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AN ANALYSIS OF PACIFIC HALIBUT BYCATCHES BY LONGLINERS
TARGETING ON SABLEFISH IN THE GULF OF ALASKA, 1987-1989

By

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Further analysis of Pacific halibut bycatches by longliners targeting on sablefish in the Gulf of Alaska, 1987-1989.

INTRODUCTION

Results of the Alaska Department of Fish and Game's observer program indicates that the bycatch of halibut in the newly emerging domestic fisheries is pervasive in both longline and bottom trawl fisheries. This particular analysis addresses the bycatch of halibut in the sablefish longline fishery in the Gulf of Alaska where observers sampled aboard 16 different vessels that targeted sablefish for a total of 18 trips (Figures 1 and 2). The overall halibut bycatch rate has been calculated to be 38.3% (383.1 kg of halibut per metric ton of landed weight) (Table 1).

RESULTS

Some qualifiers must be made when interpreting this data. For example, the eighteen observer trips represent less than .4% observer coverage of total sablefish landings from 1987-1989 (Figure 3). Although the overall bycatch rate represents Gulf-wide observer coverage, areas and boats were not sampled randomly but opportunistically resulting in uneven coverage of the Gulf (20% of the sets were made in the Eastern Gulf, 79% in the Central Gulf, and only one set was made in the Western Gulf). In 1988, observer coverage commenced in the latter part of the season, when certain fishermen could find commercial concentrations of sablefish only at depths <250 fm off the Eastside of Kodiak Island. These fishermen were not prospecting for halibut.

With the above qualifiers in mind, differences in bycatch rates have occurred between years and areas. Lower bycatch rates have been observed in the Eastern Gulf (35%) than in the Central Gulf (40%) (Tables 2 and 3). Bycatch rates for 1987 were lower (20%) than either in 1988 (68%) or 1989 (35%) (Tables 4, 5, and 6).

The highest total catches of halibut occurred in the shallower sets (<250 fm) (Figure 4). Significant zero catches of halibut occurred at depths greater than >250 fm (Figure 5).

Catch per unit effort for sablefish was fairly consistent between depths averaging from .20 kg per hook when <250 fm to .26 kg per hook when >250 fm, with an overall average of .24 kg per hook. Conversely, the CPUE for halibut was far

greater at shallower depths than at deeper depths, averaging .36 kg per hook when <250 fm and .03 kg per hook when >250 fm, with an overall average of .11 kg per hook (Figure 6).

Total number of hooks fished was closely related to total sablefish catches but was not for halibut catches (Figure 7). At depths less than 250 fm, 22% of the hooks caught 18% of the sablefish and 77% of the halibut by weight (Figure 8).

Analyzing the observer data by week shows the number of sets and attendant halibut bycatch for each week sampled. Highest bycatch rates were observed in weeks 1, 2, 9, and 10 with the highest bycatch rates coming from weeks 9 and 10 (Table 7) (Figure 9). Data shown for weeks 9 and 10 were from trips in 1988 at shallow depths (Figure 10).

Bycatch rates by statistical area were much higher at depths <250 fm (142% overall) than in depths >250 fm (9.2% overall). It appears that there may be some "problem" statistical areas where high bycatches may occur shallower and deeper of 250 fm. For example, in statistical areas 1, 3, and 13 high bycatches may be expected at all depths (Table 8).

The most complete dataset (with the least bias) is 1987 and 1989 for the Central Gulf. The mean, standard error, and standard deviation is much higher for depths less than 250 fm than those greater than 250 fm. However, there is less relative variation in the shallow water (<250 fm) sample than the deeper (>250fm) (Table 9).

Using the 1987 and 1989 data in conjunction with the assumption that the observer sample was representative of fishing at all depths and statistical areas, halibut bycatch estimates were calculated for depths <250 fm and >250 fm and expanded to the longline sablefish harvest of 1989 for the Central Gulf. It is estimated that 1800 mt of halibut were caught at depths <250 fm and 326 mt of halibut at depths >250 fm (Table 10).

CONCLUSIONS

The ADF&G observer program has sampled less than .4% of the landed catch from 1987 to 1989. Sampling has been opportunistic and not random. The most complete data with the least apparent bias is from 1987 and 1989 trips from the Central Gulf. However, these data do show that some strong apparent relationships do exist. By catch rates may vary by week, stat area, or depth. Halibut catches were significantly higher at depths <250 fm in terms of both CPUE and total catches. Although the sablefish CPUE was fairly consistent between depths, total sablefish catches were greater in deeper waters. Total number of hooks fished was not closely related to the total catches of halibut

but was for sablefish. Seventy-seven percent of the halibut (by weight) were caught at <250 fm. From these preliminary data, a depth restriction might greatly reduce halibut bycatch in future directed sablefish fisheries in the Central Gulf.

Halibut apparently have a denser and broader distribution at depths <250 fm as evidenced by the higher mean catch, standard deviation, and less relative variation as compared to halibut catches >250 fm where halibut appear to be less numerous with a patchier distribution. The 1987 and 1989 data suggests that although less than 10% of the effort was at depths <250 fm, these sets were the real "driver" in determining halibut bycatch. The large standard error from these samples (<250fm) implies that any future observer program must provide a large enough sampling effort to improve precision of the estimate of the mean. This also implies that the observer program must be large enough to represent the proportion of all effort by depth for the entire fishery if bycatch rates of halibut are to be expanded to the total catch of sablefish.

