Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC
Res. Doc. 81/64

An examination of the Effect of Size and Sex of Animals Tagged on Estimates of Exploitation rate in a Newfoundland Population of Lobsters (Homarus americanus)

by

G. P. Ennis
Department of Fisheries and Oceans
Research and Resource Services
P. O. Box 5667
St. John's, Newfoundland
A1C 5X1

ABSTRACT

Analysis of tag-recapture data from the Comfort Cove, Notre Dame Bay lobster fishery for the 1975 through 1980 seasons reveals wide variation in estimates of exploitation rate between sexes at the same size and between different sizes within each sex. The data indicate a tendency towards higher exploitation rates for males and for larger sizes, at least for males, however, because of the inconsistency and variability of the results, no definite conclusions can be drawn regarding differences in exploitation rate between males and females and between different sizes.

RESUME

Les données recueillies à la suite d'expériences de marquage-recapture de homards de l'anse Comfort (baie Notre-Dame) pendant les saisons de pêche de 1975 à 1980 accusent une forte variation dans les estimations des taux d'exploitation de mâles et de femelles de même taille, et de différentes tailles d'un même sexe. On observe une tendance vers des taux d'exploitation plus élevés des mâles et des gros homards. Cependant, à cause du manque d'uniformité et de la forte variabilité des résultats, on ne peut tirer de conclusion définitive quant aux différences de taux d'exploitation des mâles et des femelles, et des homards de différentes grosseurs.

INTRODUCTION

Estimating exploitation rates in a fishery by tag-recapture methods usually involves tagging a relatively small number of animals over a relatively short period of time at some point prior to the start of the commercial fishing season. For a variety of reasons, the tagged sample may not be representative, in terms of size and sex composition, of the standing stock. Any differences in catchability or availability over the fishing season related to size or sex would result in biased estimates.

An ongoing study of lobsters in the Comfort Cove, Notre Dame Bay area of Newfoundland has included tagging during a two week period in October, well in advance of the April 20 - July 15 fishing season, to obtain estimates of standing stock size and exploitation rate. Comparison of size and sex composition of the tagged samples with that of the commercial catch samples has shown that males outnumber the females in the tagged samples, but in the commercial catch samples the sexes are equally represented. In addition, within the males there is a higher proportion of larger animals in the tagged samples, but this is not the case for females (Ennis 1981).

The tag-recapture data from the Comfort Cove fishery for the 1975 through 1980 seasons have been analysed to examine variation in estimates of exploitation rate related to size and sex of animals tagged. The results are presented here.

MATERIALS AND METHODS

In October 1974, following the molting period, special fishing was carried out in the Comfort Cove, Notre Dame Bay area using conventional wooden traps with the 1 3/4 inches (44.5 mm) lower lath spacing required for commercial lobster fishing in Newfoundland. All lobsters caught were sexed and measured (carapace length to the nearest mm). Commercially legal lobsters (i.e. $\geq$81 mm CL and non-ovigerous) were tagged with individually numbered carapace strap tags (Wilder 1954) and released immediately after being removed from the traps. Field staff maintained frequent contact with fishermen during the following spring fishing season to ensure return of all recaptured tags. This tagging has been repeated each year since. In 1976, 1977, 1978 and 1979 highly visible secondary marks (unnumbered lobster claw bands positioned on the carpopodite of each claw) were applied as well. Fishermen were asked to maintain records of untagged lobsters bearing these marks. It was estimated that 1.7% of the tags were lost over the 6 month period between tagging and the start of the following spring fishing season (Ennis 1981). It is assumed that tag loss is independent of size and sex and the estimates of exploitation rate are based on the number of tagged lobsters estimated to be present at the start of the fishing season. A consideration of the extent to which the other assumptions of the Petersen model are met in this study (Ennis 1981) indicates no other violations which would bias exploitation rate estimates.

RESULTS AND DISCUSSION

There was wide variation in estimates of exploitation rate between sexes at the same size and between different sizes within each sex (Table 1). The differences were tested for statistical significance using X^2_c from 2x2 contingency

table. Exploitation rates were higher for males in 39 of the 48 male/female comparisons. Of these 39, 32 were tested; 8 were significant at the 1% level and 6 at the 5% level. Of the 9 comparisons where exploitation rates were higher for females, 4 were tested and none were found to be significant (Table 2). In all 13 male/female comparisons where all sizes were combined for individual years and where all years were combined for the different size groups, the males had higher exploitation rates. All of these comparisons were tested; 7 were significant at the 1% level and 2 at the 5% level.

Exploitation rates in the 81-85 mm size groups were compared with those in the 86-90, 91-95 and 96-100 mm size groups. In 17 of 21 comparisons for males, the larger size group had the higher exploitation rate. Of these 17, 16 were tested and only 3 found to be significant. Three of the 4 cases where the smaller size groups had the higher exploitation rate were tested but none were significant (Table 3). In the 20 comparisons for females, the larger size groups had the higher exploitation rate in 10 cases but in only one case was the difference significant. In only one of the 10 cases where the smaller size groups had the higher exploitation rate was the difference significant (Table 3). The data suggest that exploitation rates tend to be higher for males and for larger sizes, at least for the males. If these differences are real it means that the estimates of exploitation rate for the Comfort Cove fishery are biased upwards because, compared to the commercial catch samples, males predominate in the tagged samples and among the tagged males there is a higher proportion of larger animals. However, because of the inconsistency and variability of the results, no definite conclusions can be drawn regarding differences in exploitation rate between males and females and between different sizes.

