

Comparison of 2004-2006 Trawl Discard Estimates Obtained
Using Retained Tonnage and Trawl Hours as Measures of Effort

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The Northwest Fisheries Science Center (NWFSC) has produced reports documenting total fishing mortality for groundfish for the years 2004-2006, which are available on the NWFSC's website (Hastie 2006, Hastie and Bellman 2006, 2007). A central element of these analyses is the estimation of discard occurring in the non-hake groundfish bottom trawl fishery. This estimation process incorporates data from at-sea observations, logbooks, and fish tickets. During the past year, questions have been raised regarding the methods used to expand amounts of measured or estimated discard on observed vessels into total discard estimates for the groundfish bottom trawl fleet. As part of the Groundfish Science Report at the September 2007 Council meeting, the NWFSC presented a statement addressing several questions relating to the estimation of groundfish bycatch (Supplemental Agenda Item G.1.b). We noted that the use of tow duration as a measure of fleet effort in this expansion process could be expected to yield higher discard estimates for some species and lower estimates for others. This report documents the differences between discard amounts estimated with the method currently used to assess total mortality and estimates derived using an alternative method that utilizes tow duration, for the years 2004-2006.

Description of the Alternative Methods

Depending on the type of species, one of two approaches is currently used to expand amounts of discard in the observed fleet up to the entire fleet. For species that are commonly targeted by trawlers and for which significant percentages of catch are retained in most strata ("target species"), such as sablefish or Dover sole, discard is estimated as a function of retained catch of the individual species or species group. For each stratum delineated by area, season, and depth, the ratio of observed discarded-to-retained catch is assumed to be representative of the propensity for discard in the corresponding logbook stratum. Accordingly, logbook discards are calculated by multiplying these observed ratios by the retained weight of each target species reported in logbooks (Table 1-A, Step 1). Discard amounts estimated at the logbook level are then multiplied by each species' ratio of fish ticket-to-logbook retained weight, to produce total fleet amounts of discard (Table 1-A, Step 2). For other, "bycatch" species, where little or none of the catch is retained in many strata, discard is estimated as a function of the retained catch of all species in a "target group". This group includes all flatfish, sablefish, thornyheads, Pacific cod, skates, and spiny dogfish, in both the northern and southern areas, with the addition of slope

rockfish in the southern area. Discard amounts at the logbook level are then multiplied by the ratio of fish-ticket-to-logbook poundage for all target species, combined, as summarized in the table below. Additional details of the current method used to expand observed discard to the fleet level is presented in the most recent report of total mortality (Hastie and Bellman 2007).

Table 1.--Alternative discard estimation approaches

	Target Species (TS)	Bycatch Species
A. Current discard estimation process		
Step 1 (for each area, season, and depth) Calculate discard ratios, from observer data and fish tickets	$\frac{\text{Discard lbs (species X)}}{\text{Retained lbs (species X)}}$	$\frac{\text{Discard lbs (species Y)}}{\text{Retained lbs } (\Sigma \text{ TS})}$
Step 2 (estimate discard for logbook records) Multiply discard ratios by retained species weights reported in logbooks	$\left(\text{Step-1 ratio} \right) * \left(\frac{\text{logbook lbs}^1}{\text{(species X)}} \right)$	$\left(\text{Step-1 ratio} \right) * \left(\frac{\text{logbook lbs}^1}{(\Sigma \text{ TS})} \right)$
Step 3 (for each state and 2-month period) Calculate fish-ticket-to-logbook ratio of retained catch for each species or group	$\frac{\text{Fishticket lbs (species X)}}{\text{Logbook lbs}^1 \text{ (species X)}}$	$\frac{\text{Fishticket lbs } (\Sigma \text{ TS})}{\text{Logbook lbs}^1 \text{ } (\Sigma \text{ TS})}$
Step 4 (expand discard estimate to entire fleet) Multiply the Step-3 expansion ratio by the weight of discard estimated in Step 2	$\left(\text{Step-3 ratio} \right) * \left(\text{Est. logbook discard lbs} \right)$	$\left(\text{Step-3 ratio} \right) * \left(\text{Est. logbook discard lbs} \right)$
B. Tow-hour discard estimation process		
Step 1 (for each area, season, and depth) Calculate discard ratios, from observer data	$\frac{\text{Discard lbs (species X)}}{\text{Number of hours towed}}$	$\frac{\text{Discard lbs (species Y)}}{\text{Number of hours towed}}$
Step 2 (estimate discard for logbook records) Multiply discard ratios by the number tow hours reported in logbooks	$\left(\text{Step-1 ratio} \right) * \left(\text{Logbook tow hours} \right)$	$\left(\text{Step-1 ratio} \right) * \left(\text{Logbook tow hours} \right)$
Step 3 (for each state and 2-month period) Calculate fish-ticket-to-logbook ratio of the retained catch of each species or group	$\frac{\text{Fishticket lbs (species X)}}{\text{Logbook lbs}^1 \text{ (species X)}}$	$\frac{\text{Fishticket lbs } (\Sigma \text{ TS})}{\text{Logbook lbs}^1 \text{ } (\Sigma \text{ TS})}$
Step 4 (expand discard estimate to entire fleet) Multiply the Step-3 expansion ratio by the weight of discard estimated in Step 2	$\left(\text{Step-3 ratio} \right) * \left(\text{Est. logbook discard lbs} \right)$	$\left(\text{Step-3 ratio} \right) * \left(\text{Est. logbook discard lbs} \right)$