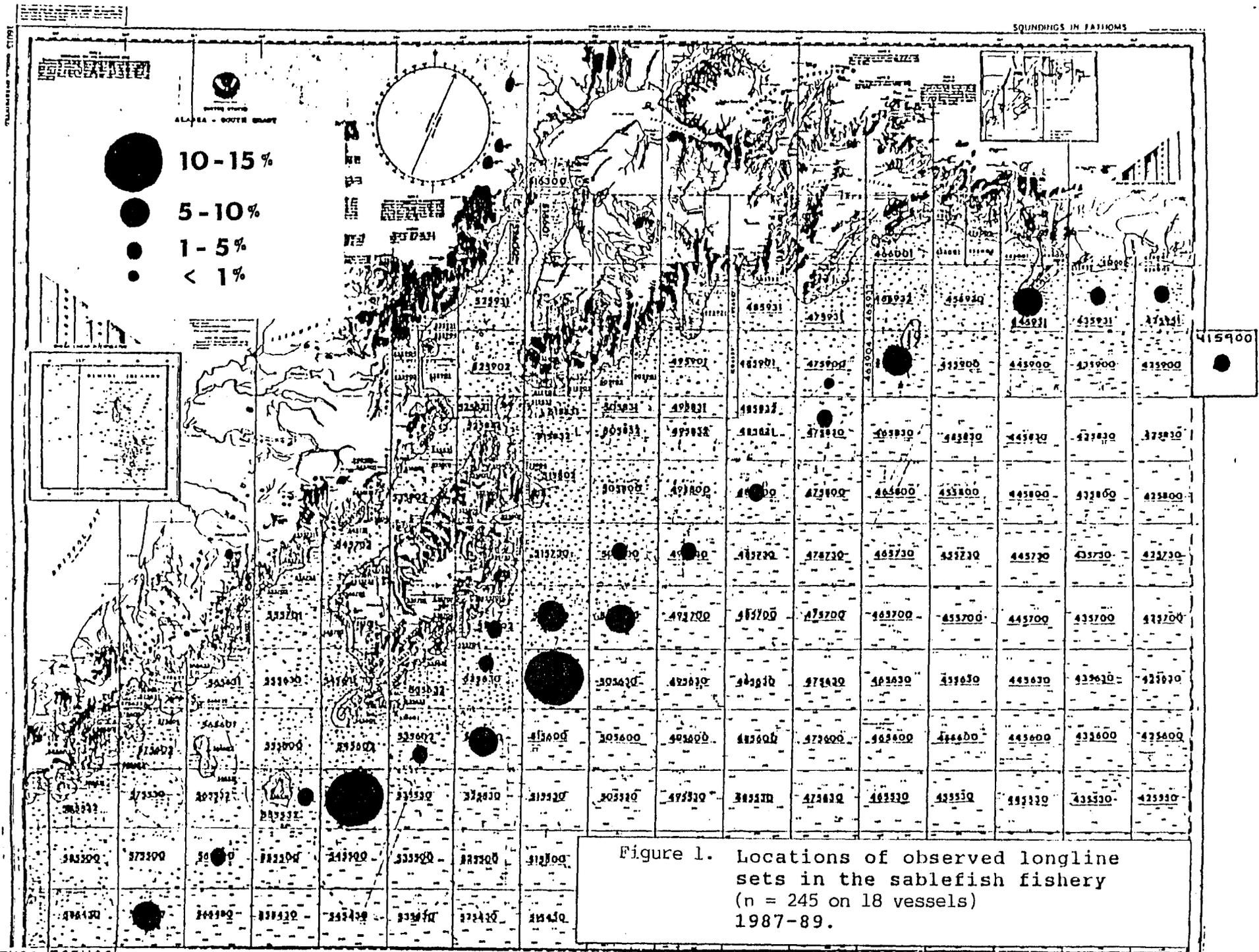


Figure 1. Locations of observed longline sets in the sablefish fishery (n = 245 on 18 vessels) 1987-89.

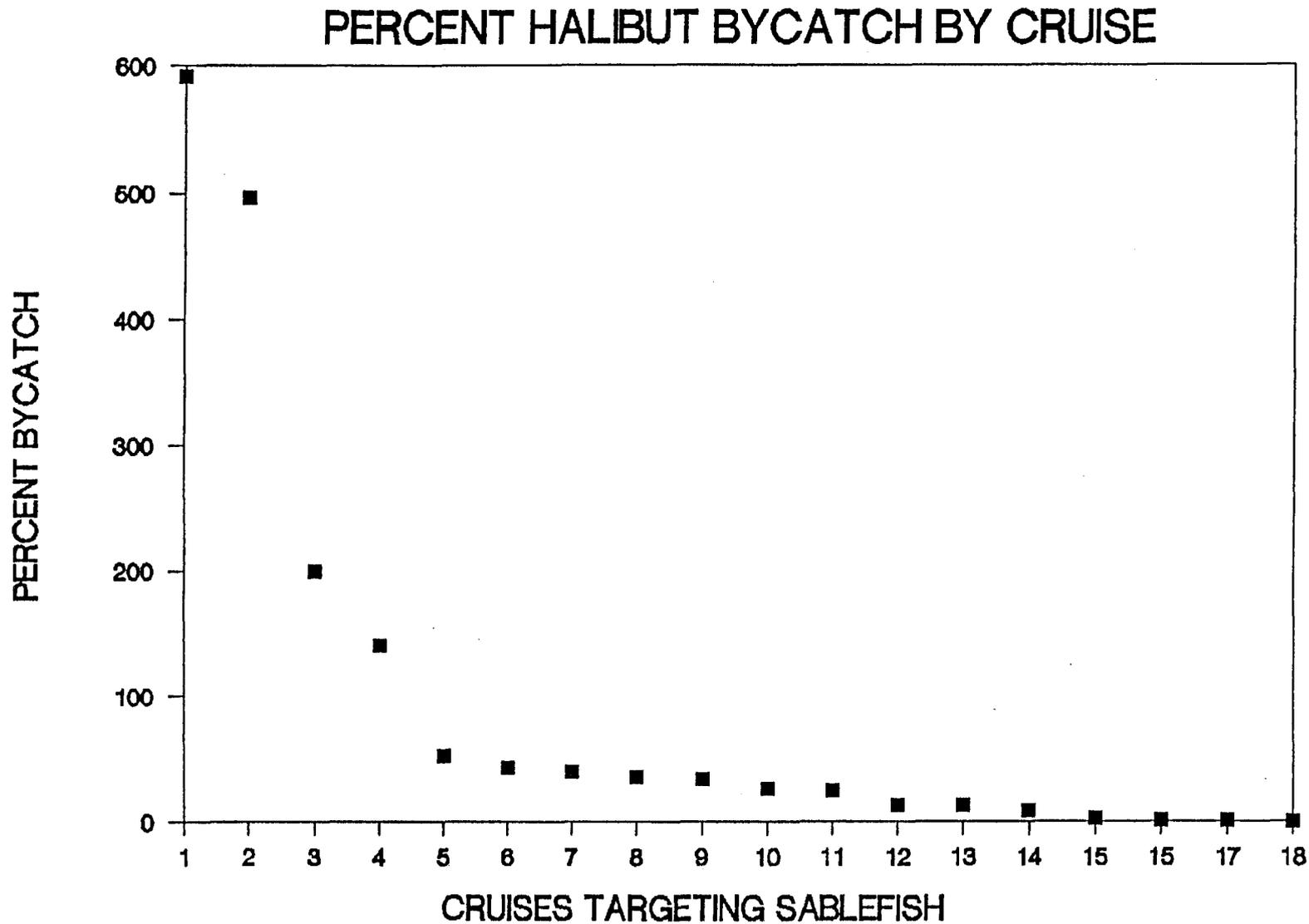


Figure 2. Percent halibut bycatch by cruise from observer samples aboard sablefish longliners (1987 - 1989), n=18. (Source ADF&G groundfish observer database).

VESSELS AND LANDINGS BY REGULATORY AREA (1987 - 1989)

