

Serial No.439Document No.4ANNUAL MEETING - MAY 1957Defects in the Recovering of Tagged Fish

by Erik M. Poulsen

1. Introduction

Cod have been and are tagged in large numbers by several member nations through the whole Convention Area from Long Island in the South to Disko in the North.

Great efforts have been made, partly with good results, with the tagging of haddock. Urged by Commission's recommendations countries are now attacking the far more difficult problem of tagging redfish, and quite recently the first promising taggings have been reported.

Also a considerable number of flatfish, among them halibut, are being tagged.

Experiments are carried out at sea and in aquaria to find the most suitable tags, i.e. tags which can easily and quickly be attached to the fish, do not damage the fish, are not too easily lost, and are easily recognizable once the tagged fish is recovered.

With this last condition we arrive at a phase of the tagging which perhaps has not received the attention due to it: the observing of the tagged fish and the reporting of the recaptures. And yet the results of the costly tagging experiments depend to a great extent upon the observing of the tagged fish in the catches and the reporting of them.

The Danish research report for 1955 (Annual Proc. Vol.6, ICNAF 1956) says, after mentioning the good system that Portugal has developed for the collection and reporting of data on recaptures, "It would be desirable if all nations.....could organize the important collection of tags and of data on recaptures in such a way that the full value of the tagging experiments can be achieved".

All are aware of the fact that not all recaptures are reported. In the busy hours of fishing, tagged fish may be overlooked or may not be sufficiently taken care of to allow later reporting. A recapture lost in this way is not only a loss of an item of important information, it is, or may be, an item of false information. This latter especially applies as we do not know to what extent tags are overlooked or not reported, and as we have every reason to assume that the percentage overlooked cannot be the same for the various fisheries.

The scope of the present paper is to show that large numbers of tags are overlooked and to a varying degree by the different fishing fleets, and further to try to find a conversion factor to use when recaptures by various fishing fleets are compiled.

2. Numbers of recaptures by the various fleets

The Danish research report for 1955 gives the number of recaptures in 1955 of Danish tagged cod in Subarea 1 by each of the nations. In the following table the number of recaptures is shown compared with the year's catch by the same nations:

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Cod, 1955 Subarea 1	No. of Recaptures Reported	Catch of Cod in Tons	No. of Rep. Recaptures per 1000 Tons Fished
Greenland	271	19,788	13.6
Faroes	7	35,982	0.2
France	4	34,118	0.1
Germany	4	7,248	0.6
Iceland	7	8,919	0.8
Norway	16	42,974	0.4
Portugal	259	103,699	2.5
Spain	1	7,451	0.1
United Kingdom	2	3,534	0.5
Total	571	263,713	2.2

The variation in number of recaptures reported per 1000 tons fished is exceedingly high. The Greenlanders reported 5 times as many as the Portuguese; and these latter 4-5 times as many as Iceland, Germany and United Kingdom; these again 8-5 times as many as France and Spain.

Facing such great variation, the question arises: Can it be attributed solely to the fleets' varying degree of opportunity of catching tagged cod, to area fished, to method of fishing; or must we assume that part of the variation is due to a more or less attentive watch for tagged fish and to the degree of efficiency of the reporting systems?

To answer this question the distribution of the fisheries of the different fishing fleets within the subarea will be considered in connection with the distribution of the tagging experiments and of tagged cod.

A considerable part of the Danish taggings are carried out in coastal waters and fjords (in 1954+55 2,802 in coastal waters and 3,485 on the banks). As coastal waters and fjords cover a smaller area than the banks, the density of the tagged cod must be greater there where only the Greenlanders fish. This may well account - at any rate partly - for the high number of recaptures by the Greenlanders.

