Possible causes of low PIT tag recovery rates in 2004

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Abstract

Unexpectedly low numbers of recoveries of PIT (Passive Integrated Transponder) tags from Areas 3 and 4 were not the result of mismatched distributions of tag releases and commercial catches (except in Area 4D and to some extent 4B). Nor were the low numbers of recoveries of larger fish in Area 3B and 4 the result of releasing mainly small fish in areas where the commercial catch was taken. Tag recovery rates in landings from the same area in different ports do show some evidence of differences in detection rates among ports, with the apparently low rates applying to landings from Areas 3 and 4.

Introduction

In 2003 IPHC staff released some 29,000 legal-sized halibut with PIT (Passive Integrated Transponder) tags in the course of the coastwide setline survey. Tags were distributed approximately in proportion to abundance by marking all fish caught on three skates of gear at each survey station (Kaimmer and Geernaert 2004). In 2004, landed halibut were scanned at all major ports. More than a million fish were scanned and 382 of the fish released during the 2003 survey were recovered (Forsberg 2005).

Harvest rates estimated from the 2004 recoveries agreed quite well with the standard stock assessment in Areas 2B and 2C. In Area 3A the mark-recapture estimates of harvest rate by length interval were about half the assessment estimates for all length groups. In Areas 3B and 4 the mark-recapture estimates were only 1-3% for all length groups, which was similar to the recovery rates of small fish in Area 3A but only about a tenth of the assessment estimates for large fish (Clark and Chen 2005).

This paper examines some possible causes of the generally low rate of recoveries in Areas 3 and 4, including the very low recovery rates of large fish in Areas 3B and 4.

Mismatched distribution of tag releases and commercial fishing

While the survey design would seem to guarantee a good distribution of tagged fish, it is possible that the fishery somehow managed to miss them in Areas 3 and 4 but not in Area 2. To check for that, the distributions of tag releases and commercial catch in each area were compared. As examples, Figure 1 shows the two distributions for Area 2B and Figure 2 for Area 3B. In both areas the distribution of tag releases is more even than the distribution of commercial catch, but the comparison is very similar for the two areas.

The table below shows some statistics of the distributions, including an objective measure of overlap which was calculated as follows. Let p_{ti} denote the proportion of tags in a given area released at station *i*, and let p_{ci} denote the proportion of the commercial landings taken at locations where station *i* is the nearest survey station and is no more than 10 nautical miles away. The measure of overlap is $\sum_i \min\left(p_{ti}, p_{ci}\right)$, which will be one if the distributions are the same and zero if they are completely disjoint. If the tag and catch distributions are thought of as discs

of various sizes placed at all the survey stations, with the catch discs on top of the tag discs, the measure of overlap is the proportion of the area of the tag discs that is covered by the catch discs.

Areas 2B, 2C, 3A, and 3B are closely similar, and Area 4A not much different. (The small difference is due to catch taken on the north side of the easternmost Aleutians where there are no survey stations.) In Area 4B there is a mismatch due to catch taken around Seguam Island and in Amchitka Pass more than 10 nautical miles from a survey station, but not much more. In Area 4D there is a gross mismatch because some 80% of the catch was taken at St. Mathew Island where no tags were released.

	Proportion of catch taken within 10 mi of a survey station	Measure of overlap between tag releases and commercial catch
Area 2B	0.89	0.37
Area 2C	0.89	0.45
Area 3A	0.96	0.41
Area 3B	0.96	0.40
Area 4A	0.82	0.35
Area 4B	0.55	0.29
Area 4D	0.15	0.11

In conclusion, mismatched distributions could account for the lack of recoveries from Area 4D and to some extent for the very low recoveries from Area 4B, but not for the low or very low recoveries in Areas 3A, 3B, and 4A.

