

Record of a Mature Female Short-finned Squid, *Illex illecebrosus*, Captured Inshore at Newfoundland and Previous Captures of Mature Females in the Northwest Atlantic

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Abstract

A mature female short-finned squid, *Illex illecebrosus*, captured inshore on the west coast of Newfoundland on 26 September 1980 represents the most northerly record of a female in near-spawning condition. The specimen was classified as mature on the basis of visual examination and the nidamental gland length/mantle length ratio. Ova in the oviducts varied in size but were considerably larger than those remaining in the ovary. Fecundity was much lower than that reported for captive animals but similar to previous estimates for mature females from the wild population. The capture of the 1980 specimen is considered in relation to six previous records of mature females captured in late spring to early autumn in the Northwest Atlantic, and possible reasons for these rare occurrences are discussed.

Introduction

Biological characteristics of short-finned squid, *Illex illecebrosus*, have been well documented for that period of the life cycle between their first occurrence on the continental shelf in May-June and their disappearance from inshore areas and the continental shelf in November. Earlier stages of the life cycle during February-April in the Northwest Atlantic have recently been described (Amaratunga *et al.*, MS 1980; Fedulov and Froerman, MS 1980; Dawe *et al.*, MS 1981). However, little data have been collected during the December-January period which is believed to encompass such critical stages in the life cycle as final maturation and spawning (Squires, 1967).

The process of maturation in males is better understood than in females because males reach advanced stages of maturity during their summer-autumn residence in inshore waters and on the continental shelf (Squires, 1967; Mercer, MS 1973). Recently, observations on maturation and spawning, as well as embryonic and early larval development, have been recorded and fecundity has been estimated for short-finned squid maintained in captivity (Durward *et al.*, 1979, 1980; O'Dor *et al.*, MS 1980). Also, a scale of maturity stages has been developed for females and an index of maturity has been proposed for use in field studies (Durward *et al.*, 1979).

In this paper, the first reported observation of a mature female short-finned squid from Newfoundland coastal waters is described. Ova sizes and fecundity are given and records of previous captures of females in advanced stages of maturity are reviewed. The index

of maturity for these specimens, based on the relationship between nidamental gland length and mantle length, is compared with that developed from laboratory observations.

Materials and Methods

A mature female short-finned squid was found in a sample from a commercial catch by Japanese-type mechanical jigger on 26 September 1980 at Cox's Cove, Bay of Islands, Newfoundland (Fig. 1). The sample was immediately frozen and thawed later for examination in the laboratory. Length and weight measurements of the thawed specimen were recorded to the nearest mm and 0.01 g respectively. Ova sizes were measured to the nearest 0.01 mm using an ocular micrometer fitted to a binocular dissecting microscope. Mean sizes of ova from ovary and oviducts were calculated from measurements of 35 ova from each organ. Fecundity was estimated from counts of three 100 mg samples of ova from the oviducts, thus making the estimate comparable to those reported by Durward *et al.* (1979) for females which matured in captivity. Such an estimate, which excludes the smaller eggs embedded in ovarian tissue in the ovary, is therefore only a partial estimate of the total number of ova present in the gonad.

Data pertaining to previous captures of mature females in the Northwest Atlantic were taken from original detailed sampling sheets and cruise reports (Mercer, MS 1969; unpublished data of Northwest

Atlantic Fisheries Center, St. John's, Newfoundland). These specimens were caught during bottom trawl surveys by the Canadian vessels *A. T. Cameron* (1968 and 1969) and *Newfoundland Hawk* (1978) and the French vessel *Cryos* (1973). Only the specimens that were positively identified as *Illex illecebrosus* were considered, as some catches included *Illex oxygonius* and *Illex coindetii*. All measurements were performed on fresh specimens. Mantle length was recorded to the nearest 0.5 cm and nidamental gland length to the nearest millimeter. Data were also available on ova diameter for the specimen captured in May 1973 (Mercer and Paulmier, MS 1974).

