

ANNUAL MEETING - JUNE 1965Defects in the Recovering and Reporting of Cod Tagged
by Denmark in Subarea 1

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In most fish tagging experiments there is a greater or minor difference between the number of fish actually recaptured and the number of recaptures reported back to the respective authorities. This difference is due partly to a non-recovering of recaptured tags and partly to a non-delivering of recovered tags.

As for non-recovery of tags, by far the best remedy is to make the tags more visible, while non-reporting may be relieved by rewards and and propaganda making the fishermen more interested in the delivering and reporting of tags.

It is often difficult to distinguish the two mentioned sources of error but in practice the most essential thing to know is the total error, hereinafter called the non-returning rate.

This non-returning rate has been calculated in various tagging experiments. Aasen (1958) and Margetts (1963) used seeding experiments which, under certain circumstances, make it possible to calculate each of the sources of error. Paulik (1961) used a direct method of estimating the non-returning rate by having trained observers examine a portion of the catch for tags. Stroud and Bitzer (1953) compared the returning from ponds where a partial creel census was made and a high reward combined with a lottery was offered with the returning from ponds where no creel census was made and no reward offered. Hysten (1963) tried to estimate the non-returning rate from the number of tags from previous years suddenly turning up when Norway introduced a lottery system. This last method, of course, gives only the non-reporting rate.

In this paper, an attempt is made to estimate the non-returning rate in Danish tagging experiments on cod in Greenland waters. This has been done in earlier years (Poulsen, 1957; Horsten, 1963). As in these earlier attempts the calculations in the present paper are based on some considerations and assumptions:

1. The Greenlanders are so interested in fishery and fishery problems and the contact between the fishermen, fishery officers and biologists is so good, that the Greenlanders' reporting rate is supposed to be very close to 100%. Furthermore, cod caught by Greenlanders will pass through the hands of a person several times. The recovering rate is therefore also supposed to be close to 100% and the non-returning rate hence negligible.
2. Since 1953 Portugal has developed an excellent organization for collecting recaptures. The Portuguese reporting rate may very well be close to 100%. The recovering rate will differ between gears. Dory vessels are supposed to be able to obtain a recovering rate of 90 to 100%. The recovering rate of Portuguese trawlers is supposed to be less than the rate of the dory vessels and may be estimated as stated in Point 3.

3. Within each Division tagged cod are supposed to be evenly mixed with the whole stock some time after tagging (here taken as from the calendar year after tagging). Hence, within a division, the chance of catching a cod tagged in previous years is supposed to be proportional to the catch (Greenlanders' fishing inshore not included here, as tagging inshore is more intensive than offshore). Hylen (loc.cit.) has pointed out, that the differences in size composition of catch between gears and fleets is a source of error here. It has, however, not been possible to find a practical way of correcting this error.
4. The error arising because of tagged cod having a higher catchability in some gears (e.g. tag tangled in net) is regarded as negligible.

In Table 1 the returning rate of Portuguese dory vessels is compared with the returning rate of Portuguese trawlers. In the years 1952 and 1953, the number of tags returned is too small for any comparison, but in 1954 as many as 182 tags were returned. From this year, the well-organized Portuguese reporting system seems to work.

Excluding the years 1952, 53, 54 and 57 when many tags are not gearwise specified and the year 1962 (special problems, see below) a mean returning rate of 48% is calculated for Portuguese trawlers. This mean has been weighted according to the catch of trawlers. The non-returning rate is thus 52%, which is very close to the earlier figures estimated by Poulsen (50%) and Horsted (60%). To simplify the calculations, a conversion factor of 2 is therefore used for tags returned by Portuguese trawlers.

Poulsen (loc.cit.) estimated separate conversion factors for each nation. Horsted (loc.cit.) found this impractical and estimated a combined conversion factor for other nations. There are still so few tags returned from other nations except Germany that it is not practical to estimate conversion factors for each nation. As the German fishery in Subarea 1 has increased considerably it is, however, of great interest to get a conversion factor for Germany, but other nations are still treated as a whole.

In Table 2, the number of tags returned by Germany and by other countries (except Portugal and Greenland) per 1000 tons of cod caught is compared with the corresponding figure for Portuguese dory vessels (1955-63) or Portugal all gears (1952-54). If the years 1952-53 (few data) and 1962 (see below) are excluded, a weighted mean from Table 2 gives a returning rate of 30% for Germany and 15% for other nations combined. This corresponds to conversion factors 3.3 and 6.7 respectively.

In the fisheries of other nations, a part of the catch is taken by long-line. Various research reports show that long-line catches normally consist of larger cod than trawl catches. Therefore, the chance of long liners catching tagged cod may well be less than that of the trawlers (Hylen, loc.cit.). It is therefore reasonable to reduce the conversion factor for other nations. Here it is roughly estimated to be 5.