Differences in length distribution between heavily and lightly fished areas

The length compositions of survey and commercial catches of legal-sized fish are similar except for the larger number of 80-90 cm fish in survey catches, indicating that the selectivities are very similar. But even if the overall selectivities are similar, the commercial tag recoveries could be weighted toward smaller fish (as observed in Areas 3B and 4) if the tag releases in heavily fished areas happened to consist largely of small fish. Figure 3 compares the length distributions of tag releases in heavily and lightly fished parts of each area. There is no difference to speak of.

Low detection rates of either whole or headed fish

Coastwide, about 40% of the scanned fish were headed and 60% were whole. Tag recovery rates did not differ consistently or substantially between headed and whole fish in landings from a given regulatory area in a given port (Forsberg 2006).

Low detection rates in some ports

Because fish in each regulatory area were tagged in proportion to abundance, the proportion of marked fish in the commercial catch from a given regulatory area should have been about the same in all ports where the fish were landed. Large differences among ports in recovery rates are therefore suggestive of substantial differences in detection rates and therefore at least some low ones. Table 1 shows the numbers of fish scanned and tags recovered by port and area of capture. Table 2 shows the corresponding recovery rates and standard deviations thereof.

In Area 2B recovery rates were almost the same in all three major ports. Likewise in Area 2C recovery rates were the same in Petersburg and Sitka, but very low by comparison in Juneau. It is curious that recovery rates were so much higher in Area 2C landings than in Area 2B landings. The major determinant of the (true) proportion of tagged fish in the landings is survey catchability, and one would not expect it to be so much higher in Area 2C than in Area 2B.

The overall recovery rate of tags from Area 3A catches was 7.7±1.8 per 10,000 fish in Petersburg and Sitka landings vs. 3.9±0.4 in Kodiak and Seward landings—a factor of two. This difference is significant at the 90% level. The recovery rate in Homer was only a quarter of the rate in Kodiak and Seward. The same contrast appears in Area 3B catches, although the recovery rate in Homer is more than one-half that for Area 3B landings in other ports. Overall the recovery rates from Area 3A and 3B catches were about the same in every port, but substantially lower in Homer landings than in Kodiak and Seward landings.

Sample sizes are too small to compare recovery rates from Area 4A landings among ports, but the absolute number in Dutch Harbor looks low in comparison with other areas.

These comparisons are not conclusive evidence of differences in detection rates among ports but they are highly suggestive. If there were differences among ports in Area 3, some of the detection rates there must have been low.

References

Clark, W. G., and Chen D.G. 2005. Preliminary estimates based on 2004 PIT tag recoveries. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2004: 199-212.

Forsberg, J.E. 2005. Portside sampling for recovered PIT tags in Pacific halibut. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2004: 363-380.

Forsberg, J.E. 2006. Portside sampling for recovered PIT tags in Pacific halibut. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2005 (this volume).

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Table 1. Tags recovered (from the 2003 survey release) and fish scanned, by port and area of capture.

	Area of capture					
Port	**Area 2B**	**Area 2C**	**Area 3A**	**Area 3B**	**Area 4A**	**Area 4B**
Vancouver	9 / 27531					
Ucluelet	1 / 11848					
Port Hardy	24 / 68764					
Prince Rupert	38 / 100791					
Petersburg		54 / 60043	4 / 7097			
Sitka		30 / 32704	11 / 13912	0 / 403		
Juneau		6 / 27472	11 / 27723			
Seward		1 / 1111	30 / 86589	7 / 27783	0 / 960	
Homer			19 / 183639	26 / 143238	0 / 9792	
Kodiak			56 / 132198	43 / 136517	0 / 1440	
Dutch Harbor				3 / 8051	6 / 43081	1 / 24685

Table 2. Tag recovery rate (tags per 10,000 fish scanned) and standard deviation. Italicized numbers indicate a cell with fewer than 3 recoveries.