The fisheries of the other countries are carried out on the banks or near the banks. Their landings from the various subdivisions (also those of the Greenlanders) were as follows for 1955:

Landings, round fresh 1955	1A		1B		1C		1D		1E		1F		Total Tons
	Ts.	%	Ts.	%	Ts.	%	Ts.	%	Ts.	%	Ts.	%	
Faroes	338	1	6,804	19	6,446	18	18,980	53	2,149	6	1,074	3	35,811
France	9		9,162	27	6,912	20	17,586	52	447	1			34,116
Germany							6,904	96	344	4			7,248
Greenlanders	591	3	5,523	28	3,225	17	4,061	21	2,773	14	3,614	18	19,787
Iceland	89	1	1,695	19	1,605	18	4,727	53	535	6	268	3	8,919
Norway	1,990	5	10,347	24	9,479	22	12,488	29	7,830	18	840	2	42,974
Portugal			36,161	34	19,888	19	47,636	46					103,685
Spain			7		2,060	28	5,265	72					7,338
U.K.							1,152	23			3,893	77	5,045
Total	3,037	1	69,699	26	49,615	19	118,799	45	14,078	5	9,689	4	264,917

It should be noted that the landings of the Faroes and Iceland are not yet reported by subdivisions; they are separated here by using the percentage landings from the other countries (excluding U.K. with landings from only 1D and 1F). For Norway only about half the landings are separated by subdivisions, the remainder is distributed in the table by applying the percentages of that part which is separated by subdivisions.

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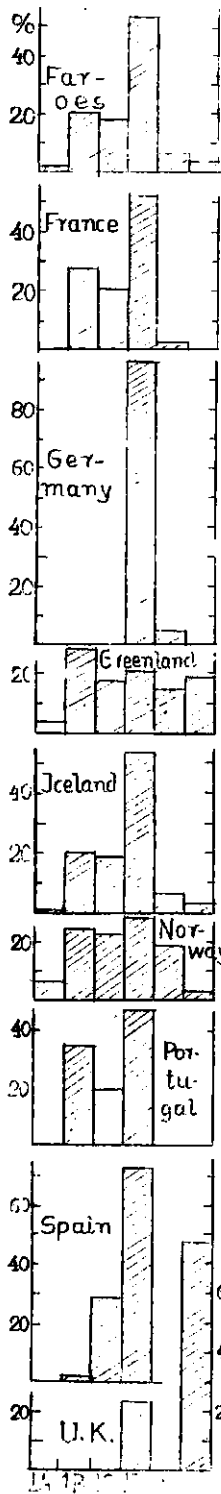


Fig. 1 - Percentage landings of cod by subdivisions in 1955.

It is apparent that by far the main part (90%) comes from Subdivisions B, C and D. The other three subdivisions, the northern A and the two southern E and F, yield only respectively 1, 5, and 4%. D yields 45% or almost twice as much as B and C, these latter respectively 26 and 19%.

Fig. 1 shows for each nation its percentage landings by subdivisions in 1955. U.K. is outstanding from the other countries as far as it mainly (77%) fishes the southern subdivision F, where the other nations (apart from the Greenlanders) hardly fish. In the northernmost subdivision, A, no important fishery is carried out by any of the nations. The Greenlanders' fishery is rather evenly distributed between B-F, and that of Norway between B-E. The other countries concentrate their fisheries in B, C and D; Portugal and Spain fished in 1955 only in these areas.

The percentage landings of each country in B, C and D are as follows:

Portugal	-	100%	Faroes	-	85%
Spain	-	100%	Norway	-	75%
France	-	99%	Greenlanders	-	66%
Germany	-	96%	United Kingdom	-	23%
Iceland	-	90%			

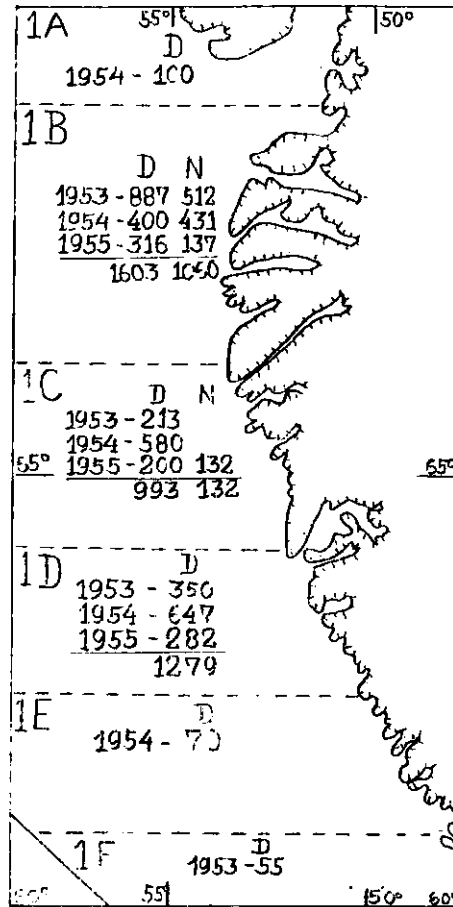


Fig. 2 - Numbers of cod tagged in offshore waters of West Greenland in 1953-55 by Denmark-D and Norway-N.