ACKNOWLEDGMENTS

A large number of technical staff and casual employees participated in various aspects of this study at different times. I am particularly indebted to G. Dawe who was responsible for carrying out most of the field work and data compilation and to P. W. Collins who participated in some of the field work and carried out most of the analyses and computations.

REFERENCES

Ennis, G. P. 1981. Annual variation in standing stock in a Newfoundland population of lobsters, Homarus americanus. CAFSAC Res. Doc. 81/69, 12 p.

Wilder, D. G. 1954. The lobster fishery of the southern Gulf of St. Lawrence. Fish. Res. Bd. Canada. Atl. Biol. Stn., Circ. 24, 16 p.

Table 1. Estimates of exploitation rates for different size groups of male and female lobsters at Comfort Cove, 1975-80. Numbers in ( ) are numbers of tagged lobsters present at the start of fishing season.

	Males							Females						
	Carapace length (mm) groups							Carapace length (mm) groups						
Year	81-85	86-90	81-90	91-95	96-100	91-100	All sizes	81-85	86-90	81-90	91-95	96-100	91-100	All sizes
1975	86.1 (86)	84.7 (111)	85.3 (197)	92.3 (39)	93.8 (16)	92.7 (55)	88.5 (261)	70.0 (60)	72.2 (18)	70.5 (78)	100 (3)	20.0 (5)	50.0 (8)	69.8 (86)
1976	85.9 (64)	92.2 (64)	89.1 (128)	92.9 (28)	100 (2)	93.3 (30)	94.9 (157)	89.7 (29)	84.0 (25)	87.0 (54)	80.0 (5)	-	80.0 (5)	89.8 (59)
1977	84.3 (121)	94.8 (134)	89.8 (255)	97.9 (93)	88.2 (17)	96.4 (110)	91.9 (370)	73.2 (56)	95.7 (47)	83.5 (103)	100 (9)	100 (3)	100 (12)	90.0 (110)
1978	89.5 (105)	89.4 (160)	89.4 (265)	94.8 (77)	100 (14)	95.6 (91)	91.4 (362)	86.8 (76)	95.7 (46)	90.2 (122)	100 (4)	50.0 (2)	83.3 (6)	90.8 (131)
1979	89.3 (84)	85.8 (141)	87.1 (225)	92.7 (55)	75.0 (8)	90.68 (63)	89.1 (293)	82.7 (81)	79.0 (81)	80.9 (162)	71.4 (21)	61.5 (13)	67.7 (34)	78.8 (198)
1980	85.2 (108)	92.1 (164)	89.3 (272)	92.3 (65)	100 (15)	93.8 (80)	91.0 (357)	80.8 (52)	88.4 (43)	84.2 (95)	80.0 (10)	60.0 (5)	73.3 (15)	82.9 (111)
All yrs	86.6 (568)	89.8 (774)	88.5 (1342)	94.4 (357)	93.1 (72)	94.2 (429)	90.9 (1800)	80.2 (354)	86.5 (260)	82.9 (614)	82.7 (52)	57.1 (28)	73.8 (80)	83.3 (695)

Table 2. χ^2_c values obtained from comparison of exploitation rates for males and females in the same size groups. The analysis was not performed when the number of tagged lobsters in either group to be compared was less than 10.

	Carapace length (mm) groups						
Year	81-85	86-90	81-90	91-95	96-100	91-100	All sizes
1975	4.63*	0.93	7.01**	-	-	-	15.43**
1976	0.03	0.58	0.02	-	-	-	1.08
1977	2.36	0.02	2.20	-	-	0.03	0.18
1978	0.10	1.02	0.002	-	-	-	0.001
1979	0.99	1.26	2.35	4.31*	-	6.46*	8.99**
1980	0.23	0.21	1.30	0.44	-	3.99*	4.99*
All yrs	6.22*	1.78	10.79**	7.75**	15.97**	31.77**	28.67**

Critical value of chi-square with 1 d.f. at P = 0.05 = 3.84*
Critical value of chi-square with 1 d.f. at P = 0.01 = 6.63**

Table 3. χ^2_c values obtained from comparison of exploitation rates for different size groups within each sex. The analysis was not performed when the number of tagged lobsters in either group to be compared was less than 10.

	Males			Females		
	Carapace length (mm) groups compared			Carapace length (mm) groups compared		
Year	81-85/ 86-90	81-85/ 91-95	81-85/ 96-100	81-85/ 86-90	81-85/ 91-95	81-85/ 96-100
1975	0.004	0.49	0.19	0.01	-	-
1976	0.72	0.35	-	0.04	-	-
1977	6.52*	9.43**	0.004	7.85**	-	-
1978	0.03	1.01	0.61	1.61	-	-
1979	0.30	0.15	-	0.16	0.73	1.94
1980	2.56	1.32	1.41	0.53	0.14	-
All years	2.93	13.4**	1.85	3.78	0.05	6.89**

Critical value of chi-square with 1 d.f. at P = 0.05 = 3.84*
Critical value of chi-square with 1 d.f. at P = 0.01 = 6.63**