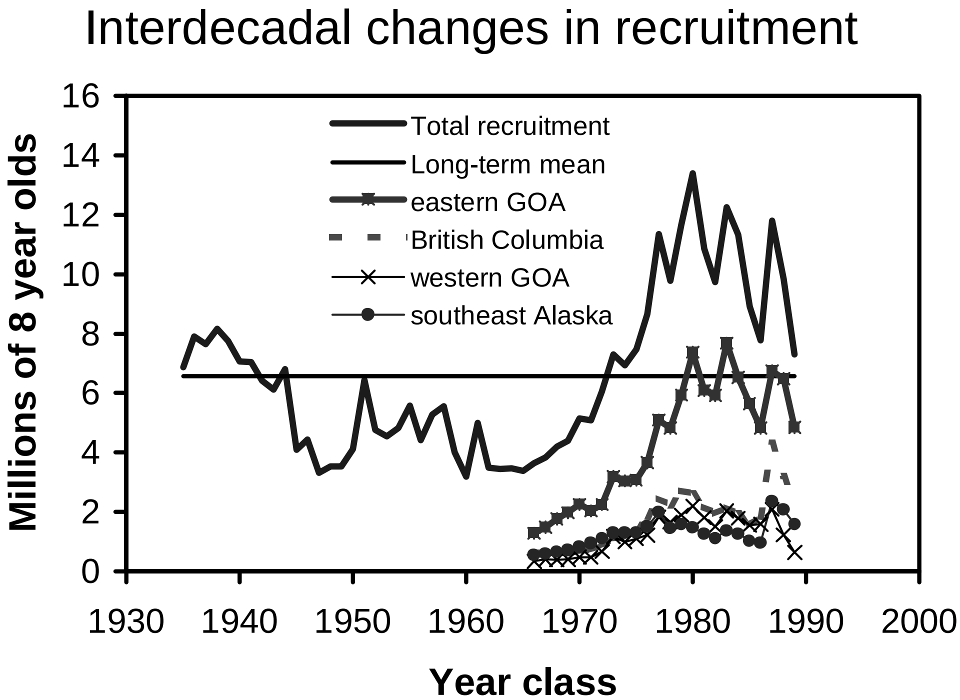

Figure 5. **Pacific halibut 8-year old recruitment since the 1935 year class.**

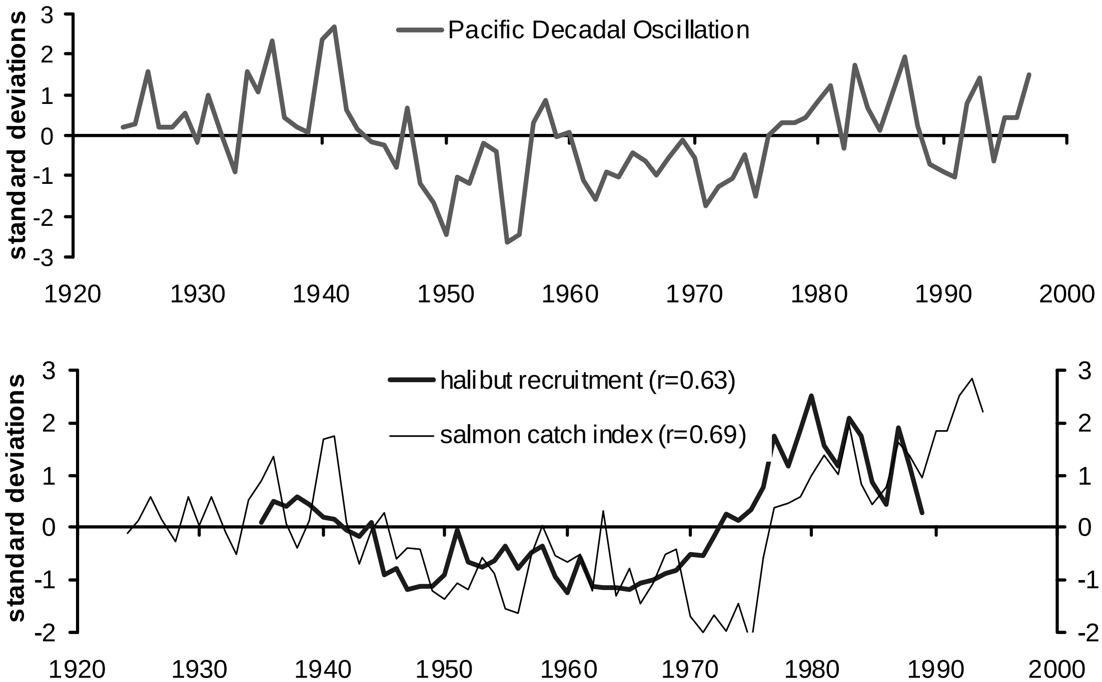

Figure 6. Times series of the Pacific Decadal Oscillation, 8-year old halibut recruitment and the leading principal component of salmon catches. The halibut and salmon data are shifted to align with birth (halibut) or ocean entry (salmon) year.

The Pacific Halibut Fishery, 1998

by

Heather L. Gilroy

In 1998 the Pacific halibut fishery was highlighted by high catches and low ex-vessel prices. The total removals including commercial and sport catch, bycatch, personal use, and wastage totaled over 94 million pounds, only 5 million pounds less than the record of 99.9 million pounds. Commercial and sport total catches were near record levels, and bycatch continued to drop from the peak experienced in 1992. Ex-vessel prices dropped by about 50% coastwide and averaged $1.10 per pound in some Alaska ports. The commercial quota share fisheries continued to operate smoothly, although the industry continues to be concerned with chalky fish and the level of enforcement. Several landings of live halibut were made in British Columbia and this issue needs to be addressed by industry and the Commission. The trends and issues relating to personal use and wastage will be discussed briefly here, while commercial catch, sport catch, and bycatch mortality will be discussed in further detail later in this report.

Personal or subsistence use harvest is small relative to other removals, but is an issue that is being addressed by both governments and is likely to increase. This year, progress was made when new personal use estimates for Alaska became available. These estimates had not been updated since 1993. Federal and State agencies are continuing to define the subsistence fishery in Alaska, which will provide a more accurate estimate of the harvest. The IPHC approved the Area 4E subsistence fishery in conjunction with the QS fishery for 1998. Discussions took place in 1998 on how to estimate the removals from this fishery and the Community Development Quota groups will be providing estimates. The Department of Fisheries and Oceans (DFO) is also working with aboriginal fishers to better estimate the Indian Food Fish harvest.

Wastage removals represent the mortality of legal-sized halibut due to lost or abandoned gear and of sublegal-sized halibut discarded in the halibut fishery. A reduction in lost gear was reported in the Bering Sea and all areas now have a similar rate of gear loss, which is lower than it was for the derby fisheries. Area 2A has the greatest ratio of lost to hauled gear and it is the only area with a fast-paced derby fishery.

The mortality of sublegal-sized halibut (as bycatch discards in other fisheries and wastage in the halibut fishery) which was deducted in setting the CEY prior to 1997, is now accounted for when setting the exploitation rate. Although the estimated amounts are not deducted in setting the CEY, they are included in the 1998 total removals.

DETAILED CATCH DATA

The 1998 removals of halibut off the Pacific coast by commercial catch, sport catch, bycatch mortality, personal use and wastage were 70.2, 8.4, 13.1, 0.7 and 2.0 million pounds, respectively (Table 1). The 1998 data are preliminary. The data sources are the IPHC, National Marine Fisheries Service (NMFS), and DFO.

Area 2A Allocation

The Pacific Fishery Management Council (PFMC) allocates halibut off Washington, Oregon, and California among commercial, sport, and treaty Indian users. The commercial fishery is open access and this is the only area with a catch limit for the sport fishery. The 1998 total catch (862,000 pounds) for commercial, sport and treaty Indian users was over the catch limit by 42,000 pounds. The sport and treaty Indian catches accounted for the overage, with the commercial catch slightly under the allocated limit.

Commercial Catch

A detailed summary of the 1998 catch and seasons by regulatory area (Fig. 1) is provided in Table 2. For comparison between years, the total of the commercial and research catches should be used. The commercial catch occurs in an open-access fishery and a treaty Indian fishery in Area 2A; the QS fisheries in British Columbia and Alaska; and a Metlakatla fishery within the Annette Island Reserve. The directed commercial fishery of Area 2A had fishing period limits (Table 3).

For the first time since the allocation of the Area 2A commercial catch to incidental and directed commercial users, catch limit remained at the end of July. As requested by the PFMC, the catch limit was made available starting in August to the incidental halibut fishery conducted during the salmon troll season. The incidental halibut fishery closed on October 31st with a catch of just over half of the initial allocation. This roll-over procedure was reviewed by the PFMC and the procedure will be different in 1999. Instead of making the amount available directly to the incidental fishery starting in August, both the directed and incidental fisheries will open with the directed fishing period limits set to take the remaining catch limit. Apparently, there was less interest in the directed fishery in 1998, possibly due to the lower ex-vessel price. The directed fishery was taken in four 10-hour fishing periods, three more openings than in 1997.

The 1998 treaty Indian catch was the highest since the initial allocation from the catch sharing plan and it was taken in the shortest time period. The fishery opened on March 15 and was closed within six days for all tribes. The 1997 tribal fishery lasted 14 days.

The catch from the Metlakatla fishery within the Annette Island Reserve was significantly lower (11,000 pounds) in 1998 than that of previous years (88,000 pounds in 1997 and 126,000 pounds in 1996). The decrease in catch was due to lower ex-vessel price and difficulty in finding the fish. The enforcement activity in 1997 may also have affected vessel activity in 1998. Several vessels are being investigated for fishing outside of the 3,000-foot Annette Island Reserve in 1997.

The total catch from the IFQ fishery for the waters off of Alaska was 7% under the catch limit. By regulatory area, catches were under the limits by 4% to 40%. The larger underages by percent (9% to 40%) occurred in the Bering Sea areas and the lowest (4%) underage was in Area 3B. Although there were significant underages, the 1998 catch is 2.7 million pounds higher than the 1997 catch. The IVQ catch from Area 2B was under the catch limit by less than 1% (125,000 pounds).

The Native communal commercial fishing program in B.C. (F licenses) had seven active vessels landing a total estimated catch of 209,151 pounds of halibut. The 1998 catch is slightly below the 1997 catch of 231,289 pounds. This program was initiated in 1996 and is part of the commercial IVQ program, not part of the Aboriginal food fish program.

One noticeable change in the commercial halibut fishery from 1997 to 1998 was that the fishers received a lower ex-vessel price. The average coast-wide ex-vessel price in 1997 was $2.25 per pound (U.S. dollars). It is too early for an average 1998 ex-vessel price to be available, however, it will be closer to $1.10 per pound. There were some late season deliveries that received over $2.00 per pound. The low ex-vessel price probably contributed to the low participation in the Bering Sea fishery.

Sport Harvest

The sport fishery prospered in 1998. Projected estimates for the sport harvest are near record levels, with the 1997 estimated harvest being the highest on record. Sport fishing regulations changed in 1998 with IPHC discontinuing the sport charter license program in Alaska and British Columbia.

The Alaska sport harvest estimates are expected to be near record levels in 1998, slightly below the records set in 1997. The Alaska Department of Fish and Game sport logbook program was implemented in 1998 and is expected to assist in sport fish estimates and in reviewing potential local depletion issues.

Revised Area 2B sport harvest estimates are expected to be provided by DFO and the data collection procedure will be reviewed by IPHC. Washington anglers landed 184,000 pounds from Canadian waters; the number of fish remained the same but the average weight increased from 1997. Landings from this fishery in 1997 totaled 159,000 pounds.

The Area 2A sport harvest was over the allocation by 19,000 pounds, primarily due to higher estimated catch rates for the inside Washington waters fishery. Methods for making more accurate catch projections are being explored.

Bycatch Mortality

Halibut bycatch continued to decline; estimates for 1998 total 13.1 million pounds which is a three percent drop from 1997. The 1998 estimate is 35 percent lower than the peak in 1992, which resulted from substantial growth of the U.S. groundfish fishery off Alaska (Fig. 2). Of note is the bycatch mortality in the 1998 Bering Sea groundfish trawl and fixed-gear fisheries, which was below the limits established by the NPFMC.

Several positive measures are occurring that may lead to future bycatch reduction. A Seattle-based trawl group, Groundfish Forum, has been experimenting with a halibut excluder device to reduce halibut bycatch in flatfish trawls. Tests conducted in 1998 indicate success in the design. If the design proves feasible and economically viable, its implementation may lead to possible bycatch reduction. In the U.S., the American Fisheries Act (Senate Bill 1221) was passed which allows fishery cooperatives for pollock. This measure should allow fishers to choose when and where to fish, replacing the current derby fishery and allowing bycatch reduction. In 1998, DFO initiated an investigation of the halibut bycatch in the shrimp trawl fishery in B.C. If any of these measures are successful, we may possibly see future bycatch reduction in Alaska and more accurate accounting of total bycatch in British Columbia.

CHANGES IN FISHING AND LANDING PATTERNS WITH THE QS FISHERIES

Changes in fishing and landing patterns were expected when British Columbia and Alaskan fisheries moved from a limited entry or open access fishery with short seasons to a quota share fishery eight months in length. In some cases changes have been minor, whereas in other cases the observed changes have been more dramatic.

One advantage of QS fisheries is that the landings are spread out over time (Table 4). The Area 2B landings were spread fairly evenly over the season, with 10% to 14% of the total Area 2B catch taken each month, with the exception of November, when the remaining 5% was landed. The busiest month for landings was April, with July a close second.

The U.S. landing patterns by regulatory area and month were similar in 1998 and 1997, with the exception of Area 3B for which landings were greatest later in the summer (August). Once again, the busiest months for landings from Areas 2C and 3A, were May and June; and the busiest months for the Bering Sea landings occurred in the summer, June through August.

For the first time, the leading U.S. landing port was Homer with landings totaling 10.4 million pounds and representing 20% of the catch. Kodiak had been the leading port since 1986 but received only 9.0 million pounds in 1998. Homer has the advantage of a road system to the southern states and a public ice-producing facility. Dutch Harbor had less importance as a halibut landing port in 1998.

Once again, the top three landing ports in Canada were Prince Rupert/Port Edward, Port Hardy and Vancouver, receiving close to 90% of the 1998 landings by weight. Prince Rupert/Port Edward received close to 40% of the Canadian poundage and the most landings. Prince Rupert also received approximately 600,000 pounds of the Alaskan IFQ catch.

LIVE FISH LANDINGS

Currently IPHC and DFO regulations are in conflict; DFO regulations do not prohibit the delivery of live fish and IPHC regulations stipulate halibut must be landed dressed at the time of offloading. In 1999, DFO will adopt whatever regulations IPHC approves at the Annual Meeting on whether round/live fish can be legally landed.

The landing of live halibut is a new marketing tool to assure fresh product to the consumer and a better price for the fisher. In 1998, approximately 9,000 pounds of live halibut was landed; the target market was public sales at the dock and the restaurant industry. The landings also included additional dead fish. Some of the live fish were immediately sold to consumers while other fish were penned, not fed, and sold at a later date. There are several industry groups in B.C. interested in pursuing the live fish market.

CHALKY FISH

For the second year, the IPHC staff continued to investigate chalky fish. Chalkiness is a condition that occurs when acidity builds up in the flesh, perhaps as a result of stress or temperature. The result is white or 'chalky' colored flesh. Chalky fish have been observed in the fishery for at least 30 years.

Initially, industry response in completing chalky fish incidence reports was poor. However, the IPHC conducted a year-end postal survey and an Area 2A phone survey. Participants from these surveys handled almost 58 million pounds of halibut, about 2/3 of the overall 1998 catch. The results confirmed low incidence of chalky fish in the commercial fishery; with occurrence of 0.4 and 0.9 percent in the U.S. and Canada, respectively. This compares to reported occurrences of 0.5 percent in U.S. and 1.0 percent in Canada in 1997. Chalkiness was again found in all areas for all months. Once again, the trend suggests a higher incidences of chalkiness in Area 2, and it is more commonly found in summer months. One concern expressed by some survey participants is that a proportion of the chalky fish goes unreported if not discovered until at the retail level (restaurants and markets). It is likely that even if the fish are handled carefully, there may always be some occurrence of chalky fish in the fishery.

The IPHC staff has no plans to continue investigations into chalky halibut at this time, as they feel continued surveys would produce similar results illustrating low incidence and would not produce any new information. If the industry wants to learn more about chalkiness, further investigations could be pursued, such as detailing the process by which the fish becomes chalky; possibly by identifying biochemical changes that occur in the flesh. Another avenue to investigate is to develop a simple and cost-effective procedure to identify chalky fish at the time the landing. Such a procedure could involve a test for pH levels in the flesh. Identifying chalky fish at unloading would prevent it from getting to the market place and would reduce loss to the buyer. The industry may want to consider collaborating with a university or fishery technology center on such projects.

HALIBUT ENFORCEMENT ISSUES

The IPHC and enforcement agencies are working to achieve the same goal of accurate catch statistics. For QS fisheries to be successful there needs to be an acceptable level of enforcement. At the beginning of 1998, the IPHC wrote letters to both the United States Coast Guard and NMFS Enforcement agencies in Washington D.C expressing its concern that the target level of enforcement is not being met in the QS halibut fisheries. One problem affecting NMFS Enforcement is the difficulty in recruiting and keeping positions filled. In 1998, 12 of 36 funded positions (33%) were vacant. The IPHC is concerned that there is no simple solution to keeping the enforcement presence at an acceptable level if new enforcement officers use these positions in Alaska as a starting point to their career. It is a concern when some of the busiest unloading ports, for example Homer, are understaffed. The 1998 enforcement coverage of landings was approximately 10% by weight. Even with full staffing it is questionable whether the goal of 20% can be reached.

In 1998, discussion about a weighmaster program (validation of offload weights) for the IFQ fishery continued. No decisions were made and the general industry opinion is that a weighmaster program should be considered after the complete compliment of NMFS officers are in place. The IPHC staff is still in favor of the weighmaster concept and its main concern is that accurate catch statistics are maintained in the future. The weighmaster concept will continue to be an issue at the NPFMC.

There has been some discussion by the Halibut Advisory Board of B.C. concerning more dockside enforcement presence. In British Columbia, offloads are validated and enforcement is notified if there are concerns. There is also a tagging program, in which fish are tagged with a unique number during the offload. Each fish can be tracked back to a specific vessel, assisting the fishery officers in enforcement. Fishery officers and the validating contractor are working on methods to obtain the data more readily.

Table 1. The 1998 removals of Pacific halibut by regulatory area in net weight (thousands of pounds).

Area	2A	2B	2C	3A	3B	4	Total
Commercial	464	13,139	10,228	25,874	11,346	9,150	70,201
Sport	383	657	1,869	5,407	23	61	8,400
Bycatch Mortality:							
Legal-sized fish	381	108	218	1,490	744	3,645	6,586
Sublegal-sized fish	233	135	143	1,362	730	3,915	6,518
Personal Use	15[1]	300	170	74	20	162	741
Wastage:							
Legal-sized fish	3	53	51	155	57	46	365
Sublegal-sized fish	4	378	180	580	290	176	1,608
Total	1,483	14,770	12,859	34,942	13,210	17,155	94,419

[1] Treaty Indian ceremonial fish authorized in the catch sharing plan.

Table 2. Fishing periods, number of fishing days, catch limit, commercial, research and total catch (thousands of pounds) by regulatory area for the 1998 Pacific halibut commercial fishery (preliminary).