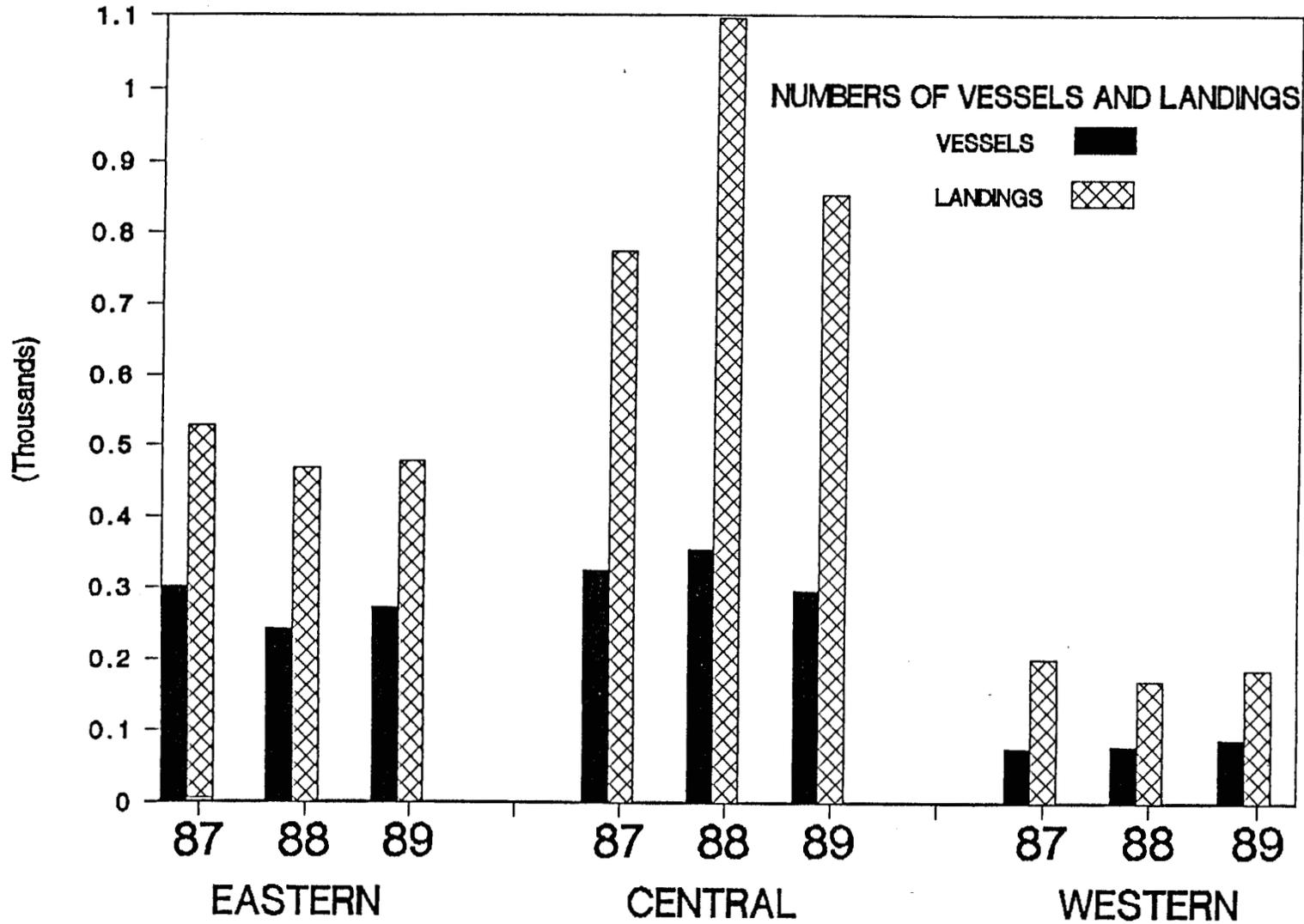


Figure 3. Vessels and landings from longline sablefish fishery (1987 -1989). Eastern includes East and West Yakutat only. (Source ADF&G fish ticket database).

HALIBUT BYCATCH AS TOTAL WEIGHT AT EACH DEPTH BY SET

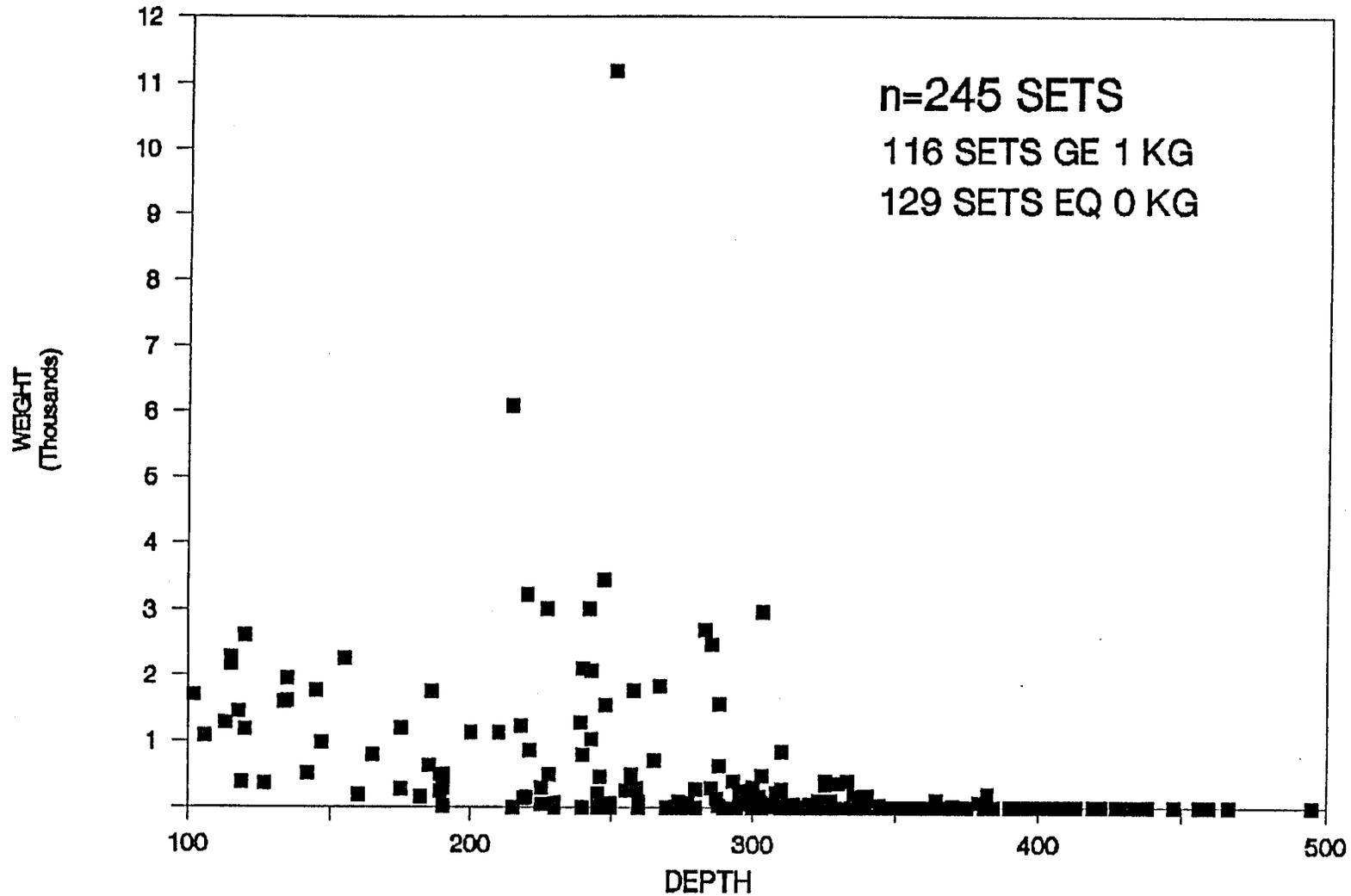


Figure 4. Halibut bycatch as total weight by set and depth from observer samples aboard longliners targeting sablefish (1987-1989), n=245. (Source ADF&G groundfish observer database).