¹ The logbook retained weights used are hail weights that have been adjusted by each state agency to be consistent, at the trip level, with weights recorded on fish tickets.

As an alternative to this approach, we calculated discard ratios for each stratum, by dividing the observed discard weight for each species by the total hours trawled on observed tows (Table 1-B, Step 1). Amounts of discard for the logbook fleet are obtained by multiplying these ratios by the number of tow hours reported in the logbooks for each stratum. Since fish tickets do not capture the number of hours trawled, a different metric must be used to adjust for landings that lack

corresponding logbook data. We elected to use the same methods as described above to expand discard estimates from the logbook level to the entire fleet (Table 1-B, Step 2).

Results

Table 1 lists the discard amounts estimated using these two approaches for 2006. Discard tonnage is summarized for areas north and south of 40°10' N. lat., and for the entire coast. Table 2 highlights the differences in the 2006 estimates generated using the existing (retained-weight) method and the alternative (tow duration) method. The data in this table are calculated by subtracting the estimated discard using the existing method from the discard generated using the tow-duration method. Consequently, positive values indicate higher amounts using the alternative (tow-duration) method and negative values indicate higher amounts using the existing (retained-weight) method. Each approach yields estimates that are higher for some species and lower for others. Tables 3 and 4 and Tables 5 and 6 provide similar overview of amounts of estimated discard and differences between methods for 2005 and 2004, respectively.

Overall, the differences in amounts of discard estimated using these two approaches vary year to year and between areas. Neither approach yields consistently higher or lower discard amounts across all species. For instance, across all rebuilding species in 2006, estimated discards are 22 mt lower using the tow duration alternative than with the existing approach, however they are 7.7 mt higher in 2004. For all other species combined, discard was estimated to be 2,614 mt higher using the tow duration approach in 2004, but 778 mt lower in 2006.

References

Hastie, J. and M. Bellman. 2007. Estimated 2006 discard and total catch of selected groundfish species. Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Blvd E, Seattle, WA. Available from http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/docs/totalmortality2006_final.pdf.

Hastie, J. and M. Bellman. 2006. Estimated 2005 discard and total catch of selected groundfish species. Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Blvd E, Seattle, WA. Available from http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/docs/totalmortality2005_final.pdf.

Table1.--Estimated discard amounts (mt) of major west coast groundfish species from non-whiting¹, commercial limited-entry groundfish trawls targeting groundfish² during 2006, under two alternative estimation methods.