	Area of capture					
Port	**Area 2B**	**Area 2C**	**Area 3A**	**Area 3B**	**Area 4A**	**Area 4B**
Vancouver	3.3 ± 1.1					
Ucluelet	*0.8 ± 0.8*					
Port Hardy	3.5 ± 0.7					
Prince Rupert	3.8 ± 0.6					
Petersburg		9.0 ± 1.2	5.6 ± 2.8			
Sitka		9.2 ± 1.7	7.9 ± 2.4	*0.0 ± 0.0*		
Juneau		2.2 ± 0.9	4.0 ± 1.2			
Seward		*9.0 ± 9.0*	3.5 ± 0.6	2.9 ± 1.1	*0.0 ± 0.0*	
Homer			1.0 ± 0.2	1.8 ± 0.4	*0.0 ± 0.0*	
Kodiak			4.2 ± 0.6	3.1 ± 0.5	*0.0 ± 0.0*	
Dutch Harbor				3.7 ± 2.2	1.4 ± 0.6	*0.4 ± 0.4*

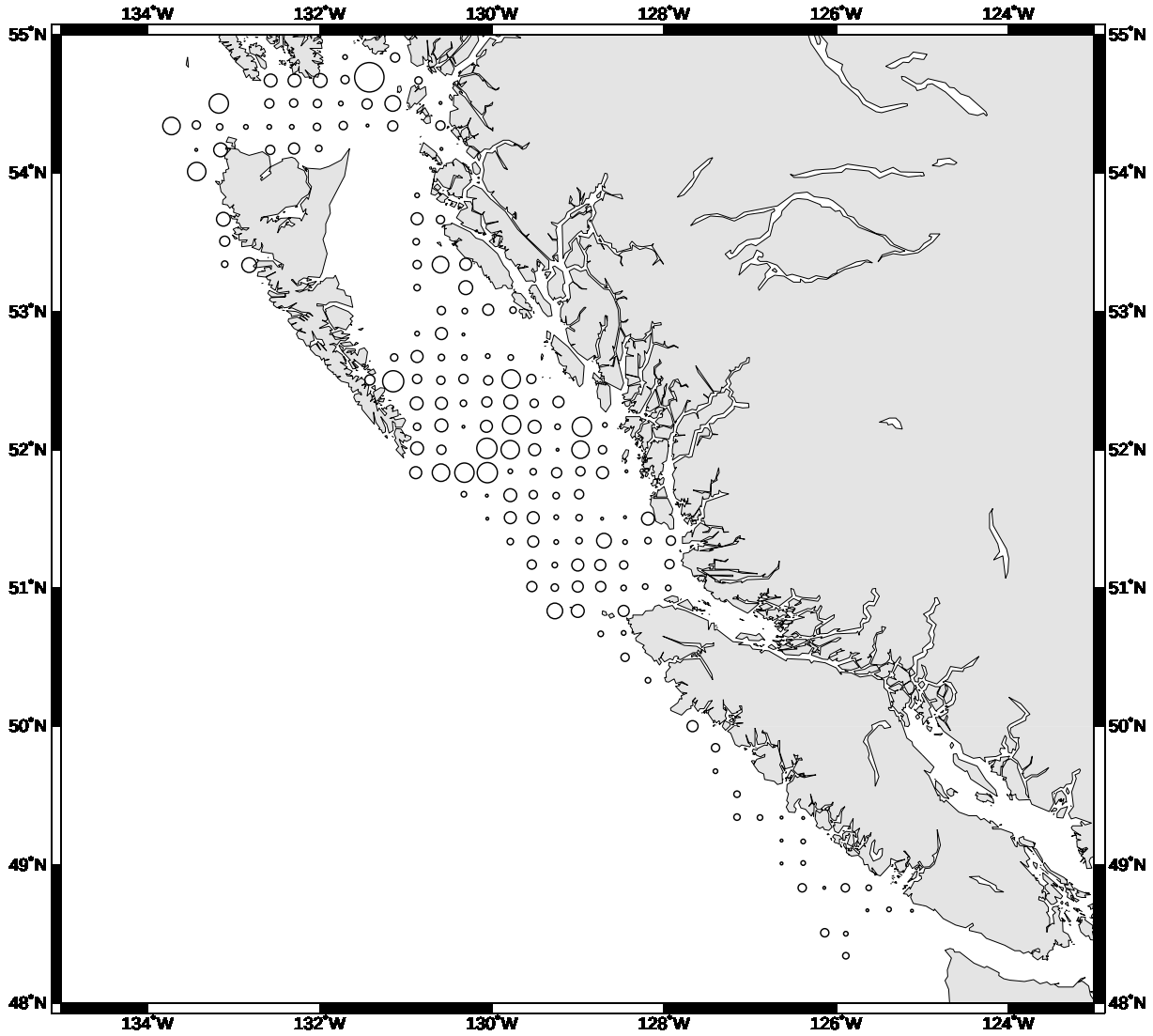

Figure 1a. Tag release distribution in Area 2B. The number of tags released at each station is proportional to the area of the plotted circle.

