

Size and age composition of Pacific halibut in NMFS Bering Sea shelf trawl surveys

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Abstract

The National Marine Fisheries Service eastern Bering Sea shelf trawl survey has been conducted annually since 1979. The survey time series is very useful for tracking large or small year classes of Pacific halibut as they move through the population and approach commercial size. Since 1998, the International Pacific Halibut Commission has deployed a biologist on the survey to collect halibut otoliths for age composition.

Introduction

The National Marine Fisheries Service (NMFS) has conducted annual bottom trawl surveys on the eastern Bering Sea (EBS) shelf since 1979. Pacific halibut occupy a vast area of the shelf for which the Commission lacks the financial resources to sample in its entirety. Therefore in some years, the trawl survey is the only measure of abundance for much of this area. This paper presents size composition and abundance estimates for the years 1990-2008 and age composition for the years 2005-2007.

The survey trawl gear is size-selective, making the data collected difficult to include directly in the International Pacific Halibut Commission (IPHC) stock assessment. Halibut are vulnerable to the trawl from about 20-100 cm, but a significant portion of the commercial-sized population (≥ 82 cm in length) exceeds 100 cm. Trawl information is also useful as a forecasting tool for upcoming year class strength. In 2006, the IPHC added stations to its setline survey in the Bering Sea region along the shelf in order to compare information from setline stations in that area with data collected on the trawl survey. The gear used in the trawl survey is size selective, making the data difficult to incorporate into the halibut stock assessment. However, after the 2006 comparative study, the IPHC staff concluded that the trawl survey provided an adequate accounting of halibut biomass on the EBS shelf (Clark and Hare 2007). The IPHC had planned to repeat the EBS shelf setline survey in 2008 to provide an additional point of comparison between the two types of surveys, however, due to logistical reasons, the EBS setline survey was not conducted in 2008.

Survey description

The trawl survey used a 20 nmi square grid design and spanned from inner Bristol Bay to St. Matthew Island, within the 200 m depth contour. The stations were placed at the center of each grid square, and additional stations were placed at the corners of grid cells in areas surrounding St. Matthew and the Pribilof Islands to better assess blue king crab (*Paralithodes platypus*) density.

From 2000 to 2004, several stations within the 0-30 m depth stratum were added to investigate juvenile yellowfin sole (*Limanda aspera*) distribution. Some halibut were caught at these nearshore stations but the results were not incorporated into the NMFS abundance estimates and are not included in this report. In 1987, stations were added to better assess the abundance and distribution of shifting populations of pollock (*Theragra chalcogramma*) and snow crab (*Chionoecetes opilio*). The number of these stations varies annually, and data from these stations are included in the abundance estimates herein. There were no adjustments made in calculations after the addition of the northerly stations; however, they appear to have very little if any affect on the overall abundance estimates for halibut.

Since 1982, the gear used for standardized bottom trawl sampling has been a NMFS 83-112 Eastern trawl with a 25.3-m headrope and 34.1-m footrope. The trawl net was deployed with equipment that recorded data for describing the physical environment and estimating area swept. Equipment included a Netmind trawl monitoring system for recording net height and width; a Seabird data logger for recording temperature and depth, and a tilt sensor for detecting when the footrope was fishing on the bottom. A 30-minute tow was attempted at each station.

Length and age distribution

All halibut caught during the survey were measured for length. Estimates of relative abundance were derived by expanding the survey catches from the area swept by the trawl to the total survey area. Estimates were not adjusted for size-specific selectivity, so the reader should exercise caution when drawing conclusions regarding halibut that are underrepresented in the trawl survey, i.e., greater than about 80 cm in length.

Total abundance as estimated by the trawl survey in 2008 was just over 108 million halibut. Abundance has been decreasing after achieving a record high of 134 million fish in 2006, but is still well above the average in recent years (Figs. 1 and 2). Generally, halibut that are 40-80 cm in length make up the largest proportion of the catch. In 2006-2007, the under-40 cm halibut dominated the overall catch, however, this year the 40-80 cm category is once again the most abundant in the catch. (Fig. 2). A similar pattern was seen in the early 1990s when the exceptionally large 1987 and 1988 year classes were moving through the juvenile population. Although the patterns are similar, the current number of juvenile halibut is estimated at about twice that seen in 1990.

