

**Pacific Halibut Bycatch in IPHC Area 2A
in the 2006 Groundfish Trawl Fishery**

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ABSTRACT

This report updates the estimates of Pacific halibut bycatch and mortality in the bottom trawl fishery through the calendar year 2006. The estimates of halibut bycatch and mortality in the bottom trawl fishery are based upon the method developed in the report for 1999 (Wallace, 2000). The current report uses halibut bycatch rates observed for the 2006 calendar year by the West Coast Groundfish Observer Program. These rates are stratified by season, depth, latitude, and amount of arrowtooth flounder catch, and then multiplied by the amount of 2006 trawl effort in each stratum determined from Oregon and Washington trawl logbooks. Estimated halibut bycatch and mortality from other gear types has not been updated for 2006. The estimate for the 2006 bottom trawl fishery is 333,000 lb net weight of total halibut bycatch mortality, of which 252,000 lb is legal-sized. The net weight is 7 percent lower than in 2005. As in past reports, forecast of bycatch for the current year (2007) or future years is not attempted.

GROUNDFISH FISHERY BACKGROUND

Changes in the groundfish fishery and its management affect not only the amount of groundfish fishing effort, but also its geographic and temporal distribution. Since halibut bycatch rates vary among time and area strata, changes in the amount and distribution of effort will alter the amount of halibut bycatch that is estimated for the trawl fleet. Here we briefly describe the management changes that occurred in 2006.

During 2006, the trawl fishery north of 40°10' N. Lat. continued to be managed with use of the Rockfish Conservation Area (RCA), and the requirement that selective flatfish gear be used for fishing shoreward of the closed area. There were two noteworthy differences in the configuration of the RCA between 2005 and 2006. In 2005, the shoreward boundary of the RAC was set at the line approximating 100 fm from March through September. For this period in 2006, the shoreward boundary was set at the line approximating 75 fm, with the exception of July and August, where the boundary was at 100 fm. During October to December of 2005, the entire area shoreward of the 250 fm line was closed to bottom trawling, however, in 2006 the shoreward boundary of the RCA continued at 75 fm throughout the end of the year and designated petrale areas between 150 and 250 fm were open. Consequently less area was open to fishing in 2006 prior to October, but considerably more area from October on. This change is reflected in the fact that the number of hours trawled shoreward of the RCA in 2006 fell by roughly 1,200 from the start of the year through August, but increased by about 1,600 from September through December. Trawling seaward of the RCA increased by roughly 2,800 hours in 2006, primarily due to the availability of the petrale areas in November and December.

Near-shore trip limits for petrale and Dover soles, as well as sablefish, were somewhat lower in 2006, except at the end of the year, when the 2005 fishery was closed shoreward of 2005 fm. Most deep-water limits, as well as near-shore limits for other flatfish were generally comparable between the two years..

2006 BYCATCH ESTIMATES

Analysis of 2006 data from the West Coast Groundfish Observer Program

The WCGOP provided data for the complete calendar year of 2006 for this assessment. There were 2,327 bottom trawl tows between 48.667 and 40.667 degrees N. latitude included in this study (Figure 1). An estimated net total weight of 152,942 lb of halibut was caught in those tows. Eighty percent of these weights are estimated by using the Pacific halibut length-weight relationship (IPHC, personal communication), four percent are from actually weighing the fish, seven percent are from visual estimates, and the remaining nine percent is from other methods. The length frequencies of the halibut measured in the 2006 observer data are given in Table 1.

For all of the Limited-Entry groundfish trawl activity, methods similar to those in Pikitch (1998) were used to analyze the observer data and identify appropriate strata for bycatch estimation. These strata are season (Jan-Aug and Sept-Dec), depth (0-75, 75-150, 150-250, 250-700 fm), area (four latitude ranges) and catch of arrowtooth flounder (0-20 lb/hour and >20 lb/hour). Numbers

of tows, halibut catches, halibut catch rates, and the proportions of legal-sized halibut (>81 cm) are listed for each of these strata in Table 2.

