

Abundance and age composition of Pacific halibut as estimated by the NOAA Fisheries Service Gulf of Alaska bottom trawl survey

Lauri L. Sadorus

International Pacific Halibut Commission

Wayne A. Palsson

NOAA Fisheries Service

Aaron M. Ranta

International Pacific Halibut Commission

Abstract

The NOAA Fisheries Service Gulf of Alaska bottom trawl survey was conducted every three years between 1984 and 1999 and every two years thereafter. The total abundance estimate for halibut peaked in 2009 at 243 million halibut and dropped substantially in 2011 to just over 136 million fish. Aging data from 2009 indicates that the 2004 and 2005 year classes make up a large proportion of the sampled fish.

Introduction

The NOAA Fisheries Service (NFS) conducts bottom trawl surveys in the Gulf of Alaska (GOA) from the Islands of Four Mountains in the western Gulf to Dixon Entrance in Southeast Alaska. This paper presents size composition and abundance estimates for the years 1990-2009 and age composition for 2007 and 2009 as estimated through the NFS trawl survey data. Age composition data from earlier surveys can be found in Sadorus et al. (2010).

NFS scientists routinely collect catch and length data for Pacific halibut, but since 1996 an International Pacific Halibut Commission (IPHC) biologist has been aboard these surveys to collect more in-depth information. The biologists are able to sample for otoliths, length, sex, and maturity data. The data are used as a stock assessment tool and to identify trends in size-at-age as well as indicate particularly large or small year classes moving through the juvenile population and approaching commercial size.

Survey description

The NFS has conducted a triennial GOA continental shelf survey since 1984, and beginning in 1999 the area has been surveyed biennially. The survey region extends from the Islands of Four Mountains (170° W longitude x 53° 30' N latitude) to Dixon Entrance (132° W longitude x 54° N latitude). The primary NFS objective for the survey is to define the distribution and relative abundance of various groundfish and invertebrate species. Due to budget and manpower issues, the 2001 survey was truncated to include only the area from the Islands of Four Mountains to

Montague Island (147° 30' W longitude x 60° N latitude) at the entrance of Prince William Sound. The full range survey was restored in 2003.

The 1993, 1996, and 2001 surveys placed stations at depths ranging between approximately 20 and 500 m. The 1999 and later surveys were extended to include the GOA slope to as deep as 1000 m, subject to budget and time constraints. Because the survey is conducted in the summer months (May to July) when halibut tend to occupy relatively shallow depths (<500 m), the variation in maximum depth has not affected halibut data collection.

A random stratified design was used based on International North Pacific Fisheries Commission (INPFC) regions (Fig. 1), bathymetry, and major geographic features (Brown 1986). Stations were allocated among strata according to expected variance of catch rates (Clark et al. 1997). A map of station locations is available in Sadorus and Palsson (2012).

Standard NMFS Poly-Nor' eastern high-opening bottom trawls, rigged with 36-cm rubber bobbin roller gear, were used exclusively for sampling the selected survey stations. Various electronic devices installed on the survey trawl to measure net spread and bottom contact were used to gauge gear performance and the vessels were equipped with military-grade GPS units for plotting distance trawled (NMFS 2001). Beginning with the 1996 survey, a 15-minute tow at a speed of 3 nmi/hr was attempted at each designated station. Prior to that year, a 30-minute tow was attempted.

Nearly all halibut caught on the surveys aboard all vessels were measured for length. Relative biomass and abundance estimates were derived by calculating a mean density of halibut for each stratum, multiplying the mean density by the stratum area, and then summing across strata (Clark et al. 1997). The data are reported by INPFC regions, which are the area designations used by NFS to present their survey results. For comparison, INPFC regions correspond with IPHC regulatory areas as follows: Shumagin encompasses the western portion of Area 4A and eastern 3B; Chirikof is almost completely contained within Area 3B with the exception of a very small portion of Shelikof Strait; Kodiak and Yakutat are primarily in Area 3A; and Southeast corresponds to the eastern portion of Area 3A and the outside waters of Area 2C (Fig. 1).