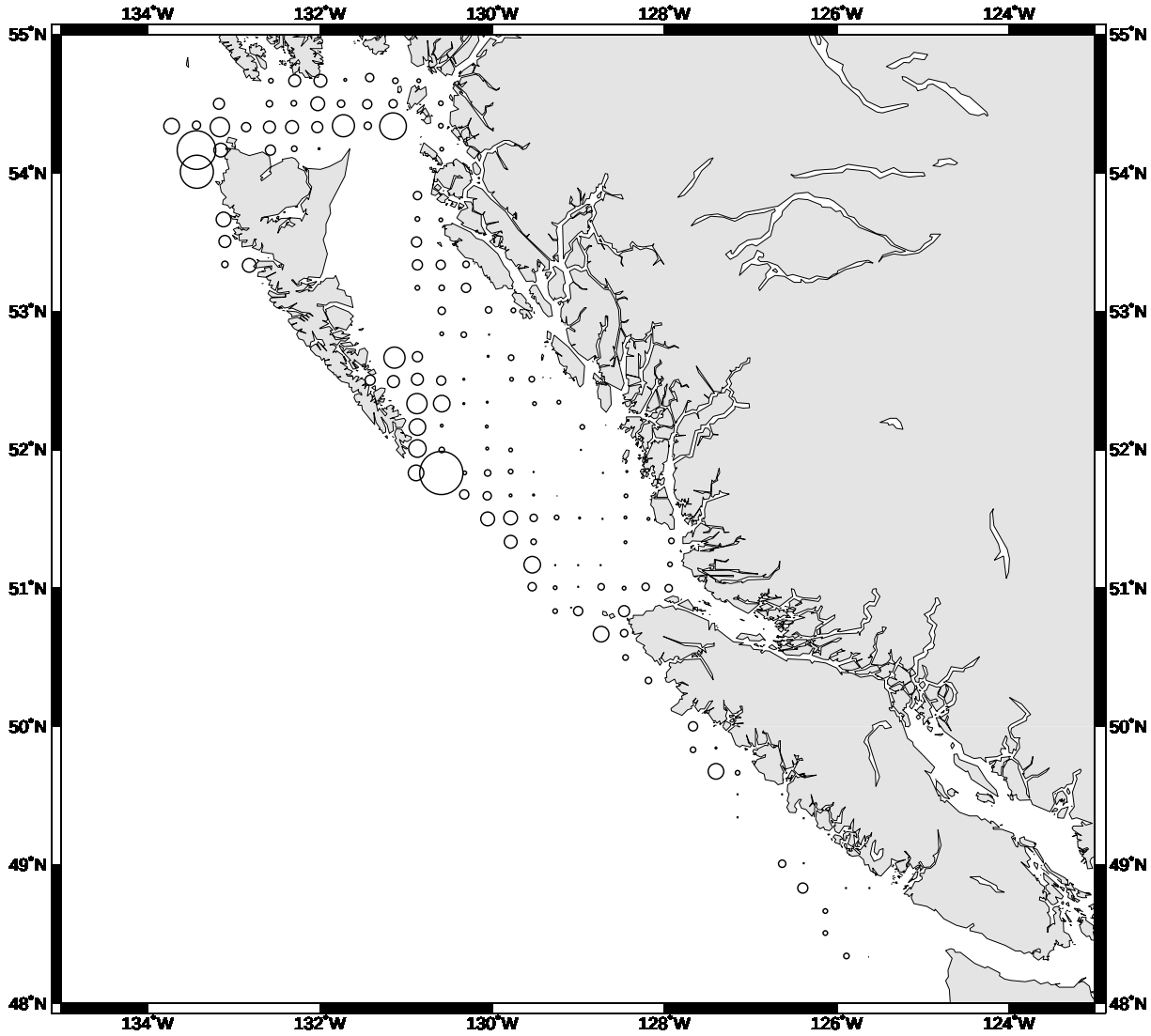

Figure 1b. Commercial catch distribution in Area 2B.