AREA	FISHING PERIOD	NO. OF DAYS	CATCH LIMIT	COMMERCIAL CATCH	RESEARCH CATCH	TOTAL CATCH
2A treaty Indian	3/15 - 3/20[1]	6	272	297	-	297
2A Commercial Incidental	May – June	61		9.1	-	9.1
	Aug. – Oct.	92		4.3		4.3
			25.3[2]	13.4		13.4
Directed	7/22	10-hours		85.0	-	85.0
	8/12	10-hours		43.0		43.0
	8/26	10-hours		13.4		13.4
	9/23	10-hours		12.0		12.0
			143.6[3]	153.4		153.4
Total			168.9	166.8		166.8
2A Total			440.9	463.8		463.8
2B	3/15 - 11/15	245	13,000[4]	12,875	264	13,139[5]
2C	3/15 - 11/15	245	10,500[6]	9,711	517	10,228[7]
3A	3/15 - 11/15	245	26,000[6]	24,800	1,074	25,874
3B	3/15 - 11/15	245	11,000[6]	10,600	746	11,346
4A	3/15 - 11/15	245	3,500[6]	3,200	196	3,396
4B	3/15 - 11/15	245	3,500[6]	2,800	113	2,913
4C	3/15 - 11/15	245	1,590[6]	1,300	-	1,300
4D	3/15 - 11/15	245	1,590[6]	1,350	-	1,350
4E	3/15 - 11/15	245	320[6]	191	-	191
TOTAL			71,440.9	67,290.8	2,910	70,200.8

1 Different treaty Indian tribes closed on different days, from 3/15 to 3/20.

2 Pounds were carried over from the incidental to directed commercial catch limit.

3 Fishing period limits by vessel class.

4 An additional 33,000 pounds available as carryover from 1997.

5 Includes the pounds that were landed by Native communal commercial licenses (F licenses).

6 Additional net carryover pounds (000's) from the underage/overage program were 2C=216; 3A =393; 3B=84; 4A=43; 4B=51; 4C=13; 4D=4.

7 Includes 11,000 pounds taken by Metlakatla Indians during additional fishing within reservation waters.

Table 3. The fishing period limits (pounds, net weight) used in the 1998 directed commercial fishery in Area 2A.

VESSEL CLASS		FISHING PERIODS			
LTR	FT	7/22	8/12	8/26	9/23
A	0-25	250	200	200	200
B	26-30	315	230	200	200
C	31-35	505	370	200	235
D	36-40	1,390	1,202	465	650
E	42-45	1,495	1,095	500	695
F	46-50	1,790	1,310	595	835
G	51-55	1,995	1,465	665	930
H	56+	3,000	2,200	1,000	1,400

Table 4. The total pounds (thousands, net weight) of 1998 commercial landings (not including research or Metlakatla fishery) of Pacific halibut for Alaska and British Columbia by regulatory area and month (preliminary).

AREA	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	TOTAL
Area 2B	1,235	1,837	1,530	1,454	1,833	1,577	1,592	1,226	591	12,875
Area 2C	1,069	1,360	1,619	1,549	705	1,043	1,274	589	492	9,700
Area 3A	1,293	2,679	4,153	3,470	2,478	3,295	3,053	2,560	1,819	24,800
Area 3B	59	450	1,508	1,413	1,771	2,252	1,691	936	520	10,600
Area 4A	0	0	257	551	931	683	496	206	76	3,200
Area 4B	0	0	123	584	680	813	392	113	95	2,800
Area 4C	0	0	0	193	705	212	152	0	38	1,300
Area 4D	0	0	9	40	463	434	218	131	55	1,350
Area 4E	0	0	7	87	74	6	2	15	0	191
Alaskan Total	2,421	4,489	7,676	7,887	7,807	8,738	7,278	4,550	3,095	53,941
Grand Total	3,656	6,326	9,206	9,341	9,640	10,315	8,870	5,776	3,686	66,816

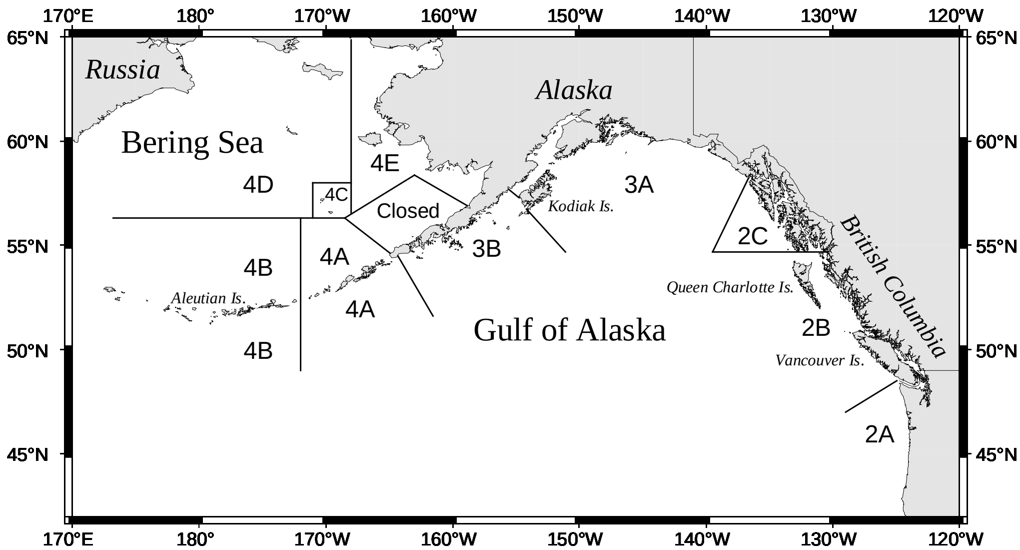

Figure 1. IPHC Regulatory Areas for the 1998 commercial halibut fishery.

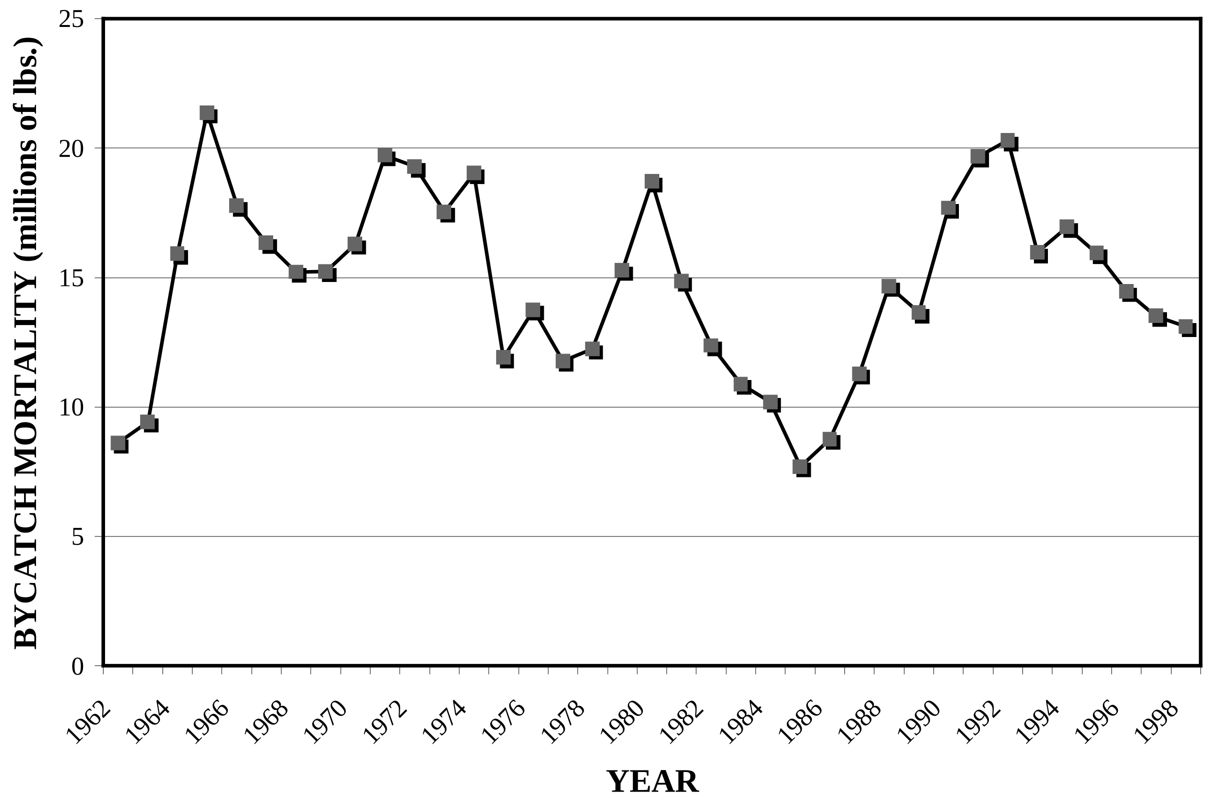

Figure 2. Pacific halibut bycatch mortality (millions of pounds, net weight) from 1962 through 1998.

Stock Assessment

by

William G. Clark and Ana M. Parma

ABSTRACT

The Pacific halibut assessment is based on fitting an age- and length-structured model to data from the fishery and IPHC setline surveys. The only major change in the model this year was a lowering of the working value of natural mortality from 0.20 to 0.15, which reduced the population estimates by about 30% in the eastern and central Gulf of Alaska (Areas 2 and 3A). Farther west (Areas 3B and 4), biomass is estimated by extrapolating the Area 3A estimate on the basis of setline survey results, and the decrease was only about 20% owing to an increase in the scaling factor resulting from the 1998 surveys. Total setline CEY (available yield at a harvest rate of 20%) is still estimated to be very high at just under 100 million pounds.

INTRODUCTION

Each year the IPHC staff assesses the abundance and potential yield of Pacific halibut using all available data from the commercial fishery and scientific surveys. Exploitable biomass in each IPHC regulatory area (except 3B and 4) is estimated by fitting a detailed population model to the data from that area. A biological target level for total removals is then calculated by applying a fixed harvest rate—presently 20%—to the estimate of exploitable biomass. This target level is called the "constant exploitation yield" or CEY for that area in the coming year. The corresponding target level for directed setline catches, called the setline CEY, is calculated by subtracting from the total CEY an estimate of all other removals—sport catches, bycatch of legal sized fish, wastage in the halibut fishery, and fish taken for personal use.

Staff recommendations for quotas in each area are based on the estimates of setline CEY but may be higher or lower depending on a number of statistical, biological, and policy considerations. Similarly, the Commission's final quota decisions are based on the staff's recommendations but may be higher or lower.

This paper summarizes the staff's estimates of total abundance, recruitment trends, exploitable biomass, and total and setline CEY by area as calculated at the end of 1998 for the 1999 fishery.

ASSESSMENT METHODS

From 1982 through 1994, stock size was estimated by fitting an age-structured model (CAGEAN) to commercial catch-at-age and catch-per effort data. In the early 1990's it became apparent that age-specific selectivity in the commercial fishery had shifted as a result of a decline in halibut growth rates, which was more dramatic in Alaska than in Canada. An age- and length-structured model was developed and implemented in 1995 that accounted for the change in growth.

It also incorporated survey (as well as commercial) catch-at-age and catch-per-effort data. The survey data contain much more information on younger fish, many of which are now smaller than the commercial size limit, and in Canada survey catch rates appear to provide a better index of relative abundance than commercial catch rates.

At first the model was fitted on the assumption that survey catchability and length-specific survey selectivity were constant, while commercial catchability and selectivity were allowed to vary over time (subject to some restraints). The resulting fits showed quite different length-specific survey selectivities in Area 2B and 3A, however, which suggested that age could still be influencing selectivity. To reflect that possibility, the new model has been fitted in two ways since 1996: by requiring constant length-specific survey selectivity (as in 1995), and by requiring constant age-specific survey selectivity. The age-specific fits generally produce lower estimates of recent recruitment and therefore present abundance, and to be conservative the staff has used those estimates to calculate CEY's.

Until 1997 the analytical model was used to estimate halibut abundance for the entire Commission area, including lightly fished regions in the western Gulf of Alaska (Area 3B) and the Bering Sea/Aleutians region (Area 4). Because there is no historical survey data series for western Alaska, the assessment relied entirely on commercial data for those areas. In 1997 the Commission first did setline surveys of the entire Commission area, and they showed substantially more halibut to be available in western Alaska (relative to other areas) than the analytical model had estimated. The reason for the discrepancy is almost certainly that the analytical model, when fitted to commercial data alone, only estimates the size of the *exploited population*, and in western Alaska fishing intensity is very low or nil over large areas, so a substantial part of the stock is effectively unexploited and therefore invisible to the model but not to the surveys.

In light of the survey results, analytical estimates of stock size in Areas 3B and 4 were suspended in 1997. The procedure now is to calculate analytical estimates for Areas 2A, 2B, 2C, and 3A, and then to scale those absolute estimates by survey estimates of relative abundance in Area 3B and 4 to obtain absolute estimates for the western areas. In 1997 the sum of the abundance estimates for Areas 2A through 3A was used as the reference point. This year the absolute estimate for Area 3A only is used as the reference point, on the grounds that survey catch rates there are more comparable to survey catch rates farther west.

LOWERING OF THE ESTIMATE OF NATURAL MORTALITY IN 1998

For many years the staff has used an estimated natural mortality rate $M = 0.20$, the midpoint of a wide range of estimates calculated by a variety of methods in the early 1960's. This estimate is very imprecise, and an examination of recent age compositions in Area 4B indicated a lower value in that area.

The natural mortality rate cannot be estimated very well by any means, but it has a number of important effects on both stock size estimates and harvest rate evaluations. During the year the staff conducted an analysis of the various effects of error in the estimate of natural mortality and concluded that an overestimate could in some circumstances lead to gross overestimates of stock size, while an underestimate is less hazardous. That finding, along with the indications that natural mortality is less than 0.20 in Area 4B, led the staff to adopt a working value of 0.15 for the model that is used to estimate stock size.

The optimum harvest rate is also affected by the value of natural mortality used in the harvest rate evaluations, but it is much less sensitive than the stock size estimates. The Commission's present target harvest rate of 20% is the bottom end of the range of 20%-30% recommended on the basis of the last harvest rate evaluation, done with $M = 0.20$. Repeating the analysis with $M = 0.15$ would probably lower the whole range by a percentage point or two, but 20% would still be near the low end and it is therefore still suitable for use in calculating estimates of setline CEY for 1999.

ANALYTICAL ASSESSMENT OF STOCK CONDITIONS IN 1998

This year's analytical estimates of stock conditions were obtained by fitting the model with constant age-specific survey selectivity to commercial and survey data from Area 2AB (2A and 2B combined, Fig. 1), 2C (Fig. 2) and 3A (Fig. 3).

All areas show the dramatic increase in recruitment (at age 8) in the mid-1980's that resulted from the climate change of 1976/77 (upper left panel), and the resulting buildup of stock biomass to the present high levels (upper right panel). The estimates show a small decrease in recruitment in Area 2 after the appearance of the very strong 1987 year-class in 1995. In Area 3A recruitment appears to have turned down in 1991, and the 1987 year-class appears much weaker than in Area 2. The last few years of recruitment estimates are uncertain in all areas, and the size of the decrease in 3A is particularly questionable. Recruitment may have peaked and declined, but it is too early to say.

In last year's assessment, the model fitted with constant length-specific survey selectivity showed no decrease in recruitment in Area 3A after 1990. In this year's assessment both kinds of fit show very similar recruitment trends in all areas, with the length-specific fit still showing higher estimated recruitment and abundance in the most recent years (Fig. 4).

The center panels of Figs. 1-3 show the fit of the model to survey and commercial catch rates in each area. The broad gray swath drawn through the survey points in the left panel shows the general trend of the survey data. The long-term changes in relative abundance are well defined by the trend of the data, but clearly there is a lot of random variation around the trend line so the year-to-year changes are not significant.

The left bottom panel shows how the average length of fish aged 8, 12, and 16 years has changed since 1974. The bottom right panel shows the same for net (headed and gutted) weight. These are estimated average values at each age for fish in the stock. The average values in the catch tend to be larger because of gear selectivity and, in the case of the commercial catch, the minimum size limit.

Eight-year-old fish show no difference in size among areas, but have decreased in average length by about 15% and in average weight be about 35% since the 1970's. In Area 2AB, 16-year-old fish show the same relative decrease in size at age as 8-year-olds. In Area 3A, however, 16-year-old fish decreased in average length by about 30% and in weight by 65%. Fish in Area 2C are intermediate. It appears that all areas have been equally affected by some factor or factors influencing juvenile growth, presumably in the nursery areas in western Alaska, while the more northerly areas have been particularly affected by some other factor or factors acting on fish older than 8 years.

EXPLOITABLE BIOMASS, TOTAL CEY, AND SETLINE CEY

Exploitable biomass is calculated by applying a commercial selectivity schedule to estimated abundance at each age. The total CEY is 20% of exploitable biomass, and the setline CEY available to the directed commercial fishery is the total CEY less other removals (sport catch, bycatch of legal-sized fish etc.).

Estimates of exploitable biomass in Areas 3B and 4 were calculated by multiplying the analytical estimate of exploitable biomass in Area 3A by the survey estimate of abundance in those areas relative to 3A, namely 87% for 3B, 29% for 4A, 22% for 4B, and 37% for 4CDE.

Setline CEY remains very high at almost 100 million pounds. This high level of abundance results from the long run of exceptionally high recruitment from 1977 at least through 1995 and an accumulation of biomass in western Alaska owing to low exploitation rates there.

The staff does not believe that total removals in excess of 100 million pounds per year are sustainable for long. The recent surveys have shown more fish in western Alaska than we previously estimated, and that has increased our estimate of long-term average production (total CEY) to perhaps 80 million pounds per year. With 15 million pounds of non-commercial removals per year, that corresponds to a setline CEY of about 65 million pounds per year as a long-term average.

Table 1. Estimates of exploitable biomass and CEY for 1999.

Area	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
1998 quota	0.82*	13.00	10.50	26.00	11.00	3.50	3.50	3.50	71.82
1999 exploitable biomass	5.36	61.64	64.00	159.00	138.33	46.11	34.98	58.83	568.25
Total CEY at 20%	1.07	12.33	12.80	31.80	27.67	9.22	7.00	11.77	113.65
Non-commercial removals:									
Sport catch	0.38*	0.66	1.87	5.41	0.02	0.06	0	0	8.40
Legal-sized bycatch	0.38	0.11	0.22	1.49	0.74	0.65	0.27	1.87	5.73
Wastage	0	0.05	0.05	0.16	0.06	0.03	0.02	0	0.37
Personal use	0	0.30	0.17	0.07	0.02	0.06	0	0.1	0.72
Total	0.38*	1.12	2.31	7.13	0.84	0.80	0.29	1.97	14.84
Setline CEY	0.69*	11.21	10.49	24.67	26.83	8.42	6.71	9.80	98.81

* In Area 2A only, the sport catch is controlled by quotas, so both the 1998 quota and the 1999 setline CEY include sport catch, while the total of non-commercial removals does not include sport catch.

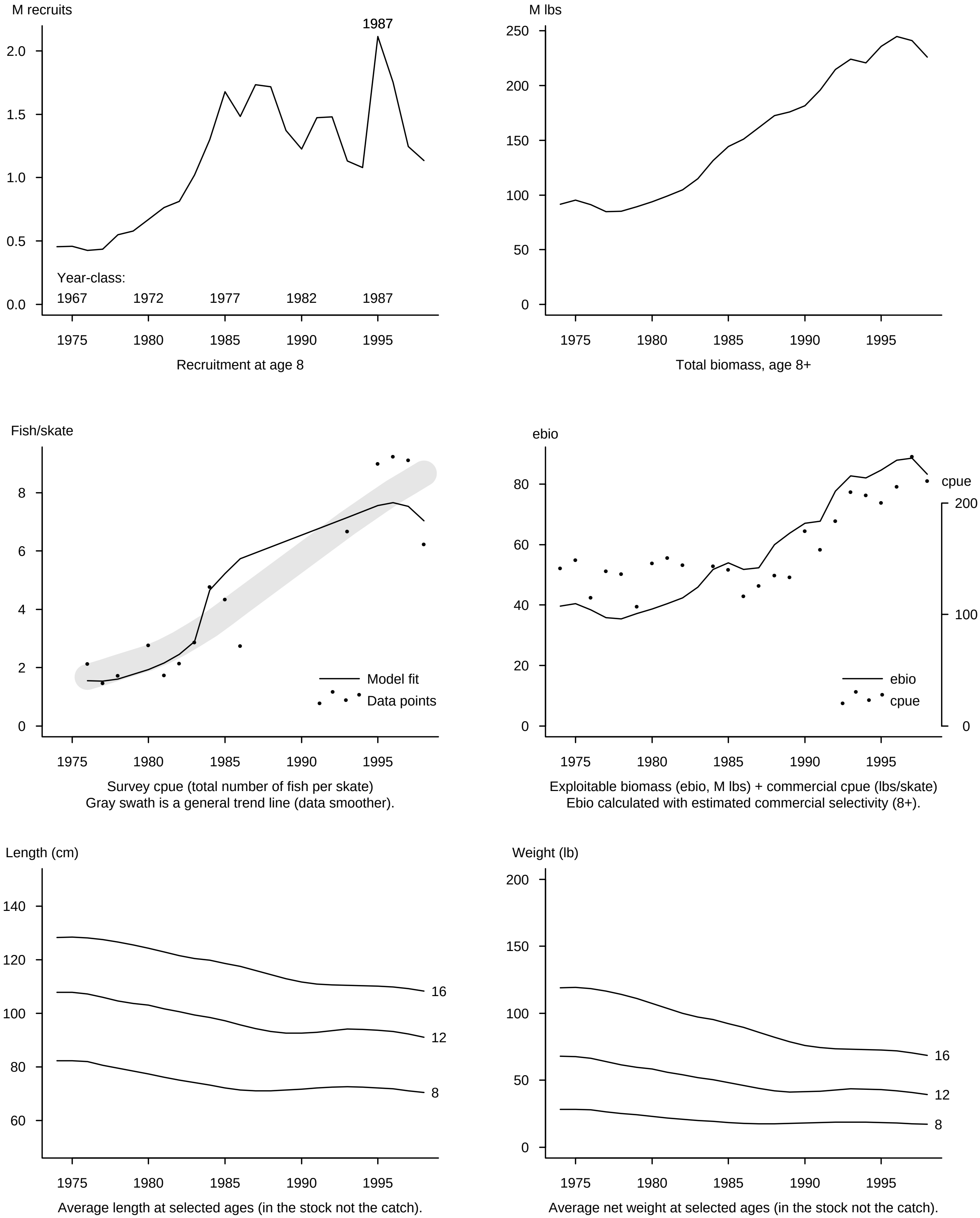

Figure 1. Features of the stock assessment for Area 2AB.