Bottom Trawl Effort from Logbooks

Logbook data for Oregon and Washington in 2006 were obtained from PacFIN. Since ODFW does not collect logbook data for 100 percent of the trawl deliveries during a typical year, Oregon logbook effort (hours towed) was expanded using fish tickets on a port and month basis. This approach was used in order to avoid any potential bias created by unequal collection of logbooks in the three major ports (Astoria, Newport, and Coos Bay). For Washington trips, WDFW's "extrapolated and expanded" trawl effort for 2006 had problems which were not rectified in time for this report; hence raw haul duration was adjusted, by strata, using the same proportional adjustments as seen in 2005.

Logbook trawl effort (hours) for Oregon was expanded to that entire fleet using the ratio of total groundfish catch reported on fish tickets divided by logbook groundfish catch, for each port and month. These expansion ratios were applied to the tow effort (hours) to arrive at the expanded effort for Oregon's trawl fleet. The stratification scheme identified through analysis of observer data was then applied to the expanded logbook effort observations. Total fleet effort for each stratum in 2006 is reported in Table 2.

Halibut bycatch in each stratum was estimated by multiplying total (expanded) stratum effort by the stratum halibut bycatch rate. Bycatch by the bottom trawl fleet is estimated by summing across strata. If there was effort within a stratum, but no observer tows, the coast-wide average bycatch rate (14.39 kg per hour) was used. This value is calculated as the unweighted average of the stratum means. Preliminary work done in 2001 using a sophisticated approach of imputing missing data showed little difference, on the calculated total bycatch, between using the unweighted average of the stratum means and the imputed values.

Results

As in earlier years, half of the released halibut are assumed to survive capture (Gregg Williams, IPHC, personal communication). Therefore, discard mortality of halibut is assumed to be 50 percent of total discard. The proportion of legal-sized halibut (> 81cm) is estimated from the length frequencies of halibut measured in the observer data (Table 1). All measurements of fish lengths were converted to fish weight based on a length-weight relationship for Pacific halibut, and the proportion of legal-sized fish (by weight) was computed for each stratum (Table 2). The average proportion legal (73.13% by weight, calculated as the unweighted average of the stratum means) was used when no other estimate was available.

For comparison purposes, 2006 totals are shown together with annual totals since 1998 in Table 3. The 95% confidence limits, based on the variability in discard of halibut per trawl hour, are given in parentheses. Note that the trawl effort is assumed known without error; hence these confidence limits are a minimum estimate. All estimates from 2002 forward incorporate

observation data collected by the WCGOP. Total estimated discard mortality of halibut decreased by 7% between 2005 and 2006, despite an increase in overall trawl effort of 8.2 percent. Trawl effort in depths less than 150 fm, where halibut bycatch rates are generally higher, increased by only 2% (Table 4). The estimated mortality of halibut at 7.8 lb/hour is the second lowest seen since 1998. Estimated mortalities of 'all' and of 'legal-sized' halibut since 1977 are listed in Tables 5 and 6, respectively. The percentage of discard comprised by legal-sized fish (0.7544) was the second highest value in the time series, eclipsed only by the high seen in 2003. However, the total amount of halibut mortality in 2006 was the second lowest amount estimated over the past decade. Halibut discard was more evenly distributed among strata in 2006, with only 33% of the estimated discard of legal-sized fish occurred in highest eight (out of 64) strata included in the analysis. In 2005, the same eight strata accounted for 58% of the estimated discard of legal-sized fish.

It is not possible to make a forecast for the 2007 fishery given lack of a methodology to project the distribution of effort among model strata prior to the complete availability of a year's logbook data.

REFERENCES

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Table 1. Length frequencies for Pacific halibut from the West Coast Groundfish Observer Program data. (The upper limits on the length intervals are inclusive, the lower limits are not.)

Length Interval (cm)	Length Freq.	Percent Length Freq.
25-30	0	0.00
30-35	0	0.00
35-40	1	0.03
40-45	2	0.07
45-50	7	0.23
50-55	27	0.88
55-60	181	5.92
60-65	512	16.74
65-70	636	20.79
70-75	522	17.06
75-80	416	13.60
80-85	258	8.43
85-90	165	5.39
90-95	111	3.63
95-100	72	2.35
100-105	48	1.57
105-110	43	1.41
110-115	23	0.75
115-120	9	0.29
120-125	8	0.26
125-130	7	0.23
130-135	5	0.16
135-140	5	0.16
140-145	0	0.00
145-150	0	0.00
150-155	1	0.03
155-160	0	0.00
160-165	0	0.00
165-170	0	0.00
170-175	0	0.00
175-180	0	0.00
180-185	0	0.00
Total	3059	100

Table 2. Numbers of tows, halibut catches, halibut catch rates and effort, by strata, observed in the bottom trawl fishery by the West Coast Groundfish Observer Program. The last two columns, from 2005, are for comparison purposes. (The upper limits are inclusive for all intervals; the lower limits are not.)