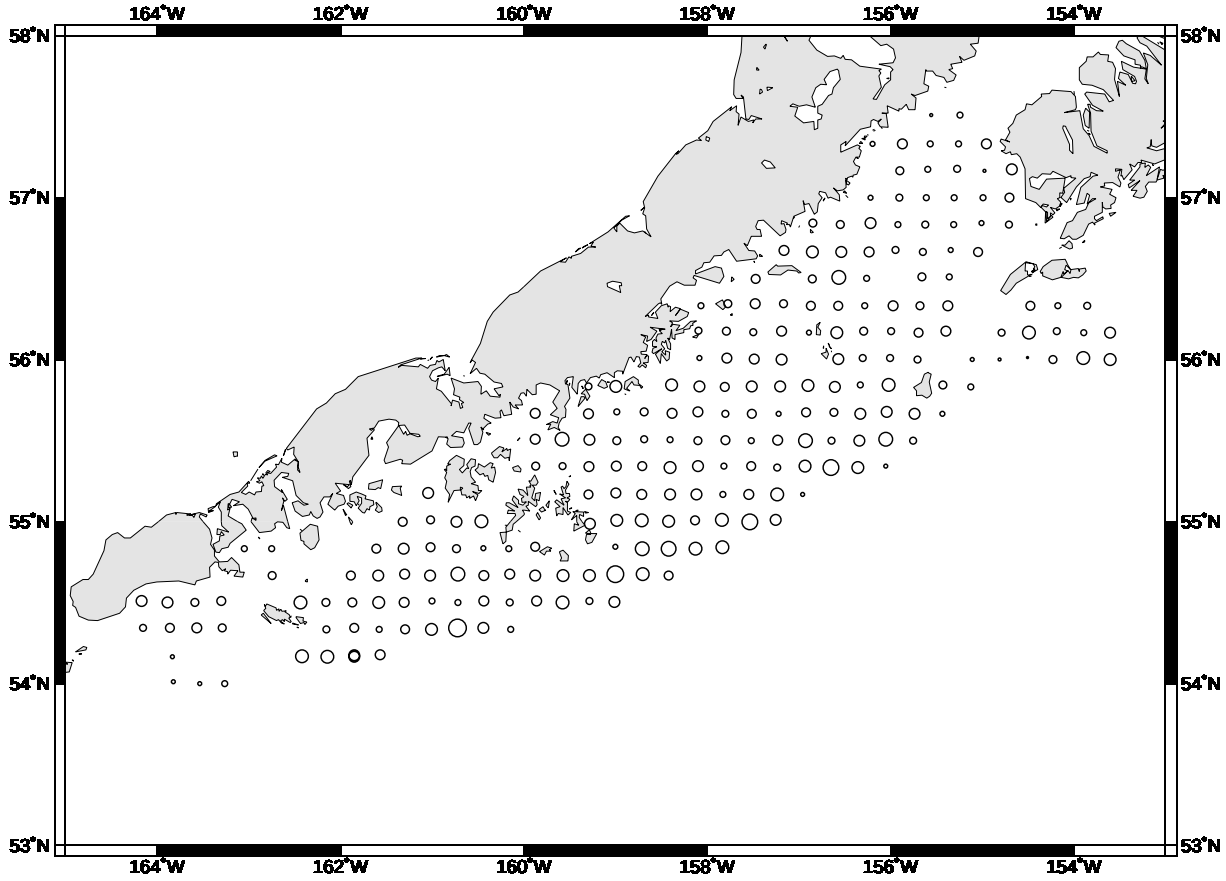

Figure 2a. Tag release distribution in Area 3B.

