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Some results of tagging experiments on the edible crab (Cancer  
pagurus) in Norwegian waters

by

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#### INTRODUCTION

Research on crabs (Cancer pagurus) in Norway includes studies of growth, migration and natural and fishing mortality. For such studies tagging experiments are considered to be of particular value.

Because of the growth by moulting, there are special problems in tagging crustacea. During the last twenty years much work have been done to develop a tag which is not lost during moulting.

Van Engel, (Butler 1957) originally devised a method for crab tagging, by which the tag persisted during the moult. The main point in this method was later used by Butler (1957), Mistakidis (1960), Gundersen (1963) and Edwards (1964), although the tag type was somewhat modified.

Gundersen (1963) used a toggle tag, and in most of the tagging experiments on crabs in Norway this type of tag has been used.

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This report deals with some results of tagging experiments on crabs on three different localities in the fjords and skerries west of Bergen 1962 -66, including simple estimates of mortalities.

#### MATERIALS AND METHODS

Crabs used in these experiments were bought from commercial fishermen, and the tagging were carried out after the main fishing season in late autumn. Because of this, most of the crabs were in "soft" condition after moulting in late summer and early autumn. It was thought to be best to use newly moulted crabs because it was easy to make the hole in the shell when inserting the tag, and these crabs would not moult before next autumn. It is possible, however, that soft crabs will shed the tags more frequently both before and during the moult, compared to crabs which are tagged in a hard shell condition.

The tagged crabs were released on three different localities, Geitanger, Rotøy and Tofteholmene near Bergen, western Norway.

These localities represent different fishing intensities. Geitanger is a living place for fishermen in the area, and crabs are heavily exploited. The fishing starts in late spring or early summer and goes on to December. The catches are sold at the fishing market in Bergen. The island of Rotøy is inhabited, but some spare-time fishermen live there during the summer. Here the crab fishery starts in the middle of the summer and continues to October. Tofteholmene is further out in the skerries. The fishing here takes place in the normal fishing time for crabs, mainly from late August to October.

All crabs for tagging were obtained at Geitanger. The tagging procedure was somewhat different for the three localities. At Geitanger crabs were taken directly from the fishermen's crates, tagged and released in the sea. Crabs for releasing at Rotøy and Tofteholmene were before and after tagging wrapped in paper to prevent drying and cooling. They were kept on board during the tagging work and then transported to the releasing localities.

In order to determine if the preservation on board after tagging increased the mortality by bleeding or drying, a special experiment was made. One part of the tagged crabs was wrapped in paper and kept on board for 3 hours while the other was dropped in the sea directly after tagging. The percentages of recapture the following years were the same.

Comparison of recaptures of tagged crabs released directly in the sea (A) and crabs released in the sea after staying on board wrapped in paper for 3 hours (B). Geitanger December 1965.

	Tagged		Recaptured						Percent of recaptures
	♂	♀	1966			1967			
			♂	♀	Tot.	♂	♀	Tot.	
A	43	58	29	26	55	-	3	3	57,4
B	43	58	27	29	56	1	1	2	57,4

Consequently the keeping of tagged crabs on board for some hours did not seem to influence the survival.

## RESULTS

Table 1,2 and 3 gives the details of released and recaptured tagged crabs in subsequent years.

There is a marked variation in the percent of recaptures on the three different localities, and the longer fishing time at Geitanger results in a higher rate of exploitation.

Estimates of mortality rates were made on the basis of the numbers of recaptured crabs at the three different localities. The recaptures as given in Table 1,2 and 3 are summarized in Table 4.

The total mortality rate, Z, was estimated from the slope of a regression line fitted to plots of the numbers recaptured (Gulland 1969);

for each locality and sex during the three years after tagging. The following Z's were found:

		Z
Geitanger	♂	0,88
	♀	1,03
Rotøy	♂	0,73
	♀	0,65
Toftehl.	♂	0,58
	♀	0,56

Estimates of the rates of fishing mortality, F, and natural mortality, M, were also made (Gulland 1969) by assuming a 25% tagging mortality for both males and females as indicated by Edwards (1965). The following M's and F's were found:

		M	F
Geitanger	♂	0,29	0,59
	♀	0,28	0,60
Rotøy	♂	0,30	0,43
	♀	0,24	0,41
Toftehl.	♂	0,27	0,31
	♀	0,30	0,27

The overall natural mortality rate is estimated to be about 0,3 for both sexes with no noticeable difference among localities. This rate corresponds to an average annual natural mortality of about 25% which is somewhat lower than that found by Hancock (1965) for the Norfolk fishery for crabs.