Age composition, abundance, and distribution

The 2011 abundance estimate of 136 million halibut is substantially less than the 2009 estimate (Fig. 2). In 2009, a strong bimodal distribution of halibut was evident with peaks in the 40-50 and 60-70 cm size categories. Age data indicated the highest peak was primarily made up of the 2004 and 2005 year classes (recent age compositions are available in Tables 1 and 2) which have also recently shown strongly in the Bering Sea (Sadorus et al. 2012). The second peak in the 2011 size distribution curve appears to generally be composed of halibut spawned during the first 3-4 years of the 2000s. In 2011, the peaks diminished considerably and there is now only a remnant of the bimodal curve with the strongest peak at the 50-60 cm size category. Age data are not yet available for these fish.

The decline in 2011 appears in all areas and across all size classes (Figs. 3 and 4). Survey data points can vary widely and any one point may not necessarily reflect stock abundance. Therefore, it will take several more years to determine if the decline is a true decline in halibut numbers, survey variability, or both.

References

- Brown, E. S. 1986. Preliminary results of the 1984 U.S.-Japan Cooperative Bottom Trawl Survey of the central and western Gulf of Alaska. In Major, R.L. (editor), Condition of groundfish resources of the Gulf of Alaska region as assessed in 1985. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-106. p.259-296.
- Clark, W. G., St-Pierre, G., and Brown, E. S. 1997. Estimates of halibut abundance from NMFS trawl surveys. Int. Pac. Halibut Comm. Tech. Rep. 37.
- National Marine Fisheries Service. 2001. Scientific Operations Plan, 2001 Gulf of Alaska Bottom Trawl Survey. Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, Seattle, Washington.
- Sadorus, L. L. and Palsson, W. A. 2012. Cruise report for the 2011 NOAA Fisheries Service Gulf of Alaska trawl survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2011: 597-604.
- Sadorus, L., Lauth, R., and Ranta, A. M. 2012. Abundance and recent age composition of Pacific halibut as estimated by the NMFS Bering Sea shelf trawl surveys Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2011: 583-588.
- Sadorus, L., Wilkins, M. E., and Ranta, A. 2010. Abundance, distribution, and age composition of Pacific halibut by the NMFS Gulf of Alaska trawl survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2009: 633-642.

Table 1. Distribution of age (years) and length-at-age (cm) in the 2007 NFS Gulf of Alaska bottom trawl survey. Note: proportion of catch is an extrapolation of fish age and length to total abundance.

Age	Mean fork length	Std. error of fork length	Fish aged	Prop. of Catch
1	17.0	-	1	0.001
2	24.7	3.36	204	0.090
3	37.3	3.86	302	0.133
4	46.3	5.63	255	0.105
5	52.1	5.00	296	0.115
6	57.5	5.53	199	0.080
7	61.3	6.15	302	0.122
8	65.0	7.32	320	0.131
9	71.2	9.90	171	0.068
10	74.1	9.11	77	0.031
11	78.1	9.34	73	0.028
12	81.1	11.12	82	0.031
13	82.8	11.83	49	0.017
14	89.6	19.55	25	0.008
15	84.8	8.45	21	0.007
16	88.8	12.30	26	0.008
17	89.5	14.37	10	0.004
18	98.6	20.93	13	0.004
19	89.0	11.92	14	0.006
20+	97.7	16.47	49	0.014
Total			2,489	1.000

Table 2. Distribution of age (years) and length-at-age (cm) in the 2009 NFS Gulf of Alaska bottom trawl survey. Note: proportion of catch is an extrapolation of fish age and length to total abundance.

Age	Mean fork length	Std. error of fork length	Fish aged	Prop. of catch
2	24.1	4.48	46	0.034
3	33.3	5.05	165	0.065
4	41.2	5.16	633	0.189
5	47.6	5.62	532	0.160
6	54.3	6.28	375	0.115
7	60.7	7.03	388	0.119
8	65.5	6.89	258	0.079
9	69.0	9.05	317	0.094
10	72.6	9.11	205	0.059
11	76.0	10.42	126	0.034
12	82.7	14.28	61	0.015
13	87.1	15.86	55	0.012
14	84.9	16.04	36	0.008
15	83.1	11.61	19	0.005
16	93.6	17.53	11	0.002
17	89.7	15.65	9	0.002
18	95.4	17.85	13	0.003
19	95.7	14.14	7	0.001
20+	96.6	9.66	21	0.003
Total			3,277	1.000