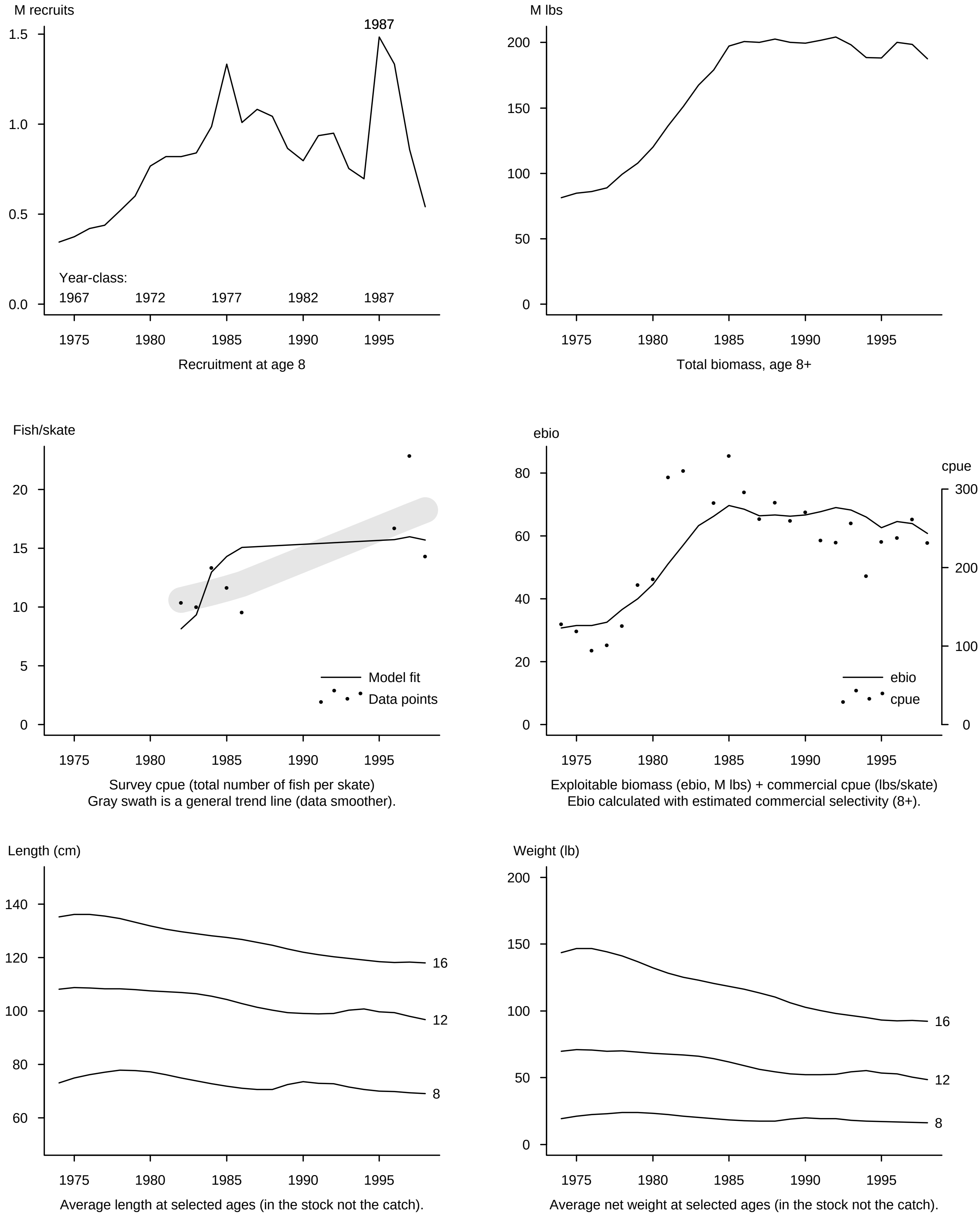

Figure 2. Features of the stock assessment for Area 2C.

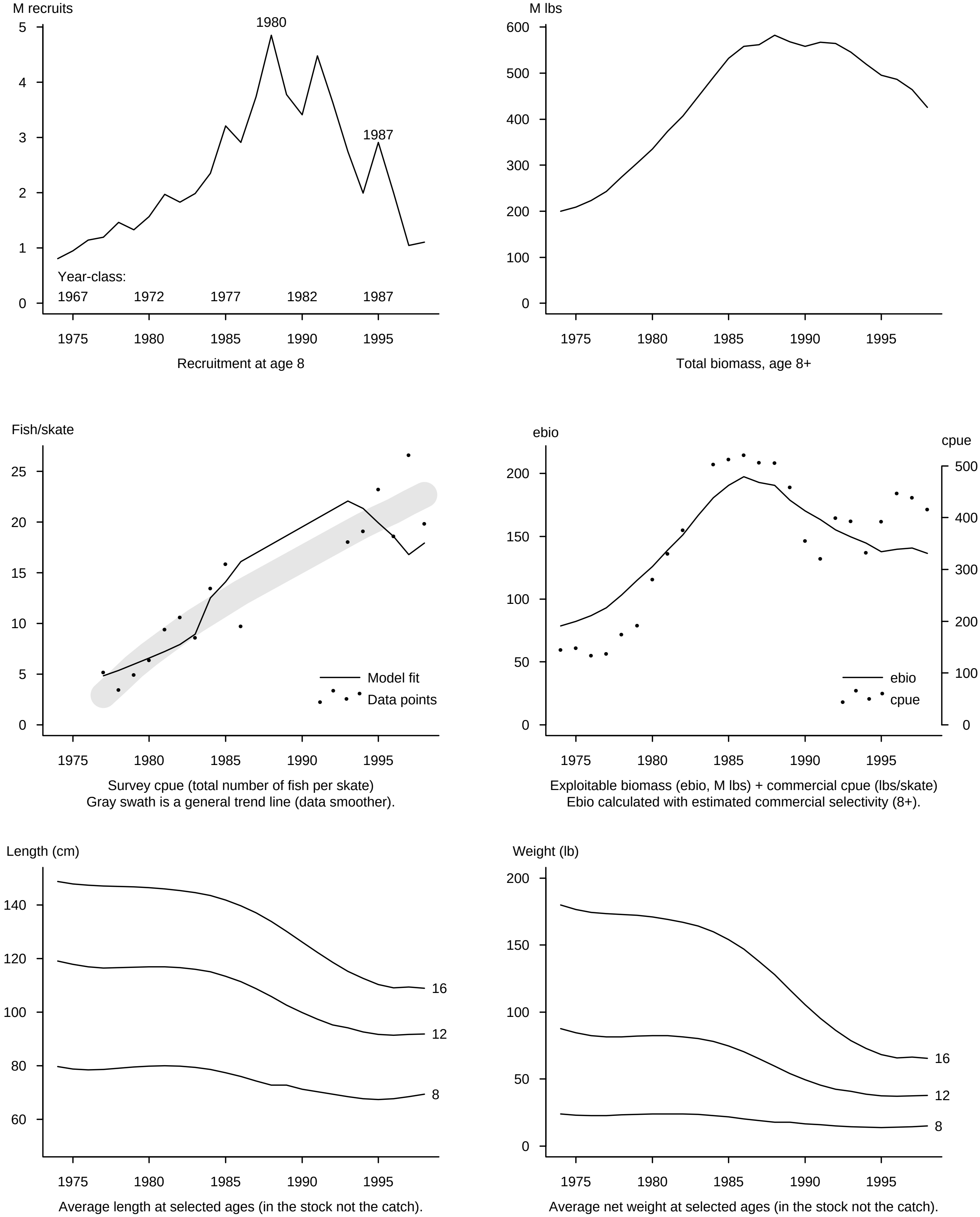

Figure 3. **Features of the stock assessment for Area 3A.**

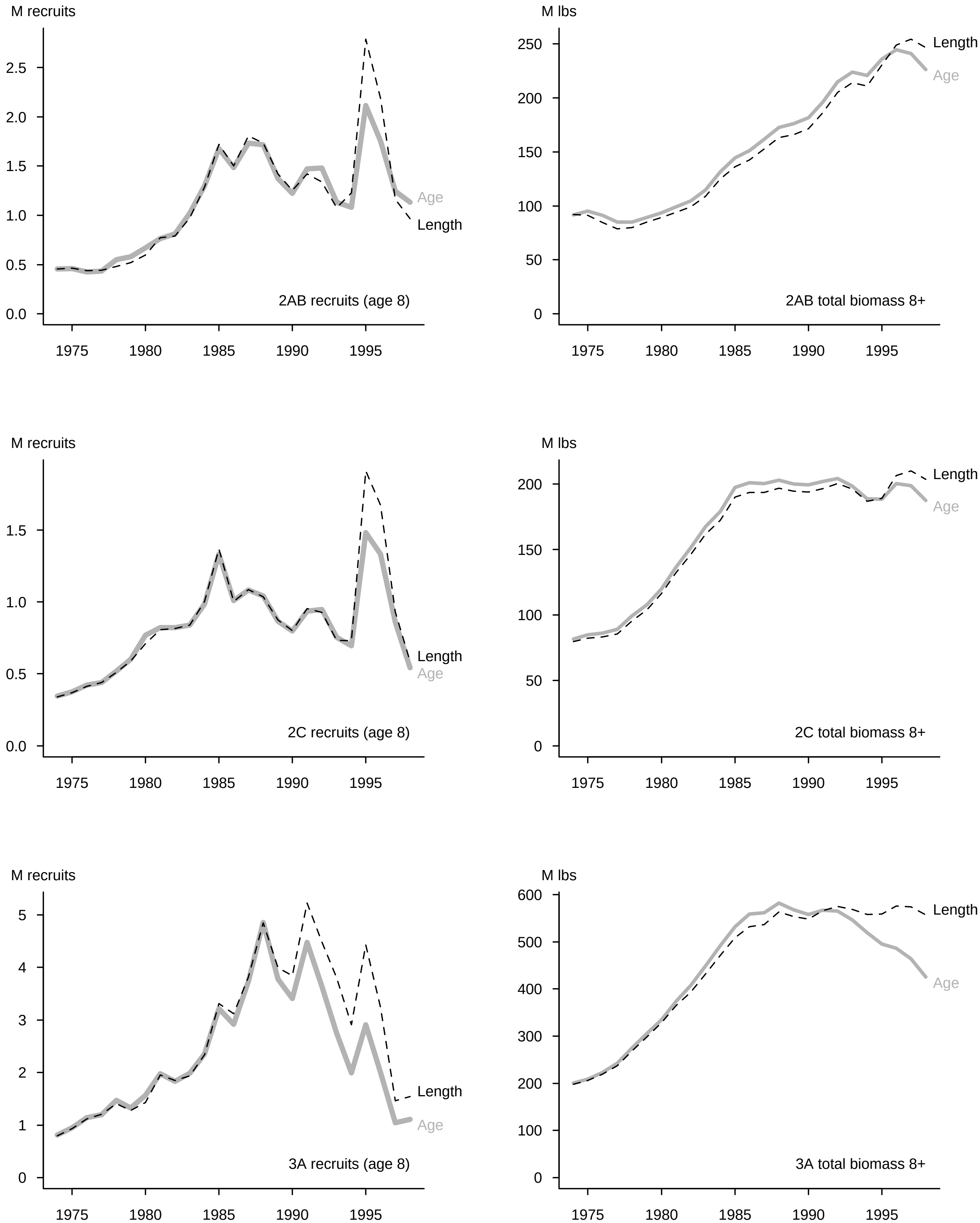

Figure 4. **Assessment results for age- and length-specific model fits.**

Effects of Imposing a Maximum Size Limit in Commercial Landings

by

Ana M. Parma

ABSTRACT

Limiting the size range of fish that can be harvested can protect the potential for renewal of a stock by creating a reproductive refuge that is independent of assessment uncertainties. The effects of different combinations of minimum and maximum size limits on expected yield and spawning biomass per recruit of Pacific halibut were evaluated using new estimates of growth, maturity and size selection by the fishery. The results show that the current minimum size limit of 32 in. (81 cm) is appropriate as the potential gains in yield derived from lowering it are small compared to the associated potential reproductive losses. Implementing a maximum commercial size limit of as low as 150 cm (about 80 lbs) does not appear to add substantial protection to the stock to justify a change in regulations. While large females can each spawn many more eggs than medium-sized females, their overall reproductive contribution is nevertheless small as not many females reach those large sizes under the current, reduced growth rates.

BACKGROUND

The harvesting strategy used for Pacific halibut consists of limiting the fraction of the exploitable biomass that is harvested each year and, in addition, controlling the size of harvested fish by imposing a minimum size limit of 32 in. on the commercial landings. Both components of the harvesting strategy - the harvest rate and the minimum size limit - were recently re-evaluated following the dramatic changes observed in the biology of halibut, as well as in recent abundance trends as estimated by the new assessment method. Harvest rates were adjusted down in part to compensate for the reduction in average lifetime reproductive contribution made by females under the current, reduced growth rates. The minimum size limit, on the other hand, was still found to be adequate in spite of the changes in life history parameters.

The 32 in. size limit was adopted in 1973 in order to increase yields when halibut growth rates were highest. Now that the growth rates have declined again, average yield per recruit could actually increase somewhat if the minimum size limit were lowered. As we discussed last year, however, potential increases in yield appear small compared to reproductive losses that would occur if the commercial selectivity shifted toward smaller fish in response to a drop in the size limit (Parma Unpub.). In other words, the current minimum size limit discourages the fleet from targeting smaller fish, reducing the possibility that too many fish are caught before they have a chance to reproduce. Along similar lines, it has been suggested that imposing a maximum size limit on the commercial landings might enhance the reproductive potential of the stock without jeopardizing yields. Because egg production is proportional to body weight, it appears *a priori* that protecting large females by carefully releasing them when caught might create a significant reproductive refuge, thus resulting in a more robust harvesting policy. Such a refuge could be an insurance against potential pitfalls in the assessment and failures to maintain harvest rates within desired sustainable levels. Below, we compare the effects of implementing different combinations of maximum and minimum size limits on potential yields and spawning biomass per recruit, to evaluate whether a change in size limit regulations may be advantageous.

EFFECTS OF MAXIMUM AND MINIMUM SIZE LIMITS ON YIELD AND SPAWNING BIOMASS PER RECRUIT

Yield and spawning biomass per recruit for Areas 2B and 3A were calculated for the current size limit (81 cm) and for a size limit of 60 cm, with and without the addition of a maximum size limit of 150 cm. The evaluation of the minimum size limit presented last year was based on a working value of natural mortality (M) equal to 0.20. While results discussed here correspond to a value of M= 0.15, conclusions were found to be robust to the choice of M values between 0.10 to 0.20.

Growth and selectivity schedules were estimated using data from the IPHC setlines surveys and from the commercial fishery for the period 1974-1997. The sex of halibut caught during setline surveys has been regularly determined and so separate growth schedules for males and females could be estimated based on those data, as shown in Fig. 1. As is the case in the stock assessment model, there is uncertainty about how to best model selectivity in the face of the substantial changes in size-at-age exhibited by Pacific halibut. Because the model used here is sex-specific, and males and females of a given age differ in size, selectivity was modeled as a function of both age and size. The idea behind this combined model is that availability of fish on the grounds would be a function of fish age, affecting the selectivity of both the survey and the commercial fishery. Vulnerability to the setline gear and targeting by the commercial fleet, on the other hand, would be mostly functions of fish size, which would differ for the survey and commercial operations. Age- and size-dependent components of the selectivities were assumed to be the same for males and females. As females grow faster, they tend to become selected when they are younger than males, and they make up the bulk of the catch in weight.

New maturity schedules were estimated from recent survey data (1995-1997) and contrasted with those observed in the 1980s (Fig. 2). The length at which 50% of females have reached maturity has decreased dramatically from 125 cm to 89 cm in Area 3A, and from 110 cm to 98 cm in Area 2B. The maturity schedules at age have been relatively more stable during this period, with age at 50% maturity remaining at 11-12 in both areas. While in Area 3A females reach sexual maturity at about the same age as they become selected to the commercial fishery, in Area 2B females become vulnerable to the fishery long before they start to reproduce (Fig. 3). Thus, under current selectivity and maturity schedules, the ability to control the harvest fraction is essential for successful reproduction.

A difficulty in evaluating yields for various size limits is that it is not at all clear how commercial selectivity might respond to a possible reduction in the minimum size limit. For example, fishing grounds that were abandoned when the 32 in. size limit was imposed due to high densities of fish smaller than the legal sized may be fished again. Due to this uncertainty, two alternative assumptions were made regarding the commercial selectivity schedule (Fig. 4). In the first, selectivity remained constant at the values estimated for 1997 in spite of changes in the size limit regulations. In the second, a drop in the minimum size limit resulted in a shift of the size selectivity towards smaller fish sizes. Only the size-dependent component of the selectivity was assumed to change in response to a drop in size limit; the age-dependent parameters were assumed to be fixed. The effect of imposing a maximum size limit of 150 cm, and either maintaining the current minimum size limit of 81 cm or reducing it to 60 cm, was evaluated under these two selectivity assumptions.

The estimated selectivities in Areas 2B and 3A indicate that, under current regulations, few fish smaller than 80 cm seem to be caught at present (Fig. 4). As a result, yield per recruit and spawning biomass per recruit were little affected by the choice of minimum size limit when the commercial selectivity was assumed to remain fixed at currently estimated values (Figs. 5 and 6). Gains in yield per recruit were somewhat larger in both areas when selectivity was assumed to shift towards smaller sizes in response to a drop in the size limit (Figs. 5 and 6, thin dashed lines). Yield increases were however not without costs: dropping the legal size resulted in major reductions in spawning biomass per recruit when the drop was followed by a shift in commercial selectivity towards smaller fish sizes. The addition of a maximum size limit did not result in significant reproductive gains in either of the cases. Trade-offs are summarized in Figure 7 for a 20% harvest rate. Increases in spawning biomass per recruit derived from protecting the large females were small (less than 5%) as only a small number of females survive to a size of 150 cm. This percentage would be even smaller if realized harvest rates were unintentionally allowed to exceed the target due to errors in the assessment. Thus, the implementation of a maximum size limit would not be an effective safeguard against recruitment overfishing in the case of severe overestimation of stock biomass. These results indicate that the current size limit regulations continue to be adequate, and that implementing a maximum size limit would not result in significant reproductive savings under the current growth schedules.