SETS WHERE HALIBUT CATCHES EQUAL ZERO

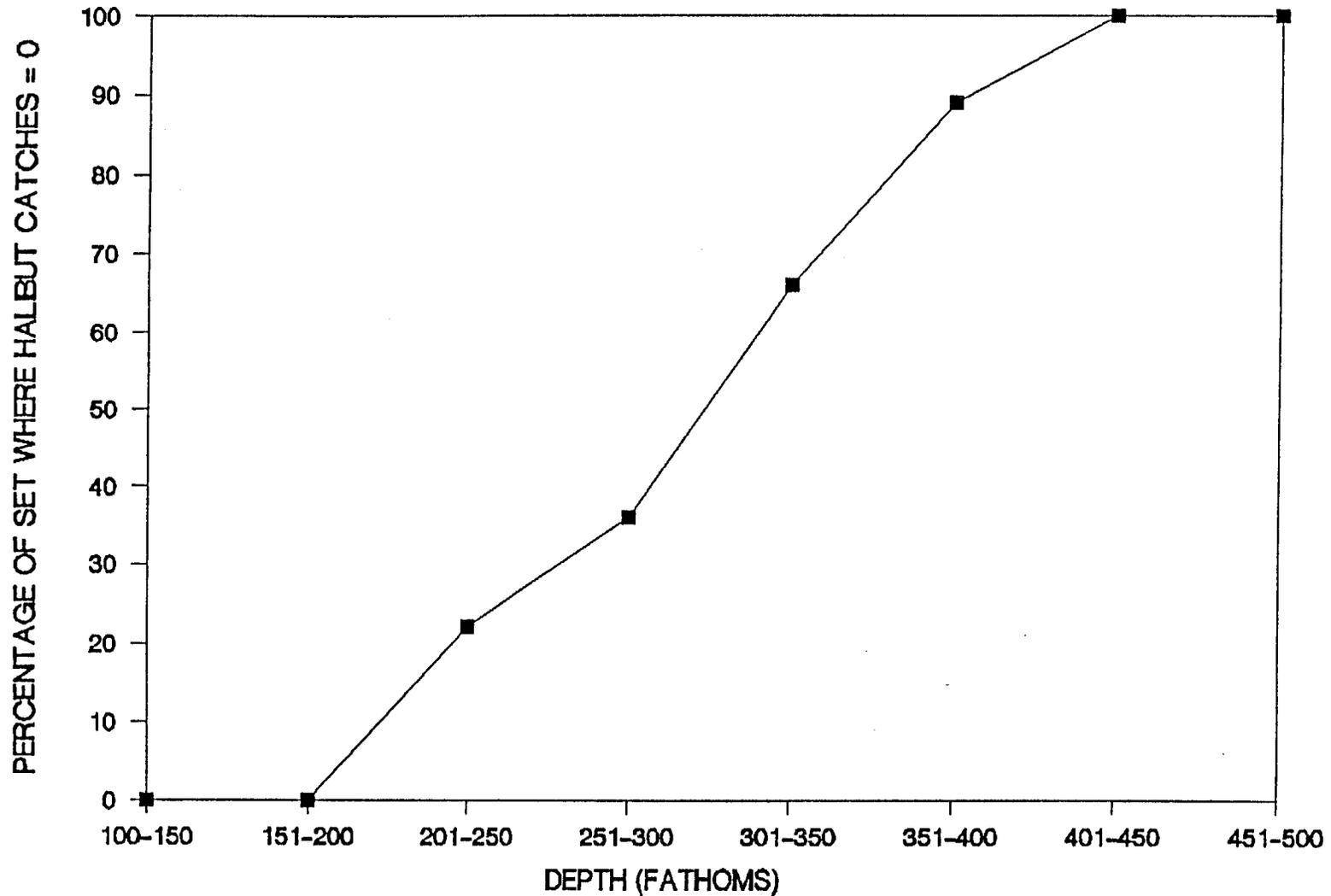


Figure 5. Sets where halibut catches equal zero as sampled by observers aboard longliners targeting on sablefish (1987-1989), n=245 (Source ADF&G groundfish observer database).

CATCH PER EFFORT FOR HALIBUT AND SABLEFISH BY DEPTH

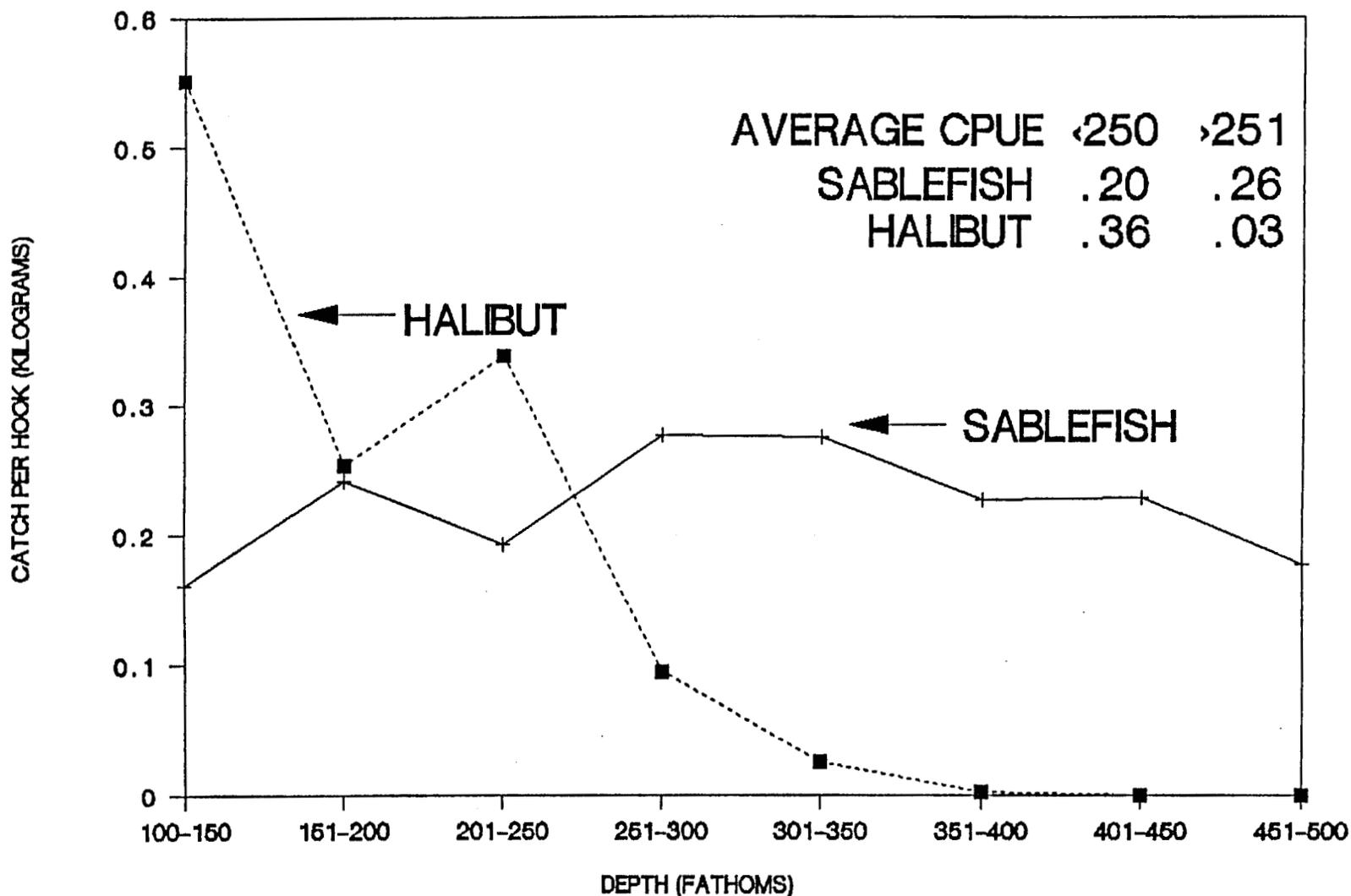


Figure 6. Catch per unit effort of halibut and sablefish from observer samples aboard sablefish longliners (1987 - 1989). (Source ADF&G groundfish observer database).