SEASON: JANUARY - AUGUST

Arrowtooth Catch (lb/h)	Latitude	Depth (Fathoms)	Number of Observed Tows	Number of Tows with ≥ 1 Halibut	Wgt. (kg., rnd) Halibut per Hour	Trawl Effort (hours) from OR & WA	Proportion Legal by Weight	Number of Observed Tows 2005	Wgt. (kg., rnd) Halibut per Hour 2005
≤ 20	40.667 - 42.667	0 - 75	0	0		264.41		0	
		75 - 150	0	0		1.01		0	
		150 - 250	9	4	3.84	439.90		2	0.00
		250 - 700	50	2	0.07	984.64	0.73	17	0.07
42.667 - 46.667		0 - 75	402	196	10.59	4158.95	0.76	316	5.83
		75 - 150	62	22	7.90	730.63	0.74	95	5.59
		150 - 250	71	18	1.83	1814.13	0.62	65	2.70
		250 - 700	137	5	0.14	3596.86	0.86	152	0.27
46.667 - 47.667		0 - 75	155	96	10.73	2092.30	0.81	294	5.35
		75 - 150	4	3	1.89	87.86		21	37.24
		150 - 250	6	4	1.63	141.35		26	6.04
		250 - 700	27	3	0.25	698.48		31	1.95
47.667 - 48.667		0 - 75	146	114	36.88	1567.38	0.71	157	71.00
		75 - 150	18	13	22.33	198.58	0.34	197	48.45
		150 - 250	24	11	5.16	531.80		36	40.18
		250 - 700	34	1	0.18	923.44	0.55	22	0.07
> 20	40.667 - 42.667	0 - 75	0	0		1.75		0	
		75 - 150	0	0		1.07		0	
		150 - 250	0	0		94.88		9	5.56
		250 - 700	3	0	0.00	73.62		6	0.00
42.667 - 46.667		0 - 75	144	90	12.82	2239.27	0.76	152	6.71
		75 - 150	83	54	13.63	919.49	0.46	119	24.04
		150 - 250	164	78	3.17	2544.76	0.57	211	4.90
		250 - 700	61	15	1.62	1174.68	0.69	126	2.40
46.667 - 47.667		0 - 75	38	29	11.25	889.50		52	8.61
		75 - 150	9	6	12.32	155.24	0.85	11	16.67
		150 - 250	15	11	5.57	350.18	0.70	30	4.14
		250 - 700	4	1	0.48	103.60		16	6.74
47.667 - 48.667		0 - 75	54	54	51.79	592.23	0.87	79	46.04
		75 - 150	36	25	44.26	306.44	0.96	97	23.49
		150 - 250	21	16	27.57	419.78	1.00	23	7.99
		250 - 700	22	16	8.83	383.56	0.65	23	15.61

Table 2. Continued.

