International Commission for the Northwest Atlantic Fisheries

Serial No. 5352

ICNAF Res. Doc. 79/II/26

SPECIAL MEETING OF STACRES - FEBRUARY 1979

A Preliminary Report on Validating Age Readings from Statoliths of the Short-finned Squid (*Illex illecebrosus*)

by

G. V. Hurley, P. Beck, J. Drew and R. L. Radtke
Fisheries and Marine Service, Newfoundland Environment Centre
St. John's, Newfoundland, Canada

Introduction

The use of statoliths as a tool for ageing squid was first proposed by Lipinski (1978). The ICNAF standing committee on research and statistics (STACRES) recommended "that studies on the ageing of squid from statoliths be vigorously pursued, and that an effort be made to validate the age readings by following the progression of modal length groups throughout the season" (ICNAF Sum. Doc. 78/VI/3). STACRES further suggested that the east coast of Newfoundland would be a choice sampling area.

The following study is a preliminary report on our attempts to validate age readings from statoliths.

Materials and Methods

There were two samples of squid analyzed in the study. One was collected offshore on the southeast slope of the Grand Banks on June 9, 1978, the other was collected inshore Newfoundland near Holyrood, Conception Bay, on August 2, 1978. Out of these samples statoliths from 28 and 12 animals respectively were read.

There were two techniques employed to extract the statoliths. Of the two methods one may be described as more restricted to sampling in the laboratory while the other should facilitate extraction of statoliths in the field. The former involves the slicing of thin sections of the skull until the two statoliths can be easily removed from the cavities in which they lie. The latter technique simply requires that the partially cleaned skull be immersed in a vial containing a solution of sodium hypoclorite and pepsin. Within an hour or so the chitinous skull will be dissolved and the two statoliths will remain on the bottom of the vial.

Terms used to describe the structure and measurements of the statolith follow Clarke (1978). Statoliths were mounted on microscope slides in Ward's 70 cement. The statolith could be easily turned by warming the slide with the flame from an alcohol burner. The lateral dome of the statolith was ground preliminarily with a fine oil-based grit. Next the statolith was turned over to the opposite lateral plane for the final grinding and polishing. A great many statoliths were fractured and rendered unreadable during the grinding process. In fact some rings may have been easily sloughed off during this procedure. We are experimenting with a clearing agent which if effective would eliminate grinding, improve the accuracy of the counts and allow many statoliths to be read in a short time.

Most statoliths were read at 500X. A drop of immersion oil on the statolith appeared to increase the resolution of the rings. The count was made by observing the number of rings from the nucleus to the anterior dorsal edge of the statolith. A mean of at least two counts was recorded for each statolith.

Results

Since the statoliths did not dissolve in sodium hypochlorite whereas the rest of the skull did, it was concluded that the two differed in composition. A sample of statoliths were analyzed by X-ray diffraction at Memorial University. They were found to be calcium carbonate in the aragonite form. Clarke (1978) also reported statoliths to consist of aragonite.

Since the methodology of preparing the statoliths for age determination is time consuming, only a sub-sample of the sample of squid taken on each date could be analyzed within the time available. However, an effort was made to select squid in each sub-sample of a size equal to the mean mantle length of the squid in the entire sample for each date. Figure 1 shows that the range of mantle lengths for the June 9 and August 2 sub-samples used in the study fell within a narrower range of lengths than those lengths measured from the samples for the corresponding dates. Further the mean lengths of the sample and sub-sample for each date are not significantly different. By sub-sampling squid of lengths close to the mean mantle length of the entire sample for both dates, it is hoped to be able to compare cohorts of squid born during a similar time period.

Table 1, 2 summarize the mantle length, body weight and mean number of rings for each specimen analyzed from the June 9 and August 2 sub-samples respectively. The difference in the mean number of rings between sub-samples measured on June 9 and August 2 = 37 (159-122). The 95% confidence intervals (Table 1, 2) give a maximum difference of 55 and a minimum difference of 19 rings.

Between June 9 and August 2 there are 54 days. At least statistically the time difference measured in days falls barely within the 95% confidence limits of the difference in mean number of rings between the two subsamples.

Table 1. The dorsal mantle lengths, body weights and mean ring counts for each statolith examined from the sample taken on 9 June 1978.

Number of Slides	Specimen I.D. Number	Mantle Length (cm)	Round Weight (Grams)	Date Caught	Mean Number of Rings
1	1	14.5	60	June 9, 1978	131
2	2	16.5	70	"	113
3	3	14.5	57	"	62
4	4	14.5	57	"	110
5	5	17.5	95	"	119
6	6	15.5	60	"	134
7	8	14.0	51	"	144
8	9	14.5	55	"	136
9	11	14.0	53	"	133
10	12	14.5	61	"	116
11	13	14.0	50	"	134
12	14	14.0	49	"	100
13	15	14.5	58	"	114
14	17	17.5	83	"	135
15	18	14.5	50	"	90
16	21	14.0	54	"	137
17	22	13.5	53	"	139
18	23	13.5	42	"	127
19	24	14.5	65	"	125
20	25	14.5	51	"	85
21	26	14.5	52	"	130
22	27	15.0	68	"	133
23	28	13.5	47	"	125
24	29	15.5	72	"	112
25	30	15.0	59	"	127
26	31	14.5	54	"	132
27	32	15.0	56	"	143
28	34	14.5	52	"	119
MEAN		14.7	58		122 ± 7.06

Table 2. The dorsal mantle lengths, body weights and mean ring counts for each statolith examined from the sample taken on 2 August 1978.