Results

The location of capture of the mature female short-finned squid on 26 September 1980 is the most northern of any of the previously reported captures of similar specimens (Fig. 1, Table 1). A specimen obtained on 19 August 1969 was captured in close proximity to the 1980 specimen but it had not attained such an advanced stage of maturity. Each of the specimens was in a more advanced stage of maturation than is observed in late-autumn samples from the commercial fishery. The specimen taken in May 1973 and two of the

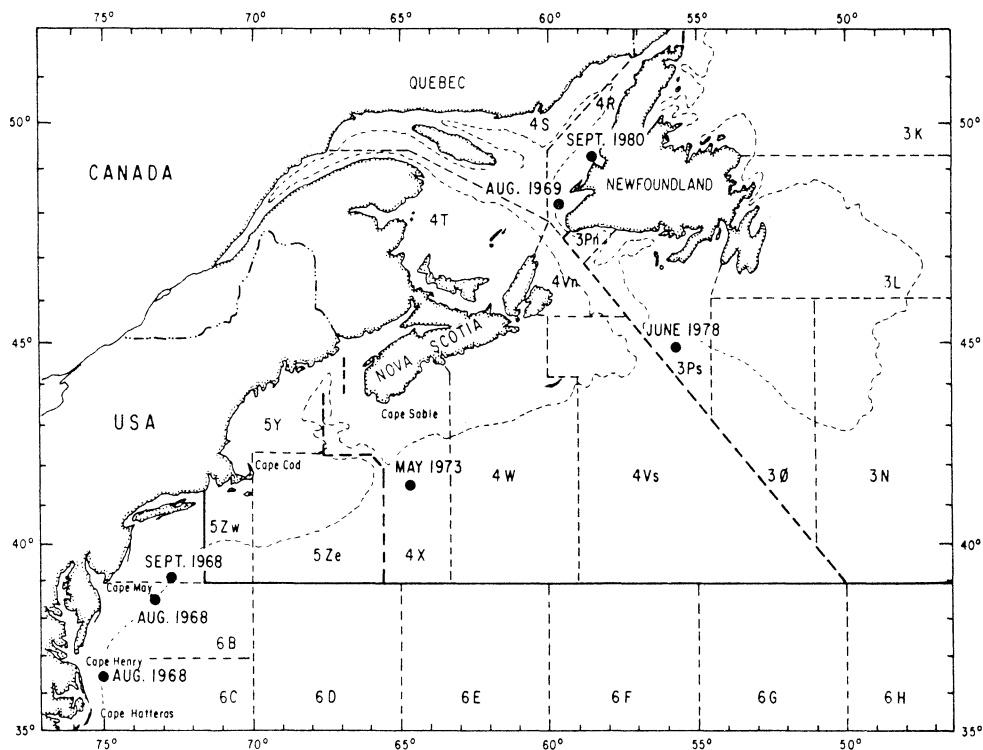


Fig. 1. Locations of capture of mature female short-finned squid in the Northwest Atlantic.

TABLE 1. Historical captures of female *Illex illecebrosus* in advanced stages of maturity. (Assignment of maturity stages based on NGL/ML ratio proposed by Durward *et al.* (1979).)

Year	Date	Location of capture	Mantle length (mm)	Nidamental gland length (mm)	NGL/ML ratio	Maturity stage
1980	26 Sep	49° 07' N, 58° 05' W	244	115	0.47	V
1978	7 Jun	44° 56' N, 55° 40' W	235	77	0.33	IV
1973	12 May	42° 24' N, 64° 52' W	305	132	0.43	V ^a
1969	19 Aug	48° 14' N, 59° 46' W	205	63	0.31	IV
1968	28 Aug	38° 33' N, 73° 17' W	235	89	0.38	V ^a
1968	28 Aug	36° 31' N, 76° 29' W	260	62	0.24	IV
1968	6 Sep	39° 00' N, 72° 48' W	255	105	0.41	V ^a

^a Spermatophores present in mantle cavity.

three specimens captured in August 1968 off the United States coast had mated, as indicated by the presence of spermatophores in the mantle cavity.