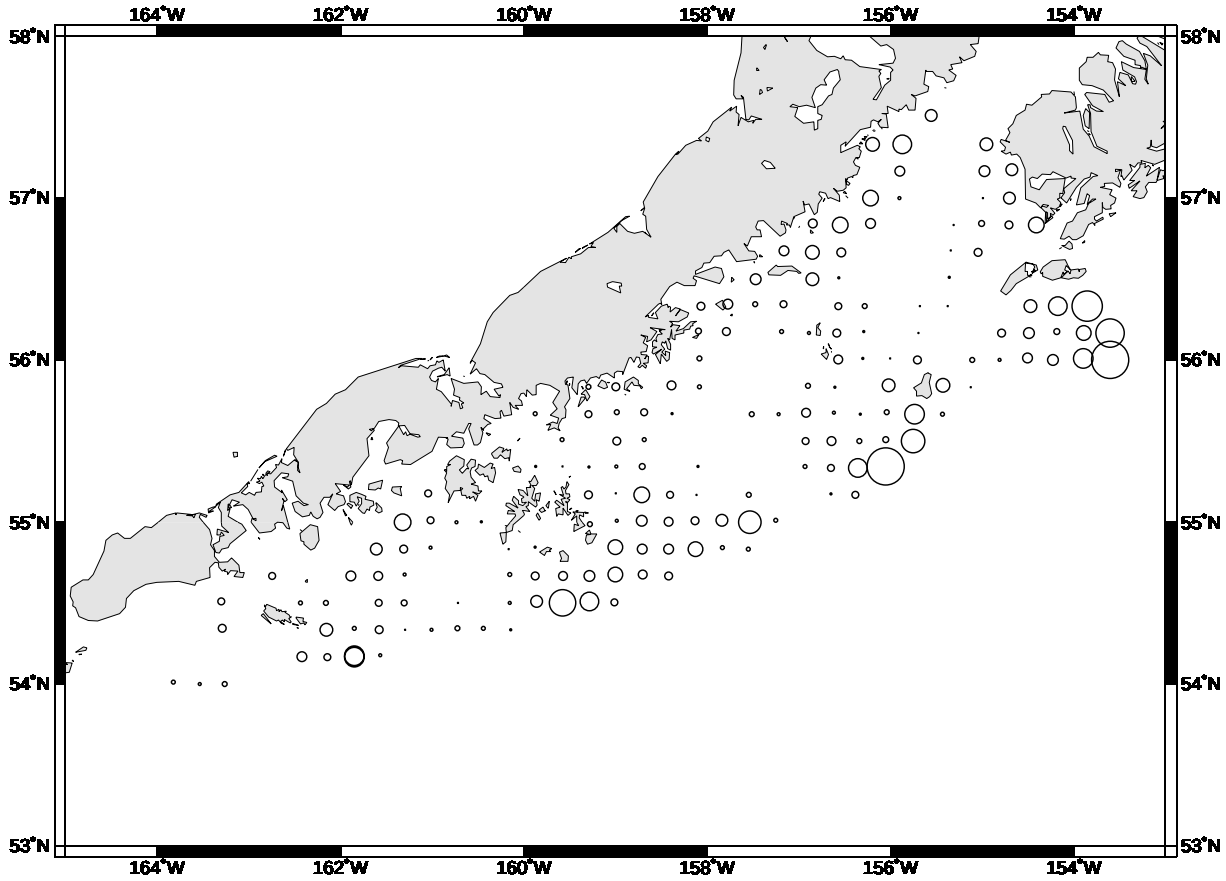

Figure 2b. Commercial catch distribution in Area 3B.