SEASON: SEPTEMBER - DECEMBER

Arrowtooth Catch (lb/h)	Latitude	Depth (Fathoms)	Number of Observed Tows	Number of Tows with ≥ 1 Halibut	Wgt. (kg., rnd) Halibut per Hour	Trawl Effort (hours) from OR & WA	Proportion Legal by Weight	Number of Observed Tows 2005	Wgt. (kg., rnd) Halibut per Hour 2005
≤ 20	40.667 - 42.667	0 - 75	0	0		85.88		0	
		75 - 150	0	0		0.00		0	
		150 - 250	5	2	1.25	315.84		0	
		250 - 700	8	1	0.91	532.23		30	0.02
	42.667 - 46.667	0 - 75	123	15	0.36	2149.03		16	5.06
		75 - 150	4	0	0.00	48.88		8	0.50
		150 - 250	8	3	5.03	707.17		12	23.79
		250 - 700	69	4	0.11	2575.73	0.77	57	0.10
	46.667 - 47.667	0 - 75	12	2	0.23	519.86		27	2.06
		75 - 150	0	0		0.00		1	2.91
		150 - 250	1	0	0.00	91.07		1	0.00
		250 - 700	1	1	0.97	193.14		9	0.00
	47.667 - 48.667	0 - 75	41	37	61.49	615.54		14	64.18
		75 - 150	6	2	75.05	74.31		7	3.42
		150 - 250	0	0	14.39	167.39		1	14.70
		250 - 700	6	3	0.81	511.73		23	2.40
> 20	40.667 - 42.667	0 - 75	0	0		2.47		0	
		75 - 150	0	0		0.00		0	
		150 - 250	0	0		37.12		1	2.66
		250 - 700	1	1	1.73	57.37		5	0.00
	42.667 - 46.667	0 - 75	76	16	0.74	1530.04		24	2.41
		75 - 150	10	2	0.49	72.63		52	8.83
		150 - 250	67	46	9.11	1603.51	0.95	22	8.50
		250 - 700	39	9	0.42	1333.55		22	1.92
	46.667 - 47.667	0 - 75	7	1	0.59	180.05		0	
		75 - 150	0	0		0.00		0	
		150 - 250	1	1	4.36	21.90		3	0.53
		250 - 700	0	0		35.21		2	0.00
	47.667 - 48.667	0 - 75	6	5	226.20	231.14		11	12.75
		75 - 150	25	2	0.71	114.91		13	9.43
		150 - 250	8	8	28.96	221.98		0	
		250 - 700	4	3	3.14	91.00		3	5.44

Table 3. Halibut bycatch and mortality in the Oregon and Washington bottom trawl fisheries for groundfish off the west coast. Estimates from 2002 forward are based on observations by the West Coast Groundfish Observer Program. All estimates in this table (except the seventh and last column) are derived from a sum over strata cells; see the text for details. The 95% confidence limits, based on the variability in discard of halibut per trawl hour, are given in parentheses. Note that the trawl effort is assumed known without error; hence these confidence limits are a minimum estimate.

Year	Trawl Effort (hours)	Estimated Halibut Bycatch (numbers)	Estimated Halibut Bycatch (kg, round)	Estimated Halibut Bycatch (lb, net)	Estimated Total Halibut Mortality (lb, net)	Est. Mortality (lb) per Trawl Hour	Estimated Legal-Sized Halibut Mortality (lb, net)	Estimated Legal-Sized divided by Total Halibut Mortality
1998	92,294	164,961	1,259,374	2,082,690	1,041,345	11.3	691,755	0.6643
1999	81,420	147,995	1,144,236	1,892,280	946,140	11.6	638,091	0.6744
2000	70,363	122,234	944,120	1,561,338	780,669	11.1	523,097	0.6701
2001	67,199	124,969	962,348	1,591,482	795,741	11.8	532,912	0.6697
2002	52,168	NA	618,913	1,023,527	511,764	9.8	286,221	0.5593
2003	58,339	NA	558,544	923,693	461,847	7.9	366,745	0.7941
2004	37,495	NA	296,225	489,882	244,941	6.5	171,754	0.7012
2005	39,377	NA	432,806	715,752	357,876	9.1	228,049	0.6372
2006	42,602	NA	403,194 (163k-688k)	666,782 (269k-1,137k)	333,391 (134k-569k)	7.8	251,507 (99k-430k)	0.7544

Note: Halibut bycatch by California bottom trawl fishery is not included. Mortality estimated at 50% of bycatch. Proportion of legal-sized mortality (>81 cm) estimated from length frequencies of fish measured by the West Coast Groundfish Observer Program. 1 kg, round = 1.65375 pounds, net weight.

Table 4. Trawl effort (hours) in the 2005 and 2006 bottom trawl fisheries off Oregon and Washington.