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The distribution of tagged cod in Subarea 1 is shown in Fig.2 giving the numbers tagged in offshore waters in 1953-55 by Denmark and Norway, the two countries carrying out taggings in these years. Very few cod were tagged in the northern (A) and southern (E and F) subdivisions. In the other three subdivisions, the following numbers were tagged in 1953-55:

	Denmark	Norway	Total	No. Tagged per 1000 km. ² within 100 Fms.
1B	1,603	557	2,160	75
1C	993	655	1,648	75
1D	1,279		1,279	71
Total	3,875	1,212 ¹⁾	5,087	

The area within the 100 fathom contour is considered as the "cod" area. It appears from the figures that almost the same numbers were tagged per square unit in the three subdivisions.

The numbers tagged over three years of course do not give the real density of tagged cod in 1955. The numbers for 1953 and 1954 will have been reduced. The numbers tagged in 1955 - mostly in July - will only have been tagged during around one-third of the fishing season, which extends in the main from May to October. In order to arrive at a better estimate of the number of tagged cod present in 1955, the following table has been compiled; here the numbers tagged in 1953 and 1954 are reduced with 30 and 15% to allow for mortality, those for 1955 with 33% as they were only there for the latter two-thirds of the fishing season:

	B	C	D
1953	1,143-30% = 800	469-30% = 328	350-30% = 245
1954	632-15% = 537	779-15% = 662	647-15% = 550
1955	385-33% = 258	401-33% = 269	682-33% = 454
Total	1,595	1,259	984
No. per km. ² of cod area	55	57	55

This calculation shows also a fairly uniform density of tagged cod in the three subdivisions B, C and D in the fishing season of 1955. Thus there is good reason to assume that the fleets fishing in this area would have about the same possibility of taking tagged cod, wherever they fish. This the more so as cod undertake seasonal migrations covering all three subdivisions (cfr. Norwegian research report 1954, Ann. Proc. Vol.5).

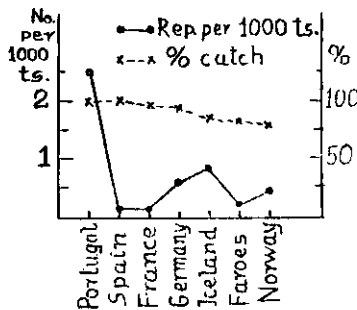


Fig.3 - No. of Recaptures reported per 1000 tons fished compared with the catch in Subdivisions B, C, D, of the fleet's whole catch.

United Kingdom takes only 23% of its landings from B, C and D where tagging mainly is carried out. The opportunity for its fleet to take tagged cod is therefore only small. The small number of tagged cod per 1000 ts. caught (0.5) can be explained by this fact. The Greenlanders are, for reasons already stated, not considered in this respect. The other fishing fleets carry out, as already shown, their main fishery (75-100%) in B, C and D, and as the density of tagged cod can be assumed to be the same within these three subdivisions, they should have much the same opportunity for capturing tagged cod.

However, the numbers of recaptured tagged cod vary considerably among the fleets. Fig.3 shows for these fleets the numbers reported per 1000 ts. fished and the only slight variation of the percentage of their landings from B, C and D.

1) A considerable part of the Norwegian taggings were carried out in Holsteinsborg Deep at the border between B and C; these numbers have here been divided between B and C (on the map, Fig.2 they are noted as tagged in B).
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Portugal, with by far the highest number of recovery reports per 1000 ts. fished, has by far the largest landing from the region. The landings by the other countries are around one-third or less of the Portugese. It might therefore be assumed that their low numbers reported are caused by their rather few vessels happening to fish in places where few tagged cod would be present. This explanation is, however, hardly valid; all vessels would endeavour to fish in areas where cod are abundant, i.e. in more or less the same parts of the regions. There are two exceptions, viz. the German and Icelandic fleets which in 1955 fished mainly for redfish:

Landings in tons	<u>Cod</u>	<u>Redfish</u>
Germany	7,248	14,586
Iceland	8,919	17,983

Redfish are mainly caught in the outer area of the banks and on the slopes, in areas where cod (and tagged cod) would be less abundant. In this fact may be found an explanation for the comparatively low reports of recoveries by these two countries compared with Portugal.