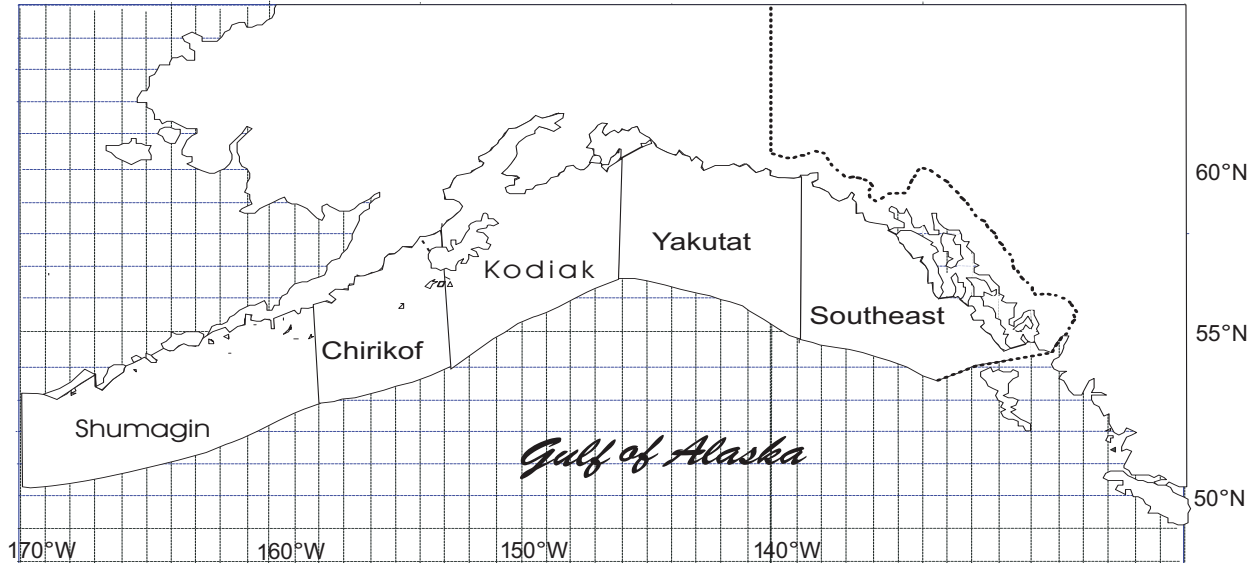


Figure 1. INPFC regions in the Gulf of Alaska.

