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LABORATORY EXPERIMENTS WITH INTERNAL TAGGING OF SAITHE

by

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INTRODUCTION

Experiments with internal tagging of fish have been carried out chiefly on species which predominantly are used in production of fish meal and oil, e.g. herring, mackerel and capelin (Fridriksson and Aasen 1950, Hamre 1970, 1975, Dragesund, Gjøsæter and Monstad 1973). During meal and oil production internal steel tags can be recovered by using magnets. Testing of the efficiency of the magnets in recovering tags makes it possible to estimate the true recapture rates. In these cases, internal tagging experiments may give valuable information about stock size, mortality and exploitation by fishing. However, because of reduced stock size and a preference for use of fish for human consumption, herring is at present practically not used in fish meal production in Norway and there is also a clear tendency for mackerel to be increasingly used for human consumption.

External tags are used on fish which are chiefly used for human consumption, e.g. cod, haddock and saithe. The observed recovery rates are, however, lower than expected from what is known about the exploitation (Hylen 1963). This can partly be ascribed to non-returning of recovered tags and to the fact that the tags frequently are not noticed by those who handle the fish. These are sources of error which are difficult to control and the results of tagging experiments with external tags have in practice been of limited use in population dynamics.

On this basis a project was started on developing a detector and ejector mechanism for fish with internal tags when the fish is used for human consumption. It was decided to start by trying to recover internal tags during the filleting process as this may give a basis for tagging experiments with important species like cod, haddock, saithe, herring and mackerel.

During the initial stages of the project 2-3 year old saithe were chosen for experiments for the following reasons:

1. Large quantities of these age groups of saithe are used in the filleting industry and estimates of stock size and mortality rates would be valuable.
2. The size of these saithe is comparable to that of herring and mackerel and a detector and ejector mechanism which are fitted to young saithe can also be used on these.
3. The fishery is conducted in coastal waters with purse seine and it is easy to obtain live fish for experiments.

The first stage of the project, which is treated in this paper, comprised biological experiments with saithe in order to compare growth and mortality for tagged and untagged fish.

Contemporarily, the development of a detector and ejector mechanism has been completed. Preliminary trials with the method at a factory during filleting of herring have given promising results.

MATERIAL AND METHODS

Young saithe caught by land seine 4 June 1975, were placed in a basin (3·6·1.7 m). Sea water from 130 m and 40 m depth, holding a temperature of 7-10°C all year, was continuously added. After the saithe were adjusted to the new conditions and had startet active feeding (19 June), they were all measured. The 49 first were tagged with internal mackerel tags of steel (20x4x0.5 mm). The remaining 56 were kept in the basin as

a control group. The tagging was carried out in the same way as used on mackerel. After making a slit in the skin just before the anal opening the tags are shoved into abdomen.

The saithe were partly infected by fin rot and in connection with the length measurement, they were classified on a scale from 0-5. The experiment startet 20 June 1975 and was concluded 1 March 1976.

RESULTS

The majority of the saithe most severely infected by fin rot, died during the first six weeks after the experiment started. More tagged than untagged fish were infected (Table 1), but there were no indications that the tags had any influence on the mortality. However, strain and stress caused by the capture, transportation and confinement to the basin, may have had negative effects on the health and resistance of the saithe to infections. Of the tagged fish, 9 (18.4%) died before 4 August and of the untagged, 2 (3.6%) died. After 4 August, there was no marked difference in the degree of infection by fin rot between the two groups.

Fig. 1 shows the length frequency distribution of tagged and untagged fish. Details about mortality and the partial samples are given in Table 2. The mean weight at the start of the experiment was calculated from an approximate length/weight relationship ($W - 0.0085 \cdot L^3$). The changes in mean length and weight during the experiment are shown on Fig. 2 and 3. It is evident that at the end of the experiment, the remaining untagged saithe were clearly longer and heavier than the tagged saithe. The difference was statistically significant on the 5% level (t-test) and was indicated already 4 August and even more so 15 January, although it was not statistically significant in these partial samples.

Table 3 shows to what extent there were visible marks on the skin caused by the tagging. On 4 August, there were clearly visible scars and this could be used to separate tagged fish from untagged. On 15 January the scars were more difficult to spot and were in fact not spotted on 2 out of 13 tagged fish. On 1 March scars were seen only on 5 of the 11 tagged fish.

Table 4 indicates the position of the recovered tags inside the fish. Most of the tags were found in the rear part of the abdomen under the intestines and just in front of the anal opening, i.e. close to where they had been introduced. Some were found under the liver or the pyloric caeca and five were found laying loose in the abdomen. One tag had caused some damage on the liver.

The results indicate that about 25% of the tags were not encapsulated in connective tissue and that encapsulation of the remaining 75% took place chiefly during the first six weeks after tagging (Table 3). Of the 18 tags that were not encapsulated, 6 were shedded some time during the experiment.

