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Historical records of mature female short-finned squid (Illex illecebrosus) from the Northwest Atlantic and the first record of a mature female captured inshore at Newfoundland

by

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Abstract

A mature female short-finned squid captured inshore on the west coast of Newfoundland on September 26, 1980 represents the first reported capture this far north of a female in such an advanced stage of maturity. Ova in the oviducts were in various stages of development and were larger than those in the ovary. Fecundity for this specimen was comparable to previous estimates for mature females from the wild population.

Maturity stages were assigned to this female and similar specimens captured previously by applying indices of maturity which were developed using data from captive females. Stages of maturity corresponded to descriptions of maturity based on visual examination. Distribution of captures of mature females suggests that high temperatures may be associated with atypically early maturation.

Introduction

Biological characteristics of short-finned squid (Illex illecebrosus) have been well described for only a portion of its life cycle. The biology of the species has been documented for that period between their first yearly occurrence on the continental shelf in May-June until their disappearance from inshore areas and the continental shelf in November. Recently, earlier stages of the life history have been described during the February-April period in the Northwest Atlantic (Amaratunga et al., MS 1980; Fedulov and Froerman, MS 1980).

However, little data have been collected between December and February which is believed to encompass such critical phases in the life cycle as final maturation and spawning (Squires, 1967). The process of maturation in males is better understood than for females since males reach advanced stages of maturity during their summer-autumn residence in inshore waters and on the continental shelf (Squires, 1957; Mercer, MS 1973). Sexual maturation in females is as yet undescribed from field data since very few mature females have been captured (Squires, 1957; Mercer and Paulmier, MS 1974).

Recently female short-finned squid have been maintained in captivity and have undergone complete maturation and spawning (Durward et al., 1979, 1980; O'Dor et al., MS 1980). Observations of spawning, as well as embryonic and early larval development have been recorded and fecundity has been estimated. Also, a scale of female maturity stages has been developed and an index of maturity has been proposed for future use in field studies (Durward et al., 1979).

In this paper the capture of a mature female short-finned squid inshore at Newfoundland is reported for the first time. Ova sizes and fecundity are described and records of previous captures of females in advanced stages of maturity are reviewed. The index of maturity based on the relationship of nidamental gland length to mantle length is calculated for these specimens and compared to corresponding values gained experimentally (Durward et al., 1979).

Materials and Methods

The mature female short-finned squid captured inshore, was part of frozen commercial samples collected from the West Coast of Newfoundland (NAFO Div. 4R). It was captured September 26, using a Japanese mechanical jigger at Cox's Cove, Bay of Islands (Fig. 1). Examination and all measurements were later performed on the specimens in thawed condition. Lengths were measured to the nearest millimeter and weights were determined to the nearest 0.01 g.

Ova sizes were measured to the nearest 0.01 mm using an ocular micrometer fitted to a Bausch and Lomb dissecting microscope. Mean size of ova from the oviducts and ovary were calculated from measurements of 35 ova from each region. Since ova from the ovary were smaller and attached to ovary tissue, an estimate of fecundity was obtained only for the oviducts. Fecundity was estimated from exact counts of three 100 mg samples of ova from the oviducts.

Data pertaining to historical captures of mature females were taken from

original detailed sampling sheets and trip reports (Mercer, MS 1969 and unpubl. material). These females were collected using bottom trawl during surveys conducted by the Department of Fisheries and Oceans and the Institut Scientifique et Technique des Pêches Maritimes, Saint-Pierre and Miquelon. Vessels involved were A.T. CAMERON (1968 and 1969), CYROS (1973) and NEWFOUNDLAND HAWK (1978). Only specimens which were positively identified as Illex illecebrosus were considered since, during several cruises extending into NAFO Subarea 6, catches also included Illex oxygonius and Illex coindetii. Identification of specimens captured during such cruises were performed by Dr. C. C. Lu.

Mantle length for these specimens was recorded to the nearest 0.5 cm, whereas nidamental gland length was measured to the nearest millimeter. Data were also available on ova diameter for the specimen captured in May, 1973 (Mercer and Paulmier, MS 1974). All measurements were performed on specimens in fresh condition.