Although there thus is some reason to assume that each of the fleets has not quite the same opportunity for catching tagged cod, the very great difference in numbers of reported recaptures per 1000 tons fished (from 0.1 to 2.5, see Fig.3) makes it impossible to disregard the possibility that the difference is due to a different handling of the fish caught, to a differing opportunity for reporting the numbers of tagged cod actually caught.

If this be so, the numbers reported do not in their entirety give the full picture of the numbers of tagged cod actually caught. The following table shows how many recaptures could have been expected in 1955 from the Danish tagging experiments if all fleets (except the Greenlanders' and United Kingdom) had reported to the same degree (2.5 per 1000 ts. landed) as the Portugese:

	<u>Catch in B, C and D in 1000 tons</u>	<u>Numbers of Tagged Cod</u>	
		<u>Actually Reported</u>	<u>To Be Expected</u>
Greenlanders	13	271	271
Faroes	33	7	83
France	34	4	84
Germany	7	4	17
Iceland	8	7	20
Norway	32	16	81
Portugal	104	259	259
Spain	7	1	19
U.K.	1	2	2
Total	239	571	836

The increase is from 571 to 836, or 46%.

From the Danish 1954 taggings a recapture of 10% was reported for 1955. According to the above calculation the percentage should have been 15, meaning that a conversion factor of 1.5 should be applied to the actual percentage recapture to bring it a step closer to reality.

There is, however, hardly reason to assume that the Portugese reports of recaptures, although by far the highest of those of the foreign fleets, are based on a complete reporting of recaptures. The big step from the Portugese 2.5 per 1000 tons to the Greenlanders' 13.6 makes this rather doubtful, even considering the Greenlanders' better opportunity for capturing tagged cod.

A certain check on the Portugese figure can be obtained by comparing the numbers reported by the two different Portugese fleets fishing in the subarea, the dory vessels and the trawlers.

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The following table shows, from lists published in "Jornal do Pescador", Lisbon, for the two fleets and for Subdivisions B, C and D the numbers of Danish and Norwegian tagged cod caught and reported in 1955, together with catches in 1000 tons and numbers reported per 1000 tons:

Subdivision	Gear	Numbers of Tagged Cod Reported	Catch in 1000 tons	Numbers Rep. per 1000 Tons
B	Trawl	3	2.4	1.25
	Dory	100	33.7	2.97
	Total	103	36.1	2.85
C	Trawl	23	10.5	2.19
	Dory	69	9.4	7.34
	Total	92	19.9	4.60
D	Trawl	45	29.9	1.50
	Dory	49	17.7	2.78
	Total	94	47.6	1.98
B, C and D	Trawl	71	42.8	1.66
	Dory	218	60.8	3.59
	Total	289	103.6	2.79

The final figure in this table, 2.79, is a little higher than that given in the preceding pages owing to the inclusion of the Norwegian tagged cod.

Fig.4 shows the figures in graphic form. The highest number of reported recaptures per 1000 tons comes from C, both for dory vessels and trawlers. B and D yield about the same numbers.

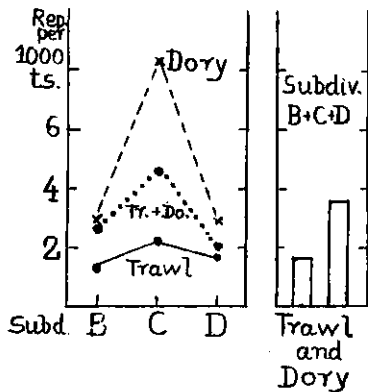


Fig.4 - Numbers of recaptures reported per 1000 tons landed by Portuguese trawlers and dory vessels in 1955 in the various Subdivisions B, C, and D (left), and in the three subdivisions together (right).