Number of Slides	Specimen I.D. Number	Mantle Length (cm)	Round Weight (Grams)	Date Caught	Mean Number of Rings
1	1	21.5	200	Aug. 2, 1978	170
2	2	20.5	180	"	147
3	3	22.0	215	"	122
4	4	21.5	208	"	172
5	7	22.0	224	"	159
6	8	23.0	235	"	160
7	9	21.5	188	"	157
8	10	21.5	186	"	178
9	12	21.5	192	"	156
10	21	21.5	183	"	130
11	22	21.5	180	"	165
12	23	21.0	186	"	186
MEAN		21.6	198		159 ± 10.75

Discussion

The use of the statolith as a tool for ageing squid was first introduced by Lipinski (1978). He found fine growth increments within the nucleus which he believed to be daily marks. Beyond this zone of the statolith he observed rings which he concluded corresponded to monthly growth increments.

In the present study, the mean number of rings for both sub-samples (122 for June 9 and 159 for August 2) was too high to represent monthly rings. Bearing in mind the crudity of the grinding process and the limited number of statoliths examined the difference in the mean number of rings between sampling dates approximates more the difference in time measured in days rather than months as suggested by Lipinski (1978). In fact the mean number of rings is probably an underestimate of the true number of rings because as previously mentioned, the outer edges of some of the statoliths were damaged during preparation and some of the rings may have been ground off.

In fish, daily growth rings have been found (Brothers et al. 1976; Pannella, 1971; Ralston, 1976; Taubert and Coble, 1976). If the marks on the statolith are interpreted as daily growth rings then a simple back-calculation from both the June 9 and August 2 mean counts results in an estimated date of birth during February. This is consistent with the hypothesis put forward by Squires (1957).

Acknowledgements

We would like to thank G.P. Ennis for having initiated this study and for his critical review of the manuscript.

Literature Cited

Brothers, E.B., C.P. Mathews and R. Lasker. 1976. Daily growth increments in otoliths from larval and adult fishes. Fish. Bull. 74(1): 1-9.

Clarke, M.R. 1978. The cephalopod statolith - an introduction to its form. J. Mar. Biol. Ass. U.K. 58, 701-712.

Lipinski, M. 1978. The age of squids, *Illex illecebrosus* (LeSueur, 1821), from their statoliths. ICNAF Res. Doc. 78/II/15.

Pannella, G. 1971. Fish otoliths: Daily growth layers and periodical patterns. Science 173: 1124-1126.

Ralston, S. 1976. Age determination of a tropical reef butterfly fish utilizing daily growth rings of otoliths. Fish. Bull. 74: 990-994.

Squires, H.J. 1967. Growth and hypothetical age of the Newfoundland bait squid *Illex illecebrosus*. J. Fish. Res. Board Can. 24 (6): 1209-1217.

Taubert, B.D. and D.W. Coble. 1977. Daily rings in otoliths of three species of *Lepomis* and *Tilapia mossambica*. J. Fish. Res. Board Can. 34: 332-340.

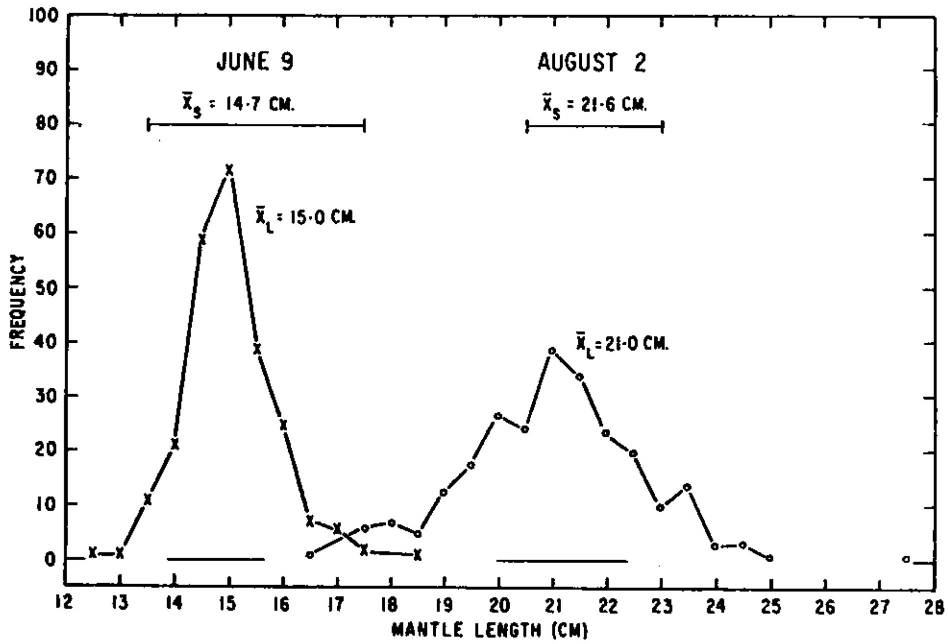

Fig. 1. Length frequencies from June 9 and August 2, 1978 samples. Range of lengths for statolith sub-samples are also given.