Results

The location of capture of a mature female short-finned squid on September 26, 1980 is shown in relation to historical captures of similar specimens (Fig. 1; Table 1). Most earlier captures occurred further south. One specimen (August 19, 1969) was captured in close proximity to the 1980 specimen, but it had not attained such an advanced stage of maturity (Table 1). All but two of these specimens were captured during August and all were in more advanced stages of maturation than is normally observed in late autumn commercial samples. The May 1973 specimen and two of the three females captured during August 1968 in NAFO Subarea 6 had mated (Table 1), as indicated by the presence of spermatophores inside the mantle cavity.

The September 26, 1980 specimen was described as mature based on visual examination (Fig. 2), the nidamental glands were greatly enlarged, white and firm. The oviducal glands were swollen and the oviducts and ovary were yellow and also enlarged. Ova were loose in the mantle cavity upon dissection.

Oblate spherical ova in the oviducts ranged in size from 0.76 x 0.69 mm to 1.63 x 1.09 mm. The average size for the sample was 0.88 x 0.75 mm. Those examined from the ovary were much smaller ranging 0.29 x 0.22 mm to 0.69 x 0.30 mm with a mean size of 0.38 x 0.26 mm.

The oviducts contained 19.27 g of ova in various stages of development. An estimate of fecundity for this specimen was 36,288 ova. An index of maturity,

based on the relationship of ovary weight (52.16 g) to body weight (155.84 g) was 0.34.

An index of maturity, based on the relationship of nidamental gland length to mantle length was calculated for the 1980 specimen and other specimens captured previously (Table 1). Values for this index ranged from 0.24 to 0.47. Based on this index the 1980 specimen and all three earlier specimens which had mated corresponded to stage V of maturity. The other three specimens corresponded to stage IV.

Discussion

The September 26, 1980 capture of a mature female short-finned squid represents the first record of a female in such an advanced stage of maturity from inshore Newfoundland waters. The fact that the only previous capture of an early-season maturing female this far north occurred in the same general area suggests that higher temperatures in the vicinity of the Gulf of St. Lawrence may be associated with acceleration of sexual maturation. Males from the West Coast were found to be more mature than those from other areas of insular Newfoundland (Beck et al., this meeting). Mercer (MS 1973) noted that areal differences in the rate of maturation of males may be due to variations in temperature.

All captures of mature females in NAFO Subarea 6 occurred during late August or early September. However such occasional captures probably do not indicate time of spawning, as few surveys have been conducted in this area later in the year. Durward et al. (1980) noted that such rare captures are probably oddities, rather than a part of the normal breeding population.

The females captured between June and September seem to have matured atypically early. However, the May 1973 specimen was probably one which matured and mated the previous winter, but did not spawn. This is suggested by the anomalously large size of the specimen and the high index of maturity, based on the relationship of nidamental gland length to mantle length. The mean size of ova for this specimen was 0.9 x 0.6 mm (Mercer and Paulmier, MS 1974), larger than that for the September 1980 specimen, but the same size as for females which matured in captivity (Durward et al., 1979). The capture of two other mature females on the Grand Bank in May has been previously reported (Squires 1957). These were large specimens with ova diameters of 0.83 mm and 1.00 mm, indicating that they had also probably matured the previous winter.

An estimate of fecundity for the 1980 Newfoundland specimen (36,288) was much lower than that estimated for captive females (400,000) (Durward et al., 1979). However it closely approximates estimates obtained by Lipinski (MS 1979) for two maturing specimens captured in late May, 1975 in NAFO Subarea 6. Using a similar method Lipinski estimated fecundity to be 31,100 and 39,400 for these specimens which were smaller than the 1980 specimen described here. Although fecundity for the 1980 specimen may be an underestimate, since freezing may have caused some of the ova to rupture (O'Dor, pers. comm.), close agreement with estimates of Lipinski suggest that actual fecundity may be much lower than estimated from captive females (Durward et al., 1979). Fecundity of Illex illecebrosus is probably related to the number of finished ova in the oviducts at time of spawning (O'Dor et al., MS 1980) and may further be reduced in that this species does not appear to be a complete spawner (Durward et al., 1980). Large uniform ova sizes and high estimates of fecundity for captive females probably reflect atypically complete maturation of these females in the absence of males. The presence of mature males is believed to serve as the spawning stimulus (O'Dor et al., MS 1980).