Alternative ->	1 (current estimates)			2		
	Status quo stratification (area: season: depth)			Status quo stratification (area: season: depth)		
	status quo approach used to expand observer data to logbook and fish ticket levels			Tow duration used to expand observer data to logbook level		
	Estimated discard (mt)			Estimated discard (mt)		
	North of 40°10'	South of 40°10'	Total	North of 40°10'	South of 40°10'	Total
Sablefish	366.09	22.77	388.85	337.18	19.23	356.40
Shortspine thornyhead	95.19	26.01	121.20	99.31	22.92	122.23
Longspine thornyhead	77.66	13.54	91.20	84.27	11.53	95.80
Dover sole	905.10	842.49	1,747.6	863.47	98.74	962.21
Petrale sole	95.25	17.29	112.55	94.63	13.97	108.60
English sole	335.00	84.92	419.92	343.46	42.03	385.49
Arrowtooth flounder	1,096.5	7.07	1,103.6	649.94	7.00	656.94
Other Flatfish	679.51	80.68	760.19	650.66	69.44	720.10
Blackgill rockfish ³	na	26.30	26.30	na	1.95	1.95
Splitnose rockfish ³	na	63.84	63.84	na	629.77	629.77
Other slope rockfish	109.34	65.15	174.49	121.75	149.90	271.65
Yellowtail rockfish ⁴	8.30	na	8.30	4.72	na	4.72
Chilipepper rockfish ⁵	na	98.86	98.86	na	67.09	67.09
Other shelf rockfish	31.98	17.01	48.98	32.55	11.99	44.54
Black rockfish	2.24	0.04	2.28	2.20	0.03	2.23
Other nearshore rockfish	1.90	0.00	1.90	1.88	0.00	1.88
Pacific hake/whiting	749.94	191.43	941.37	767.87	174.08	941.95
Lingcod	314.50	1.08	315.59	309.46	0.85	310.32
Pacific cod	5.77	0.00	5.77	5.27	0.00	5.27
Spiny dogfish	506.32	74.80	581.11	493.09	76.02	569.11
Unspecified skate	45.19	1.66	46.84	71.88	8.27	80.16
Big skate	158.38	6.15	164.53	157.16	4.44	161.60
Longnose skate	435.34	133.56	568.90	429.89	123.36	553.26
Shortbelly rockfish	0.02	0.66	0.68	0.02	0.42	0.44
Other groundfish	600.17	147.99	748.16	603.50	108.04	711.54
Canary rockfish	19.14	1.12	20.26	18.70	0.78	19.49
Widow rockfish	0.13	0.40	0.53	0.13	0.30	0.43
Yelloweye rockfish	0.88	0.00	0.88	0.88	0.00	0.88
Bocaccio ⁵	na	18.10	18.10	na	10.25	10.25
Cowcod ⁵	na	0.91	0.91	na	0.70	0.70
Pacific ocean perch ⁶	7.73	na	7.74	7.42	na	7.43
Darkblotched rockfish	90.28	0.22	90.50	77.53	0.24	77.77

¹ Includes only landings containing less than 2 mt of Pacific hake/whiting.

² Includes only landings in which groundfish weight was greater than or equal to the weight of non-groundfish species.

³ Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Slope Rockfish category.

⁴ Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Shelf Rockfish category.

⁵ Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Shelf Rockfish category.

⁶ Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Slope Rockfish category.

Table 2.--Differences in estimated **2006** discards (mt) of major west coast groundfish species under two alternative estimation methods.

