

Abundance and recent age composition of Pacific halibut as estimated by the 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. The abundance estimate for 2011 was 96.2 million halibut, continuing a several-year downward trend in abundance. The 2004 year class remains strong based on age compositions through 2010. An exploration into the more northerly areas of the Bering Sea and Norton Sound showed that there are reasonable numbers of halibut residing there and that these fish are larger at the same age than their southern Bering Sea counterparts.

Introduction

The National Marine Fisheries Service (NMFS) has conducted annual bottom trawl surveys on the eastern Bering Sea (EBS) continental shelf since 1979 and also conducted an exploration into the more northerly areas of the Bering Sea and Norton Sound in 2010 (Lauth 2011). Pacific halibut occupy a vast area of the shelf for which the Commission lacks the financial resources to sample in its entirety. Therefore, in most years, the NMFS trawl survey is the only measure of abundance for much of this area. This paper presents size composition and abundance estimates for the years 1991-2011 and age composition for 2010 (see Sadorus et al. (2011) for earlier years).

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 fork length (FL), but a substantial portion of the commercial-sized population (O32 or ≥ 81.3 cm FL) 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 on the shelf in order to compare information from setline stations in that area with data collected on the trawl survey. After the study, the IPHC staff concluded that the trawl survey provided an adequate accounting of halibut biomass on the EBS shelf (Clark and Hare 2007). Although IPHC has not repeated its entire shelf setline survey since 2006, stations around the Pribilof Islands and St. Matthew Island have been permanently incorporated into the annual setline survey.

Survey descriptions

The standard trawl survey used a 20 nmi square grid design extending 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 and again in 2011, several stations within the 0-30 m depth stratum were added to investigate the near shore distribution of either juvenile yellowfin sole (*Limanda aspera*) or red king crab (*P. camtschaticus*). 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 2001, stations were added north of the standard survey sampling area to better assess abundance and distribution of pollock (*Theragra chalcogramma*) and snow crab (*Chionoecetes opilio*) populations. The number of these stations has varied 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, or no, effect on the overall abundance estimates for halibut.

Since 1982, the area was surveyed using 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 describing each tow: a Netmind¹ trawl mensuration system recorded net height and width, a Sea-Bird² data logger recorded temperature and depth, and a tilt sensor was used to detect when the footrope hit the bottom. A 30-minute tow was attempted at each station.

Length and age distribution

Standard survey

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., halibut greater than about 100 cm in length.

Total abundance as estimated by the trawl survey in 2011 was just over 96 million fish, which continues a downward trend in total abundance seen in recent years (Figs. 1 and 2). Except for a slight increase in 2010, total abundance has been decreasing steadily since achieving a record high of 134 million fish in 2006. In 2006-2007, the under-40 cm halibut dominated the overall catch, but in 2008, the 40-79 cm size class regained that position and has been increasing ever since (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. The overall patterns are similar, but growth rates are substantially lower now than in the early 1990s, which could delay and/or dampen the overall contribution these fish make to the commercial fishery.

The age compositions for 2010, for both the standard survey and the exploratory northern extension, are shown in Tables 1 and 2, respectively. In 2006, ages from the sampled fish showed that almost half, or 47% of the surveyed population, were 2-year olds, making this the largest year class represented in the survey since the IPHC began the survey annual sample in 1998. This 2004 year class has remained strong in samples from subsequent years and as 6-year-olds in 2010, was

¹Northstar Technical Inc., 1 Duffy Place, St. John's, NL, A1B 4M6.

²Sea-bird Electronics Inc., 13431 NE 20th Street, Bellevue, WA, 98005.

estimated at 30% of the population in the standard area and 28% in the northern extension. It's also interesting to note that average fork length of these and other year classes was substantially higher at age in the north than in the standard area.

References

- Clark, W. G., and Hare, S. H. 2007. Assessment of the Pacific halibut stock at the end of 2006. IPHC Report of Assessment and Research Activities 2006: 97-128.
- Lauth, R.R. 2011. Results of the 2010 eastern and northern Bering Sea continental shelf bottom trawl survey of groundfish and invertebrate fauna. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-227, 256 p.
- Sadorus, L. L., Lauth, R. and Ranta, A. 2011. Size and age composition of Pacific halibut in NMFS Bering Sea shelf trawl surveys. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2010: 451-458.

Table 1. Age composition information for the 2010 NMFS Bering Sea trawl survey standard grid where the proportion of the catch is an extrapolation of fish age and length to estimated abundance.