For the three subdivisions separately and taken together there is a considerable difference in the number of recaptures reported by the two fleets, the dory vessels reporting about twice as many as the trawlers (3.59 against 1.66). This difference could be explained by one or more of the following causes:

1. A tagged cod might be more easily caught compared to a non-tagged cod by hooks (dory) than by trawl.
2. The dory fleets might fish in areas with a greater density of tagged fish than the trawlers.
3. Tagged cod are more easily observed in dory than in trawl fishery.

ad.1. The Danish and Norwegian tags are external tags, either plastic tags or Petersen disk tags, fastened to the gill cover. There is no reason to assume that a cod tagged in this way would be more easily caught by hooks than by trawls. Rather the opposite could be expected.

ad.2. The distribution of the Portuguese dory and trawl fishery in 1955 is shown by subdivisions in Fig.5. In that year Portugal fished only in B, C and D, the landings from B and D being considerably larger than those from C (see also table p. 6). There was a great difference in

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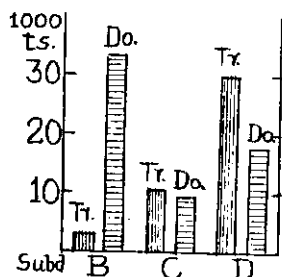


Fig. 5 - Distribution in Subarea 1 of the Portuguese Trawl and Dory Fishing in 1955.

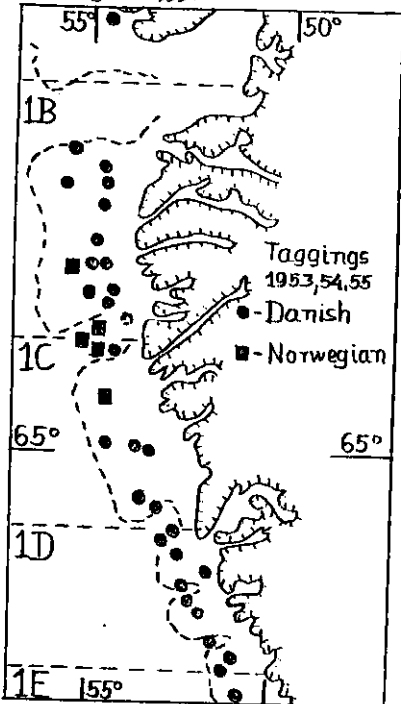


Fig. 6 - Localities where cod were tagged by Denmark and Norway 1953-55.

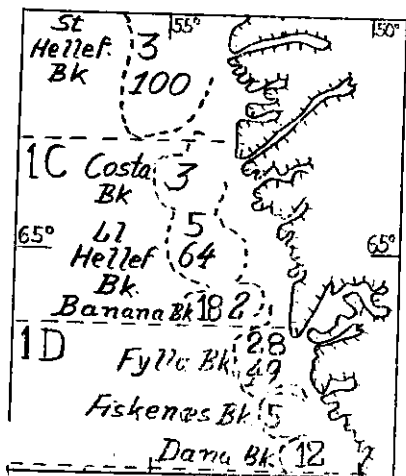


Fig. 7 - Portugal, 1955, numbers of recaptured cod reported from Trawlers and from Dory Vessels (italics)

the distribution of the two fisheries. Trawl fishing was only very small in B (2-3000 tons), where, however, the largest dory fishery (34,000 tons) occurs. In C the two fisheries were of almost the same size (9-10,000 tons). In D trawl fishery predominated (30,000 tons against 18,000).

There remains the possibility that within the subdivisions one of the fisheries is restricted to certain grounds and that these may happen to have a comparatively great density of tagged cod. Trawl fishery will be restricted to areas with a rather even bottom. Dory fishing will not be to that degree dependent on the nature of the bottom. The main part - if not all - of the cod used for tagging are caught on hooks; it might therefore be expected that the taggings were mainly carried out in places where hook (dory) fishing is prevalent. In the present case this hardly applies as most of the taggings, 3,875 out of 5,087, are carried out from "Dana" during its researches which are distributed evenly over the fishing area. The map, Fig. 6, shows the Norwegian and Danish tagging localities, 1953-55; they are fairly equally spread over the fishing area of B, C and D.