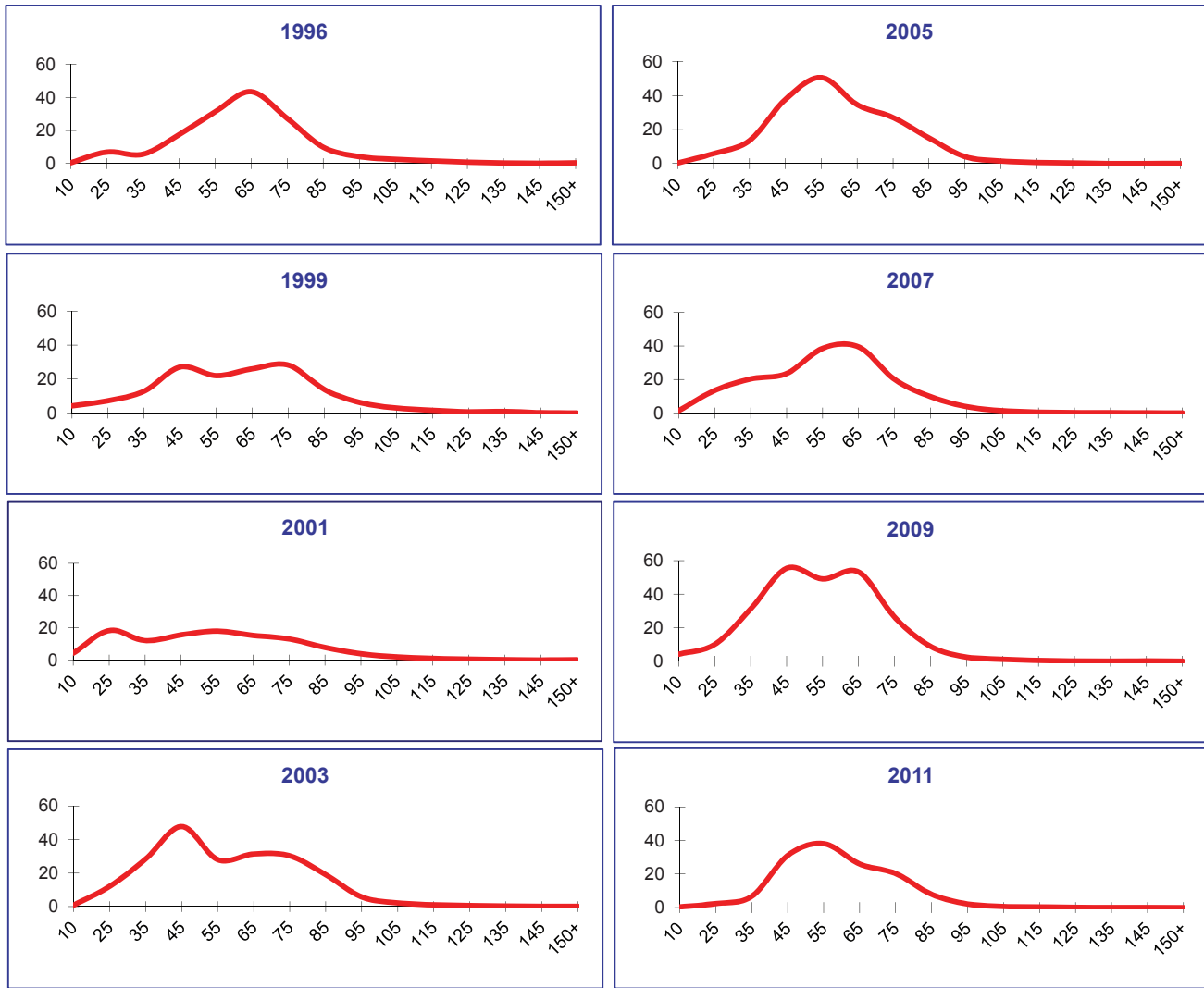


Figure 2. Halibut abundance in the Gulf of Alaska as estimated by the NFS bottom trawl survey. (Vertical axis is millions of fish, horizontal axis is length, line is lowess-smoothed by 10-cm size category). Note: The 2001 abundance estimates include only the Shumagin, Chirikof, and Kodiak regions. The Yakutat and Southeast regions were not surveyed. All other years include all areas.

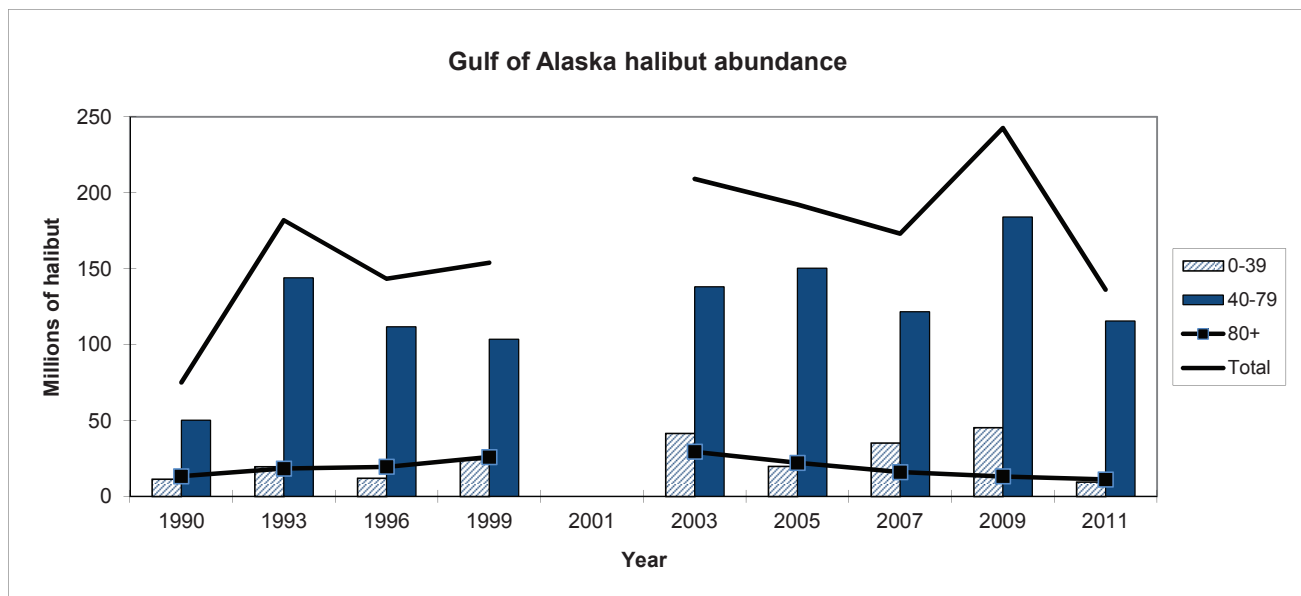


Figure 3. Total abundance (millions of halibut) by size category for the years 1990-2011 as estimated by the NFS Gulf of Alaska bottom trawl survey. Note that the 2001 estimate is absent in this figure because the survey did not include all areas that year.