Age	Mean fork length (cm)	Std. error of fork length	Fish aged	Prop. of catch
1	20.0	0.00	2	0.001
2	21.4	1.81	108	0.043
3	29.7	4.03	93	0.043
4	37.0	3.46	187	0.099
5	43.3	5.68	276	0.162
6	48.3	5.98	483	0.303
7	56.7	7.79	244	0.153
8	62.3	6.84	155	0.100
9	68.3	9.07	89	0.055
10	80.9	10.40	27	0.016
11	89.1	16.85	15	0.009
12	89.4	14.99	7	0.005
13	81.2	7.56	5	0.002
14	103.5	25.96	4	0.004
15	81.7	1.15	3	0.002
16	99.0	12.73	2	0.001
17+	106.2	27.46	6	0.004
Total			1,706	1.000

Table 2. Age composition information for the 2010 NMFS Bering Sea trawl survey northern exploratory stations where the proportion of the catch is an extrapolation of fish age and length to estimated abundance.

Age	Mean fork length (cm)	Std. error of fork length	Fish aged	Prop. of catch
4	39.3	3.06	3	0.012
5	49.3	4.23	58	0.274
6	56.7	5.10	56	0.282
7	63.4	7.36	33	0.162
8	73.3	5.82	35	0.164
9	81.4	13.89	11	0.052
10	90.1	7.61	8	0.035
11	92.8	2.99	4	0.015
12	132.0	-	1	0.004
Total			209	1.000