	Difference in discards between Alternative 2 (using tow duration) and the status quo method (Alternative 1)					
	North of 40°10'		South of 40°10'		Coastwide	
	mt	%	mt	%	mt	%
Sablefish	-28.9	-8%	-3.5	-16%	-32.4	-8%
Shortspine thornyhead	4.1	4%	-3.1	-12%	1.0	1%
Longspine thornyhead	6.6	9%	-2.0	-15%	4.6	5%
Dover sole	-41.6	-5%	-743.8	-88%	-785.4	-45%
Petrale sole	-0.6	-1%	-3.3	-19%	-3.9	-4%
English sole	8.5	3%	-42.9	-51%	-34.4	-8%
Arrowtooth flounder	-446.6	-41%	-0.1	-1%	-446.7	-40%
Other Flatfish	-28.9	-4%	-11.2	-14%	-40.1	-5%
Blackgill rockfish ³	na	na	-24.4	-93%	-24.4	-93%
Splitnose rockfish ³	na	na	565.9	887%	565.9	887%
Other slope rockfish	12.4	11%	84.8	130%	97.2	56%
Yellowtail rockfish ⁴	-3.6	-43%	na	na	-3.6	-43%
Chilipepper rockfish ⁵	na	na	-31.8	-32%	-31.8	-32%
Other shelf rockfish	0.6	2%	-5.0	-30%	-4.4	-9%
Black rockfish	0.0	-2%	-0.01	-19%	-0.05	-2%
Other nearshore rockfish	0.0	-1%	0		-0.01	-1%
Pacific hake/whiting	17.9	2%	-17.3	-9%	0.6	0.1%
Lingcod	-5.0	-2%	-0.2	-21%	-5.3	-2%
Pacific cod	-0.5	-9%	0.0		-0.5	-9%
Spiny dogfish	-13.2	-3%	1.2	2%	-12.0	-2%
Unspecified skate	26.7	59%	6.6	399%	33.3	71%
Big skate	-1.2	-1%	-1.7	-28%	-2.9	-2%
Longnose skate	-5.4	-1%	-10.2	-8%	-15.6	-2.7%
Shortbelly rockfish	-0.001	-3%	-0.2	-36%	-0.2	-35%
Other groundfish	3.3	1%	-40.0	-27%	-36.6	-5%
Sum of differences for species above	-495.5		-282.2		-777.7	
Canary rockfish	-0.4	-2%	-0.3	-30%	-0.8	-4%
Widow rockfish	-0.003	-2%	-0.1	-25%	-0.1	-19%
Yelloweye rockfish	-0.003	-0.4%	0.0		-0.003	0%
Bocaccio ⁵	na	na	-7.9	-43%	-7.9	-43%
Cowcod ⁵	na	na	-0.2	-24%	-0.2	-24%
Pacific ocean perch ⁶	-0.3	-4%	na	na	-0.3	-4%
Darkblotched rockfish	-12.7	-14%	0.0	9%	-12.7	-14%
Sum of differences for rebuilding spec.	-13.5		-8.5		-22.0	

Note: negative numbers indicate that Alternative 2 results in LOWER discard estimates.

³ South of 40°10' N. Lat., only; northern catch is included in the Other Slope Rockfish category.

⁴ North of 40°10' N. Lat., only; southern catch is included in the Other Shelf Rockfish category.

⁵ South of 40°10' N. Lat., only; northern catch is included in the Other Shelf Rockfish category.

⁶ North of 40°10' N. Lat., only; southern catch is included in the Other Slope Rockfish category.

Table 3.--Estimated discard amounts (mt) of major west coast groundfish species from non-whiting¹, commercial limited-entry groundfish trawls targeting groundfish² during **2005**, under two alternative estimation methods.