Arrowtooth Catch (lb/h)	Latitude	Depth (fathoms)	Trawl effort (hours)		% change from 2005 to 2006
			2005	2006	
≤ 20	40.667 - 42.667	0 - 150	171	351	105%
		150 - 700	1,741	2,273	31%
	42.667 - 46.667	0 - 150	6,724	7,087	5%
		150 - 700	6,629	8,694	31%
	46.667 - 47.667	0 - 150	2,220	2,700	22%
		150 - 700	1,318	1,124	-15%
	47.667 - 48.667	0 - 150	3,325	2,456	-26%
		150 - 700	1,603	2,134	33%
Total		0 - 150	12,441	12,595	1%
		150 - 700	11,292	14,225	26%
		All depths	23,733	26,820	13%
> 20	40.667 - 42.667	0 - 150	1	5	400%
		150 - 700	537	263	-51%
	42.667 - 46.667	0 - 150	4,303	4,761	11%
		150 - 700	6,569	6,657	1%
	46.667 - 47.667	0 - 150	777	1,225	58%
		150 - 700	633	511	-19%
	47.667 - 48.667	0 - 150	1,905	1,245	-35%
		150 - 700	920	1,116	21%
Total		0 - 150	6,986	7,236	4%
		150 - 700	8,659	8,547	-1%
		All depths	15,644	15,783	1%
Total	Total	0 - 150	19,427	19,831	2%
		150 - 700	19,950	22,772	14%
		All depths	39,377	42,602	8%

Table 5. Summary of total estimated bycatch mortality of Pacific halibut, in thousands of pounds, net weight, by fishery in 2A. Bycatch mortality estimates for 1977-1997 are reported from Table 3 in Williams, et al. 1998.

Year	Foreign, JV & Catcher-Proc.	Groundfish Trawls	Shrimp Trawls	Hook & Line	TOTAL
1977	3	308	82	16	409
1978	2	308	82	16	408
1979	1	308	82	16	407
1980	1	308	82	16	407
1981	Trace	308	82	16	406
1982	Trace	308	82	16	406
1983	1	308	82	16	407
1984	Trace	308	82	16	406
1985	Trace	308	82	16	406
1986	1	308	82	16	407
1987	1	308	82	16	407
1988	1	308	82	16	407
1989	2	308	82	16	408
1990	2	308	82	16	408
1991	2	308	82	16	408
1992	0	385	43	16	444
1993	0	385	43	16	444
1994	0	385	43	16	444
1995	0	548	50	16	614
1996	0	548	50	16	614
1997	0	548	50	16	614
1998	0	1,041	25	---	---
1999	---	946	---	---	---
2000	---	781	---	---	---
2001	---	796	---	---	---
2002	---	512	---	---	---
2003	---	462	---	---	---
2004	---	245	---	---	---
2005	---	358	---	---	---
2006	---	333	---	---	---

Note: Bycatch mortality by groundfish trawls in 1998-2004 does not include fisheries off California. Bycatch mortality by shrimp trawls in 1998 does not include fisheries off California and Washington.

Table 6. Summary of estimated mortality of legal-sized Pacific halibut, in thousands of pounds, net weight, by fishery in Area 2A. The bycatch mortality estimate for legal-sized halibut for 2005 is from this report. (Sums across fisheries may not equal the TOTAL due to rounding.)

Year	Foreign, JV & Catcher-Proc.	Groundfish Trawls	Shrimp Trawls	Hook & Line	TOTAL
1977	2	191	51	10	254
1978	1	191	51	10	253
1979	0.6	191	51	10	252
1980	0.6	191	51	10	252
1981	Trace	191	51	10	252
1982	Trace	191	51	10	252
1983	0.6	191	51	10	252
1984	Trace	191	51	10	252
1985	Trace	191	51	10	252
1986	0.6	191	51	10	252
1987	0.6	191	51	10	252
1988	0.6	191	51	10	252
1989	1	191	51	10	253
1990	1	191	51	10	253
1991	1	191	51	10	253
1992	0	239	27	10	275
1993	0	239	27	10	275
1994	0	239	27	10	275
1995	0	340	31	10	381
1996	0	340	31	10	381
1997	0	340	31	10	381
1998	0	692	16	---	---
1999	---	638	---	---	---
2000	---	523	---	---	---
2001	---	533	---	---	---
2002	---	286	---	---	---
2003	---	367	---	---	---
2004	---	172	---	---	---
2005	---	228	---	---	---
2006	---	252	---	---	---

Note: Bycatch mortality by groundfish trawls in 1998-2004 does not include fisheries off California. Bycatch mortality by shrimp trawls in 1998 does not include fisheries off California and Washington.