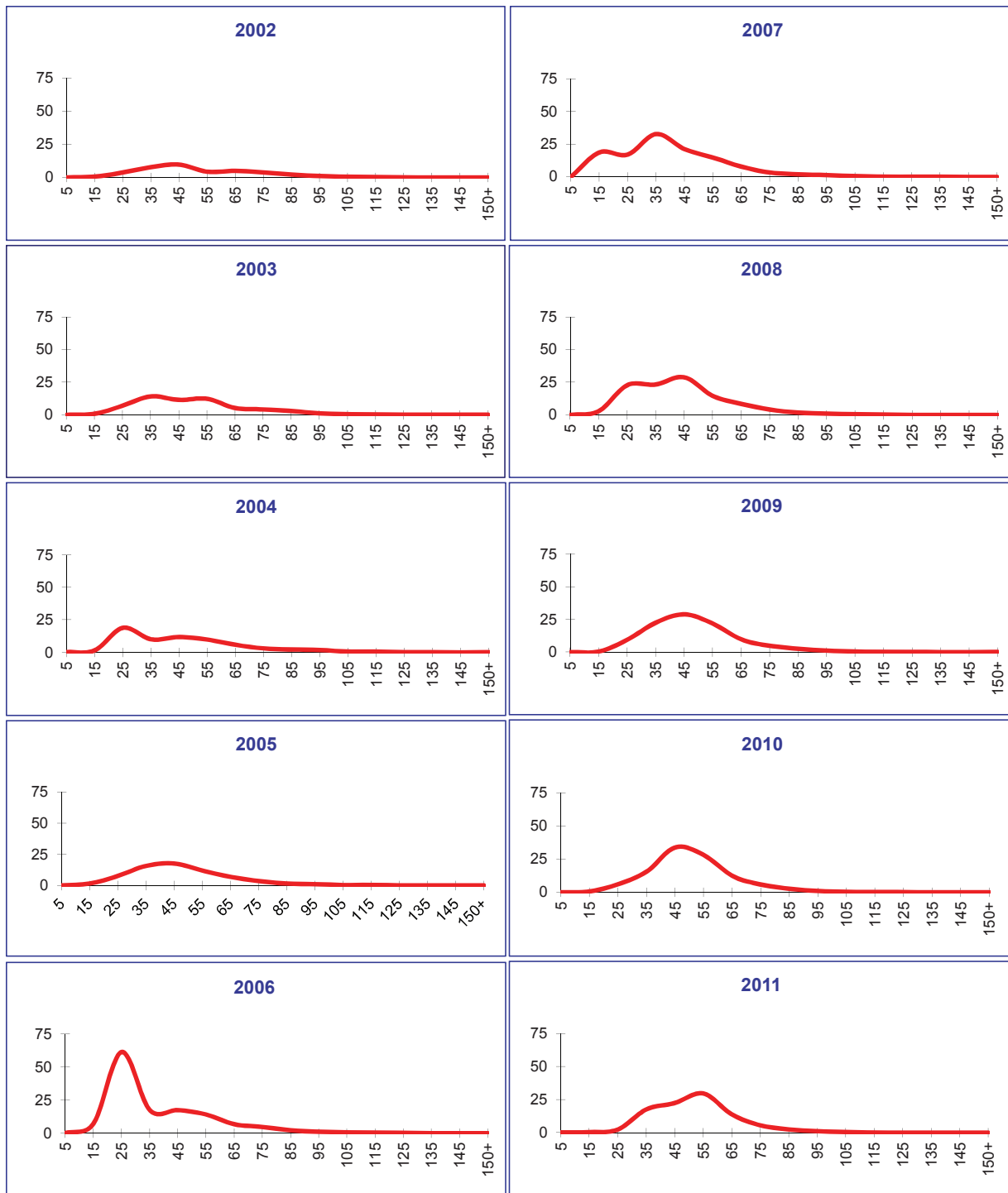


Figure 1. Halibut abundance in the Bering Sea as estimated by the NMFS Bering Sea trawl survey for the years 2002-2011. Note: Horizontal axis is fork length Lowess smoothed by 10-cm size category; vertical axis is millions of halibut.

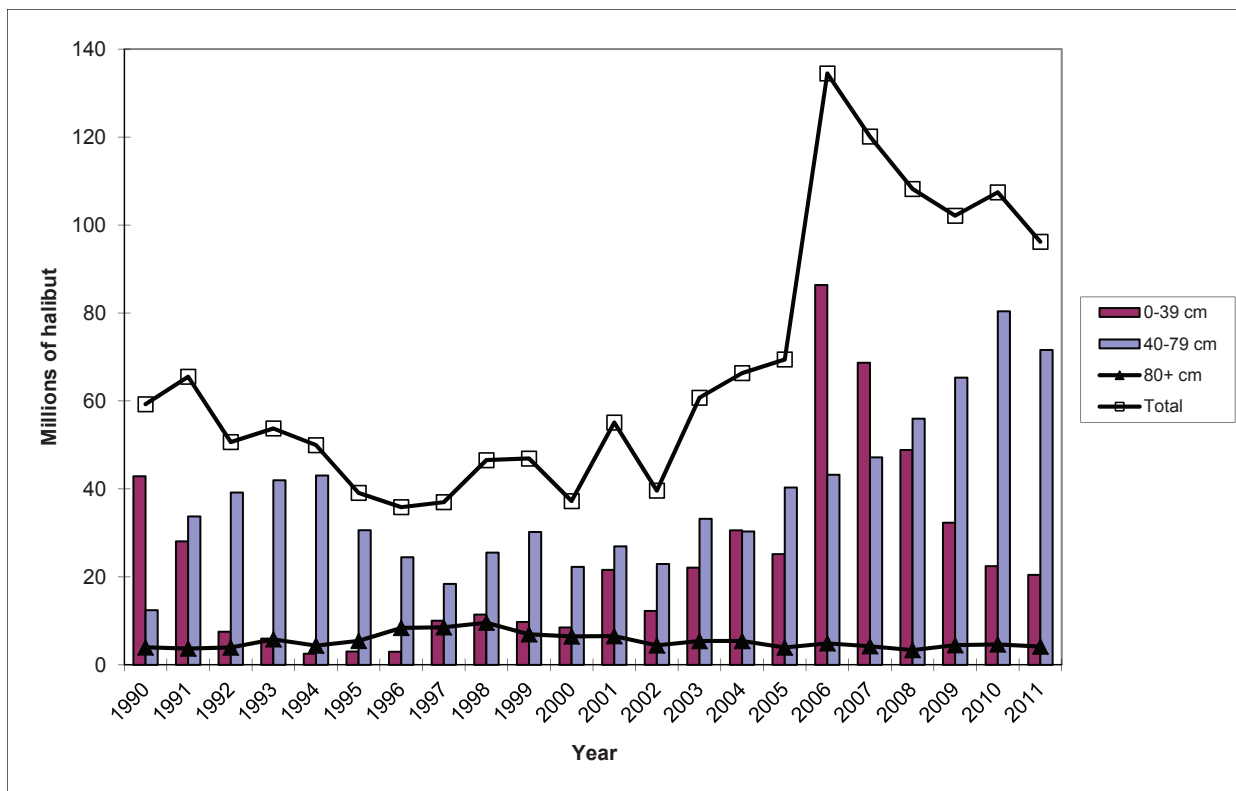


Figure 2. Abundance of halibut by length category in the NMFS Bering Sea trawl survey from 1991-2011, using area-swept estimates.