The September 1980 specimen was described as mature on the basis of 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 diameter (major and minor axes) from 0.76×0.69 mm to 1.63×1.09 mm, the average size being 0.88×0.75 mm. Ova from the ovary were smaller, ranging from 0.29×0.22 mm to 0.69×0.30 mm with mean size of 0.38×0.26 mm.

The oviducts contained 19.27 g of ova in various stages of development, representing 12% of the total weight of the specimen. There were 188 ± 8.34 ova (mean \pm standard deviation) per 100 mg sample from the oviducts, giving a mean fecundity estimate of 36,288 ova. The gonad weight (ovary, oviducts and oviducal glands) was 52.16 g and the body weight was 155.84 g. The ratio of gonad weight to body weight (0.34) is greater than the minimum ratio (0.09) indicated by Durward *et al.* (1979) for stage V from their study on captive animals.

The ratio of nidamental gland length (NGL) to mantle length (ML) for the seven specimens ranged from 0.24 to 0.47, the highest value being for the 1980 specimen (Table 1). According to the index of maturity proposed by Durward *et al.* (1979), the maturity of the 1980 specimen and the three females which had mated corresponds to stage V ($NGL/ML > 0.35$) and that of the remaining three specimens to stage IV.

Discussion

The capture of a mature female short-finned squid on 26 September 1980 represents the first record of a female in such an advanced stage of maturity from Newfoundland inshore waters. The location of this and the only previous capture of a maturing female so early in the season on the west coast of Newfoundland suggests that acceleration of sexual maturation may be associated with higher water temperatures in that area than are prevalent in other coastal areas. Beck *et al.* (MS 1981) found that males from the west coast were more mature than those from other areas of insular Newfoundland. Mercer (MS 1973) noted that areal differences in the rate of maturation of males may be due to variation in temperature.

If spawning occurs in January–February (Squires, 1967), the mature females captured in May–September either matured atypically very early in the season or are survivors from the previous winter spawning. However,