Classification of the 1980 specimen as stage V based on the $\frac{OW}{BW}$ and $\frac{NGL}{ML}$ ratios agrees with the subjective classification based on visual examination. Also, using the $\frac{NGL}{ML}$ index all three mated females captured earlier were classified as stage V. Thus, although unavailability of data throughout the continuous process of maturation has precluded exact definition of maturity stages, the index of maturity proposed by Durward et al. (1979) does appear to be applicable to specimens from the wild population.

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References

Amaratunga, T., T. Rowell, and M. Roberge. MS 1980. Summary of joint Canada/USSR research program on short-finned squid (Illex illecebrosus) 16 February to 4 June 1979: spawning stock and larval survey. NAFO SCR Doc. 80/II/38, Ser. No. N069, 36 p.

Durward, R. D., T. Amaratunga, and R. K. O'Dor. 1979. Maturation index and fecundity for female squid, Illex illecebrosus (LeSueur, 1821). ICNAF Res. Bull 14: 67-72.

Durward, R. D., E. Vessey, R. K. O'Dor, and T. Amaratunga. 1980. Reproduction in the squid, Illex illecebrosus: first observations in captivity and implications for the life cycle. ICNAF Sel. Pap. 6: 7-13.

Fedulov, P. P. and Yu. M. Froerman. MS 1980. Effect of abiotic factors on distribution of young shortfin squids, Illex illecebrosus (LeSueur, 1821). NAFO SCR Doc. 80/VI/98, Ser. No. N153, 22 p.

Lipiński, M. MS 1979. Universal maturity scale for the commercially-important squids (Cephalopoda: Teuthoidea). The results of maturity classification of the Illex illecebrosus (LeSueur, 1821) populations for the years 1973-1977. ICNAF Res. Doc. 79/II/38, Ser. No. 5364, 40 p.

Mercer, M. C. MS 1969. A. T. CAMERON cruise 150, otter-trawl survey of the mid-Atlantic Bight, August-September 1968. Fish. Res. Board Can. Tech. Rep. No. 122, 47 p.

MS 1973. Sexual maturity and sex ratios of the ommastrephid squid, Illex illecebrosus (LeSueur), at Newfoundland (Subarea 3). ICNAF Res. Doc. 73/71, Ser. No. 3023, 14 p.

Mercer, M. C., and G. Paulmier. MS 1974. Distribution and biological characteristics of the short-finned squid (Illex illecebrosus) on the continental shelf of subareas 3 and 4 in May-June, 1973. ICNAF Res. Doc. 74/87, Ser. No. 3323, 11 p.

O'Dor, R. K., E. Vessey, and T. Amaratunga. MS 1980. Factors affecting fecundity and larval distribution in the squid, Illex illecebrosus. NAFO SCR Doc. 80/II/39, Ser. No. N070, 9 p.

Squires, H. J. 1957. Squid, Illex illecebrosus (LeSueur), in the Newfoundland fishing area. J. Fish. Res. Board Can. 14: 693-728.

1967. Growth and hypothetical age of the Newfoundland bait squid Illex illecebrosus illecebrosus. J. Fish. Res. Board Can. 24: 1209-1217.

Table 1. Time and location of historical captures of female short-finned squid in advanced stages of maturity. Maturity stages are assigned based on $\frac{NGL}{ML}$ relationship. (An asterisk indicates females which had mated).

Time of capture Year	Date	Location of capture	Mantle length (mm)	Nidamental gland length (mm)	$\frac{NGL}{ML}$	Stage of Maturity[a]
1980	Sept. 26	Bay of Islands	244	115	0.47	V
1978	June 7	44°55'30"N 55°40'00"W	235	77	0.33	IV
1973	May 12	42°24'80"N 64°52'40"W	305	132	0.43	V*
1969	Aug. 19	48°14'00N 59°45'30"W	205	63	0.31	IV
1968	Sept. 6	39°00'00"N 72°48'00"W	255	105	0.41	V*
1968	Aug. 28	38°33'00"N 73°17'15"W	235	89	0.38	V*
1968	Aug. 28	36°30'30"N 76°29'00"W	260	62	0.24	IV

[a] as proposed by Durward et al. (1979).