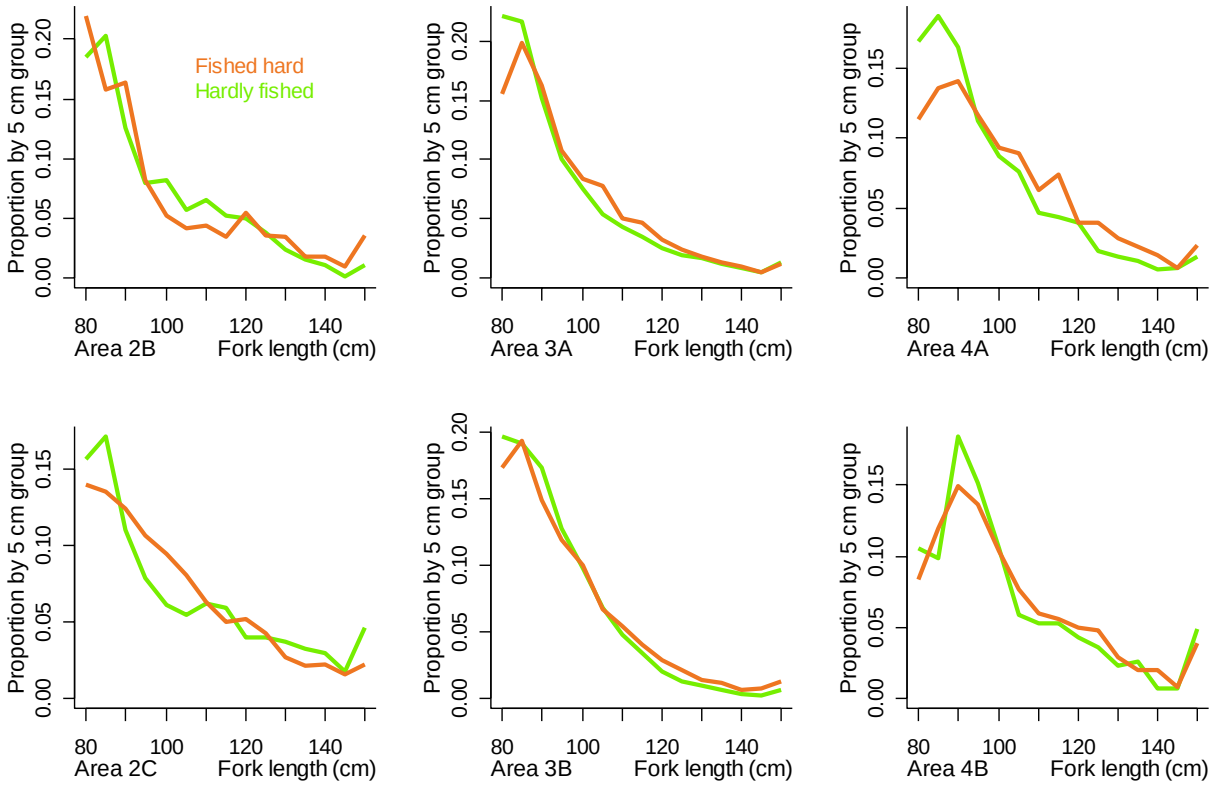

Figure 3. For each area, the length distribution of released fish at stations in heavily fished and lightly fished zones. The solid lines refer to survey stations with the most commercial catch taken in their vicinity, totalling 75% or more of the logged catch.