PERCENT OF TOTAL HOOKS AND WEIGHT BY DEPTH

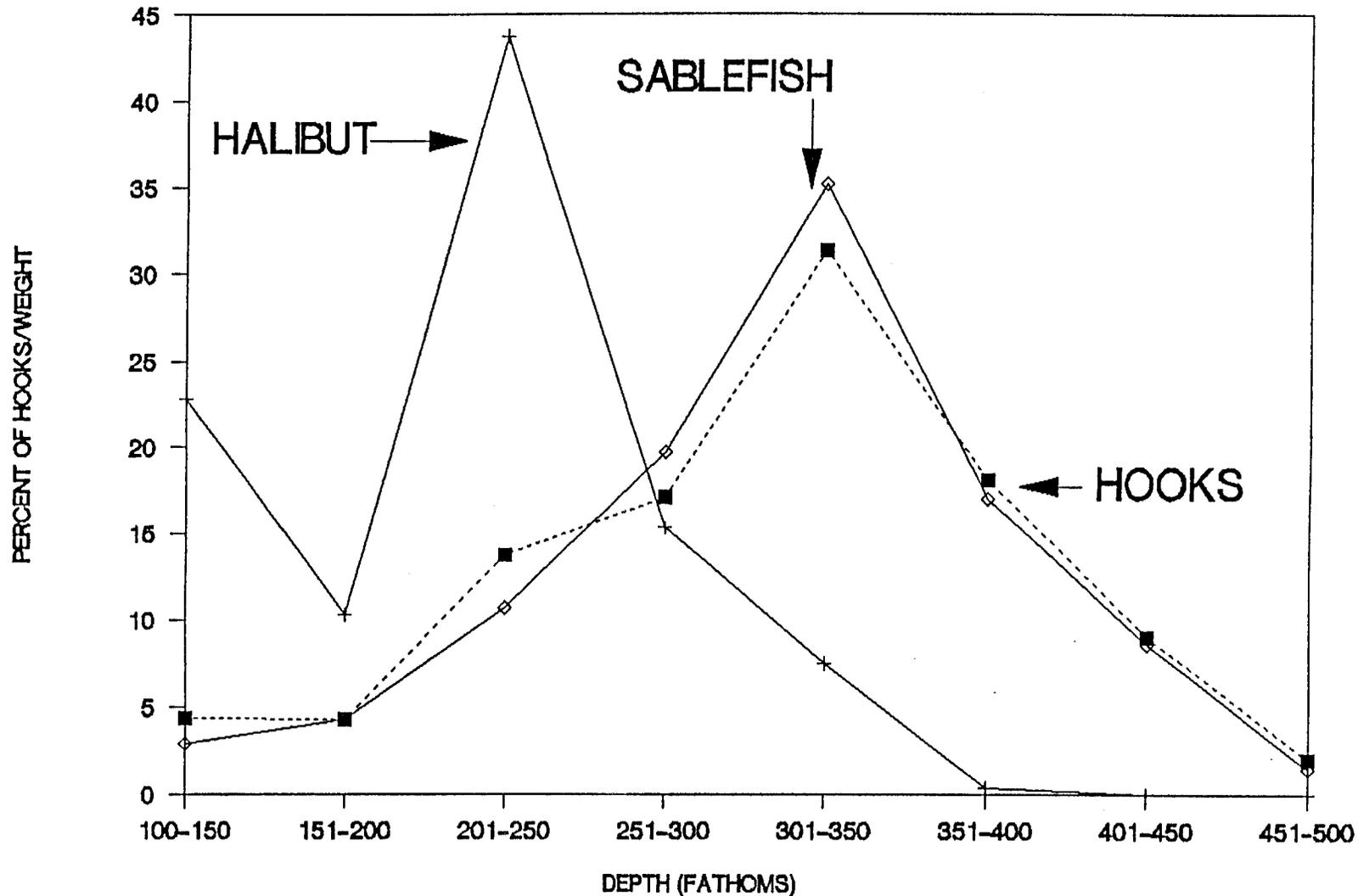


Figure 7. Percent of total hooks and weight of halibut and sablefish by depth from observer samples aboard longliners targeting sablefish. (1987 - 1989). (Source ADF&G groundfish observer database).

PERCENT OF TOTAL HALIBUT, SABLEFISH, AND HOOKS BY DEPTH

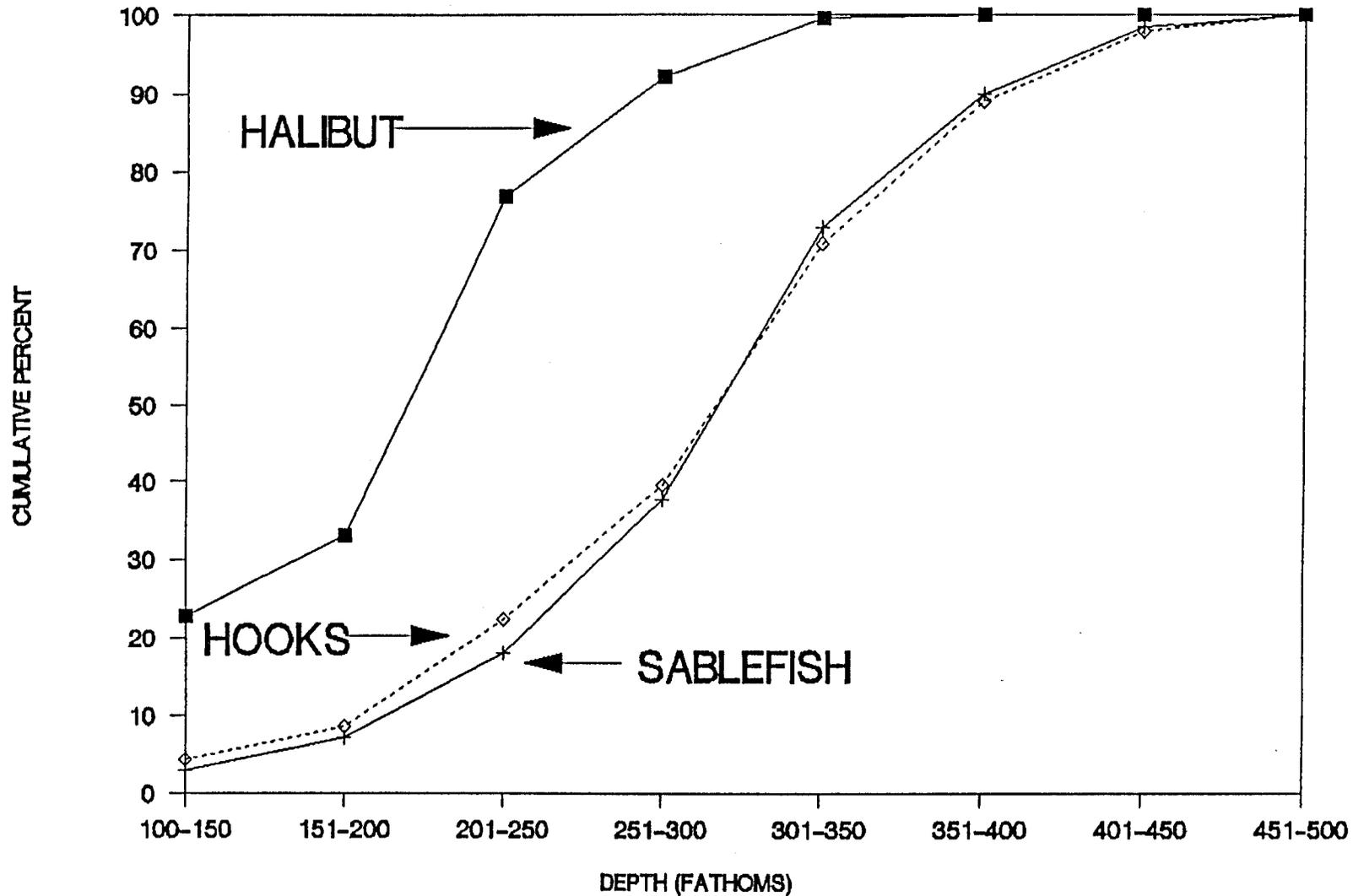


Figure 8. Percent of total weight of halibut, sablefish, and hooks by depth from observer samples aboard longliners targeting sablefish, (1987-1989). (Source ADF&G groundfish observer database).