The estimated rates for fishing mortality are found to be equal for the sexes, but differ markedly among the three localities. As pointed out above, the Geitanger area is fished very intensively and can not be considered representative for Western Norway as a whole. The two other localities are fished lighter, and the calculated F's are probably typical of most crab fishing districts

in Western Norway. The average annual fishing mortality can therefore be considered to be in the range of 25-35%.

The data given above must be considered preliminary as the assumptions underlying the calculation have not been fully evaluated. A more detailed study of the tagging results will give information on influencing factors such as tagging mortality, shedding of tags and migration out of the fishing area.

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Table 1

Recaptures of crabs (Cancer pagurus) released at Geitanger 1962 - 1968

Tagging Year	Number tagged ♂	Number tagged ♀	Recaptures												Tot. %											
			1962 ♂	1962 ♀	-63 ♂	-63 ♀	-64 ♂	-64 ♀	-65 ♂	-65 ♀	-66 ♂	-66 ♀	-67 ♂	-67 ♀		-68 ♂	-68 ♀	-69 ♂	-69 ♀	-70 ♂	-70 ♀	-71 ♂	-71 ♀	-72 ♂	-72 ♀	
1962	115	276	7	8	37	138	6	16	2	1																55,0
1963	60	92			1		30	54	5	2	1															61,2
1964	295	454					5	133	189	9	17															47,3
1965	133	186								73	91	1	7	1												54,2
1966	165	286								16	32	27	63	1	4											31,9
1967	130	217										8	37	52	42	4	10									44,1
1968	201	195														122	100	5	6	3	3					81,1

Table 2

Recaptures of crabs (Cancer pagurus) released at Rotøya 1962 - 1968

Tagging Year	Number tagged		Recaptures												Tot. %										
	♂	♀	1962	-63		-64		-65		-66		-67		-68		-69		-70		-71		-72			
			♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
1962	108	241	1	9	1	2	1	1																	41,3
1963	7	36			1	5	1	1																	37,2
1964	148	235			1	1	69	122	5	3	2														53,0
1965	96	105							28	34	4	5	2	7											40,8
1966	90	108									9	20	5	15	2	2									26,8
1967	104	102											41	31	8	7									42,2
1968	112	126													52	56	9	6	3	2					53,8

Table 3

Recaptures of crabs (Cancer pagurus) released at Tofteholmene 1962 - 1968

Tagging Year	Number tagged		Recaptures												Tot %											
	♂	♀	1962 ♂	1962 ♀	-63 ♂	-63 ♀	-64 ♂	-64 ♀	-65 ♂	-65 ♀	-66 ♂	-66 ♀	-67 ♂	-67 ♀		-68 ♂	-68 ♀	-69 ♂	-69 ♀	-70 ♂	-70 ♀	-71 ♂	-71 ♀	-72 ♂	-72 ♀	
1962	44	88			11	21	2	4	2	2	1	1														33,3
1963	5	48				9	1	4			2															30,2
1964	-	-																								
1965	184	181							3	83	80		9	4	9	6										53,4
1966	40	130										4	21	3	7											22,9
1967	118	163												30	31		2	8	1	1						26,0
1968	68	82													2		7	12	5	3	2		1			24,6



Table 4 Numbers of recaptured crabs in years after tagging, based on data in Tabs 1, 2 and 3

Locality		Tagged, total no.	Recaptures in year no.					
			0	1	2	3	4	5
Geitanger	♂	1099	31	474	31	6	1	0
	♀	1706	83	677	62	6	0	0
Rotøy	♂	655	1	230	32	8	0	0
	♀	953	19	367	39	14	2	1
Tofteholmene	♂	459	0	136	21	14	2	0
	♀	692	14	169	26	15	2	0