The age composition for 2005-2007 is shown in Tables 1-3. In 2006, ages from the sampled fish showed that almost half, 47% of the surveyed population, were 2-year olds, making this the largest year class represented in the survey since we began our age sampling in 1998 (Table 2). While it is highly likely this year class is larger than most, it will take many more years of data to clearly understand its contribution to the stock and the commercial fishery. Age composition tables for 1998 through 2004 can be found in Sadorus and Lauth (2007), and Sadorus and Lauth (2008).

References

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Table 1. Age composition information for the 2005 NMFS Bering Sea trawl survey where the proportion of the catch is an extrapolation of fish age and length to total abundance.

Age (years)	Mean length (cm)	Std. dev of length	Fish aged	Prop. of catch
2	23.1	3.37	99	0.128
3	38.0	4.02	254	0.348
4	47.6	4.07	147	0.180
5	54.6	4.19	75	0.105
6	60.5	5.59	68	0.088
7	68.6	6.86	54	0.059
8	69.0	8.11	15	0.021
9	80.2	12.06	18	0.018
10	78.3	13.18	12	0.015
11	78.6	3.91	5	0.006
12	-	-	0	0.000
13	92.5	3.54	2	0.003
14	104.0	-	1	0.003
15	103.3	23.97	3	0.003
16	103.4	15.98	8	0.005
17+	109.0	30.56	20	0.018
Total			781	1.000

Table 2. Age composition information for the 2006 NMFS Bering Sea trawl survey where proportion of the catch is an extrapolation of fish age and length to total abundance.

Age (years)	Mean length (cm)	Std. dev of length	Fish aged	Prop. of catch
1	12.8	2.36	4	0.001
2	22.2	2.13	1,422	0.469
3	32.0	6.23	446	0.185
4	47.1	4.34	338	0.156
5	54.8	4.50	137	0.061
6	62.1	7.71	82	0.038
7	68.2	9.16	68	0.033
8	74.5	9.53	49	0.022
9	76.9	9.01	14	0.006
10	81.1	13.33	16	0.007
11	82.2	9.78	14	0.008
12	92.8	14.24	5	0.002
13	85.7	13.28	3	0.002
14	-	-	0	0.000
15	95.0	-	1	0.000
16	102.5	33.60	6	0.003
17+	109.8	20.54	16	0.007
Total			2,621	1.000

Table 3. Preliminary age composition information for the 2007 NMFS Bering Sea trawl survey where proportion of the catch is an extrapolation of fish age and length to total abundance. Note that a large portion of the halibut that were ≤ 30 cm forklength were kept for a separate project (Wischniowski 2009) and have not yet been aged. Therefore, the smallest size classes may be misrepresented.

Age (years)	Mean length (cm)	Std. dev of length	Fish aged	Prop. of catch
2	19.7	3.55	25	0.184
3	33.4	3.89	149	0.178
4	39.1	5.92	351	0.245
5	46.1	7.11	293	0.166
6	53.1	7.88	165	0.093
7	60.2	9.48	90	0.056
8	68.3	11.52	47	0.030
9	78.9	13.47	34	0.022
10	74.5	10.76	17	0.011
11	87.0	10.68	4	0.003
12	82.2	11.23	6	0.005
13	107.0	-	1	0.000
14	112.3	8.42	4	0.001
15	112.7	35.02	3	0.001
16	-	-	0	0.000
17+	109.5	16.53	10	0.004
Total			1,199	1.000