As mentioned earlier in this paper, special problems arise in relation to the recaptures made in 1962. Table 2 shows that Germany, as well as other nations, apparently had a much better returning rate in 1962 than in preceding years. In 1963 these rates are back at a more normal level. However, it is not a much better returning from Germany and other nations that is the reason for these outstanding 1962 figures but a lower returning rate from Portugal. The relatively small number of tags from Portugal indicates this. There is not only a small number of Portuguese returns in 1962, but the Portuguese figures for returns per 1000 tons is also remarkably low. To judge whether something extraordinary has happened to Portuguese returns in 1962 it is necessary to compare between years the number of returns per 1000 tons with the number of tagged cod present. This is rather impossible, but as the calendar year after

tagging nearly always is the year giving most recaptures from the respective experiments, then it may be sufficient to use figures as simple as those in Table 3.

Table 3 gives a review of the number of offshore releases in Div. 1B, 1C and 1D where the Portuguese fleet is concentrated. These figures are compared with the number of returns per 1000 tons in the following year. It is quite obvious then, that the Portuguese returning rate is extraordinarily low in 1962, hardly reliable to be 100% for dories or 50% for trawlers.

Provided that the 1962 returning rates of Germany and other nations are 30% and 15% respectively, as in other years, then Table 2 indicates that the returning rate of Portugal (all gears) in 1962 was between 43% (based on the German figure) and 17% (based on the other nations' figure). Roughly estimated it looks as if 2/3 of the Portuguese tags caught in 1962 disappeared in one or the other link of the reporting system.

In practice the following conversion factors are used, but the factors for Portugal in 1962 must be taken with even greater reservation than the other factors.

Greenland	All gears	1
Portugal	Dory vessels	1 (in 1962 perhaps 3)
"	Otter trawlers	2 (in 1962 perhaps 3)
Germany	Otter trawlers	3
Other nations	All gears	5

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TABLE 1. COMPARISON BETWEEN RETURNS FROM PORTUGUESE TRAWLERS (OT) AND DORY VESSELS (DV). FISH RECAPTURED IN THE YEAR OF TAGGING NOT INCLUDED. NK = GEAR NOT KNOWN.
 RT = NUMBER OF RETURNS. RT/Y = NUMBER OF RETURNS PER 1000 TONS COD CAUGHT. MEAN RT/Y UNWEIGHTED IS CALCULATED FROM TOTAL FIGURES, WHILE WEIGHTED MEAN IS
 WEIGHTED WITH CATCH OF OT IN EACH DIVISION AS WEIGHTING FACTOR.

YEAR OF RECAPTURE		1952		1953		1954		1955		1956		1957		1958		1959		1960		1961		1962		1963		1964	
DIVISION	GEAR	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y	RT	RT/Y
I B	DV	0	-	0	-	29	-	68	2.02	91	2.86	125	3.21	54	1.71	82	2.56	51	1.42	15	0.51	18	0.35	42	1.15	33	-
	OT	1	-	0	-	9	-	5	2.05	5	1.00	1	0.60	7	1.55	6	1.30	8	25.32	0	0.00	2	0.37	1	24.39	11	-
	NK	2	-	13	-	63	-	2	-	0	-	8	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	TOTAL	3	0.09	13	0.41	101	1.84	75	2.07	96	2.61	134	3.30	61	1.69	88	2.40	59	1.63	15	0.48	20	0.35	43	1.18	44	-
I C	DV	0	-	0	-	2	-	52	5.56	31	4.23	74	7.07	79	9.17	28	3.54	30	3.09	46	5.01	6	0.85	13	1.55	43	-
	OT	1	-	0	-	2	-	24	2.28	15	1.38	8	1.46	16	1.45	0	0.00	4	36.00	0	0.00	3	2.21	0	0.00	6	-
	NK	3	-	0	-	5	-	0	-	1	-	6	-	0	-	0	-	1	-	0	-	0	-	2	-	0	-
	TOTAL	4	1.75	0	0.00	9	3.53	76	3.82	47	2.59	88	5.51	95	4.83	28	3.46	35	3.57	46	5.00	9	1.07	15	1.79	49	-
I D	DV	0	-	0	-	19	-	41	2.31	104	3.52	136	5.48	135	4.66	38	4.27	75	5.59	104	3.91	21	0.94	55	3.27	97	-
	OT	0	-	0	-	12	-	37	1.24	56	1.49	13	1.32	24	2.54	5	1.20	8	5.49	2	38.46	1	0.94	2	30.77	27	-
	NK	1	-	12	-	41	-	0	-	1	-	4	-	0	-	0	-	0	-	1	-	0	-	1	-	0	-
	TOTAL	1	0.06	12	0.67	72	1.32	78	1.64	161	2.40	153	4.41	159	4.14	43	3.29	83	5.58	107	4.01	22	0.94	58	3.44	124	-
TOTAL	DV	0	-	0	-	50	-	161	2.65	226	3.29	335	4.51	268	3.88	148	3.03	156	2.65	165	2.53	45	0.56	116	1.79	173	-
	OT	2	-	0	-	23	-	66	1.54	76	1.42	22	1.29	47	1.88	11	1.23	20	10.62	2	0.97	6	0.77	3	2.79	44	-
	NK	6	-	25	-	109	-	2	-	2	-	18	-	0	-	0	-	1	-	1	-	0	-	3	-	0	-
	TOTAL	8	0.12	25	0.48	182	1.61	229	2.21	304	2.49	375	4.11	315	3.35	159	2.61	177	2.91	168	2.49	51	0.58	116	1.58	217	-
MEAN RT/Y OT UNWEIGHTED		-	-	-	-	-	-	58		43		29		48		41		401		38		138		1385		-	-
IN % OR RT/Y DV WEIGHTED		-	-	-	-	-	-	43		40		(23)		44		39		444		25		132		1224		-	-
TONS CAUGHT BY OT		11101		6119		42503		42876		53513		17051		25033		8971		1883		2063		7828		121		-	-