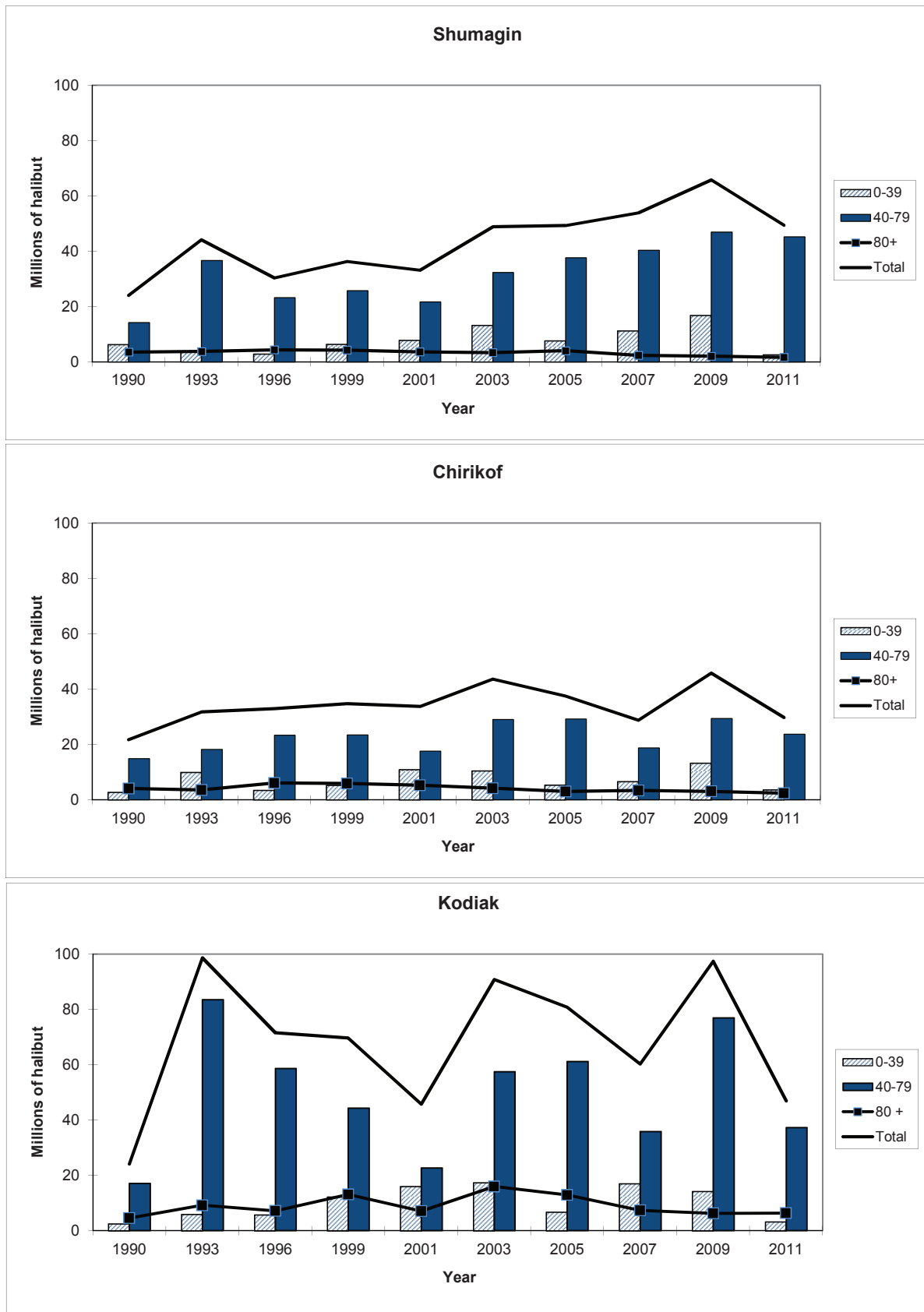


Figure 4a. Abundance trends (millions of halibut) by size category for the Shumagin, Chirikof, and Kodiak regions for the years 1990-2011 as estimated by the Gulf of Alaska NFS trawl survey.