Alternative ->	1 (current estimates)			2		
	Status quo stratification (area: season: depth)			Status quo stratification (area: season: depth)		
	status quo approach used to expand observer data to logbook and fish ticket levels			Tow duration used to expand observer data to logbook level		
	Estimated discard (mt)			Estimated discard (mt)		
	North of 40°10'	South of 40°10'	Total	North of 40°10'	South of 40°10'	Total
Sablefish	426.27	98.04	524.32	445.69	108.63	554.31
Shortspine thornyhead	93.16	40.14	133.30	96.56	44.05	140.61
Longspine thornyhead	63.27	28.89	92.16	65.09	33.48	98.57
Dover sole	545.48	110.67	656.15	545.75	92.98	638.73
Petrale sole	51.14	3.60	54.74	50.93	0.34	51.27
English sole	248.88	52.81	301.69	233.58	1.18	234.76
Arrowtooth flounder	1,393.66	3.80	1,397.5	2,046.54	8.73	2,055.27
Other Flatfish	589.43	141.92	731.36	606.42	24.03	630.45
Blackgill rockfish ³	na	2.26	2.26	na	1.37	1.37
Splitnose rockfish ³	na	143.87	143.87	na	926.72	926.72
Other slope rockfish	22.34	4.67	27.01	34.59	11.94	46.53
Yellowtail rockfish ⁴	28.58	na	28.58	36.65	na	36.65
Chilipepper rockfish ⁵	na	51.75	51.75	na	0.60	0.60
Other shelf rockfish	74.77	6.30	81.07	91.85	0.79	92.64
Black rockfish	0.59	0.00	0.59	0.69	0	0.69
Other nearshore rockfish	0.06	0.22	0.28	0.07	0	0.07
Pacific hake/whiting	612.83	209.59	822.42	633.16	127.11	760.27
Lingcod	363.70	19.70	383.40	445.22	7.36	452.58
Pacific cod	4.45	0	4.45	6.27	0.00	6.27
Spiny dogfish	942.82	124.51	1,067.3	1,114.76	144.58	1,259.34
Unspecified skate	134.23	3.70	137.93	163.94	4.89	168.82
Big skate	104.95	5.59	110.54	122.44	0.09	122.53
Longnose skate	426.39	210.68	637.07	485.36	127.82	613.19
Shortbelly rockfish	0.00	1.10	1.11	0.00	0.47	0.48
Other groundfish	1,230.69	293.52	1,524.2	402.68	30.22	432.89
Canary rockfish	21.50	0.05	21.56	26.59	0.01	26.60
Widow rockfish	3.16	0.18	3.34	2.91	0.19	3.10
Yelloweye rockfish	0.62	0	0.62	0.73	0	0.73
Bocaccio ⁵	na	27.71	27.71	na	10.65	10.65
Cowcod ⁵	na	1.43	1.43	na	0.10	0.10
Pacific ocean perch ⁶	10.77	na	10.77	10.49	na	10.49
Darkblotched rockfish	22.80	0.90	23.69	22.46	1.17	23.63

¹ Includes only landings containing less than 2 mt of Pacific hake/whiting.

² Includes only landings in which groundfish weight was greater than or equal to the weight of non-groundfish species.

³ Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Slope Rockfish category.

⁴ Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Shelf Rockfish category.

⁵ Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Shelf Rockfish category.

⁶ Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Slope Rockfish category.

Table 4.--Differences in estimated **2005** discards (mt) of major west coast groundfish species under two alternative estimation methods.

	Difference in discards between Alternative 2 (using tow duration) and the status quo method (Alternative 1)					
	North of 40°10'		South of 40°10'		Coastwide	
	mt	%	mt	%	mt	%
Sablefish	19.4	5%	10.6	11%	30.0	6%
Shortspine thornyhead	3.4	4%	3.9	10%	7.3	5%
Longspine thornyhead	1.8	3%	4.6	16%	6.4	7%
Dover sole	0.3	0.0%	-17.7	-16%	-17.4	-3%
Petrale sole	-0.2	0%	-3.3	-91%	-3.5	-6%
English sole	-15.3	-6%	-51.6	-98%	-66.9	-22%
Arrowtooth flounder	652.9	47%	4.9	130%	657.8	47%
Other Flatfish	17.0	3%	-117.9	-83%	-100.9	-14%
Blackgill rockfish ³	na	na	-0.9	-40%	-0.9	-40%
Splitnose rockfish ³	na	na	782.9	544%	782.9	544%
Other slope rockfish	12.2	55%	7.3	156%	19.5	72%
Yellowtail rockfish ⁴	8.1	28%	na	na	8.1	28%
Chilipepper rockfish ⁵	na	na	-51.1	-99%	-51.1	-99%
Other shelf rockfish	17.1	23%	-5.5	-87%	11.6	14%
Black rockfish	0.10	16%	0		0.1	16%
Other nearshore rockfish	0.010	17%	-0.2		-0.2	-76%
Pacific hake/whiting	20.3	3%	-82.5	-39%	-62.1	-8%
Lingcod	81.5	22%	-12.3	-63%	69.2	18%
Pacific cod	1.8	41%	0		1.8	41%
Spiny dogfish	171.9	18%	20.1	16%	192.0	18%
Unspecified skate	29.7	22%	1.2	32%	30.9	22%
Big skate	17.5	17%	-5.5	-98%	12.0	11%
Longnose skate	59.0	14%	-82.9	-39%	-23.9	-4%
Shortbelly rockfish	0.0006	29%	-0.6	-57%	-0.6	-57%
Other groundfish	-828.0	-67%	-263.3	-90%	-1,091.3	-72%
Sum of differences for species above	270.5		140.0		410.6	
Canary rockfish	5.1	24%	-0.05	-88%	5.0	23%
Widow rockfish	-0.3	-8%	0.01	4%	-0.2	-7%
Yelloweye rockfish	0.1	18%	0		0.1	18%
Bocaccio ⁵	na	na	-17.1	-62%	-17.1	-62%
Cowcod ⁵	na	na	-1.3	-93%	-1.3	-93%
Pacific ocean perch ⁶	-0.3	-3%	na	na	-0.3	-3%
Darkblotched rockfish	-0.3	-1%	0.3	31%	-0.1	-0.2%
Sum of differences for rebuilding spec.	4.3		-18.1		-13.8	