TABLE 2. RETURNING OF GERMAN FLEET AND OTHER NATIONS' FLEETS COMPARED WITH RETURNING OF PORTUGUESE DORY VESSELS (1952-54) OR PORTUGUESE DORY VESSELS (1955-63). RT = NUMBER OF RETURNS. % P AND % DV = NUMBER OF RETURNS PER 1000 TONS COD IN % OF CORRESPONDING PORTUGUESE FIGURE. MEAN IS WEIGHTED WITH CATCH AS WEIGHTING FACTOR AND IS ONLY BASED ON FIGURES FROM DIV. 1B, 1C AND 1D. MEAN IS RAISED BY THE PROPORTION OF TAGS FROM DIV. 1 NK. NO CATCH REPORTED = X

YEAR OF RECAPTURE		1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
DIVISION	NATION	RT - % P	RT - % P	RT - % P	RT - % DV	RT - % DV	RT - % DV	RT - % DV	RT - % DV	RT - % DV	RT - % DV	RT - % DV	RT - % DV
1 B	GERMANY	0	0	0	-	1	0	2	4	0	0	0	5
	OTHER	6	8	9	13	4	4	12	21	13	14	16	12
1 C	GERMANY	0	0	0	-	2	37	1	1	5	22	18	17
	OTHER	1	4	3	3	9	4	18	6	8	18	22	14
1 D	GERMANY	1	0	0	2	15	0	8	6	20	64	32	32
	OTHER	7	14	14	13	21	9	19	31	18	36	50	29
1 E	GERMANY	0	0	0	-	0	-	3	1	3	8	12	46
	OTHER	0	0	0	6	7	12	13	7	14	14	1	35
1 F	GERMANY	2	0	1	0	0	5	14	8	6	16	15	22
	OTHER	5	13	3	2	3	7	11	15	18	16	16	19
1 NK	GERMANY	1	0	0	0	3	1	7	1	3	27	15	28
	OTHER	0	0	1	1	7	4	7	3	5	7	12	9
TOTAL AND WEIGHTED MEAN	GERMANY	4	0	1	2	21	8	35	21	37	137	92	150
	OTHER	19	39	30	33	51	49	80	83	76	105	117	118
TONS COD IN 1B+1C+1D	GERMANY	X)-	X)-	1080	6904	28403	9310	19826	14464	16123	62686	93352	91940
	OTHER	161905	109929	147817	117603	129446	87065	119264	89584	87022	123704	158764	136246

TABLE 3. COMPARISON BETWEEN RETURNING OF PORTUGUESE DORY VESSELS AND NUMBER OF FISH TAGGED. THE FIGURES REFER TO DIV. 1B, 1C AND 1D. RETURNS INCLUDE ALL RETURNS EXCEPT THOSE RECAPTURED IN YEAR OF TAGGING. NUMBER OF TAGS REFERS ONLY TO OFFSHORE TAGGING.

YEAR OF RECAPTURE	1955	1956	1957	1958	1959	1960	1961	1962	1963
(1) RETURNS PER 1000 TONS	2.65	3.29	4.51	3.88	3.03	2.65	2.53	0.56	1.79
(2) NUMBER TAGGED ONE YEAR BEFORE	1628	896	2023	1644	1300	1379	2923	1973	909
(1) IN ⁰ /100 OF (2)	1.63	3.67	2.29	2.36	2.33	1.92	0.87	0.28	1.97