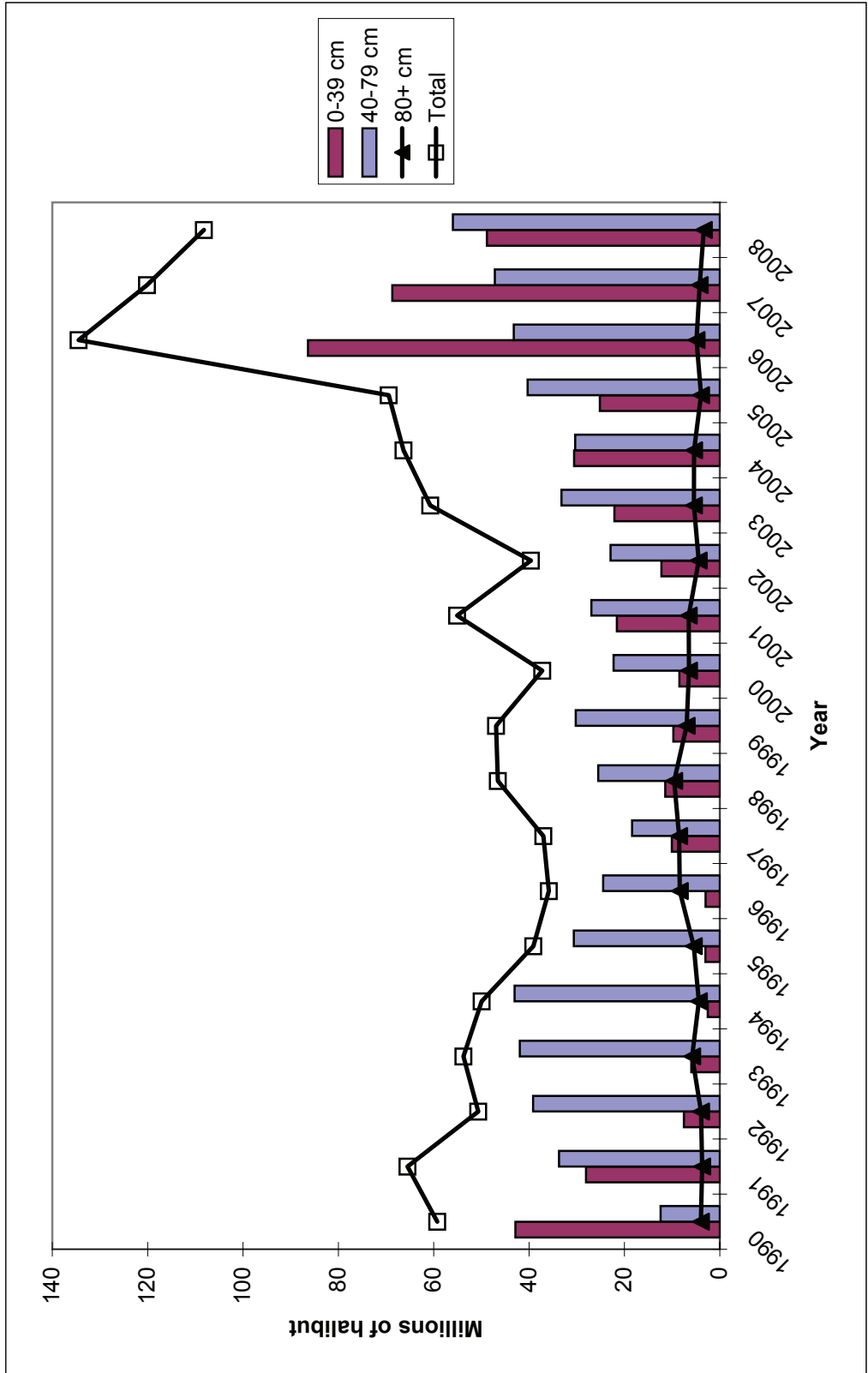


Figure 1. Abundance of halibut by length category in the NMFS Bering Sea trawl survey from 1990 to 2008, using area-swept estimates.



Figure 2. Abundance of halibut grouped by 10-cm size category in the NMFS Bering Sea trawl survey for the years 1999-2008 (horizontal axis is length in cm; vertical axis is millions of halibut).