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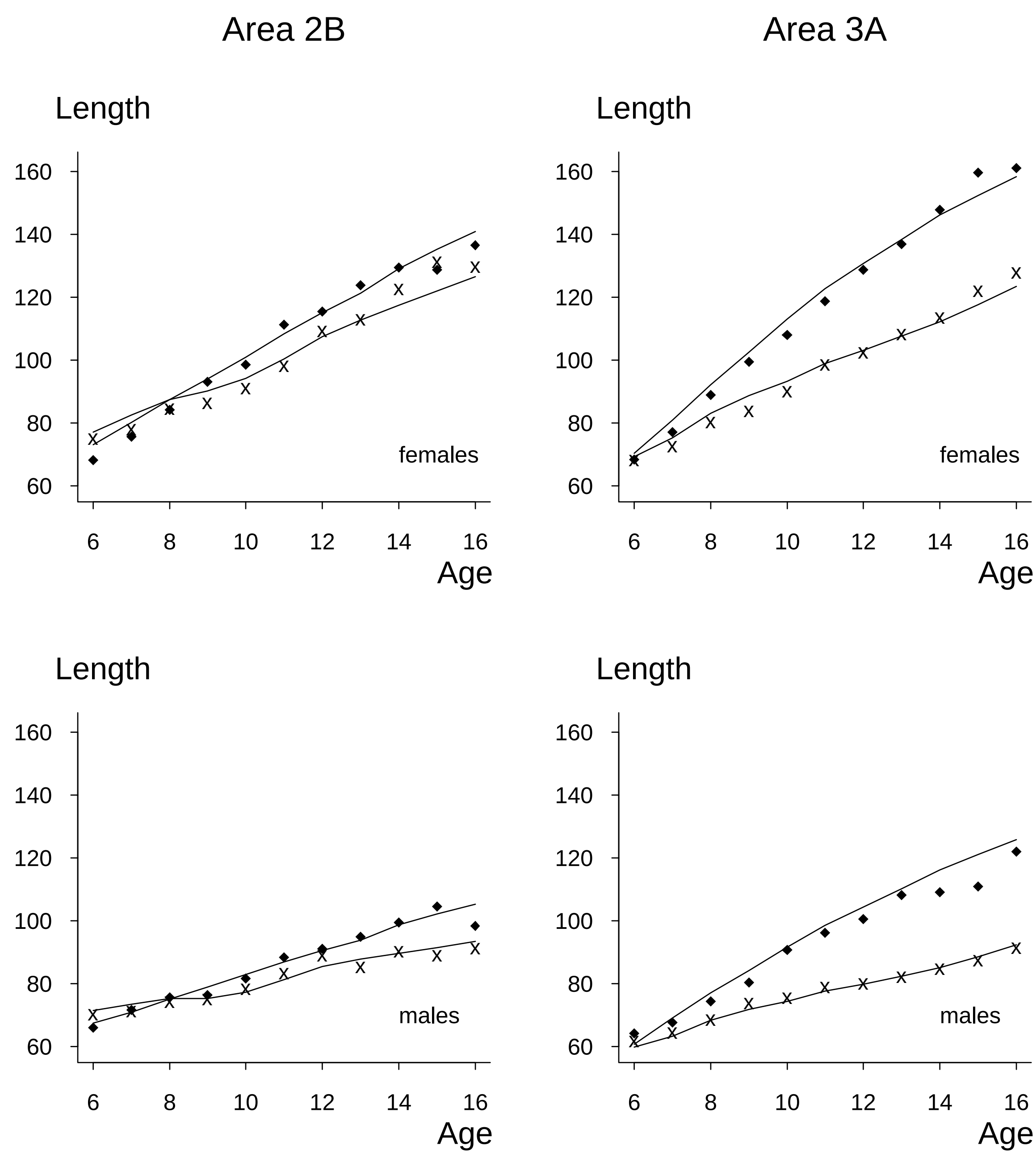


Figure 1. Observed and predicted growth schedules for 1986 (dots) and 1997 (crosses) in Areas 2B and 3A.

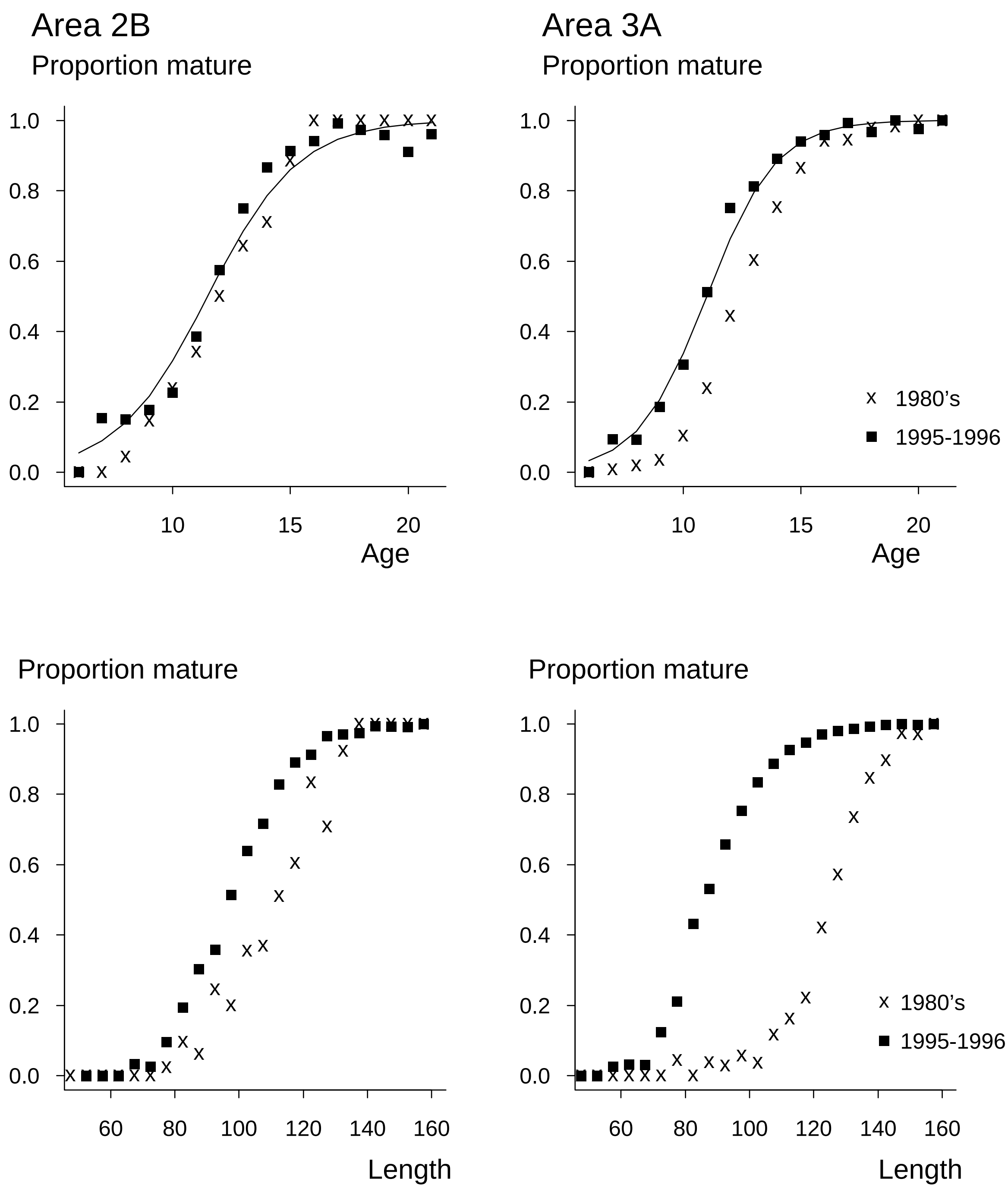


Figure 2. **Female maturity schedules in Areas 2B and 3A. Solid line is a model fitted to data from 1995-1997.**

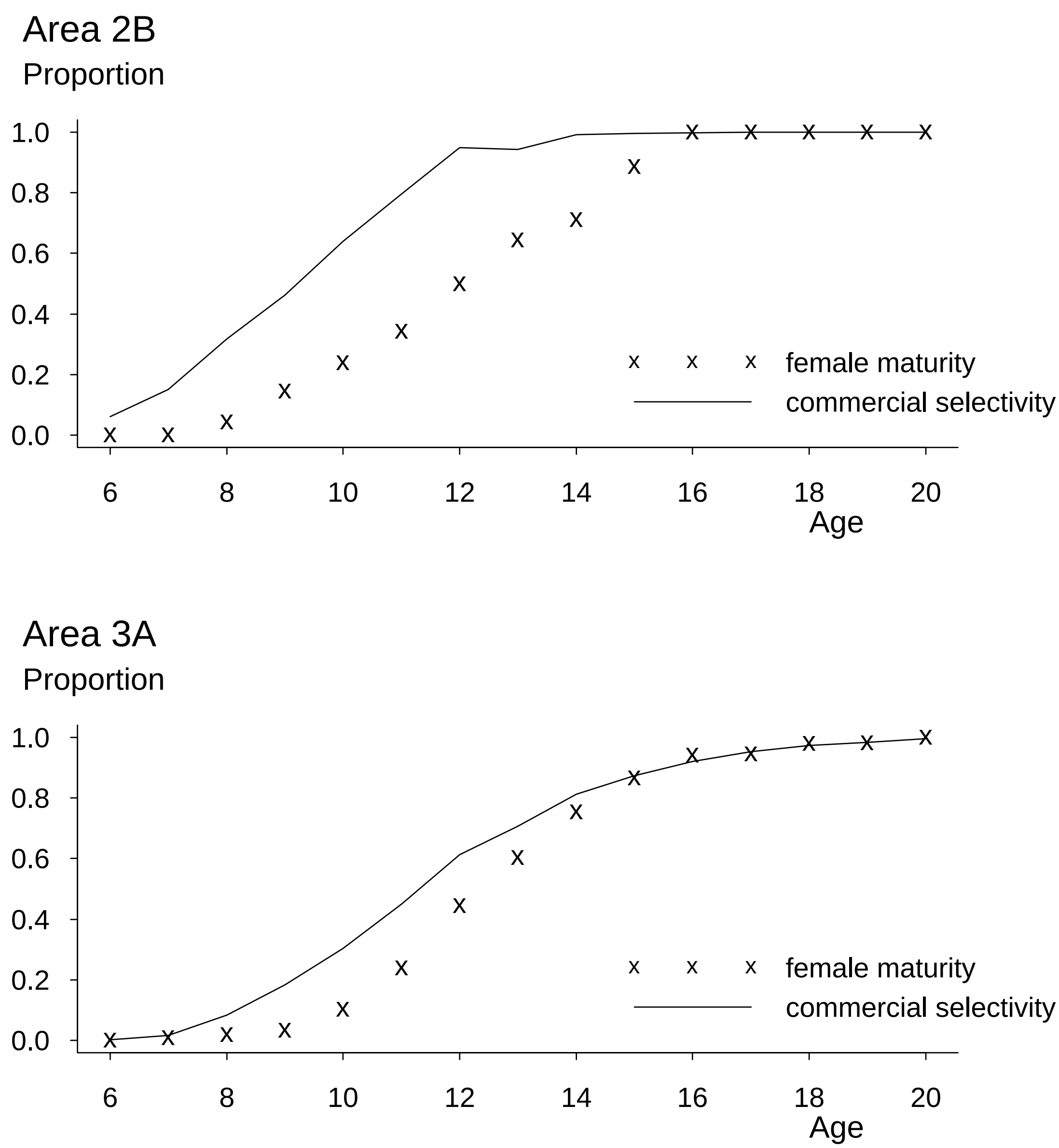
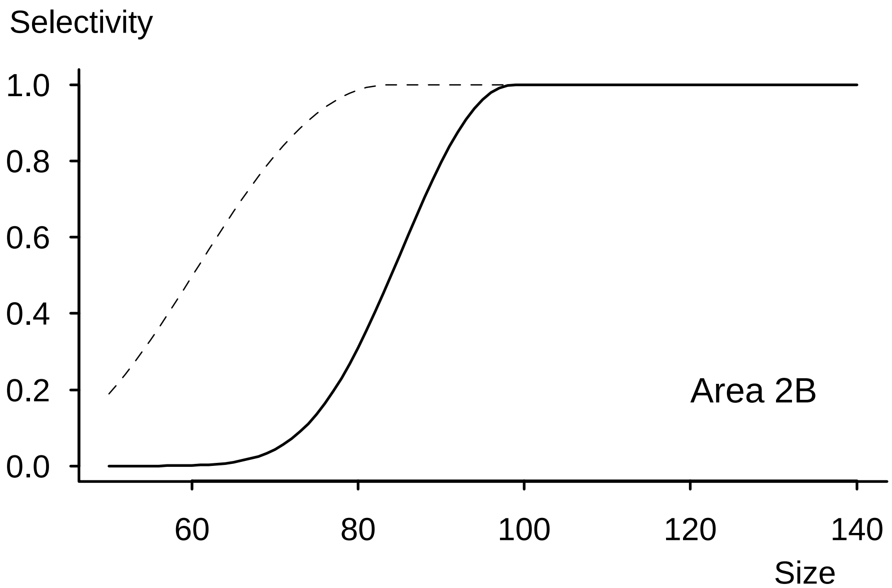


Figure 3. **Female maturity by schedule (average for 1995-1997) and commercial selectivity of females in Areas 2B and 3A.**



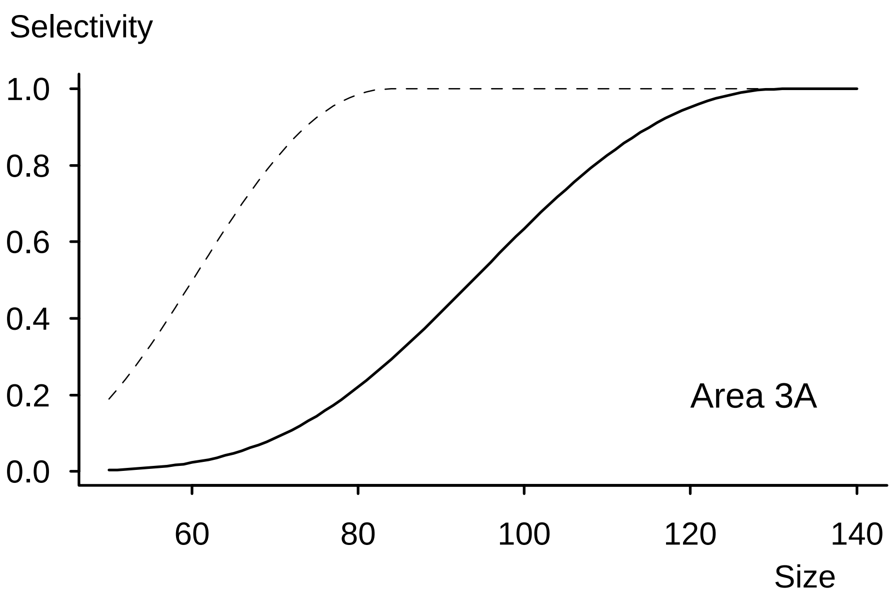


Figure 4. **Two alternative assumptions about setline selectivity were used to compute yield per recruit and spawning biomass per recruit (1) selectivity remains fixed at the values estimated for 1997 (solid lines) or (2) selectivity shifts to smaller fish sizes (dashed lines).**

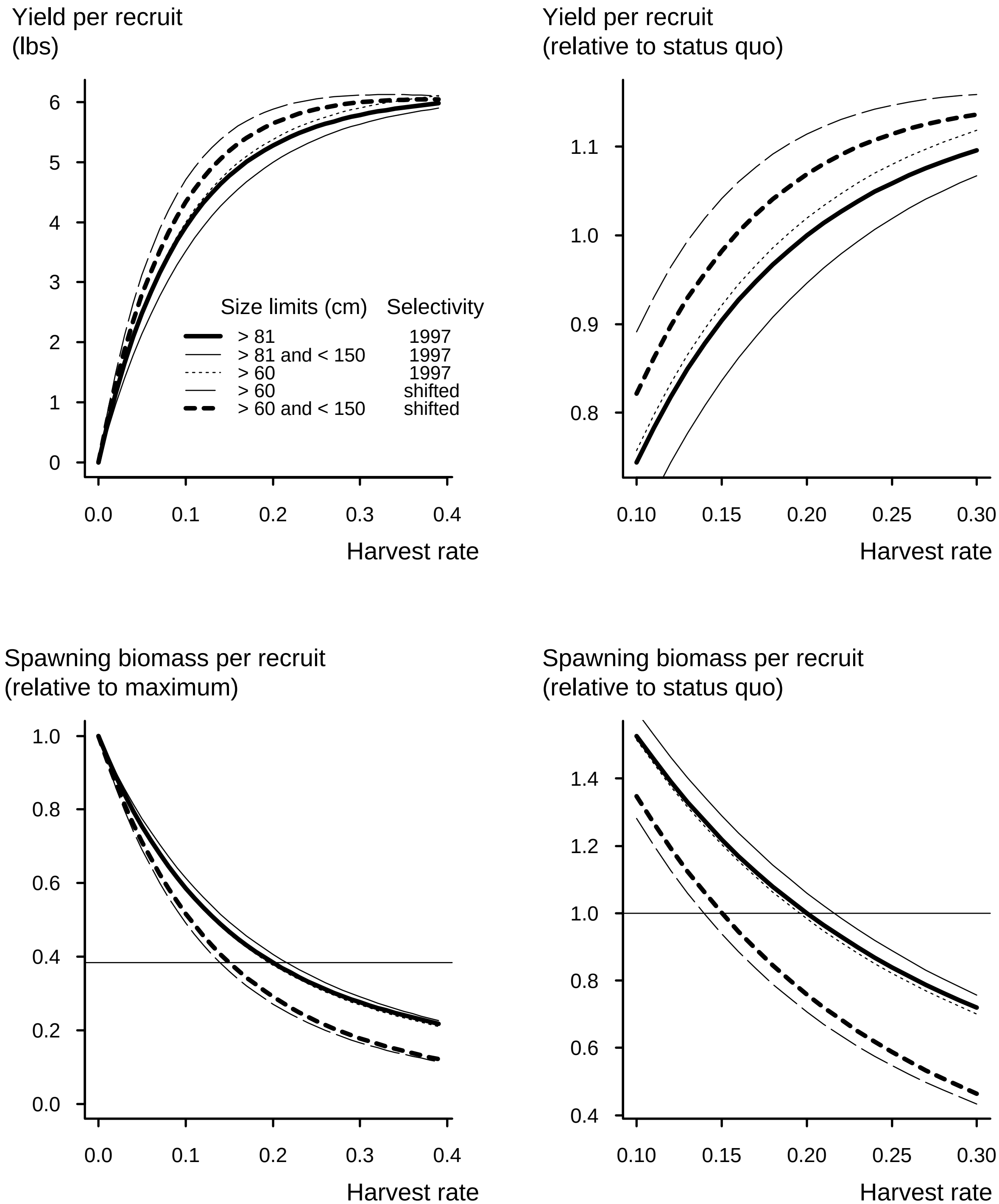


Figure 5. **Area 3A female + male yield per recruit and spawning biomass per recruit. Thick solid lines show status quo (minimum size limit = 81 cm and selectivity as estimated for 1997) other lines indicate the effect of different combinations of minimum and maximum size limits when selectivity is as estimated for 1997 and when it shifts left in response to a drop in the size limit.**