At Gade's Institute, University of Bergen, samples of the tissue encapsulating the tags were examined. It was not different from normal tissue of the same type, except for having fewer cell layers. There were no signs of infection or disease caused by the encapsulation.

DISCUSSION

When results of tagging experiments are used in population dynamics, certain assumptions are made. The most common are that

1. the tagging mortality either is constant from experiment to experiment or measurable.
2. the natural mortality is the same for tagged and untagged fish.
3. tagged and untagged fish are equally vulnerable to fishing gears.
4. the tagged fish mix completely with the untagged fish.

Introduction of a foreign body of a length which is approximately 5% of the length of the fish will mean an extra strain on the organism. In addition, the process of capture, tagging and release usually involves some rough treatment of the fish. The high mortality rate observed on the saithe with fin rot, indicates that tagging mortality may be increased by poor health condition of the fish although not necessarily as an effect of the tag itself.

Knowledge about diseases of fish, especially with regard to yearly variations, is poor, but epizooties occur and even if conditions during tagging apparently are kept constant from experiment to experiment, variations in tagging mortality caused by variations in the health condition of the fish can hardly be avoided.

For most species, behaviour, migration pattern and sexual maturity are influenced by the length of the fish. A difference in growth between tagged and untagged fish may therefore cause a difference in the availability of the two groups for different fishing gears and in different areas. In addition, there may be differences in catch for fishing gears selective of fish size.

According to Winters (1975), practically all tags not encapsulated in connective tissue will be shedded during spawning. Tagging experiments carried out shortly before spawning will therefore give few recaptures. The observations on the encapsulation in saithe indicates that the critical time interval between tagging and spawning is somewhere between 0 and 6 weeks. A longer time interval will probably not increase the percentage of tags encapsulated very much. In any case, one will have to take into consideration that some tags will be shedded also outside the spawning season. The effect of this on an experiment will be similar to that of a tagging mortality.

SUMMARY

Recovery of internal tags during the filleting process would create new possibilities for tagging experiments on several species, in Norwegian fisheries primarily cod, haddock, saithe, herring and mackerel. In connection with a program for developing a detector and a device for recovery of internally tagged fish, laboratory experiments with tagging of young saithe were carried out.

The results showed that after six weeks about 75% of the tags were encapsulated by tissue without any signs of infection or disease. Later, apparently no more tags were encapsulated. Approximately one third of the non-encapsulated tags were extruded. The growth of the tagged fish was significantly lower than for the untagged fish.

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Table 1. Infection by fin rot for tagged and untagged saithe initially and in each partial sample during the tagging experiment 19 June 1975 to 1 March 1976. 0: No fin rot, 5: Strongly infected.

Date	Tagged							Untagged						
	Fin rot							Fin rot						
	0	1	2	3	4	5	Sum	0	1	2	3	4	5	Sum
19.6	27	5	5	6	3	3	49	33	14	6	1	2		56
19.6-4.8	1					8	9					2		2
4.8	5	3	1			1	10	5	3	2				10
15.1	8	1	1	1		2	13	20	5		2	1		28
1.3	6	1	2			2	11	15	6				1	22
					Sum		43					Sum		62

Table 2. Mean length and mean weight initially and in each partial sample.

Date	Tagged			Untagged		
	Number	$\bar{l}$ cm	$\bar{w}$ g	Number	$\bar{l}$ cm	$\bar{w}$ g
20.6	49	29.24	(203)	56	29.04	(198)
20.6-4.8	9			2		
4.8	10	28.90	237	10	29.10	248
15.1	13	31.60	302	28	32.30	356
1.3	11	33.80	466	22	37.50	640
Sum	43			Sum	62	

Table 3. Number in each partial sample with wound or scar from the tagging and number of tags encapsulated.

Date	Wound or scar		Number encapsulated	Number in sample
	Outside	Inside		
15.6-4.8	9	9	2	9
4.8	10	5	9	10
15.1	11	10	11	13
1.3	5	0	9	11

Table 4. Position in abdomen where tags were found.

	Near the anal opening	Under the intestines	Under the liver	Under the pyloric caeca	Elsewhere
Number	13	15	6	4	5