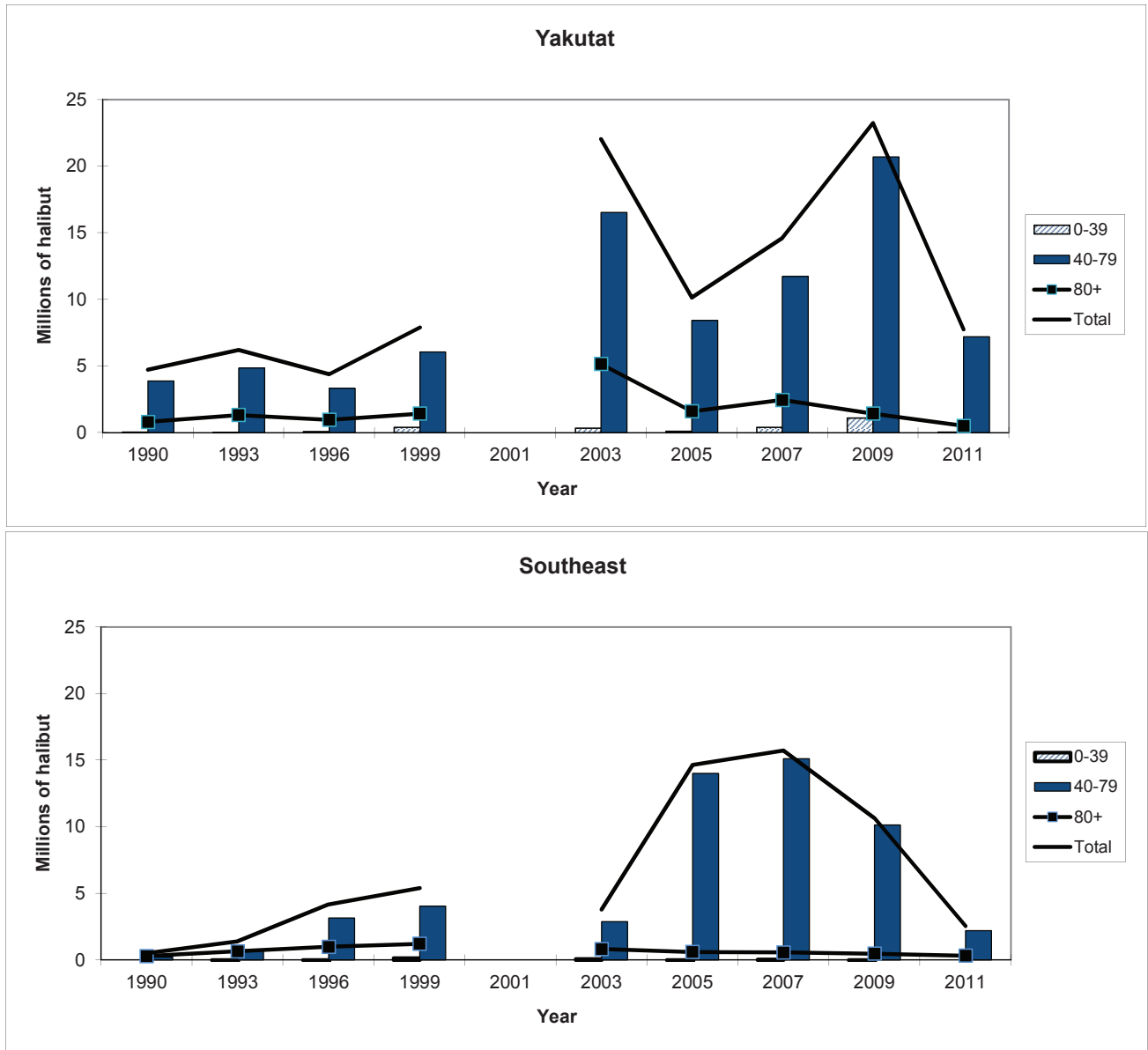


Figure 4b. Abundance trends (millions of halibut) by size category for the Yakutat and Southeast regions for the years 1990-2011 as estimated by the Gulf of Alaska NFS trawl survey. Note that the 2001 survey did not include these areas.