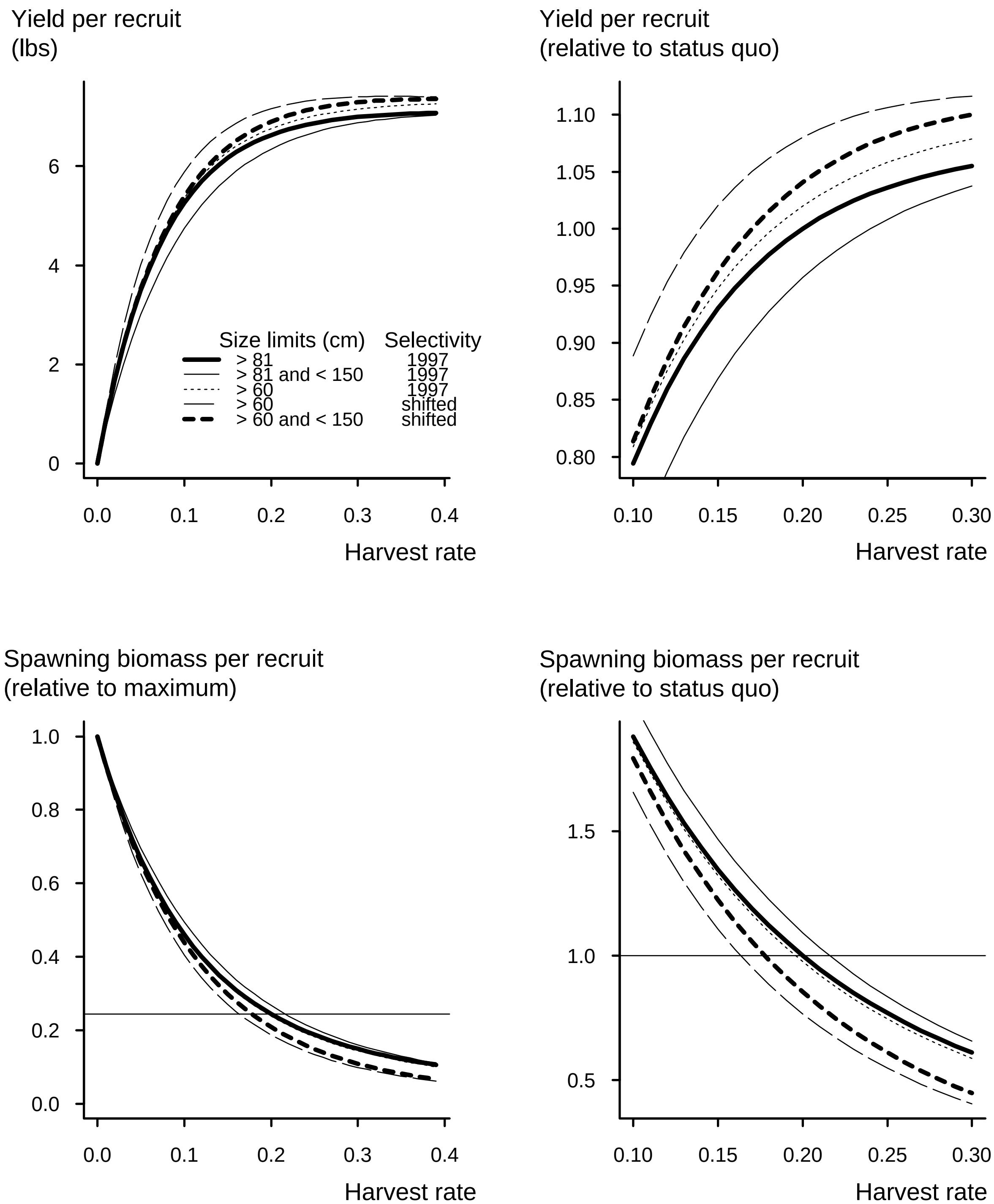


Figure 6. **Area 2B female + male yield per recruit and spawning biomass per recruit. Thick solid lines show status quo (minimum size limit = 81 cm and selectivity as estimated for 1997) other lines indicate the effect of different combinations of minimum and maximum size limits when selectivity is as estimated for 1997 and when it shifts left in response to a drop in the size limit.**

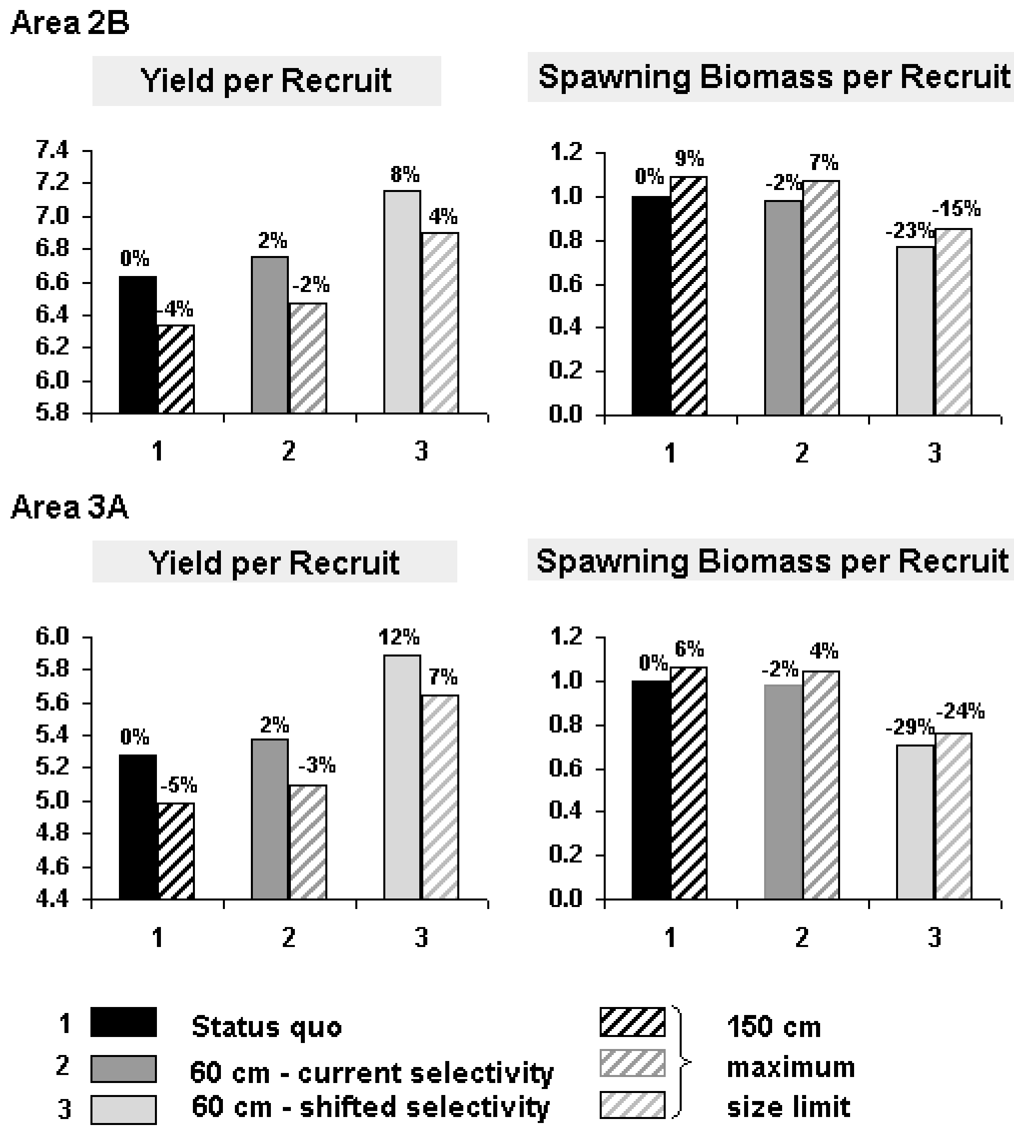


Figure 7. Yield per recruit and spawning biomass per recruit for Areas 2B and 3A computed under (1) status quo (i.e. minimum size limit = 81 cm, setline selectivity as in 1997 and harvest rate = 0.20), (2) minimum size limit = 60 cm and selectivity fixed at the 1997 value, and (3) minimum size limit = 60 cm and selectivity shifted to smaller sizes. Columns show the effects of adding a maximum size limit = 150 cm.

Staff Regulatory Proposals: 1999

by

Bruce M. Leaman

CATCH LIMIT RECOMMENDATIONS

The presentation of staff recommendations for 1999 follows a format similar to that used in 1998. For 1999, we again present estimated exploitable biomass using two different assumptions about the selectivity for fish in the standardized setline surveys. However, we undertake constant exploitation yield (CEY) estimation only for the results obtained with the age-specific assumption. This is the same basis used for 1998 yield estimation. We also present the yields estimated from the 1998 assessment and the quota adopted by the Commission in 1998, for reference (Tables 1 and 2).

The first assumption is that the selection of the fish by the survey is based primarily on the size of the fish, because fish of different sizes are not equally vulnerable to the survey gear. For example, the fish might have to be of a certain minimum size to bite the size of hooks used in the fishery. Under this assumption, selectivity at length is held constant throughout the period of the assessment, even when growth rates change. The second assumption is that selectivity of fish by the survey gear is based primarily on the age of the fish and reflects the availability of fish of different ages on the grounds. For example, if recruitment were governed by the time halibut took to migrate to the fishing grounds, irrespective of size, then selectivity would be determined by age, rather than size. Under this assumption, it is the selectivity at age that is held constant over time. Both of these assumptions are plausible although neither may fully reflect the true underlying relationships.

For 1999, the analytic assessment model contains only one significant change from that presented last year. The IPHC has used an estimated rate of natural mortality of M=0.20 for some time. This value was an average of a wide range of estimates and some previous IPHC studies have employed estimates other than 0.2. New data with which to evaluate M are unlikely to be generated through any technique currently available.

An analysis conducted by staff during 1998 indicated that the consequences of mis-estimation of M are not symmetric. Using an overestimate of M in the estimation of biomass increases the risk of over-harvest far more than using an underestimate of M would risk an under-harvest. The staff reviewed available evidence in consideration of these results and adopted a revised value of M=0.15, a 25% reduction from the previous value. This analysis also concluded that the harvest rate policy used by the IPHC (CEY equal to 20% of exploitable biomass) does not require adjustment in consideration of a different natural mortality rate.

Estimates from the assessment model continue to indicate a substantial biomass of halibut although there are some reductions in the estimates for the central and southern portions of the range. Exploitable biomass estimates that assume survey selectivity is a function of length are about 9-14% larger than those that assume selectivity is based on age.

Commercial CPUE decreased from 5-11% during 1998 for Areas 2A-3A but increased by a similar amount in Areas 3B and 4. Survey CPUE estimates declined more and increased less for the same areas. Recruitment of halibut in recent years has declined from the peak seen in 1995, when the 1987 year class began recruiting to the fishery. The abundance of age 8 recruits (the age at which halibut generally approach minimum legal size) has returned to mid-1970s levels in Area 3A but is higher and similar to the early 1980s period in Area 2B. In both areas the fishery will continue to be dominated by the 1987 cohort over the next several years. Exploitable biomass is expected to decline over the next 3-5 years as this year class passes out of the exploitable stock.

In summary, the analytic assessment, the standardized surveys, and the commercial fishery all indicate that the exploitable biomass remains at a relatively high level but that it has declined slightly in the central and southern portions of the halibut range. The major changes in the estimates of exploitable biomass for 1999 derive from the change in the estimate of natural mortality, rather than from stock condition indices. In developing catch limit recommendations based on these findings, the staff was also guided by consideration of other issues about the dynamics of the halibut stock and the need for a precautionary approach to management. The following items, some of which were expressed in previous recommendations, are of concern.

1. The present levels of halibut biomass and the associated setline yields are likely not sustainable. Halibut stocks are at a high level because recent exploitation rates have been low and a strong year class has recruited to the exploitable stock. The stock biomass is expected to decline, as a result of natural fluctuations in recruitment. This decline is expected to occur over the next 3-5 years and may lead to lower estimates of available yield.

2. Staff is concerned that the level of total removals suggested by the assessment is near the historic high from the history of the stock. Staff uses a harvest policy that aims to minimize the probability that the stock biomass will decrease below the historic minimum level, largely because we do not know the dynamics of the stock below this level. Similarly, we have limited experience with removals from the stock at present high levels and we wish to exercise caution.

3. Areas 4 and 3B have limited or no history of standardized surveys and/or commercial catch sampling sufficient for a detailed analytic assessment. We therefore use the relative abundance from standardized stock assessment surveys as an index of biomass distribution. Variability in these survey estimates within a year is low (5-10% coefficient of variation (CV) in mean catch rate) but among-year variation can be substantially higher (30-40% CV). This latter variation is of greatest significance for those areas where the yield recommendations are based on survey partitioning, i.e. Areas 3B and 4. We are particularly concerned about the estimation of yield for Area 4, where the biomass is widely distributed at low densities but the fishery is concentrated in small areas of high density.

4. The observed distribution of fish during 1998 surveys may reflect a broad-scale shift in fish distribution in response to environmental features. We note that distributions of some other marine species (e.g. hake and sardine) were shifted notably northward during the summer of 1998 and may have been associated with environmental forcing. We do not know whether this has occurred for halibut but the influence of survey and fishery catch rates on yield estimation suggests caution.

5. Uncertainty concerning the appropriate assumption for the selectivity of the surveys, either age-specific or length-specific, remains. Resolution of this uncertainty may not be possible within the near future and it is possible that the correct assumption may embody elements of both age and size specificity. We choose to focus our attention on the age-specific results because they are the most conservative basis for yield recommendations.

Staff catch limit recommendations in 1998 incorporated a cautious approach to the increased yields suggested by the revised analytic model. We recognize the sensitivity of estimates from the model-based assessment to changes in parameters. We would like to avoid large shifts in yield recommendations while we conduct additional evaluations of model structure and assumptions. Due to the lifespan and slow recruitment of halibut, a large proportion of yield forgone in one year can be recovered in subsequent years if underharvesting has occurred. For this reason, staff will continue to exercise caution and recommend slow increases in catch limits when biomass estimates increase, but more rapid decreases in catch limits when biomass estimates decrease (a "slow up – quick down" response).

The analytic assessment model has been used to calculate exploitable biomass for Areas 2A-3A. For 1999, we have incorporated an additional change in the model (lower M) that reduces the estimates of exploitable biomass for these areas. The range in estimated exploitable biomass for areas 2A-3A is 290-326 Mlb for the two selectivity assumptions. Our framework for catch limit recommendations in Areas 2A-3A is to adopt the most conservative of the two estimates from the analytic assessment. This results in recommended catch limits that are lower than the 1998 quotas by 14-20% in Areas 2A and 2B, marginally greater in Area 2C, and lower by 6.5% in Area 3A (Tables 1 and 2).

For Areas 3B and 4A/B, we use a modified procedure that was first introduced in 1998. For 1998, the procedure scaled the estimates of exploitable biomass and setline CEY in Areas 2A-3A (the reference area), by the relationship between estimated survey biomass in either Areas 3B or 4A/B to that in Areas 2A-3A. For 1999, we use Area 3A as the reference area because this area is the centre of stock distribution, has a diverse base of data for assessment, and is closer to the areas of application for the procedure. While the relationship of estimated survey and model abundance should not change among areas, the proximity of Areas 3A, 3B, and 4A/B should result in the greatest coherence of underlying dynamics in the reference and application areas.

The estimates of exploitable biomass in Areas 3B and 4 generated using this modified procedure (Table 3) and the CEY associated with these estimates are similar to those generated in 1998 (Tables 1 and 2). This occurred because the decrease in estimated biomass, associated with a lower natural mortality rate, was offset by higher CPUE values for the surveys in these areas.

In 1998 we recommended increasing yields by 33% of the difference between the 1997 catch limits and the estimated setline CEYs from the assessment. Estimated 1999 setline CEYs for Areas 3B and 4A/B are similar to those estimated in 1998. For 1999, we continue to advocate a cautious approach to harvests from these areas. Standardized surveys covered less of Area 4 in 1998 than 1997 and their application is therefore less comprehensive. In addition, commercial fishery data from Area 3B continue to indicate much higher levels of fishing in the eastern portions of the area. Staff has concerns about the long-term effects of localized harvest of the majority of the quota from this smaller area. Accordingly, the yield recommendations for Areas 3B and 4A/B are increased by 15% of the difference between 1998 quotas and the estimated 1999 CEY using the age-specific survey selectivity assumption (Tables 1-3).

Lastly, we required a specific procedure to provide a recommendation for Area 4C/D/E. The fishery in this area is largely concentrated on the edge of the continental shelf, but the exploitable biomass is widely distributed at low density across the entire Bering Sea shelf. If this entire shelf area were to be fully included in catch limits, then the estimated setline CEY would be approximately 9.80 Mlb. We believe that some of this biomass eventually mixes across the 'edge' and is not separately vulnerable to a fishery on the shelf. However, a great deal of uncertainty about the spatial dynamics of halibut on the Bering Sea shelf and edge remains. We therefore consider that even greater caution should be applied to the Area 4C/D/E quota than for those in Areas 3B and 4A/B. Staff recognizes that yield should be increased over that which would be calculated solely from consideration of the 'edge' area but are adopting a more conservative policy for this area. We recommend adding only ten percent of the difference between the 1998 catch limit and the 1999 estimated age-specific CEY value to the previous quota of 3.5 Mlb, leading to our recommended catch limit of 4.1 Mlb.

FISHING PERIODS

Individual quota fisheries will be in effect for all areas except Area 2A. The staff continues to favour a winter closure to reduce the interception of fish that move between regulatory areas during spawning migrations, but will not object to the March 15 to November 15 season that was in place during 1998.

In Area 2A, the staff recommends fishing periods similar to those in effect in 1998: a series of 10-hour periods, with fishing period limits to ensure that the catch quota is not exceeded. The size of the fishing period limit will be determined when more information on fleet participation becomes available.

The Commission does not make allocative decisions within regulatory areas. However, for Areas 2A and 4CDE the staff has recommended in the past that the Commission endorse the catch sharing plans developed by the Pacific and the North Pacific Fishery Management Councils for these areas, respectively.

MISCELLANEOUS RECOMMENDATIONS

Proposed Changes to the IPHC regulations

The staff recommends defining offloading to include the option of washing and heading of halibut prior to weighing, when relating to U.S. commercial landings. The regulations currently identify the need for a scale weight obtained at the time of offloading. The original intent and emphasis was for the offload weight to be a *scale* weight, not a *calculated* weight, because standard deductions were not in effect at the time. The scale weight of washed and headed fish (i.e. washing lines) is an acceptable form of offload weight, provided that the fish can be accurately tracked from the boat to the weighing point. Currently, the regulation is being interpreted differently at different plants and the goal for changing the regulation is to identify the acceptable forms of scale weight and promote consistency.

The staff recommends that all three acceptable measures for careful release of halibut occur outboard of the roller or rail. Currently, IPHC regulations only require hook straightening to occur outboard of the roller, and do not specify where cutting of the gangion or twisting of the hook with a gaff are to occur. NMFS regulations require careful release to occur outboard of the rail. We therefore recommend the change so that IPHC and NMFS regulations are consistent. It would also promote conservation as halibut that are to be returned to the sea would not be allowed to sit on the deck of a vessel.

In 1998 the Commission approved a regulation allowing the Community Development Quota (CDQ) fishers in Area 4E to retain halibut smaller than legal size for personal use, in 1998 and 1999. The program will be reviewed in 1999 when the regulation expires. Staff believes that data must be collected to provide a basis for review of the program. Therefore we propose an addition to the regulations governing this fishery that will require the CDQ groups of Area 4E to provide IPHC with information on the amount of halibut caught which are smaller than the size limit. Documentation on how this catch information was calculated should also be provided.

Table 1.

Pacific Halibut 1999 Yield Estimation (M = 0.15)

Areas 3B and 4 Based on Survey Partitioning Relative to Area 3A

Area	2A+2B	2A	2B	2C	3A	3A Biomass	3B	4A	4B	4CDE Total	Grand Total
1998 quota		*0.82*	*13.00*	*10.50*	*26.00*		*11.00*	*3.50*	*3.50*	*3.50*	*71.82*
Age-specific estimates											
1999 exploitable biomass	67.00	5.36	61.64	64.00	159.00	159.00	138.33	46.11	34.98	58.83	568.25
Total CEY at 20%		1.07	12.33	12.80	31.80		27.67	9.22	7.00	11.77	113.65
Non-commercial removals		0.38	1.12	2.31	7.13		0.84	0.80	0.29	1.97	14.42
Age-Specific Setline CEY		**0.69**	**11.21**	**10.49**	**24.67**		**26.83**	**8.42**	**6.71**	**9.80**	**98.82**
Length-specific estimates											
1999 exploitable biomass	86.00	6.88	79.12	67.00	173.00	173.00	150.51	50.17	38.06	64.01	628.75
STAFF 1999 YIELD RECOMMENDATIONS		***0.69****	***11.21***	***10.49***	***24.67***		***13.37***	***4.24***	***3.98***	***4.13***	***72.78***

* Area 2A recommendation includes sport catch and other removals that would be included in a PFMC catch sharing plan.

Table 2. Halibut Setline Yield.