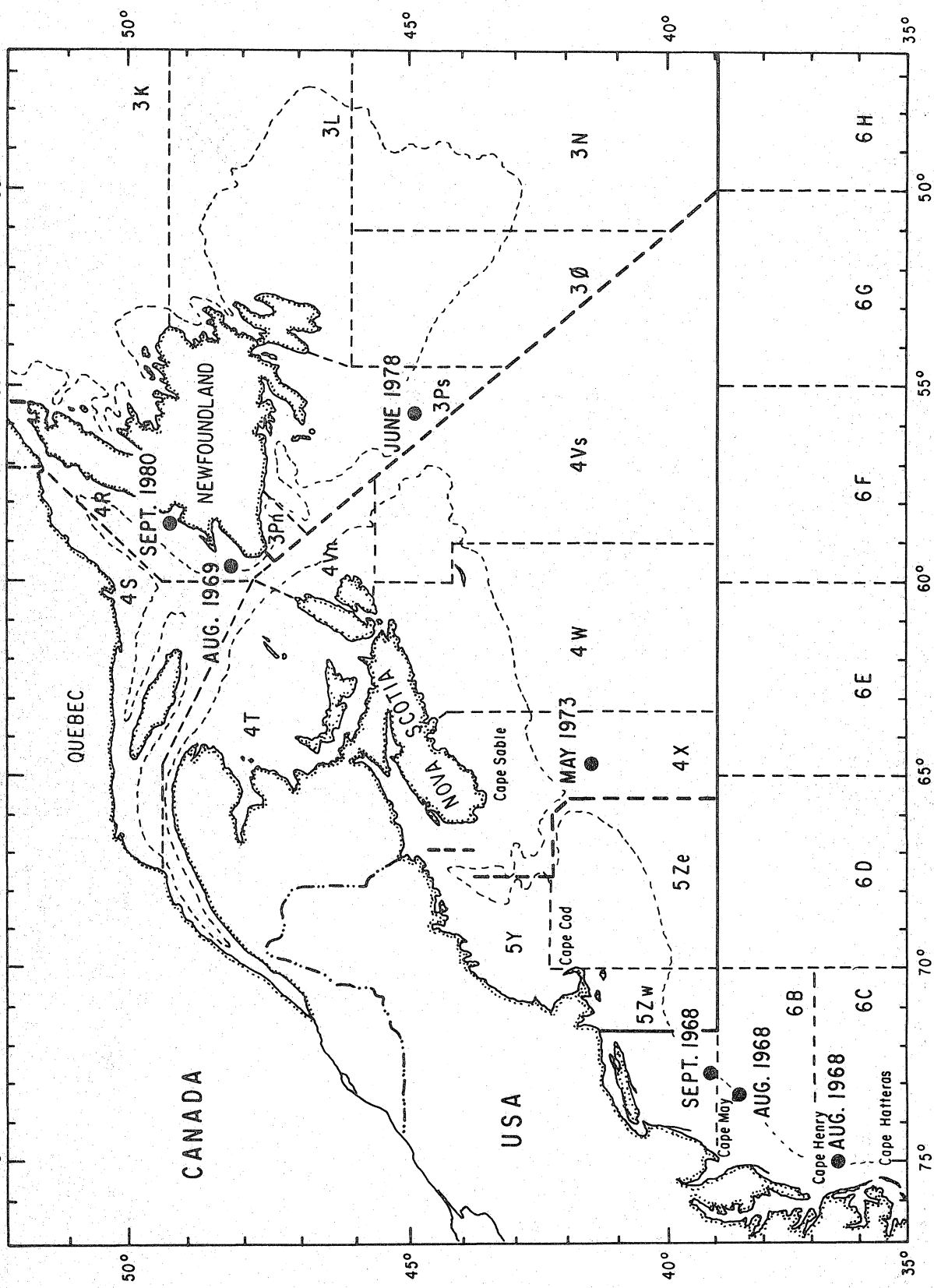

Fig. 1. Map showing location and time of capture of mature female short-finned squid in the Northwest Atlantic.