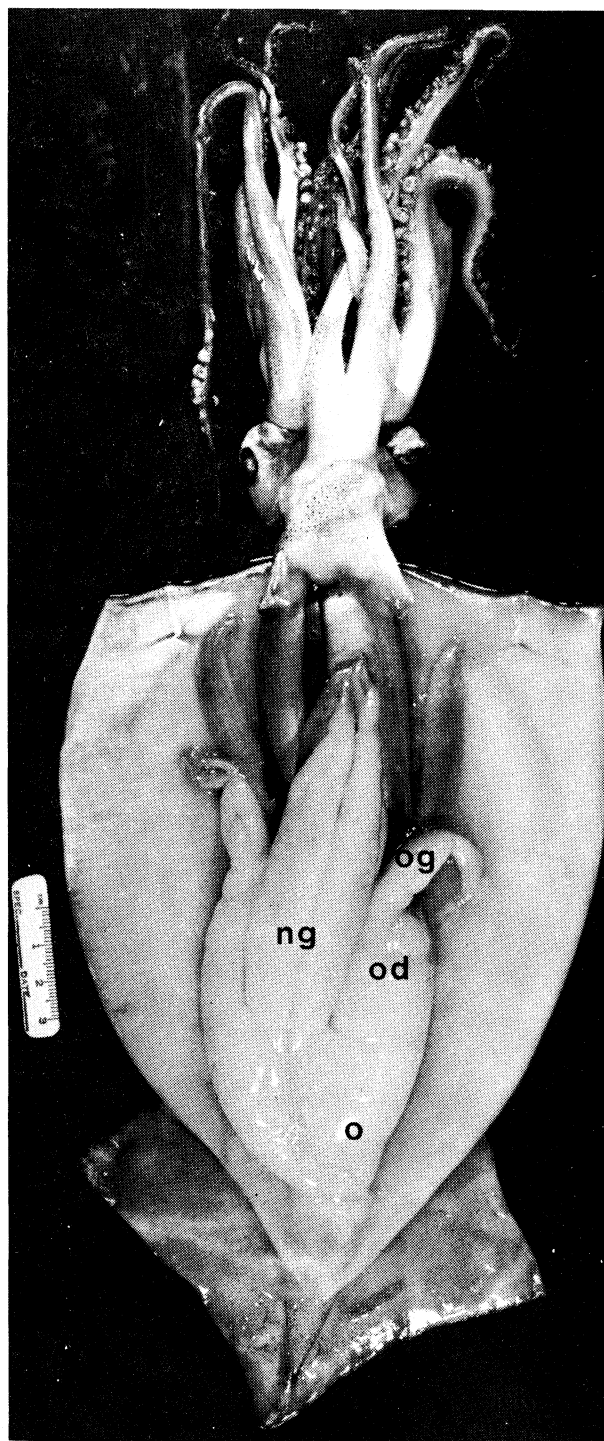


Fig. 2. Mature female short-finned squid captured on 26 September 1980 in Bay of Islands, Newfoundland. (ng = nidamental gland, od = oviduct, og = oviducal gland, o = ovary.)

if protracted spawning occurs off the United States coast (Lange, MS 1981), the mature females captured in Subarea 6 during late August–early September may

actually be indicative of some autumn spawning in that area. However, these captures may not be indicative of the time of peak spawning but could reflect non-uniform seasonal sampling effort, as few surveys have been conducted in this area later in the year. Durward *et al.* (1980) noted that occurrence of mature females in late spring and summer is so rare that they are more likely to be oddities rather than a part of the normal breeding population.

Because of its large size and high index of maturity, the specimen taken in May 1973 probably matured and mated during the preceding winter but did not spawn. The mean size of ova in this specimen was 0.9×0.6 mm (Mercer and Paulmier, MS 1974). Squires (1957) reported the capture on Grand Bank in May 1953 of two large females with ova diameters of 1.00 and 0.83 mm, which he (pers. comm.) indicated to be maximum diameters. These animals probably matured in the preceding winter but did not spawn.

The fecundity estimate for the September 1980 specimen (36,288 ova) is much lower than that reported for captive females (400,000 ova) (Durward *et al.*, 1979) but similar to estimates (31,100 and 39,400 ova) for two smaller mature females captured in Subarea 6 in late May 1975 (Lipinski, MS 1979). It is possible that the fecundity of the September 1980 specimen may be underestimated, as freezing may have caused some of the eggs to rupture (R. K. O'Dor, pers. comm.), but close agreement with Lipinski's estimates indicates that fecundity in the wild population may be much lower than that estimated from captive females (Durward *et al.*, 1979). Fecundity of *I. illecebrosus* is probably related to the number of completely developed ova in the oviducts at the time of spawning (O'Dor *et al.*, MS 1980), but it may be lower in that some ova may remain in the oviducts after spawning (Durward *et al.*, 1980). Therefore, partial fecundity based on the number of ova in the oviducts may better represent the spawning potential of a female than total fecundity based on all ova in the gonad. Large uniform ova and high fecundity of captive females probably reflect atypical maturation in the absence of males. O'Dor *et al.* (MS 1980) noted that fertilized captive females had many more incompletely developed ova remaining in the ovary than did mature females which were maintained in the absence of males. The presence of males is believed to serve as the spawning stimulus (O'Dor *et al.*, MS 1980).

Classification of the 1980 specimen as maturity stage V, based on the gonad weight/body weight and nidamental gland length/mantle length ratios, agrees with the subjective classification based on visual examination. Also, all three females with spermatophores in the mantle cavity were classified as stage V by the nidamental gland length/mantle length ratio. Thus, although the unavailability of data for all stages

of the maturation process has precluded exact definition of maturity stages, the index of maturity proposed by Durward *et al.* (1979) appears to be applicable to specimens from the wild population.

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