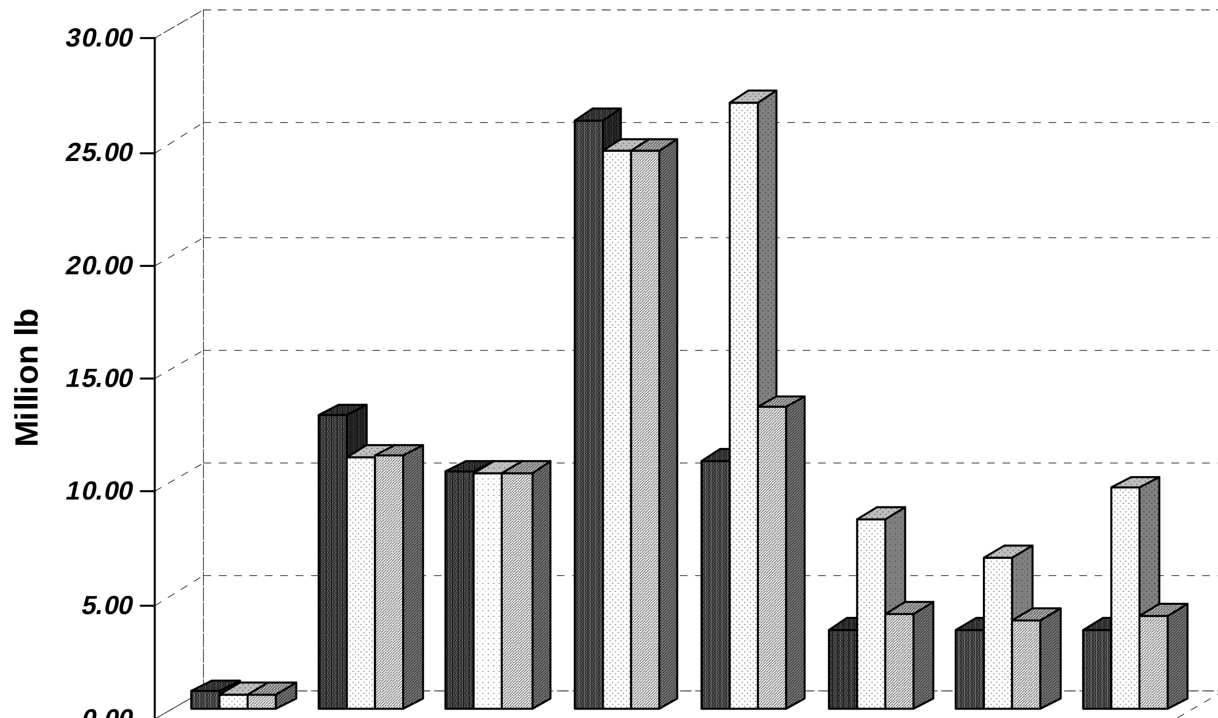
	1998		1999	
Area	Age Selectivity	Adopted	Age Selectivity	Recommended
2A	1.05	0.82	0.69	0.69
2B	15.38	13.00	11.21	11.21
2C	15.48	10.50	10.49	10.49
3A	38.71	26.00	24.67	24.67
3B*	30.99	11.00	26.83	13.37
4A*	11.11	3.50	8.42	4.24
4B*	10.21	3.50	6.71	3.98
4CDE Total*	13.28	3.50	9.80	4.13
Stock Total	136.21	71.82	98.82	72.78

* CEY scaled using survey estimates

- All closed area bycatch assumed to be in IPHC Reg. Areas 4C, 4D and 4E

Table 3. Exploitable biomass (millions of pounds) in Areas 3B and 4, relative to exploitable biomass in Area 3A.

		Biomass relative to 3A	
Area	% Std Biomass	Age Selectivity	Length Selectivity
3B	87	138.33	150.51
4A	29	46.11	50.17
4B	22	34.98	38.06
4CDE Total	37	58.83	64.01



	2A	2B	2C	3A	3B	4A	4B	4CDE Total
1998 quota	0.82	13.00	10.50	26.00	11.00	3.50	3.50	3.50
1999 Age-Specific Setline CEY	0.69	11.21	10.49	24.67	26.83	8.42	6.71	9.80
STAFF RECOMMENDATIONS	0.69	11.21	10.49	24.67	13.37	4.24	3.98	4.13

Figure 1.

Appendix:
Staff Recommendations for Research and Assessment: 1998/1999 and 1999/2000

by

International Pacific Halibut Commission Staff

INTRODUCTION

The presentation of research proposals for FY 1998/99 differs from previous years, as a result of changes in our budget process and format. Research proposals are presented under three categories that reflect availability of research funds. Very little research requiring cash outlay is possible under the basic $1.6M government appropriations, although a number of programs can be conducted using only the staff resources that are supported by the appropriations. The three categories are:

1. Appropriations: Necessary research projects of high priority that can be conducted under the basic $1.6M budget.
2. Supplemental: Necessary research projects of high priority that can only be conducted with revenues generated by survey fishing in 1999, grants or contributions, or carry-over from 1998.
3. Unfunded: Necessary research projects of both high and lower priority but for which we have insufficient staff or financial resources. If sufficient survey revenues are available, some of these projects will be conducted on a priority and funds-needed basis. **(Many of these projects require a new biometrician, at about $70,000 per year for salary and benefits)**

Nearly all of the research done by the staff is directed toward one of three continuing objectives of the Commission:

i) improving the annual stock assessment and quota recommendations;
ii) developing information on current management issues;
iii) adding to knowledge of the biology and life history of halibut.

In each of these areas our routine work program applies the best information and methods available, and our research program aims to improve the information and methods by answering the most important outstanding questions.

This report presents information on both continuing and new projects for FY 1998/1999. Information is provided on when each project began, the anticipated completion date, the annual cost and total cost, a description of the costs, and the purpose of the project. This report does not include ongoing staff tasks such as data collection and processing that are necessary for the management of the fishery.

STATUS OF PROJECTS PROPOSED LAST YEAR: 1997-1998

1. Halibut bycatch and habitat database development – modified/deferred
2. Data collection on NMFS trawl surveys – continuing (Section S.16)
3. Halibut DNA – continuing, partially deferred (Sections C.23, S. 17, U. 9)
4. Environmental research: Fisheries Oceanography – continuing (Sections C.7, C.8, C.9, C.10 S.2, S.9)
5. Environmental research: Halibut Early Life History – cancelled
6. Environmental research: Stable Isotopes – continuing (Section A.1)
7. Sport tagging program – to be determined (S.14)
8. Gilbert St-Pierre project completion – continuing (Section A.11)
9. Alternative assessment methods – continuing (Section A.2)
10. Peer review – completed
11. Systematic setline surveys – continuing (Section S.1)
12. Relative fishing power of J hooks and circle hooks – completed (Sections C.18, C.19)
13. Establishment of a data base for NMFS trawl survey data on halibut – continuing (Section S.16)
14. Distributions of age and size at length in commercial landings, 1963-1990 – continuing (Section A.8)
15. Guide to IPHC setline data – continuing (Section A.5)
16. Misclassification of ages – deferred
17. Discard mortality estimates – continuing (Section A.9)
18. Evaluation of management procedures – continuing (Section A.2)

SUMMARY OF PROJECTS

C Completed Projects in 1998/1999

Published articles

- C.1 Injury, condition, and mortality of Pacific halibut bycatch following careful release by Pacific cod and sablefish longline fisheries.
- C.2 Size-specific dynamics of Pacific halibut: A key to reduce bycatch in the groundfish fisheries
- C.3 Pacific halibut bycatch in Pacific cod fisheries in the Bering Sea: an analysis to evaluate time-area management
- C.4 Northeast Pacific flatfish management.
- C.5 Decadal changes in halibut growth and recruitment
- C.6 Accounting for bycatch in management of the Pacific halibut fishery
- C.7 Effects of interdecadal climate variability on the oceanic ecosystems of the NE Pacific
- C.8 Inverse production regimes: Alaskan and West Coast Salmon
- C.9 A comment and response on time series outlier analysis
- C.10 Pacific - basin climate variability and patterns of northeast Pacific marine fish production
- C.11 Recent El Niño brought downpour of media coverage

Articles in review

C.12 Direct observations on the hooking behavior of Pacific halibut.
C.13 Comparison of surface and break-burn otolith methods of ageing Pacific halibut
C.14 Age validation of Pacific halibut
C.15 Estimation of discard mortality rates for Pacific halibut bycatch in groundfish longline fisheries
C.16 A study of the dynamics of a small halibut fishing ground in northern British Columbia
C.17 Effect of error in estimated natural mortality on age-structured assessments
C.18 Documentation of the 1998 stock assessment

Other projects

C.19 Relative fishing power of J hooks and circle hooks
C.20 Time-stratified observer sampling for halibut trawl viability
C.21 Effects of different minimum/maximum size limits on yield and spawning biomass per recruit of Pacific halibut
C.22 Evaluation of maintaining the IPHC closed area in the Bering Sea
C.23 Halibut DNA
C.24 Setline halibut surveys: 1989 and 1992 Otolith collections

New or Continuing Projects For 1998/1999

A *Appropriations:*

A.1 Stable isotope analysis ($13,799 and Staff costs)
A.2 The 1999 stock assessment (Staff costs)
A.3 Evaluation of MCMC and other methods of estimating the posterior distribution of model parameters and conducting risk analysis (Staff costs)
A.4 Rewrite of assessment model (Staff costs)
A.5 Documentation of Setline survey data (Staff costs)
A.6 IPHC statistical area documentation (Staff costs)
A.7 Review and analysis of historical IPHC tagging data (Staff costs)
A.8 Document otolith sampling procedures and age composition estimates, 1963-1990 (Staff costs)
A.9 Discard mortality estimates (Staff costs)
A.10 Pacific Halibut aging manual (Staff costs)
A.11 Gilbert St-Pierre project (Staff costs)

Note: Total cost is $13,799 plus staffs costs.

S *Supplemental:*

S.1 Standardized stock assessment surveys 1999 (Revenue positive plus Staff costs)
S.2 Influence of near-bottom ocean conditions on juvenile halibut growth ($2,000 plus Staff costs)
S.3 Time-stratified sampling by observers for halibut bycatch viability and length ($1,000 plus Staff costs)
S.4 Revision of discard mortality estimates (Staff costs)
S.5 Bycatch Length Composition for Stock Assessment (Staff costs)
S.6 Prior hook injury (PHI) study on setline surveys (Staff costs)
S.7 Performance of age- and length-based fits when applied to simulated data of either kind (Staff costs)
S.8 Density-dependent and independent control of halibut growth and recruitment (Staff costs)
S.9 Rescue of IPHC hydrographic data back to 1935 (Staff costs)
S.10 Commercial catch database (Staff costs)
S.11 Review of the port sampling program, 1994 to present (Staff costs)
S.12 Halibut otolith exchange with eastern Canada (Staff costs)
S.13 Sport halibut fishery review (Staff costs)
S.14 Sport tagging review ($3,000 plus Staff costs)
S.15 Marginal increment analysis (Staff costs)
S.16 NMFS trawl survey database at IPHC ($30,000 plus Staff costs)
S.17 DNA development and evaluation ($18,000 plus Staff salaries)

Note: Total cost is $54,000 plus staffs costs.

U *Unfunded*

U.1 Detailed analysis of trawl and setline survey data from Areas 2A and 3A (biometrician: $10,000)
U.2 Effect of survey frequency on variability of biomass estimates (biometrician:$25,000)
U.3 Misclassification of ages (biometrician: $25,000)
U.4 Determination of the sex of landed halibut (biometrician: $10,000)
U.5 Complete stock assessment survey coverage of IPHC areas (Depends on fish price—several hundred thousand dollars)
U.6 Geographical information system (programmer salary—half time: $30,000)
U.7 Comparisons of halibut viability data between individual observers (Observer costs: $50,000 plus Staff costs)
U.8 Trawl tagging for discard mortality rates (Staff costs)
U.9 Halibut population identification using microsatellite cloning ($30,000 plus Staff salaries)

DESCRIPTION OF RESEARCH AND ASSESSMENT PROJECTS

C Completed Projects in 1998/1999

Published Articles

C.1 Injury, condition, and mortality of Pacific halibut bycatch following careful release by Pacific cod and sablefish longline fisheries.
Status: Completed (Journal article)
Cost: staff salary
Personnel: Kaimmer, Trumble

Pacific halibut caught as bycatch or intended for discard by longline vessels in U. S. and Canadian waters of the north Pacific must be removed from the hook using careful release techniques required by regulation. In many fisheries, trained observers subsample the released halibut for fish condition. These condition codes are used to track cumulative bycatch mortality in these fisheries. Tag return rates of halibut released from longline gear near Kodiak Island, Alaska, are used to estimate relative and absolute mortalities of fish by release method, hook removal injury, and condition code. Generally, the proper application of the careful release techniques results in only minor hook removal injuries. Survival rates of moderately and severely injured halibut are 1.5 to 2 times higher than previously assumed. One result of our study is the finding that not all fish judged at tagging as likely to die actually die. We recommend a reworking of the condition code methodology.

C.2 Size-specific dynamics of Pacific halibut: A key to reduce bycatch in the groundfish fisheries
Status: (IPHC Tech. Rep.)
Cost: Staff salary, $46,000 SK Grant
Personnel: Adlerstein, Trumble

Maps of size-specific distributions of Pacific halibut based on indices of relative abundance from bycatch were produced by month for January to November. Halibut size correspond approximately to halibut ages 2 to 8+, respectively. The basic data for constructing the maps consist of numbers of bycaught halibut and halibut length frequency distribution from records of individual bottom trawl hauls in the 1990 to 1993 Pacific cod (*Gadus macrocephalus*), rock sole (*Lepidopsetta bilineata*), and yellowfin sole (*Limanda aspera*) fisheries. Spatial-temporal patterns of halibut bycatch are qualitatively predictable in the Bering Sea for the size groups we presented, given trawl survey results such as provided by Clark and Walters (1997). We conclude that the best use of this data set is by fishermen voluntarily adjusting fishing pattern to harvest groundfish with a minimum of halibut bycatch. Such voluntary action is most likely under an as yet undeveloped management program incorporating individual responsibility for bycatch reductions.

C.3 Pacific halibut bycatch in Pacific cod fisheries in the Bering Sea: an analysis to evaluate time-area management
Status: Completed (Journal article)

Cost: Staff salary
Personnel: Adlerstein, Trumble

Mortality of discarded Pacific halibut bycatch from Pacific cod fisheries in the Bering Sea leads to significant losses to the halibut fishery, and to the Pacific cod fishery if closures occur because of halibut bycatch. Significant differences in Pacific halibut bycatch rates and associated yield losses were found among months and areas in the Bering Sea in the longline and trawl fisheries for Pacific cod in 1990-1992. Characteristics of halibut bycatch change seasonally, by area, and annually, but patterns of high bycatch rates occur predictably.

C.4 Northeast Pacific flatfish management.
Status: Completed (Journal article)
Cost: Staff salary
Personnel: Trumble

Exploitation of northeast Pacific flatfish effectively began in the late 1800s with the fishery for Pacific halibut. Harvest of other flatfish occurred on a limited, local basis until foreign fishing fleets came to the area in the late 1950s. When US and Canadian fishermen replaced the foreign fleets in the 1970s and 1980s, a conservation-based management system designed to control foreign fishing was applied to the domestic fleet. Flatfish stock assessment is based on scientific surveys, both trawl and longline, and on catch-age models. In Alaskan waters since 1989 and since 1996 in Canadian waters, mandatory observers collect data on species composition, discards of flatfish and other groundfish, and catch and discards of prohibited species. Fishermen pay observer costs. Most biomass and harvest occurs in the Bering Sea-Aleutian Islands area. Many northeast Pacific flatfish are near record high abundance, an order of magnitude higher than 20 years ago. Exploitation rates based on $F_{35\%}$ or $F_{0.1}$ generate acceptable biological catch of more than 1 million mt, but annual harvest reaches only 300,000 mt. Total groundfish harvest is limited by an optimum yield limit of 2 million mt in the Bering Sea-Aleutian Islands, where the acceptable biological catch is 3 million mt, and by limits on amounts of Pacific halibut and other prohibited species bycatch. Most flatfish are relatively low value species, and fishermen chose to fish for more valuable species. A large, powerful fleet which developed under open access in the US saw fishing time decline and economic problems increase as catching capacity grew, while Canada stabilized its fleet with limited entry and catch restrictions for individual vessels.

C.5 Decadal changes in growth and recruitment of Pacific halibut
Status: Completed (Journal article)
Cost: staff salaries
Personnel: Clark, Hare, Parma, Sullivan, Trumble

Since the climate regime shift of 1976-77 in the North Pacific, the individual growth of halibut (*Hippoglossus stenolepis)* has decreased dramatically in Alaska but not in British Columbia. Recruitment has increased dramatically in both areas. The decrease in age-specific vulnerability to commercial longline gear resulted in a persistent underestimation of incoming recruitment by the age-structured assessment method (CAGEAN) that was used to assess the stock. This problem has been corrected by adding temporal trends in growth and fishery selectivity to the assessment model. The recent sustained high level of recruitment at high levels of spawning biomass has erased the previous appearance of strong density dependence in the stock-recruitment relationship and prompted a reduction in the target full-recruitment harvest rate from 30-35% to 20-25%. The climate regime shift affected a number of other stocks of vertebrates and invertebrates in the North Pacific. While the general oceanographic changes have now been identified, the specific biological mechanisms responsible for the observed changes have not.

C.6 Accounting for bycatch in management of the Pacific halibut fishery

Status: completed (journal article)
Cost: staff salaries
Personnel: Clark, Hare

Since the 1960s, fisheries for other species of groundfish have caused an average of about 9,000 metric tons (mt) of Pacific halibut *Hippoglossus stenolepis* bycatch mortality every year, while directed catches have varied from 13,000 to almost 50,000 mt (both measured in round weight). Around half of the bycatch consists of juvenile fish caught in Alaska, some of whom would otherwise migrate south and contribute to the fishery in British Columbia. These interceptions have long been a difficult issue for the United States and Canada. At recent high levels of juvenile abundance, juvenile bycatch reduces coastwide recruitment by about 10%. The resulting yield loss, plus bycatch of adult fish, reduces yield to the directed fishery by about 11,000 mt per year. Migration modeling indicates that the yield loss due to bycatch occurs almost entirely in the area where the bycatch is taken. In particular, bycatch in Alaska reduces Pacific halibut yields in British Columbia by at most a few percent. During the 1980s and early 1990s, annual quotas in the directed Pacific halibut fishery were reduced by an amount equal to (or sometimes greater than) the amount of *total* Pacific halibut bycatch mortality, and the quota reduction was distributed among regulatory areas in proportion to Pacific halibut biomass. At present, the Pacific halibut quota in each regulatory area is reduced by the amount of *adult* Pacific halibut bycatch mortality in that area, and the target exploitation rate is adjusted downward (slightly) to offset the bycatch mortality of juveniles.

C.7 Effects of interdecadal climate variability on the oceanic ecosystems of the NE Pacific

Status: Completed
Cost: Staff salaries
Personnel: Francis, Hare, Hollowed, Wooster

A major reorganization of the North-east Pacific biota transpired following a climatic 'regime shift' in the mid 1970s. In this paper, we characterize the effects of interdecadal climate forcing on the oceanic ecosystems of the NE Pacific Ocean. We consider the concept of scale in terms of both time and space within the North Pacific ecosystem and develop a conceptual model to illustrate how climate variability is linked to ecosystem change. Next we describe a number of recent studies relating climate to marine ecosystem dynamics in the NE Pacific Ocean. These studies have focused on most major components of marine ecosystems - primary and secondary producers, forage species, and several levels of predators. They have been undertaken at different time and space scales. However, taken together they reveal a more coherent picture of how decadal scale climate forcing may affect the large oceanic ecosystems of the NE Pacific. Finally, we synthesize the insight gained from interpreting these studies.

C.8 Inverse production regimes: Alaskan and West Coast Salmon
Status: Completed (Journal article)
Cost: Staff salaries
Personnel: Hare, Mantua, Francis

A principal component analysis reveals that Pacific salmon catches in Alaska have varied inversely with catches from the United States West Coast during the past 70 years. If variations in catch reflect variations in salmon production, then results of our analysis suggest that the spatial and temporal characteristics of this "inverse" catch/production pattern are related to climate forcing associated with the Pacific Decadal Oscillation, a recurring pattern of pan-Pacific atmosphere-ocean variability. Temporally, both the physical and biological variability are best characterized as alternating 20- to 30-year-long regimes punctuated by abrupt reversals. From 1977 to the early 1990's, ocean conditions have generally favored Alaska stocks and disfavored West Coast stocks. Unfavorable ocean conditions are likely confounding recent management efforts focused on increasing West Coast Pacific salmon production. Recovery of at-risk (threatened and endangered) stocks may await the next reversal of the Pacific Decadal Oscillation. Managers should continue to limit harvests, improve hatchery practices and restore freshwater and estuarine habitats to protect these populations during periods of poor ocean productivity.