HALIBUT BYCATCH BY WEEK (APR 1 - JUN 15, 1987 - 1989)

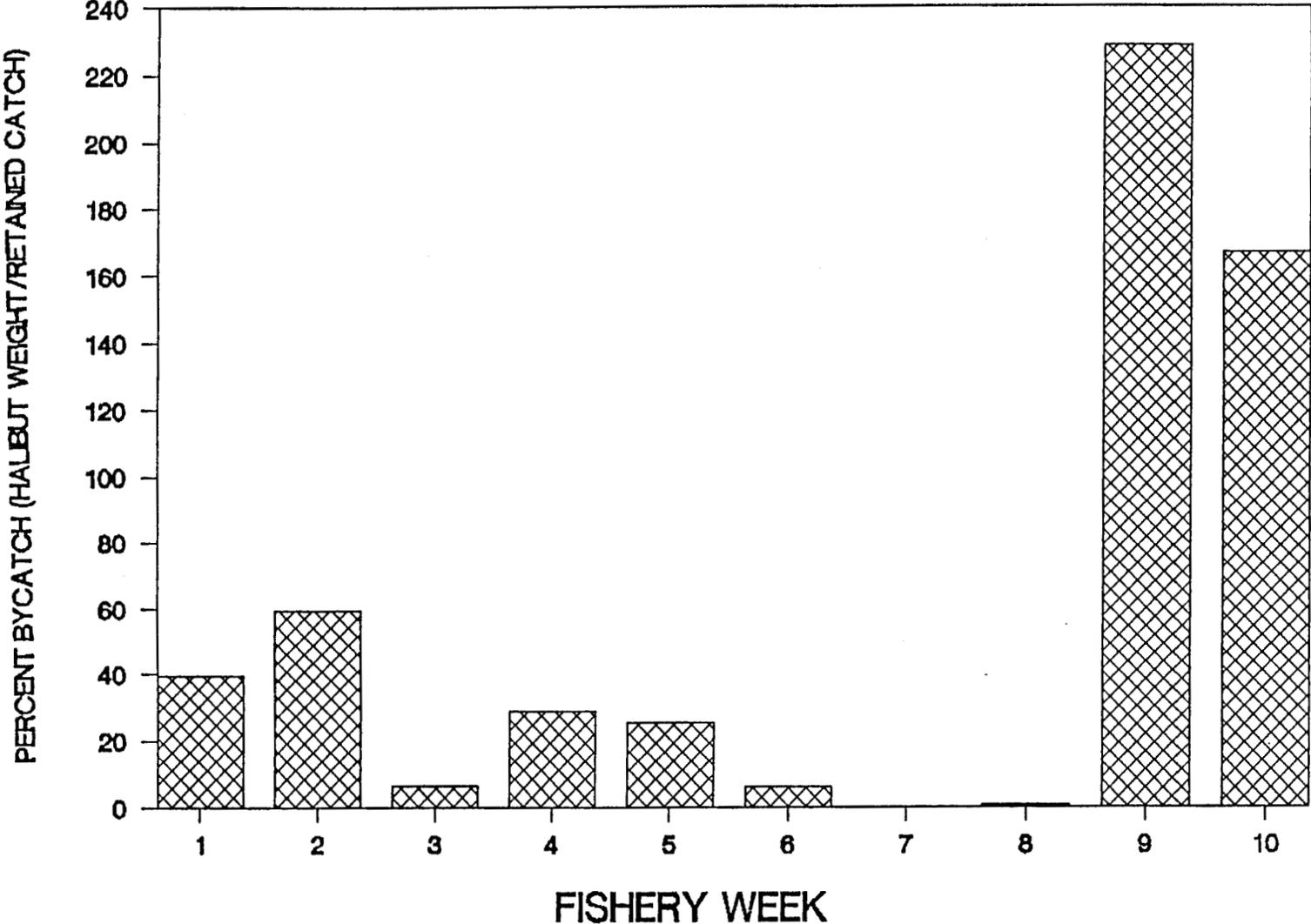


Figure 9. Halibut bycatch by week during the sablefish fishery as sampled by observers (1987 -1989). (Source ADF&G goundfish observer database).