Note: **negative** numbers indicate that Alternative 2 results in LOWER discard estimates.

³ South of 40°10' N. Lat., only; northern catch is included in the Other Slope Rockfish category.

⁴ North of 40°10' N. Lat., only; southern catch is included in the Other Shelf Rockfish category.

⁵ South of 40°10' N. Lat., only; northern catch is included in the Other Shelf Rockfish category.

⁶ North of 40°10' N. Lat., only; southern catch is included in the Other Slope Rockfish category.

Table 5.--Estimated discard amounts (mt) of major west coast groundfish species from non-whiting¹, commercial limited-entry groundfish trawls targeting groundfish² during **2004**, under two alternative estimation methods.

Alternative ->	1			2		
	(current estimates)			Status quo stratification (area: season: depth)		
	Status quo stratification (area: season: depth)			Tow duration used to expand observer data to logbook level		
	status quo approach used to expand observer data to logbook and fish ticket levels			Status quo approach used to expand estimated discard from logbook to fish ticket levels		
	Estimated discard (mt)			Estimated discard (mt)		
	North of 40°10'	South of 40°10'	Total	North of 40°10'	South of 40°10'	Total
Sablefish	850.70	103.76	954.46	969.09	112.27	1,081.36
Shortspine thornyhead	129.88	73.66	203.54	133.41	71.53	204.95
Longspine thornyhead	73.29	53.50	126.79	79.80	50.23	130.03
Dover sole	300.79	182.70	483.49	290.81	166.31	457.12
Petrale sole	93.27	5.13	98.39	78.80	6.18	84.98
English sole	133.55	47.79	181.33	147.13	52.30	199.43
Arrowtooth flounder	2,049.0	24.30	2,073.3	809.18	12.48	821.66
Other Flatfish	369.70	97.53	467.23	298.97	92.61	391.58
Blackgill rockfish ³	na	1.56	1.56	na	2.94	2.94
Splitnose rockfish ³	na	104.83	104.83	na	3,359.17	3,359.17
Other slope rockfish	38.83	5.76	44.58	74.25	7.49	81.74
Yellowtail rockfish ⁴	7.94	na	7.94	6.35	0	6.35
Chilipepper rockfish ⁵	na	34.87	34.87	na	51.36	51.36
Other shelf rockfish	25.85	10.84	36.69	29.79	14.19	43.98
Black rockfish	0.17	0.00	0.17	0.19	0	0.19
Other nearshore rockfish	1.24	0.01	1.25	1.23	0.01	1.24
Pacific hake/whiting	2,017.8	196.04	2,213.8	2,118.11	233.30	2,351.41
Lingcod	148.75	30.55	179.30	168.94	38.62	207.56
Pacific cod	48.97	0	48.97	63.55	0	63.55
Spiny dogfish	596.90	34.77	631.67	690.30	44.17	734.47
Unspecified skate	279.22	61.79	341.01	316.84	70.05	386.90
Big skate	90.15	15.42	105.57	91.43	17.46	108.90
Longnose skate	206.23	102.42	308.65	227.23	118.89	346.12
Shortbelly rockfish	0.01	4.07	4.08	0.01	5.22	5.23
Other groundfish	419.36	179.42	598.77	583.05	161.15	744.20
Canary rockfish	5.67	0.47	6.14	6.08	0.58	6.66
Widow rockfish	2.69	0.54	3.24	3.35	0.70	4.05
Yelloweye rockfish	0.41	0	0.41	0.40	0	0.40
Bocaccio ⁵	na	4.74	4.74	na	5.61	5.61
Cowcod ⁵	na	0.45	0.45	na	0.51	0.51
Pacific ocean perch ⁶	22.29	na	22.29	24.63	na	24.63
Darkblotched rockfish	32.85	0.81	33.66	35.68	1.05	36.74

¹ Includes only landings containing less than 2 mt of Pacific hake/whiting.