C.9 A comment and response on time series outlier analysis
Status: Complete (Journal article)
Cost: Staff salaries
Personnel: Hare, Francis, Farley, Murphy

This comment and response discussed factors hypothesized as having an influence on the variability of salmon populations in Bristol Bay, Alaska. There was also discussion on what type of analyses are most appropriate for studies of population variability.

C.10 Pacific - basin climate variability and patterns of northeast Pacific marine fish production
Status: Completed (Journal article)
Cost: Staff salaries
Personnel: Hollowed, Hare, Wooster

Review of oceanographic and climate data from the North Pacific and Bering Sea revealed climate events that occur on two principal time scales: a) 2-7 years (i.e., El Nino Southern Oscillation (ENSO) events), and b) inter-decadal (i.e., Pacific Decadal Oscillation). The timing of ENSO events and of related oceanic changes at higher latitudes was examined. The frequency of ENSO was high in the 1980s. Recruitment data for 23 groundfish and 5 non-salmonid pelagic species from three large geographic regions were examined for evidence of Pure Temporal Variability (PTV) caused by large scale forcing at one or more of the time scales noted in oceanographic and climate data. Most salmonids and some flatfish stocks exhibited high autocorrelation in recruitment coupled with a significant step in recruitment in 1977, suggesting a relationship between PDO forcing and recruitment success. Six of the dominant groundfish stocks (Atka mackerel, Pacific cod, Pacific hake, and walleye pollock) exhibited a higher incidence of strong year classes in years associated with Niño North conditions. These findings suggest that PTV may play an important role in governing year-class strength of northeast marine fish stocks.

C.11 Recent El Niño brought downpour of media coverage
Status: Completed (Journal article)
Cost: Staff salaries
Personnel: Hare

This was a short humorous article written on the media coverage of the 1997/98 El Niño event.

<u>*Articles in Review*</u>

C.12 Direct observations on the hooking behavior of Pacific halibut.
Status: Final review (Journal article)
1998 est. cost: staff salaries
Personnel: Kaimmer

Direct observation using an underwater camera of a 6-hook model setline off Canada's northwestern coast allowed estimation of approach direction, attack rate, and hooking success for Pacific halibut (*Hippoglossus stenolepis*). In observations of 129 halibut approaches, 29 halibut simply continued swimming past the gear and away. The remaining 100 halibut responded in some way to the gear, exhibiting behaviors ranging from a simple change in swimming direction towards the gear to bites on the baited hooks. Behavior transitions are described both leading up to and following 57 observed bites. Halibut displayed a positive rheotactic response, 74% approaching upstream toward the bait. A higher proportion of the upstream approaches resulted in bites than those from other directions or those which occurred during slack current. Most bites were associated with a vigorous rushing behavior, which often led to hooking. A length-selective nature of the hooking probability was demonstrated, ranging from zero for smallest fish to approaching one for largest sizes caught. Very low rates of hooking success were observed for some rockfish which in some areas are important bycatch species to the halibut fishery.

C.13 Comparison of surface and break-burn otolith methods of ageing Pacific halibut
Status: In review (Tech. Rep.)
1998 est. cost: Staff salaries
Personnel: Blood

A comparison of the surface and break and burn age reading methods for 1,324 Pacific halibut otoliths produced results which were very close for ages 6-15 years. Break and burn ages were slightly, but consistently older than surface ages through age 20. Since ages 20 and older are pooled for IPHC stock assessment analysis and differences in this study through age 15 are minimal, surface ages in practical terms have provided reasonable estimates. We recommend breaking and burning otoliths which are greater than 15 years when aged by the surface method.

C.14 Age validation of Pacific halibut
Status: In review (Tech. Rep.)
1998 est. cost: staff salaries
Personnel: Blood

A mark-recapture study was initiated to validate halibut otolith growth rings as being annular in nature. In 1982 and 1983, the International Pacific Halibut Commission tagged and injected 1,791 Pacific halibut with oxytetracycline (OTC) off the coasts of Alaska and British Columbia and recoveries through 1989 have been analyzed. Both surface and break and burn methods of age reading were used to test criteria for age validation. Regression analysis of estimated versus known time at large read by three age readers suggests slight over aging using the surface technique. The most experienced age reader tested the break and burn technique and under estimated the time-at-large. Deviation from the known age was usually ±1 year using both techniques with a tendency toward a +1 year error in surface aging and -1 year error using break and burn aging. Error was identified primarily in misinterpretation of the OTC mark, particularly in halibut injected in May. Aging error did not increase with time-at-large. Over estimation of ages may be acceptable in older halibut, but misclassifies recruitment classes. When both time-at-large and overall age were in agreement between all three readers, the ages 4 through 15 were validated about 50 per cent of the time. Results suggest further examination of the criteria used to describe annuli is necessary to eliminate inconsistency between readers.

C.15 Estimation of discard mortality rates for Pacific halibut bycatch in groundfish longline fisheries
Status: In review (Journal article)
1998 est. cost: Staff salaries
Personnel: Trumble, Kaimmer, Williams

Mandatory release to the sea of Pacific halibut bycatch in Alaskan and Canadian waters has the potential to close groundfish fisheries to individuals or specific fisheries that reach bycatch mortality limits. Tagging experiments of halibut from longline gear demonstrated that halibut with similar types of injuries experienced lower mortality when released from small hooks than from large hooks. Investigation of hook size effects established that the current viability criteria for individual halibut currently overestimate discard mortality rates. Proposed, simplified four-category viability criteria based on injury codes increased accuracy of bycatch mortality calculations over the present three-category criteria. The new criteria may reduce calculated discard mortality of Pacific halibut released from longlines by 20 percent. Use of the new criteria would result in more accurate estimates, lower probability of bycatch-induced fishery closures, and more halibut available for a directed fishery.

C.16 A study of the dynamics of a small halibut fishing ground in northern British Columbia
Status: In review (Tech. Rep.)
1998 est. cost: Staff salaries
Personnel: Geernaert, Trumble

In 1988 the International Pacific Halibut Commission conducted a study of the dynamics of the commercial halibut fishery on a small fishing ground in the northern portion of Area 2B. Two research trips to the survey grounds fishing for a combined total of 21 days, tagged and released 2,652 halibut. Halibut catch varied with time but no trend was observed. In contrast, dogfish catches decreased markedly over time. Through the end of 1997 nearly half of the tags were recovered, indicating a high exploitation rate on the grounds. Very little movement out of the study area was seen with nearly 90 percent of tags recovered on or adjacent to the release area. A subsample of the tagged fish were sexed at release. A near equal number of females and males were released as well as recovered. Legal sized tagged fish were recovered at a higher rate than sublegal sized fish, suggesting size selectivity occurred in the recoveries.

C.17 The effects of an erroneous natural mortality rate on a simple age-structured stock assessment
Status: In review (Journal article)
1998 est. cost: Staff salaries
Personnel: Clark

The abundance of many stocks is estimated by fitting an age-structured model to catch-at-age and relative abundance data from the commercial fishery and scientific surveys. The natural mortality rate used in the model is usually estimated externally and its value is uncertain. An erroneous natural mortality rate will bias the stock size estimates obtained by fitting the model and it will also bias the yield calculations that are done to choose a harvest rate and recommend quotas. This paper describes the general features of both effects by analyzing a simple age-structured model fitted to artificial data.

C.18 Documentation of the 1998 stock assessment
Status: Final review (Sci. Rep.)
1998 est. cost: Staff salaries
Personnel: Sullivan, Parma, Clark

Other Projects

C.19 Relative fishing power of J hooks and circle hooks
Status: Completed
Cost: Staff Salary
Personnel: Clark

C.20 Time-stratified observer sampling for halibut trawl viability
Status: Completed
Cost: $1000
Personnel: Williams, Hare

Halibut release viability is a time-dependant variable: the longer the fish is out of the water, the lower the viability. This project was a pilot effort to explore if observers could collect these data where the time of collection was controlled, rather than on an opportunistic basis as is currently the case. Results indicated that the time-stratified design was feasible, however, so few halibut were caught on the vessels involved that no further analysis could be conducted.

C.21 Effects of different minimum/maximum size limits on yield and spawning biomass per recruit of Pacific halibut

Status: Completed
Cost: Staff salaries
Personnel: Parma

The effects of different minimum and maximum commercial size limits on expected yield per recruit and female spawning biomass per recruit were evaluated. Growth parameters for female and male halibut, and size-specific selectivity of the commercial fishery were estimated for Areas 2B and 3A by fitting a sex-specific, age-structured population model to data from the setline surveys and the commercial fishery for the period 1974-1997. The analysis of the minimum commercial size limit conducted in 1997 was based on the assumption that natural mortality equals 0.20. Following new developments in the stock assessment model, the current analysis of size limits was expanded to include a range of likely M values.

C.22 Evaluation of maintaining the IPHC closed area in the Bering Sea

Status: Complete
Cost: Staff salary
Personnel: Trumble

The existing IPHC closed area in the Bering Sea provides little biological benefit to the halibut resource or fishery. In spite of the weak Bering Sea data set, the very low directed fishery exploitation on legal-sized fish has little effect on halibut abundance. Except for bycatch mortality from groundfish fisheries, which is substantial, the nearly unfished Bering Sea shelf may function as a reserve. Marine reserves may be appropriate for areas of high exploitation or high data uncertainty. At this time, only data uncertainty provides justification for a reserve in the Bering Sea. Should circumstances make a reserve potentially desirable, a special project to develop a purpose and criteria for a reserve should occur.

C.23 Halibut DNA

Status: Completed
1998 budget: $12,500
1998 cost: $11,572
Began: 1992 (as mitochondrial DNA project)
Total costs through 1998:
Description of costs: Salary, equipment
Personnel: Larsen

Initial work on the Halibut DNA project has been completed and the results of the work will be presented in the 1998 RARA. Initial results found three primer sets out of a screening of 2,000 for use in the population survey. Some differences were found between populations but the high levels of polymorphism within the loci (and implied high mutation rates) made it difficult to determine whether the mutations were convergent across the populations. It is apparent from the study that additional collections and research would validate current work. Three objectives were identified as important: 1) complete collections from winter grounds, 2) identification of additional primer sets, and 3) testing of Mendelian inheritance. Mendelian inheritance was identified in 1998 as a part of the project but never completed due to lack of funding and samples.

C.24 Setline Halibut Surveys: 1989 and 1992 Otolith Collections
Status: In review (Technical report)
Personnel: Larsen

Technical paper describing the results from the otolith collection cruises used to examine the fish weight at age issue. Currently in final edit prior to outside review.

New or continuing Projects For 1998/1999

A. *Appropriations Projects*

A.1 Stable isotope
Status: Continuing
1998 budget: $30,000 (IPHC costs)
1998 cost: $33,017
1999 est. cost: $13,799
Began: 1997
Anticipated ending: September 1999. Future work will continue with outside funding if obtained.
Total costs through 1998: $33,017
Description of costs: Salary, equipment
Personnel: Gao, Trumble

The International Pacific Halibut Commission (IPHC) has funded since September 1997 a Post Doctoral Fellow stationed in Nanaimo Canada to conduct research on the stable isotopes of oxygen and carbon of Pacific halibut. The IPHC research has two main objectives. The first is a record of temperatures experienced by halibut during the summer fishing and feeding period, determined by oxygen isotope ratios. The second is examination of evidence for migratory patterns of halibut, again using oxygen ratios and possibly carbon ratios. NMFS and DFO will provide necessary funds through the end of the fiscal year. The IPHC intends to submit a proposal in February 1999 to the National Science Foundation (NSF) for future funding of the project.

We are in the process of conducting four experiments in preparation for the NSF proposal. We will hold halibut in several temperatures and salinities of seawater to determine the relationship of temperature, salinity, and oxygen isotope ratio for seawater and for halibut otoliths. We have selected otoliths from tagged halibut to provide insight into the time halibut resided in nursery areas, the time at which they arrived in British Columbia, and the duration of migration. We have selected otoliths from halibut tagged and recovered from the Bering Sea and from the Gulf of Alaska during a period of relatively stable bottom temperatures or a period of changing bottom temperatures. We expect the isotope ratios to mirror the temperature changes. We have taken several samples from single annuli on several otoliths to examine repeatability of measurements.

A.2 The 1999 stock assessment

Status: ongoing
Cost: Staff salaries
Began: mid-1980s
Anticipated ending: ongoing
Personnel: Clark, Parma, Hare

The annual stock assessment process comprises a large amount of work including preparation of IPHC data, estimation of bycatch by length in other fisheries, model development and validation, model fitting, examination of residuals, comparison of alternative model specifications, sensitivity tests, evaluation of harvest strategy, incidental analyses, and reporting. In total it takes up the bulk of the time of the three remaining quantitative scientists on the staff.

A.3 Evaluation of MCMC and other methods of estimating the posterior distribution of model parameters and conducting risk analysis.

Status: Ongoing
Cost: Staff salaries
Began: 1997
Anticipated ending: 1999
Personnel: Parma, Clark

Two types of uncertainty affect the results of the stock assessment: parameter uncertainty and model uncertainty. The latter, also known as structural uncertainty, corresponds to uncertainty about the assumptions built into the model. Different assumptions can be made about the stock dynamics, the fishing process and the way the input data to the assessment relate to these processes, which will generally result in different estimates of model parameters. The staff evaluates on a regular basis the sensitivity of the stock assessment to alternative model structures and key assumptions. Parameter uncertainty, on the other hand, refers to uncertainty about the values that model parameters could take, conditioned on the structure of the assessment model being correct. This type of uncertainty is usually represented as error bars or confidence intervals around parameter estimates. In nonlinear models, such as the one used for halibut assessment, these confidence intervals are only approximated. Bayesian techniques such as Markov Chain Monte Carlo methods are now used in fisheries stock assessment to quantify and represent parameter uncertainty and to conduct risk analyses. AD Model Builder (ADMB), the software used to implement the halibut assessment model, has been recently enhanced to allow for the use of MCMC. During 1998, the staff explored the performance and convergence properties of these computing-intensive techniques using simpler models than the one used for halibut and results were satisfactory. The plan is to use MCMC methods in the 1998 halibut assessment to evaluate posterior distributions for some parameters of management interest such as exploitable biomass and recruitment. MCMC techniques will be used to conduct risk analyses in the assessment of 1999.

A.4 Rewrite of assessment model

Status: new
Cost: Staff salaries

Anticipated ending: 1999
Personnel: Clark, Hare, Parma

Beginning in 1995, the staff developed a new age- and size-structured model to replace CAGEAN. This model is implemented in C++ and fitted with AD Model Builder, a software library that generates analytical derivatives and provides a number of other capabilities that are essential for fitting large models. The present model code has evolved over time as the staff has gained experience with the software and insights into the behavior of the more complicated population model. At this point the code would benefit from an overhaul, and in the wake of Pat Sullivan's departure the present assessment staff need to go through the exercise of overhauling the code to familiarize themselves thoroughly with its workings.

A.5 Documentation of setline survey data

Status: new
Cost: Staff salaries
Anticipated ending: 2000
Personnel: Hoag, Randolph

In 1999, we plan to complete clean-up and documentation of systematic setline survey data going back to the 1960's when systematic surveys were initiated. We also plan to begin summarizing data on CPUE, size, age and sex composition by sampling area and year. The results of this project will form the basis of a historical report, which we hope to complete by 2000.

A.6 IPHC statistical area documentation

Status: Ongoing
Cost: Staff salaries
Began: 1998
Anticipated ending: ongoing
Personnel: Wade, Geernaert, Kong, Gilroy

Part 1: IPHC inside/outside (I/O) and baseline statistical areas were defined in Technical Report 14. IPHC has more detailed statistical areas in the inside waters of British Columbia and S.E. Alaska. These finer resolutions of statistical areas need to be defined and documented. Also, changes were made to the IPHC statistical areas in the early 1990s. The finer statistical area resolutions and the changes need to be documented so the data can be available to the industry. We are now providing the industry with halibut catch data by statistical area but the definitions are not all available. In the past, detailed statistical area data were not provided to the industry; the data were summarized by I/O statistical areas only. The commercial catch database will be updated to reflect current and historical statistical areas where necessary. All databases (age, survey) will need to be updated and made consistent.

Part 2: Polygons are being defined with latitude and longitude information and statistical area so that statistical area boundary maps and a computer program can take a point and determine in which statistical area it lies. The programming and database for this project is the Geographical Information Systems. Input data can be directly mapped by computer into the appropriate statistical area. This project is the first stage of the long-term implementation of geo-referenced data for analysis by many IPHC programs.

A.7 Review and analysis of historical IPHC tagging data

Status: new
Cost: Staff salaries
Anticipated ending: 2000
Personnel: Leaman, Kaimmer, (Biometrician)

The IPHC has conducted many tagging programs since the 1920s. These programs have had a variety of objectives (migration, mortality, growth) and have used a variety of methodologies (tag types, areas, capture gear). The IPHC has also conducted at least five reviews of these programs, again with differing objectives. However, many of these reviews did not account for significant issues concerning the details of the programs or their analyses. In particular, the issues of non-reporting or differential reporting of tags by areas, fishing effort effects on recovery probabilities, the relationship of initial tag releases and the density of fish in given areas, and the effect of seasonal migratory patterns on the analysis of recoveries were not always considered.

Several recent developments have highlighted the need to re-examine our knowledge of halibut movements. In particular, a changed paradigm for the area-specific impacts of juvenile bycatch, questions concerning the effects of changing seasonal distribution of fishing effort, potential halibut distribution changes with climatic shifts, and the utility of juvenile surveys in specific areas have all prompted concerns about halibut movements. During 1997 and 1998 IPHC staff have been assembling the first complete summary of IPHC tagging programs. We propose to use this summary as a starting point to conduct a more comprehensive review of halibut migration. Candidate data sets for inclusion in revised analysis will be identified and, depending on availability of a new analyst, a new analytic framework will be developed. This project will also compile information on selectivity available from tagging programs, to assist in the evaluation of the potential tagging program in areas 3A/B and 2B.

For reference: Thompson and Herrington (1930), Kask (1935), Dunlop et al. (1964), Best (1968), Skud (1977), Deriso and Quinn (1983), Deriso et al. (1985), Trumble et al. (1990), Skalski et al. (1993), and Hilborn et al. (1995)

A.8 Document otolith sampling procedures and age composition estimates, 1963-1990.

Status: mostly done.
Cost: Staff salaries
Began: 1996
Anticipated ending: 1999
Personnel: Clark, Forsberg, Blood, Vienneau

We have completed a project to standardize, check, and document all of the commercial age and size sampling data back to 1963. The report includes a history of the sampling methods used to collect the data, an inventory by area and year, and a guide to the table in the relational database. From 1963 through 1990, IPHC port samplers did not measure the length of sampled fish, and only a stratified subsample of the otoliths were read. The length distribution of the sampled fish can be estimated from otolith measurements and survey collections of measured fish in the same years, and the age compositions can be estimated by correctly expanding the sample data. A lot of calculation is required. We have done the calculations; this report will document the procedures and results. (Since 1991 the age sample has been a simple random sample, and all fish have been measured, so the age and size composition estimates are straightforward.)

A.9 Discard mortality estimates

Status: Continuing
Cost: Staff salaries
Began: mid 1970s
Anticipated ending: ongoing
Personnel: Williams, Trumble, Sadorus, Hare

The IPHC staff assembles halibut bycatch data from the NMFS observer program and calculates discard mortality rates by gear, area, and target fishery for the groundfish fisheries in Alaskan waters. NMFS applies these values to total halibut bycatch to calculate total halibut bycatch mortality. DFO supplies this information for Canadian groundfish fisheries, and IPHC staff reviews the information. We monitor bycatch mortality through the season. The IPHC staff has long emphasized methods of reducing bycatch, and the staff works with the NPFMC process to assist with information and evaluation of potential programs such as VBA. Staff members train and debrief observers from the Alaskan fisheries, and work with the Observer Program to improve halibut bycatch sampling procedures.

A.10 Pacific halibut aging manual

Status: New
Cost: Staff salaries
Anticipated ending: 1999
Personnel: Forsberg, Blood, Kong

This will be a descriptive document, detailing procedures, materials and criteria used in determining ages of Pacific halibut. There will be quite a few otolith photographs, and should be useful both in training new readers and as a reference for experienced readers.

A.11 Gilbert St-Pierre project

Status: Continuing
1998 budget: $5,000
1998 cost: $5,952
1999 est. cost: Staff salaries
Began: 1995
Anticipated ending: 1999
Total costs through 1998: $36,152
Description of costs: Staff salaries
Personnel: Trumble

In 1998,Gilbert completed the data analysis and completed a report of stomach contents of halibut captured during IPHC surveys. The analysis and report will be reviewed and edited during 1999.