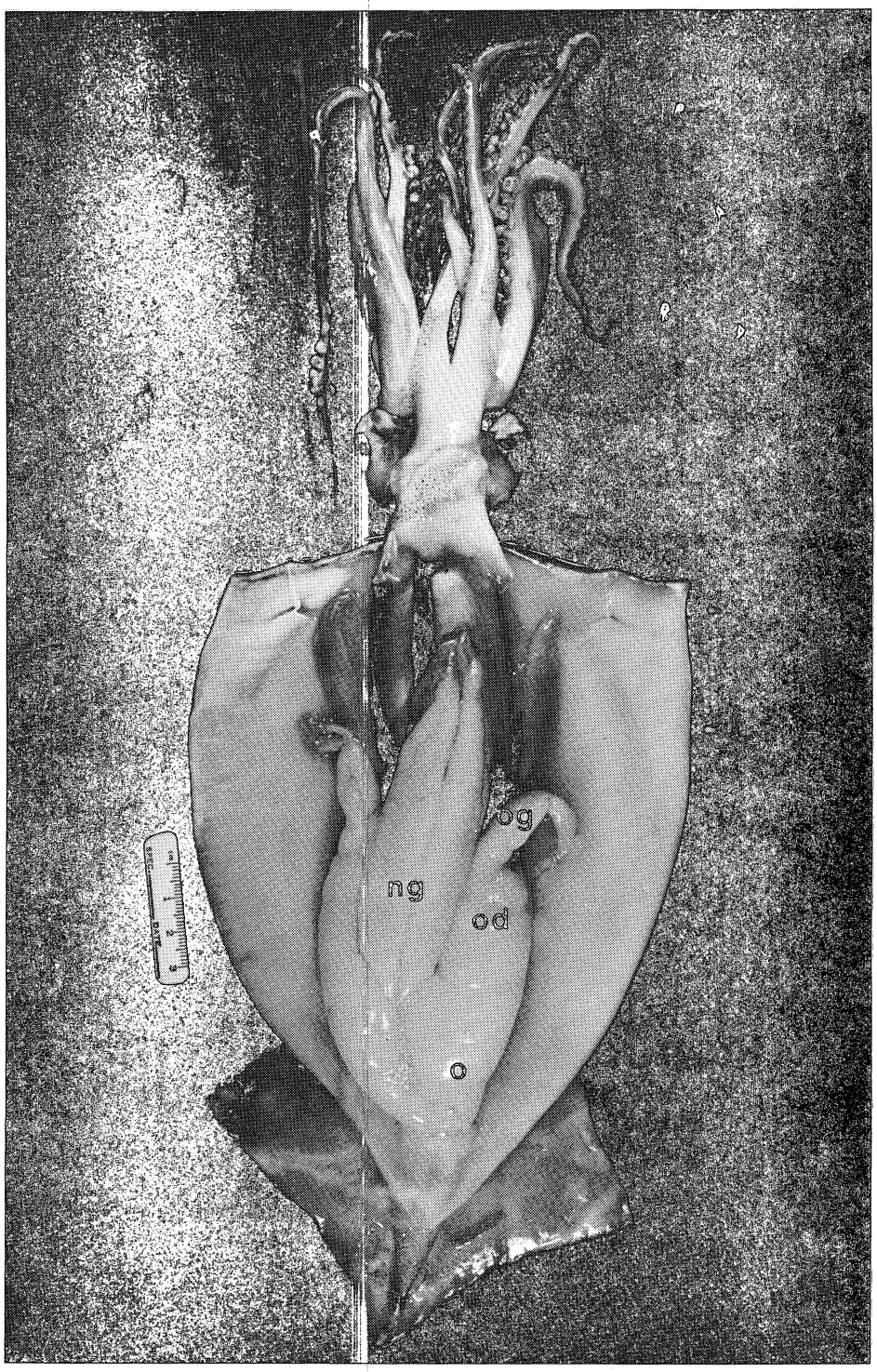

Fig. 2. Mature female short-finned squid captured September 26, 1980 at Cox's Cove, Bay of Islands, Newfoundland (ng = nidamental gland; od = oviduct; og = oviducal gland; o = ovary).