No information is published of the distribution of the Portuguese fishery within each of the subdivisions. However, the tagging recaptures are reported by fishing grounds, and by using them a more detailed picture can be obtained. The map, Fig. 7, shows for 1955 the number of recaptures reported for each of the fishing grounds. For 1B, the tagging reports reveal the same as the landings, that the fishery here is almost exclusively by dories. In the northern and central part of 1C the fishery is also almost exclusively by dories. In the southern part, Banana Bank, however, trawl fishery is absolutely predominant. In 1D both fisheries are of importance on Fylla Bank, dory fishing being, however, most used. In the southern part of 1D trawl fishery alone is carried out, i.e. judging from tagging recoveries.

Thus - apart from Fyllas Bank - the areas of the two fisheries are rather well separated from one another. However considering that the density of tagged cod can be regarded as fairly equal, we may well be justified in assuming that both fleets would have about the same possibility to catch tagged cod. This leaves us the third case to consider.

ad.3. Are tagged cod more easily observed by dory fishing than by trawl fishing? On board the vessels the handling of dory-caught and trawl-caught cod (cleaning,

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sorting, salting) is about the same; but in addition to this, each dory-caught cod has been handled individually once, when hauled into the dory and taken off the hook, and almost individually when forked from the dory to the deck of the vessel. There can be hardly any doubt that the opportunity for observing tagged cod is greater and better in dory fishery than in trawl fishery. We are therefore forced to admit the possibility or even probability of a large number - about one-half - of the recoveries being lost in the trawl fishery. In cases where internal marks are used, this, of course, does not apply; internal marks are much in use in Subarea 3.

Finally it might, however, be argued that only one year, only 289 recoveries, are considered, and that it might be just chance that has caused the difference between the two fleets. However, the fact that the difference exists not only in the total, but also for each of the three subdivisions (see Fig.4), speaks against mere chance as an explanation.

The Portuguese dories report 3.59 recaptures per 1000 tons fished, the trawlers only 1.66. Assuming that the above reasoning is just, this means that around half of the actual recoveries of tagged cod are overlooked in the trawl fishery, not only the Portuguese, but trawl fishery on the whole. To make trawl recaptures comparable to dory (hook) recaptures, a conversion factor of 2.0 has to be applied. When applying the factor 2.0 on all trawl-caught cod, we get the following table of recaptures, 1955:

	Number of Danish Tagged Cod		Tot. Trawl.		Recaptures from Trawl		Recapt. from other Fisheries	Total Calculated Recaptures
	Actually Reported in 1955	Expected From Portuguese Rec. % (Table p.5)	Land. 1000 Tons	Land. 1000 Tons	Exp. from Portuguese rec.%	corrected by using C.F. 2.0		
Greenlanders	271	271	20	0	0	0	271	271
Faroese	7	83	36	18	42	84	41	125
France	4	84	34	34	84	168	0	168
Germany	4	17	7	7	17	34	0	34
Iceland	7	20	9	9	20	40	0	40
Norway	16	81	43	4	8	16	73	89
Portugal	259	259	104	43	107	214	152	366
Spain	1	19	7	7	19	38	0	38
U.K.	2	2	4	4	2	4	0	4
Total	571	836	264	126	299	598	537	1,135

The final figure means that whereas in 1955 571 tagging recaptures were reported, this figure should have been 1,135, provided that the same reported numbers per 1000 tons catch as the Portuguese was applied for the other countries (apart from Greenlanders and United Kingdom), and that a conversion factor of 2.0 was applied on trawl recaptures.

The so adjusted figure is twice that actually reported. This means f.i. that the Danish figure for the recapture in 1954/55 of cod tagged in 1954 of ca. 10% should be 20%.

It may well be argued that some of the factors influencing the number of recaptures have not been correctly judged, and that possibly others have been disregarded; this especially is possible where detailed distribution of the various fisheries and density of tagged cod are concerned. It can however, hardly be doubted that the percentage reported of actually captured tagged cod varies greatly from fleet to fleet.

The figures arrived at here may serve as a warning that tagging results when achieved through a compilation or a comparison of recoveries by different fishing fleets can be highly misleading, partly due to the varying possibility of observing tagged fish in the various fishing fleets, partly from a more or less efficient reporting system. The remedies can be: more conspicuous, eye-catching tags, increased propaganda (information and rewards) for the crews, and facilitating of the reporting along the line from fishermen to research institutions.