S *Supplemental Projects*

S.1 Standardized stock assessment surveys 1999

Status: continuing
Cost: Revenue positive
Began: 1994
Anticipated ending: ongoing
Personnel: Hoag, Randolph

In 1998, we redesigned the survey stations and began work on documenting the documenting the design and sampling procedures used historically in previous surveys. We planned to survey all areas of the coast in 1998, but a major drop in halibut price forced us to abandon the Area 2A, southern Area 2B, and 4D surveys because of expected low revenue.

In 1999, we plan to survey Areas 2B (northern), 2C, 3A, 3B, and the southern portion of Area 4A. Depending on halibut prices, all of these areas with the possible exception of Area 2B should be at least revenue neutral. The survey design was changed in 1998 and we would like to test if the change in station pattern was partially responsible for the sharp drop in CPUE observed in some areas. We suggest fishing both the 1997 and 1998 survey stations in Area 2C in 1999 to estimate the effect, if any, of the change in design. Area 2C was one of the areas showing a sharp drop in CPUE during 1998.

S.2 Influence of near-bottom ocean conditions on juvenile halibut growth (IPHC staff and Juneau Center of the University of Alaska Fairbanks).

Status: Ongoing
1998 budget: Staff salaries
1998 cost: Staff salaries
1999 cost: $2000 plus staff salaries
Began: 1998
Anticipated ending: 1999
Total costs through 1998: Staff salaries
Description of costs: imaging hardware and software
Personnel: Hare, Blood, Hagen, Quinn

Halibut growth has exhibited both interannual and interdecadal trends this century. An ongoing question of both scientific interest and importance to halibut management is whether these changes are driven by density dependent or independent processes. Earlier investigations into this question have reached conflicting conclusions and generated hypotheses that require further investigation. For example, it has been proposed that halibut growth is positively related to water temperature. However, halibut size at age has decreased considerably during the past 20 years, a time during which Gulf of Alaska water temperatures (surface temperatures) have been anomalously warm. One likely problem of past studies examining environmental influences on growth has been the use of ocean surface indices that may not reflect conditions at depth where halibut reside. This study will use the Ocean Bottom Properties database compiled as part of the Fisheries Oceanography project last year. We will use near bottom temperature and salinity records dating back 40+ years to investigate variability in juvenile growth as recorded in otoliths. Growth trajectories for the 1953-1978 year class halibut were derived in an earlier study. We will extend that record through the 1990 year class (and perhaps earlier in time prior to the 1953 year class) giving us a larger sample of growth trends in the post-1977 regime shift period.

S.3 Time-stratified sampling by observers for halibut bycatch viability and length.

Status: New
1999 est. cost: $1,000
Anticipated ending: 2000
Description of costs: equipment
Personnel: Williams, Trumble

The objective of this project is collect halibut bycatch length and viability data independent of species composition sampling on trawl catcher/processors. This information will improve the accuracy of halibut viability data collected by observers. Observers will be tasked with conducting special halibut length/viability (L/V) sampling during a portion of their vessel assignment in lieu of their regular (traditional) sampling for halibut length and viability. During a special sampling period, sampling the catch from an individual haul for species composition will occur from basket samples, as has been past practice. L/V sampling of halibut bycatch will be conducted from the same hauls as the basket samples, but during specific separate time intervals, rather than at the observer's discretion. Sampling will occur at intervals of 0-30 minutes, 30-60 minutes, and >60 minutes after the codend is pulled on deck. Within the time interval, sampling at the point of discharge would continue for 15 minutes, or until 5 halibut are sampled. Observers will be noting the amount of time involved with specific aspects of their sampling activities. This project is a follow-up to a feasibility study conducted in October, 1995, which demonstrated the time-stratified sampling design could be followed by observers without sacrificing other duties.

S.4 Revision of discard mortality estimates

Status: Continuing
1998 est. cost: staff salaries
Costs through 1998: $25,000 plus staff salaries
Began: 1993
Anticipated ending: ongoing
Personnel: Williams, Kaimmer, Sadorus, Trumble

For the past several years, the IPHC staff has emphasized methods of reducing mortality of discarded halibut from longline and trawl fisheries, and of improving estimates of discard mortality rates. The staff tagged nearly 20,000 halibut from longliners and trawlers to assist in improving discard mortality rate estimates. Longline tag returns demonstrated that current criteria overestimate discard mortality rates. Analysis completed in 1998 resulted in revised estimates of survival and recommendations for revising observer sampling. Examination of trawl tag returns from 1995-

1998 showed insufficient number of returns for further analysis. This project will continue to obtain and analyze information to improve the estimates of discard mortality rates.

S.5 Bycatch length composition for stock assessment

Status: Continuing
Cost: Staff salaries
Began: 1996
Anticipated ending: ongoing (Tech. Rep. 1999)
Personnel: Hare, Williams

The revised stock assessment requires area-specific data on historic bycatch levels and the size distribution (sublegal vs. legal) of the bycaught fish. This project resulted in data for the assessment and an IPHC report describing the results. A secondary, but important, outcome of this analysis was a recalculation of discard mortality rates for the groundfish fisheries off Alaska. Fishery-specific DMRs were calculated using a weighted average of observer data and bycatch mortality was retrospectively re-estimated. This project will use bycatch data provided annually by the NMFS Observer Program to calculate fishery-specific discard mortality rates and fishery-specific length frequencies.

S.6 Prior hook injury (PHI) study on setline surveys

Status: Continuing
Cost: Staff Salaries
Began: 1997
Anticipated ending: ongoing
Personnel: Williams, Barto

Data on the presence and severity of prior hook injuries on halibut caught on the 1998 setline surveys were analyzed. The report is in the 1999 Report of Assessment and Research Activities. This continues the data collection and analysis which began with the 1997 surveys. The 1998 results are very similar to those observed in 1997, which was on overall injury rate of about 6%. This work will continue for several years to see if the incidence of prior hooking injuries decreases, as the halibut careful release program for longline fisheries should cause fewer release injuries of bycaught halibut.

S.7 Performance of age- and length-based fits when applied to simulated data of either kind

Status: Ongoing
Cost: Staff salaries
Began: 1997
Anticipated ending: 1999
Personnel: Parma, Sullivan

A main source of uncertainty of the assessment is in the modeling of survey selectivity, specifically, to what extent selectivity is a function of fish size, fish age or both. In the past, the assessment has been conducted under two alternative assumptions: (1) survey selectivity at length has remained constant while size-at-age and, in turn, selectivity-at-age have decreased, or (2) survey selectivity-at-age mostly reflects the relative availability of the age classes on the grounds, and has remained constant while growth rates declined. So far model fits have not indicated a definite advantage of one model structure over the other, and it is not clear how many more years of data will be needed before this issue is resolved, or even what kinds of diagnostics will help in discerning between these alternative hypotheses. The staff has developed a simulation model that uses the basic structure of the assessment model and software to generate "halibut-like" data under different assumptions about the stock dynamics. This simulator will be used to explore the performance of estimations conducted using the different model structures when input data have been generated under the two different assumptions about survey selectivity. In addition, the performance of a simple catch-at-age model in which trends in selectivity are not driven by trends in growth will be evaluated to see to what extent recent trends in selectivity are estimable in the absence of data on size at age. This simple model was developed at the request of the panel of experts that reviewed the assessment in 1997.

S.8 Density-dependent and independent control of halibut growth and recruitment

Status: Ongoing
Cost: Investigator salary, some travel
Began: 1997
Anticipated ending: ongoing
Personnel: Hare, Clark

The specific mechanisms driving the observed interdecadal trends in halibut growth and recruitment remain largely unexplained though more specific hypotheses have been developed in the past two years. Work towards better understanding whether density dependent (intra- or inter-specific) or density independent factors are responsible continues and remains the core research focus of the fisheries oceanography project. Progress in this area will require examination of all potential influences and collaborative research. Several recent collaborations have helped shape the regime shift hypothesis and demonstrated that many components of the North Pacific marine ecosystems respond synchronously to these shifts. A recent analysis of groundfish, salmonid and pelagic recruitment time series, however, show that there are distinct differences among groups of species. There are several ongoing investigations that will continue through the next year, including: how have oceanographic conditions on the continental shelf differed from surface conditions; has there been a regime shift since the 1976/77 event; is halibut growth affected by the density of other flatfish populations; are there basin-wide patterns in zooplankton population variability? In keeping with the NOAA movement towards ecosystem considerations in fisheries management, we will attempt to derive a framework whereby the results of fisheries oceanography investigations can provide useful input for management purposes, such as determining safe harvest levels or forecasting near-term recruitment.

S.9 Rescue of IPHC hydrographic data back to 1935

Status: New
Cost: Staff salaries
Began: 1999

Anticipated ending: 1999
Personnel: Hare, Hollowed, PMEL

This project calls for the rescue of historical water column properties data that have been collected but never digitized by several agencies and institutions around the Pacific Rim. The data will be added to the IPHC Ocean Bottom Properties database and provided to the National Oceanic Data Center, worldwide repository of oceanographic data. A cursory examination of IPHC logbooks and archived material revealed a substantial number of hydrocasts and water bottle samples dating back to the 1930s. These data exist in no database and would be of considerable interest to the oceanographic community in retrospective and model verification studies. Additionally, there is growing interest in the water column structure in the North Pacific resulting from several U. S. GLOBEC studies and the need to identify essential fish habitat in the North Pacific and Bering Sea. Under a joint proposal to NOAA, an expert oceanographer would be hired to handle transferal of data from paper media and perform detailed quality checks for accuracy and reliability.

S.10 Commercial catch database
Status: continuing
Cost: Staff salaries
Started: 1997
Anticipated ending: 1999 (part 1); 2000 (part 2)
Personnel: Gilroy, Geernaert, Taheri

Part 1: The project is to make records available from 1974 of the commercial landing (tickets) and fishing logbook data in an on-line log-dealer relational database system. The earlier data were transferred from archival tapes to the current database. The data are being edited to match the current format. Data are then summarized and cross-checked with historical documentation for accuracy. The years that are currently being validated are 1974 through 1981. The data are necessary for stock assessment and to assist in answering industry requests.

Part 2: The IPHC homepage will be updated to provide commercial catch data. Data will be added sequentially by year starting with 1998. Data through 1988 should be available in 1999, and data through 1974 should be available in 2000. The data tables will include commercial catch by year, fishing period, regulatory area, and landings by ports, catch by statistical areas.

S.11 Review of the port sampling program, 1994 to present.
Status: New
1999 est. cost: Staff salaries
Anticipated end: 2000
Personnel: Wade, (possibly Barto/Forsberg/Kong, Geernaert)

Report on the changes that have occurred in the commercial catch sampling and port sampling program from 1994 to the present. For example, the report will review the changes made to the program due to the implementation of the IFQ fishery in Alaska, the changes in the method of logbook data collection in the U.S., as well as changes in the Canadian program. This is an update of Technical Report number 32.

S.12 Halibut otolith exchange with eastern Canada
Status: new
Cost: Staff salaries
Anticipated ending: 2000
Personnel: Blood, Trumble

IPHC has been involved with several otolith exchanges over the years to compare aging methods with various agencies. The Committee of Age Reading Experts (CARE) encourages age determination units to regularly exchange otoliths to gain new perspectives on age reading. Atlantic halibut otoliths were provided for IPHC age-readers in the early 1980s, but a larger scale exchange would be useful to compare the aging methods, criteria, and time of formation of annuli between Atlantic and Pacific halibut. Otolith exchange will occur in 1999, but reading and analysis will not be complete until 2000.

S.13 Sport halibut fishery review
Status: new
Cost: Staff salaries
Anticipated ending: 1999
Personnel: Blood

Technical Report Number 13, The Sport Fishery for Halibut: Development, Recognition and Regulation by Bernard Skud, was written over 20 years ago and the nature of the sport fishery has matured and changed greatly since that initial report. This report would trace the growth of the sport fishery for halibut over the last 25 years, describe the changing role of the IPHC to that fishery, and document data collection of sport harvest. The IPHC role has recently diminished to little more than monitoring management activities of other agencies and councils, and receiving and assembling catch data from those agencies.

S.14 Sport tagging review
Status: ongoing
Cost: $3,000 plus staff salaries
Began: 1995
Anticipated ending: under review
Personnel: Blood

This review will bring up to date the sport tagging program which was begun in 1994 at the request of the sport charter industry. This program is basically a cost $0 program since the IPHC charges participants for the cost of tagging supplies. We canvassed tagging participants in 1997 to see if the program addressed their needs and whether it should be continued. Over 110 charters have participated in the program, but only a core group of 15 to 25 are active participants.

S.15 Marginal increment analysis
Status: new
Cost: Staff salaries

Anticipated ending: 2001
Personnel: Blood, Trumble

This project is being initiated to improve reliability of the age determination for Pacific halibut. For this study, we are collaborating with observer programs in both Canada and the United States. Selected observers on board groundfish vessels will collect several halibut otoliths per month. Data collection and otolith processing will occur in 1999 and 2000. Analysis will occur in 2001. We will use the otoliths collected to observe when during the year the halibut deposit annual growth rings. We will also investigate whether the timing varies by area and sex. This project was recommended after analyzing otoliths from the OTC age validation project.

S.16 NMFS trawl survey database at IPHC
Status: ongoing
1998 budget:
1998 cost:
1999 est. cost: $30,000 for otolith collection at sea, Staff salaries for database work
Began: 1995
Anticipated ending: ongoing
Total costs trough 1998
Description of costs: Sea sampler salaries
Personnel: Clark, Forsberg, Ranta

A series of NMFS trawl survey data on halibut, parallel to our setline data, would be extremely valuable to IPHC as a second fishery-independent data source for stock assessment. Trawl data are particularly useful because they include large numbers of juveniles (ages 3-7) that do not appear in large numbers in the setline survey. Since 1995 IPHC staff have collected otoliths on the triennial surveys. The halibut age data are incorporated into a copy of the NMFS haul data, expanded to estimates of relative abundance and age/size composition by IPHC area (NMFS calculates estimates by INPFC area), and stored in a database at IPHC. The task in this project is to add data from 1997 and 1998.

S.17 DNA development and evaluation
Status: New
Cost: Staff salary, $18,000
Personnel: Trumble, Larsen
Anticipated ending: 1999

This project is a direct result of the findings of the initial DNA project as addresses the three shortcoming of the pilot project: 1) complete collections from winter grounds, 2) identification of additional primer sets, and 3) testing of Mendelian inheritance. It is expected that the IPHC will collect samples from the 1998-99 winter surveys for use in further DNA microsatellite cloning work. This work would include the identification of additional primers which exhibit more moderate variability than currently identified primers. The third section of this project would involve basic research to confirm that the primers that have been selected follow standard Mendelian inheritance rules for alleles. The proposed work may be completed through a contract with Dr. Paul Bentzen of the University of Washington who has completed the current Halibut DNA contract.

U *Unfunded: Proposed Projects with Funding and Staff Unavailable with Current Budget (Many of these projects require a new biometrician, at about $70,000 per year for salary and benefits)*

U.1 Detailed analysis of trawl and setline survey data from Areas 2A and 3A.
Status: new
Cost: part of biometrician salary: $10,000
Personnel: biometrician

A detailed comparison of trawl and setline survey results from Area 2A and 3A could in principle show whether there are differences in setline catchability and selectivity between Area 2 and Area 3, both important questions for our present methods of assessment in Areas 2 and 3, and for our present method of quota allocation in Areas 3B and 4.

U.2 Effect of survey frequency on variability of biomass estimates.
Status: new
Cost: part of biometrician salary: $25,000
Personnel: biometrician

For areas where surveys lose money, the question is whether skipping some years really costs very much in terms of variance, or alternatively whether doing only very infrequent surveys produces usable estimates.

U.3 Misclassification of ages
Status: new
Cost: part of biometrician salary: $25,000
Personnel: biometrician, Forsberg

Halibut age readings (either surface or break-and-burn) are somewhat variable, and using them at face value misrepresents the age composition of the landings. In particular, it leads to underestimates of the strength of large year-classes. The error can be corrected by estimating a misclassification matrix and incorporating it into the assessment model. We have assembled datasets of independent readings by both methods for this purpose, but the analysis has not been done.

U.4 Determination of the sex of landed halibut
Status: new
Cost: part of biometrician salary: $10,000
Personnel: biometrician

Because of the changes in growth schedule that have taken place in the halibut stock, the distribution of size at age, and its variation over time, have an important effect on our model-based stock size estimates. One of the major determinants of the form of the size-at-age distribution is the difference in growth rate between females and males (females growing faster). We are not able to include this effect in our model because halibut are eviscerated at sea and the sex cannot be determined thereafter. Don McCaughran has done some work on sex discrimination based on otolith features. This work needs to be followed up and other possibilities pursued.

U.5 Complete stock assessment survey coverage of IPHC areas
Status: continuing (postponed)
Cost: Depends on fish price
Personnel: Hoag, Randolph

The staff would like to survey all areas of the coast annually. Funds are not available to survey Areas 2A, southern 2B, Area 4A edge, Area 4B, and Area 4D. These areas cost more to survey than the revenue they bring in from fish sales. To survey these areas in the future will require additional funding from government or industry, or an increase in fish prices. If fish prices increase in 1999 and surplus funds are available from the 1999 survey, it may be possible to survey some of these areas in 2000.

U.6 Geographical information system
Status: ongoing-new
Cost: half time salary for programmer: $30,000
Personnel: yet to be decided (Kong, Gilroy)

Geographical information systems (GIS) have been successfully used elsewhere in the analysis of fishery stock distributions, satellite imagery, demographics, and physical phenomenon such as depth and temperature. This project will develop a GIS system which will link habitat information with IPHC database records and develop a dynamic system for assessing habitat that can be compared with historical habitat measures previously developed using pencil and paper plotting techniques. Currently logbook location data are coded in an IPHC statistical area by hand, for example latitude and longitude are plotted on the chart the statistical area are determined. When this project is completed, IPHC statistical areas would be computer generated from the latitude/longitude location entered into the database.

U.7 Comparisons of halibut viability data between individual observers.
Status: New
Cost: observer costs for several vessels: $50,000
Personnel: Williams, Trumble

The objective is to test for observer bias in the current sampling for halibut viability determination. The current determination of excellent, poor, or dead viability is judged against subjective criteria by the observer. Recent proposals for new halibut bycatch monitoring in Alaskan CDQ fisheries would involve individual vessel bycatch quotas, with the vessel's ability to continue fishing based on the observer estimate of mortality, rather than on fleet performance against a fishery bycatch limit. Concern over the potential for observer bias or the repeatability of the observations has created the need to conduct this project, which would probably require 15-20 pairs of observers collecting viability observations on the same fish. Differences between observers would be tested for significance. This project could not be completed in Alaskan waters in 1999 because the Observer Program cannot the additional work. If funding for observers could be obtained, we may be able to do the work in Canada.

U.8 Trawl tagging for discard mortality rates.
Status: New
1998 est. cost: staff salaries
Personnel: Williams, Trumble

The objective is to improve our estimates of survival of halibut bycatch discarded from trawlers, and to relate survival to factors such as time on deck, haul size, and fish length. Discard mortality rates are an integral part of bycatch management in Alaskan and Canadian waters, and to efforts to reduce bycatch mortality. The project will be cost-neutral, as groundfish catch will be sold to offset IPHC travel and sea sampler costs. High staff commitments for other research activities preclude this work in 1999. A similar project conducted in 1995 resulted in almost 5,000 tags released, but the returns by the trawl fleet were insufficient for analysis. This proposal is expected to require 10,000 to 15,000 tagged halibut. Finally, this project is intended to update the initial work conducted off Canada with shore-based trawlers almost 30 years ago.

U.9 Halibut population identification using microsatellite cloning
Status: New
Cost: Staff salary, $30,000
Personnel: Trumble, Larsen
Anticipated ending: 2000

Using the results from the DNA Primer Set Identification project, samples that are collected during winter and summer surveys will be processed and analyzed. The number of samples and number of alleles that might be sampled would depend heavily on the results from the DNA Primer Set Identification project. The project goal is to expand and augment the initial Halibut DNA project by improving the identified deficiencies in the initial work while expanding the number of samples and alleles to offset the expected moderate (but hopefully not high) variability with the new primers. It is expected that the proposed work may be completed through a contract with Dr. Paul Bentzen of the University of Washington who has completed the current Halibut DNA contract.