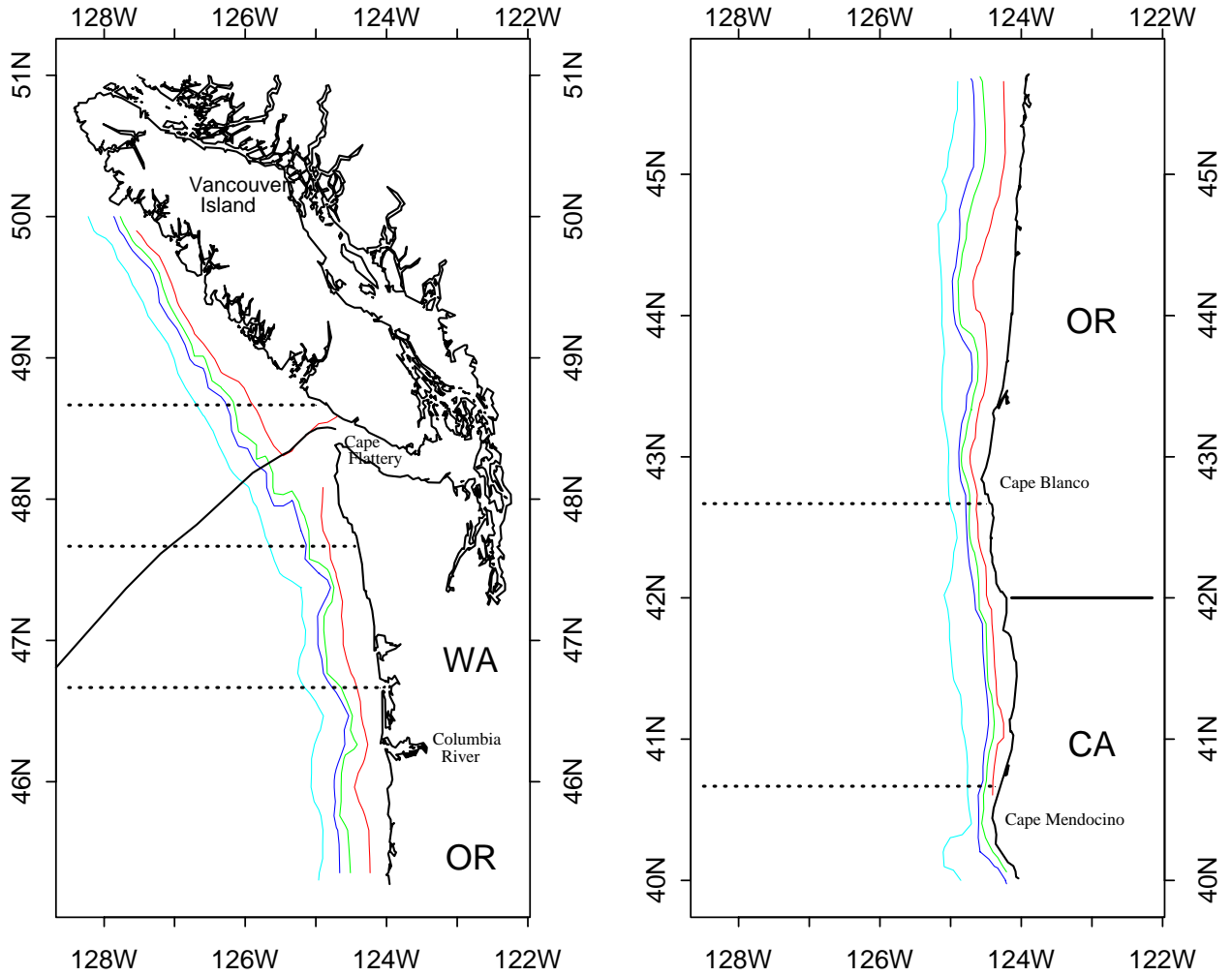


Figure 1. A map of IPHC area 2A with the latitudinal strata demarcated by dotted lines. In the most northerly strata only the area east of the EEZ line is covered by this report. Depth contours are plotted for 75, 150, 250, and 700 fathoms.