DEPTH OF SETS BY DATE

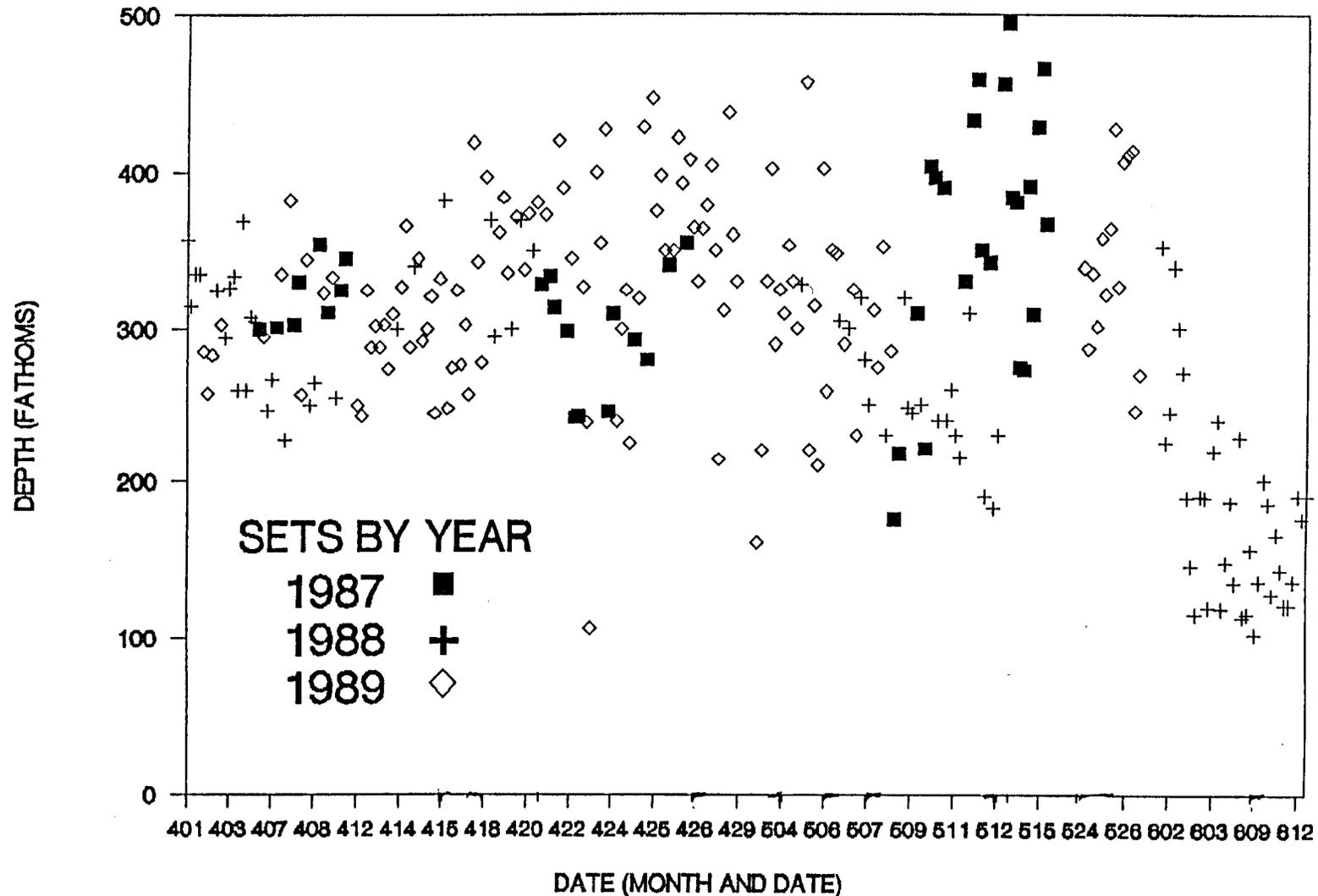


Figure 10. Depth of sets by date from observer samples aboard longliners targeting sablefish (1987-1989), n=245. (Source ADF&G groundfish observer database).

Table 1. Bycatch rate of prohibited species and species composition in domestic commercial fisheries as observed by the Alaska Department of Fish and Game.

Catch Details	Species	1	2	
		Catch (%)	---Bycatch---	---
			No./mt	Kg/mt
	Prohibited			
Area: Gulf of Alaska	Halibut	5.7	33.3	383.1
Gear: Longline	Tanner crab	T	T	T
Target Species: Sablefish	R.king crab	0.0	0.0	0.0
	Salmon	0.0	0.0	0.0
Inclusive Dates:	Herring	0.0	0.0	0.0
Sablefish Seasons 1987-89	Commercial			
Vessels Observed: 16	Pacific cod	0.7		
Trips Observed: 18	Pollock	T		
Hauls/Sets Observed: 245	Flounder	4.8		
Total Landing: 265.8 mt	Sablefish	58.0		
Stat. Areas Observed:	Rockfish	16.5		
415900 425931 435931	Other	14.4		
445931 465901 475830				
475900 485800 495730				
505700 505730 515630				
515700 525600 525630				
525702 535602 545530				
555532 565000 575430				
585400 595400				

1. Catch (%) refers to total catch brought on deck and is based on the observed weight of fish caught or, for longline and pot gear, the number of fish caught. Species proportions in individual trawl tows (or sets of longline/pot gear) were determined by observer's samples and expanded to the total tow weight which was visually estimated by the skipper or observer.
 2. Bycatch = kg or no. per metric ton of landed fish (whole fish, all species, including landed discard) as listed on the fish ticket. Longline and pot gear kg/mt was generated from the average weight of those fish which were weighed.
- T = trace, less than 0.05
0.0 = no catch.
Sum of visually estimated catch = 365.13 mt.

Table 2. Bycatch rate of prohibited species and species composition in domestic commercial fisheries as observed by the Alaska Department of Fish and Game.

Catch Details	Species	1	2	
		Catch (%)	---Bycatch---	---
			No./mt	Kg/mt
	Prohibited			
Area: Eastern Gulf	Halibut	4.4	28.0	349.2
Gear: Longline	Tanner crab	0.0	0.0	0.0
Target Species: Sablefish	R.king crab	0.0	0.0	0.0
	Salmon	0.0	0.0	0.0
Inclusive dates:	Herring	0.0	0.0	0.0
Sablefish Seasons 1988-89	Commercial			
Vessels Observed: 3	Pacific cod	T		
Trips Observed: 4	Pollock	T		
Hauls/Sets Observed: 52	Flounder	5.4		
Total Landing: 81.2 mt	Sablefish	59.9		
Stat. Areas Observed:	Rockfish	11.7		
415900 425931 435931	Other	18.5		
445931 465901				

1. Catch (%) refers to total catch brought on deck and is based on the observed weight of fish caught or, for longline and pot gear, the number of fish caught. Species proportions in individual trawl tows (or sets of longline/pot gear) were determined by observer's samples and expanded to the total tow weight which was visually estimated by the skipper or observer.
2. Bycatch = kg or no. per metric ton of landed fish (whole fish, all species, including landed discard) as listed on the fish ticket. Longline and pot gear kg/mt was generated from the average weight of those fish which were weighed.

T = trace, less than 0.05

0.0 = no catch.

Sum of visually estimated catch = 137.76 mt.

Table 3. Bycatch rate of prohibited species and species composition in domestic commercial fisheries as observed by the Alaska Department of Fish and Game.

Catch Details	Species	1	2	
		Catch (%)	---Bycatch---	---
			No./mt	Kg/mt
	Prohibited			
Area: Central Gulf	Halibut	6.3	35.9	400.6
Gear: Longline	Tanner crab	T	T	T
Target Species: Sablefish	R.king crab	0.0	0.0	0.0
	Salmon	0.0	0.0	0.0
Inclusive Dates:	Herring	0.0	0.0	0.0
Sablefish Seasons 1987-89	Commercial			
Vessels Observed: 14	Pacific cod	1.1		
Trips Observed: 15	Pollock	T		
Hauls/Sets Observed: 192	Flounder	4.5		
Total Landing: 183.5 mt	Sablefish	57.2		
Stat. Areas Observed:	Rockfish	18.7		
475830 475900 485800	Other	12.2		
495730 505700 505730				
515630 515700 525600				
525630 525702 535602				
545530 555532 565000				
575430 585400				

1. Catch (%) refers to total catch brought on deck and is based on the observed weight of fish caught or, for longline and pot gear, the number of fish caught. Species proportions in individual trawl tows (or sets of longline/pot gear) were determined by observer's samples and expanded to the total tow weight which was visually estimated by the skipper or observer.
2. Bycatch = kg or no. per metric ton of landed fish (whole fish, all species, including landed discard) as listed on the fish ticket. Longline and pot gear kg/mt was generated from the average weight of those fish which were weighed.

T = trace, less than 0.05

0.0 = no catch.

Sum of visually estimated catch = 224.92 mt.

Table 4. Bycatch rate of prohibited species and species composition in domestic commercial fisheries as observed by the Alaska Department of Fish and Game.

Catch Details	Species	1	2	
		Catch (%)	---Bycatch---	---
			No./mt	Kg/mt
	Prohibited			
Area: Gulf of Alaska	Halibut	3.2	17.3	201.2
Gear: Longline	Tanner crab	0.0	0.0	0.0
Target Species: Sablefish	R.king crab	0.0	0.0	0.0
	Salmon	0.0	0.0	0.0
Inclusive Dates:	Herring	0.0	0.0	0.0
Sablefish Season 1987	Commercial			
Vessels Observed: 3	Pacific cod	T		
Trips Observed: 3	Pollock	T		
Hauls/Sets Observed: 43	Flounder	6.0		
Total Landing: 53.7 mt	Sablefish	66.4		
Stat. Areas Observed:	Rockfish	9.0		
505700 515630 525600	Other	15.4		
525630 525702 545530				

1. Catch (%) refers to total catch brought on deck and is based on the observed weight of fish caught or, for longline and pot gear, the number of fish caught. Species proportions in individual trawl tows (or sets of longline/pot gear) were determined by observer's samples and expanded to the total tow weight which was visually estimated by the skipper or observer.
 2. Bycatch = kg or no. per metric ton of landed fish (whole fish, all species, including landed discard) as listed on the fish ticket. Longline and pot gear kg/mt was generated from the average weight of those fish which were weighed.
- T = trace, less than 0.05
0.0 = no catch.
Sum of visually estimated catch = 0. mt.