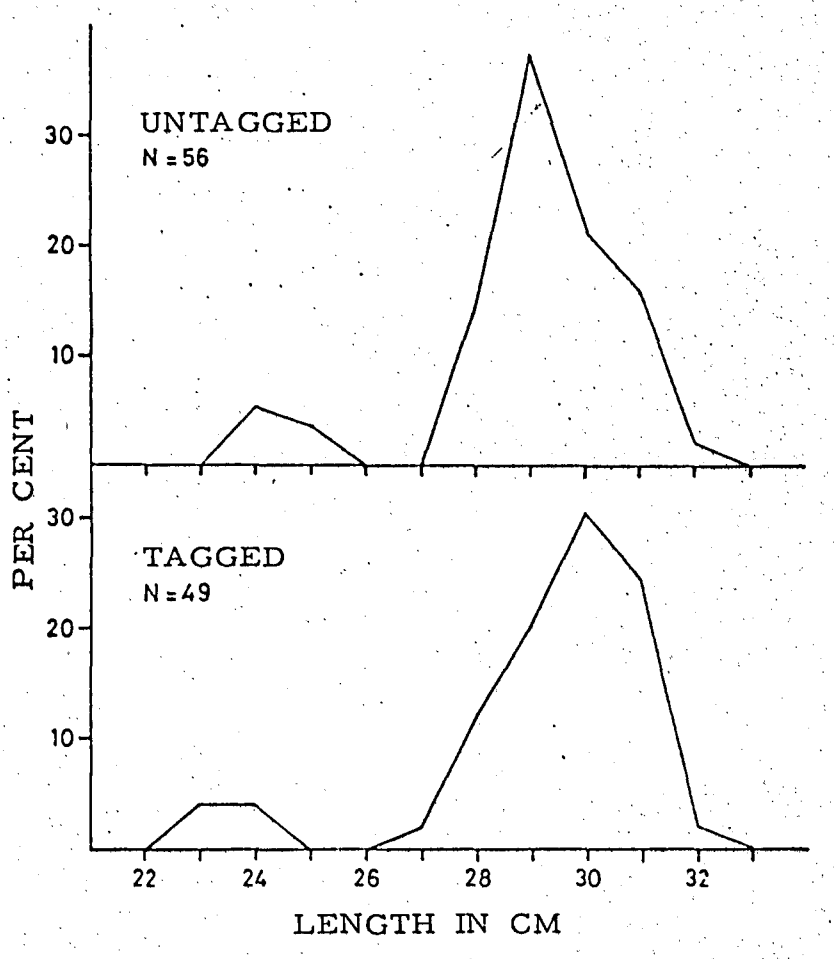

Fig. 1. Length frequency distribution of tagged and untagged fish. Tagging experiment on saithe 19 June 1975 - 1 March 1976.

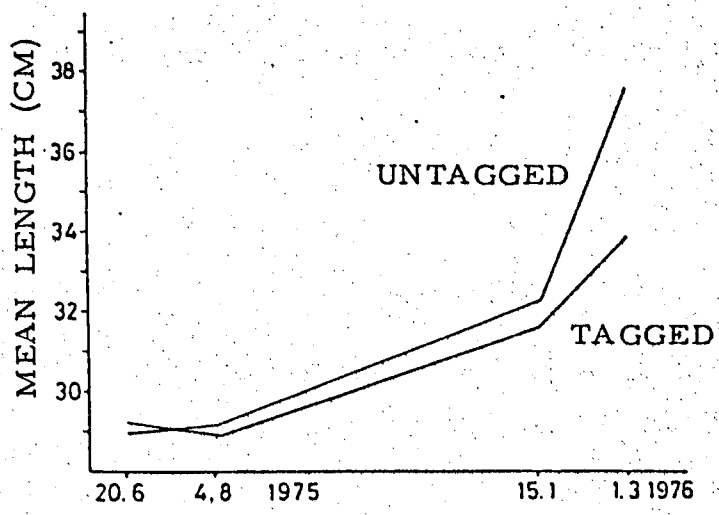

Fig. 2. Mean length of tagged and untagged saithe initially and in each partial sample.

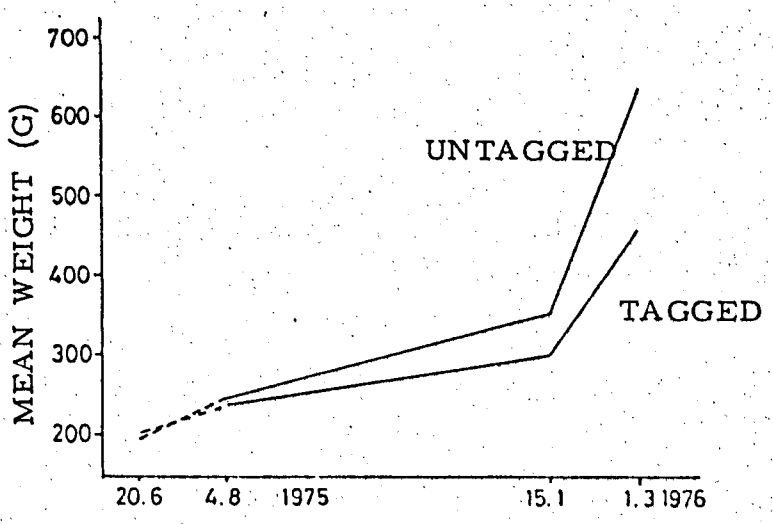

Fig. 3. Mean weight of tagged and untagged saithe in each partial sample. Mean weights initially are calculated from length-weight relationship.