² Includes only landings in which groundfish weight was greater than or equal to the weight of non-groundfish species.

³ Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Slope Rockfish category.

⁴ Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Shelf Rockfish category.

⁵ Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Shelf Rockfish category.

⁶ Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Slope Rockfish category.

Table 6.--Differences in estimated **2004** discards (mt) of major west coast groundfish species under two alternative estimation methods.

	Difference in discards between Alternative 2 (using tow duration) and the status quo method (Alternative 1)					
	North of 40°10'		South of 40°10'		Coastwide	
	mt	%	mt	%	mt	%
Sablefish	118.4	14%	8.5	8%	126.9	13%
Shortspine thornyhead	3.5	3%	-2.1	-3%	1.4	1%
Longspine thornyhead	6.5	9%	-3.3	-6%	3.2	3%
Dover sole	-10.0	-3%	-16.4	-9%	-26.4	-5%
Petrale sole	-14.5	-16%	1.1	21%	-13.4	-14%
English sole	13.6	10%	4.5	9%	18.1	10%
Arrowtooth flounder	-1,239.9	-61%	-11.8	-49%	-1,251.7	-60%
Other Flatfish	-70.7	-19%	-4.9	-5%	-75.7	-16%
Blackgill rockfish ³	na	na	1.4	88%	1.4	88%
Splitnose rockfish ³	na	na	3,254	3104%	3,254	3104%
Other slope rockfish	35.4	91%	1.7	30%	37.2	83%
Yellowtail rockfish ⁴	-1.6	-20%	na	na	-1.6	-20%
Chilipepper rockfish ⁵	na	na	16.5	47%	16.5	47%
Other shelf rockfish	3.9	15%	3.4	31%	7.3	20%
Black rockfish	0.02	9%	0		0.02	9%
Other nearshore rockfish	-0.01	-1%	0.001		-0.01	-1%
Pacific hake/whiting	100.4	5%	37.3	19%	137.6	6.22%
Lingcod	20.2	14%	8.1	26%	28.3	16%
Pacific cod	14.57	29.76%	0		14.57	29.76%
Spiny dogfish	93.4	16%	9.4	27%	102.8	16%
Unspecified skate	37.6	13%	8.3	13%	45.9	13%
Big skate	1.3	1%	2.0	13%	3.3	3%
Longnose skate	21.0	10%	16.5	16%	37.5	12%
Shortbelly rockfish	0.0014	14%	1.2	28%	1.2	28%
Other groundfish	163.7	39%	-18.3	-10.2%	145.4	24%
Sum of differences for species above	-703.1		3,317.2		2,614.1	
Canary rockfish	0.4	7%	0.11	23%	0.5	8%
Widow rockfish	0.7	24%	0.2	29%	0.8	25%
Yelloweye rockfish	-0.01	-2%	0		-0.01	-2%
Bocaccio ⁵	na	na	0.9	18%	0.9	18%
Cowcod ⁵	na	na	0.1	14%	0.1	14%
Pacific ocean perch ⁶	2.3	10%	na	na	2.3	10%
Darkblotched rockfish	2.8	9%	0.2	30%	3.1	9%
Sum of differences for rebuilding spec.	6.2		1.4		7.7	

Note: **negative** numbers indicate that Alternative 2 results in LOWER discard estimates.

³ South of 40°10' N. Lat., only; northern catch is included in the Other Slope Rockfish category.

⁴ North of 40°10' N. Lat., only; southern catch is included in the Other Shelf Rockfish category.

⁵ South of 40°10' N. Lat., only; northern catch is included in the Other Shelf Rockfish category.

⁶ North of 40°10' N. Lat., only; southern catch is included in the Other Slope Rockfish category.