Table 5. Bycatch rate of prohibited species and species composition in domestic commercial fisheries as observed by the Alaska Department of Fish and Game.

Catch Details	Species	1	2	
		Catch (%)	---Bycatch---	---
			No./mt	Kg/mt
	Prohibited			
Area: Gulf of Alaska	Halibut	11.0	64.2	678.5
Gear: Longline	Tanner crab	T	T	T
Target Species: Sablefish	R.king crab	0.0	0.0	0.0
	Salmon	0.0	0.0	0.0
Inclusive Dates:	Herring	0.0	0.0	0.0
Sablefish Season 1988	Commercial			
Vessels Observed: 4	Pacific cod	2.9		
Trips Observed: 5	Pollock	T		
Hauls/Sets Observed: 62	Flounder	6.6		
Total Landing: 63.6 mt	Sablefish	63.9		
Stat. Areas Observed:	Rockfish	12.2		
435931 445931 475830	Other	3.3		
475900 495730 505730				
515700 525600 525630				
535602				

1. Catch (%) refers to total catch brought on deck and is based on the observed weight of fish caught or, for longline and pot gear, the number of fish caught. Species proportions in individual trawl tows (or sets of longline/pot gear) were determined by observer's samples and expanded to the total tow weight which was visually estimated by the skipper or observer.
2. Bycatch = kg or no. per metric ton of landed fish (whole fish, all species, including landed discard) as listed on the fish ticket. Longline and pot gear kg/mt was generated from the average weight of those fish which were weighed.

T = trace, less than 0.05

0.0 = no catch.

Sum of visually estimated catch = 118.38 mt.

Table 6. Bycatch rate of prohibited species and species composition in domestic commercial fisheries as observed by the Alaska Department of Fish and Game.

Catch Details	Species	1	2	
		Catch (%)	---Bycatch---	----
			No./mt	Kg/mt
	Prohibited			
Area: Gulf of Alaska	Halibut	4.6	28.0	349.4
Gear: Longline	Tanner crab	0.0	0.0	0.0
Target Species: Sablefish	R.king crab	0.0	0.0	0.0
	Salmon	0.0	0.0	0.0
Inclusive Dates:	Herring	0.0	0.0	0.0
Sablefish Season 1989	Commercial			
Vessels Observed: 9	Pacific cod	0.1		
Trips Observed: 9	Pollock	T		
Hauls/Sets Observed: 120	Flounder	3.8		
Total Landing: 136.2 mt	Sablefish	52.1		
Stat. Areas Observed:	Rockfish	19.7		
415900 425931 465901	Other	19.7		
485800 505700 515630				
515700 545530 555532				
565000 575430 585400				
595400				

1. Catch (%) refers to total catch brought on deck and is based on the observed weight of fish caught or, for longline and pot gear, the number of fish caught. Species proportions in individual trawl tows (or sets of longline/pot gear) were determined by observer's samples and expanded to the total tow weight which was visually estimated by the skipper or observer.
2. Bycatch = kg or no. per metric ton of landed fish (whole fish, all species, including landed discard) as listed on the fish ticket. Longline and pot gear kg/mt was generated from the average weight of those fish which were weighed.

T = trace, less than 0.05

0.0 = no catch.

Sum of visually estimated catch = 231.97 mt.

Table 7. Number of sets, catch rates¹, and standard deviations by fishery week as sampled by observers aboard longliners targeting sablefish (1987-1989).

Week	No. of Sets	Average Catch/Set (kg)	Bycatch Rate (%)	Standard Deviation (kg)
1	28	752.4	39.6	1114.7
2	26	694.6	59.3	2153.6
3	33	74.8	6.6	271.6
4	44	421.4	28.8	1056.7
5	32	178.1	25.3	583.8
6	33	118.1	6.2	319.1
7	3	0	0	0
8	14	9.5	0.8	34.3
9	20	699.3	228.5	707.2
10	15	1219.2	166.6	770.6

¹Bycatch rates were calculated by dividing the halibut bycatch by the observer's estimate of retained catch.

Table 8. Number of vessels, sets, hooks, and bycatch rates¹ for each stat area fished in the Gulf of Alaska from observer samples aboard longliners targeting sablefish, (1987-1989). (Source ADF&G groundfish observer database).

Area	Statarea	Vessels	Sets	No. of Hooks	All Depths (%)	<250 Fms (%)	>250 Fms (%)
Eastern	1	1	11	42500	93.0	0	93.0
Eastern	2	1	5	24800	5.1	0	5.1
Eastern	3	1	7	31800	70.2	131.8	30.8
Eastern	4	1	15	66400	6.5	-	6.5
Eastern	5	1	14	64625	31.5	140.9	3.1
Central	6	1	4	17780	0.6	-	0.6
Central	7	1	1	4200	4.9	-	4.9
Central	8	1	4	9660	0	-	0
Central	9	1	5	15400	180.3	271.9	0
Central	10	4	20	71843	2.0	-	2
Central	11	1	9	36217	141.2	167.5	0
Central	12	4	34	118090	0.9	3.4	0.3
Central	13	4	17	58172	417.9	631.3	123.4
Central	14	2	13	48400	22.2	113.7	1
Central	15	2	3	34600	110.6	310.1	0.5
Central	16	1	4	15660	10.4	-	10.4
Central	17	1	11	61547	112.8	112.8	-
Central	18	3	26	118220	17.3	70.9	4.3
Central	19	1	2	7840	0	-	0
Central	20	1	6	37450	3.7	17.5	1.2
Central	21	2	17	95244	0.6	-	0.6
Central	22	1	16	90296	42.3	303.3	1
Western	23	1	1	6132	0	-	0

Mean Bycatch 32.7 142.3 9.2

¹Bycatch rates were calculated by dividing the halibut bycatch by the observer's estimate of retained catch.

Table 9. Mean, standard deviation, standard error, and coefficient of variation for total halibut weight caught per set using 1987 and 1989 observer data collected aboard longliners targeting sablefish in the Central Gulf.

Depth Class	(n)	Mean	(S.E)	Standard Deviation	Coefficient of Variation
All Depths	(134)	312.6	(100.9)	1168.1	373.7
LE 250	(18)	1940.5	(617.4)	2619.2	135.0
GT 250	(116)	60.0	(17.8)	191.6	319.3

Table 10. Estimate of halibut bycatch for sablefish longliners by using the observer data from 1987 and 1989 for the central Gulf to calculate the total halibut bycatch for the entire Central Gulf sablefish longline fishery for 1989 deeper and shallower of 250 fathoms. (Source ADF&G observer database).

Depth Class (n) (fm)	Total ¹ Halibut Weight (kg)	Total Sablefish		Total Hooks (#)	Sablefish ² (mt)	Halibut (mt)
		Retained Weight (kg)	Halibut Bycatch (%)			
Le 250 (18)	29190.9	12130	240.6	47102	748	1800
Gt 250 (116)	5339.0	147090	3.6	454331	9065	326

¹The observer sample was assumed to be representative of the entire fishing fleet for 1989.

²Total catch sablefish in the 1989 longline fishery was 9813 mt.

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