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Biological Characteristics of Squid (*Illex illecebrosus*) in the Newfoundland Area (NAFO Subarea 3) During 2001-2003

by

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Abstract

Squid sampled from the Newfoundland inshore fishery were much smaller in 2003 than during the previous two years. Size distributions were comprised almost exclusively of a single modal group of large maturing squid during 2001 and 2002, as opposed to a single modal group of small immature squid during 2003. The increased prominence of such small squid at Newfoundland in some recent years may reflect a gradual decline in the productivity of large winter-spawned squid, relative to groups of smaller squid spawned later. Offshore samples collected in October on the Grand Bank, during an annual bottom trawl survey, included both the group of small immature squid and a group of larger maturing squid that was virtually absent from inshore commercial samples.

Introduction

This paper provides an update of trends in size and maturity of squid from Newfoundland waters (NAFO Subarea 3) during 2002 and 2003. Length composition and (for males) maturity are described for those biological samples that could be obtained from the inshore commercial fishery and from offshore fall multispecies bottom trawl surveys. Biological characteristics have been described for most years between 1965 and 2000 (Mercer, 1975; Collins and Ennis, 1978; Hurley *et al*., 1979; Beck *et al*., 1980, 1981, 1982, 1983, 1986, 1989, 1994, 1998; Drew *et al*., 1984, 1985**;** Dawe *et al*., 1999, 2001).

Materials and Methods

Biological samples were taken from the Newfoundland inshore commercial jig fishery, when available, at New Bonaventure in NAFO Div. 3L during 2001-2003 (Fig. 1). Samples were also taken, when available, during fall (Sep-Dec) multi-species bottom trawl surveys throughout NAFO Div. 2J+3KLNO. This stratified random survey (Doubleday, 1981) has utilized a Campelen 1800 shrimp trawl with rockhopper footgear since 1995. Further details regarding survey sampling gear and procedures can be found elsewhere (McCallum and Walsh, 1996, 2002; Walsh and McCallum, 1996)

All squid samples were dissected, sexed, and measured in dorsal mantle length (ML) to the nearest 0.5 cm. Maturity stages for males were assigned according to Mercer (1973). Samples were pooled over biweekly periods for descriptions of length, sex, and maturity composition

Results and Discussion

Inshore commercial fishery samples

Length frequency distributions at New Bonaventure (Fig. 1) were generally unimodal for all time periods and both sexes during 2001 (Fig. 2) and 2002 (Fig. 3), as is usually the case for inshore Newfoundland inshore samples (Beck et al 1998, Dawe *et al*., 2001). Squid were larger in 2002 than in 2001. For example modal length of males increased, between early September and late October, from 19 to 23 cm in 2001 versus from 21 to 25 cm in 2002. Similarly, female modal lengths increased, over the same time period, from 20 to 24 cm in 2001 *versus* 22 to 27 cm in 2002. Sexual maturation progressed throughout the season in males, such that most males were fully mature by early-November in 2001 and by late October in 2002 (Fig. 2). Squid from a smaller modal group were quite uncommon during 2001 and 2002; for example, they were represented by a few 19-21 cm females during early-October of 2002 (Fig. 3).

The New Bonaventure length frequency distributions were remarkably different in 2003 (Fig. 4) from those of the previous two years. The modal group of large squid that almost exclusively comprised the commercial samples during 2001 and 2002 was virtually absent during 2003, except during late August. This was most clearly evident in males, in that large maturing males of about 25 cm modal length were very weakly represented in late-September and early-October samples. The inshore 2003 length frequency distributions were, however, comprised mostly of a distinct modal group of smaller squid, that was virtually absent in 2001 and 2002. Males of this group increased in modal length from about 16 to 19 cm between early-August and early-October and remained immature throughout the season (Fig. 4).

The unusual predominance of small squid in 2003 was reflected in a sharp decrease in mean mantle length for both sexes in both periods of September (Fig. 5). For example the mean length of males in early September dropped from 21.3 cm in 2002 to16.8 cm in 2003 (Fig. 3-5). Squid of such small mean length have been encountered previously at the same sampling site in early September of 1996 and 2000 (Fig. 5). However some sexual maturation of small males was evident in both those earlier years (Beck *et al*., 1998, Dawe *et al*., 2001), whereas small males remained immature in 2003. This unusual occurrence of a modal group of small immature squid throughout the fishing season at Newfoundland was associated with record high catch rate and record small size of squid observed in the Subareas 5+6 autumn survey during 2003 (Hendrickson *et al*., 2004).

Large sizes in the Newfoundland inshore fishery during 1976-82 (Fig. 5) is believed to be related to relatively early spawning, in winter, in years of high abundance (Coelho *et al*., 1994, Dawe and Beck, 1997). Mean length declined gradually during 1982-1992, but has been highly variable in more recent years. However, mean weight in the Subareas 5+6 autumn survey has continued to decline overall since 1981, to record small sizes during 2001-2003 (Hendrickson *et al*., 2004). This decline in size could be due to reduced growth rates, progressively earlier spawning within winter-spring by the modal group of large squid, or reduced productivity of large winter-spawned squid relative to groups of smaller spawned later (eg. in spring-summer). Unfortunately, there are no yearly size frequency data from Subareas 5+6.

While spawning occurs throughout the year, there are several seasonal peaks (Lange and Sissenwine, 1983; Coelho *et al*., 1994; Dawe and Beck, 1997). The group of large winter-spawned squid has historically represented the main contributor to high abundance and biomass levels in Subareas 3 and 4, whereas modal groups of smaller squid, have historically not been prevalent in Newfoundland inshore waters (Lange and Sissenwine, 1983; Coelho and O'Dor, 1993, Coelho *et al*., 1994). The gradual decline in mean weight in the Subareas 5+6 autumn survey, together with the prominence of the modal group of small squid at Newfoundland in some recent years, may reflect a gradual decline in the productivity of large winter-spawned squid relative to groups of smaller squid, spawned later (Lange and Sissenwine, 1983; Coelho *et al*., 1994).

Offshore survey samples

Length distributions were generated from samples collected on the Grand Bank (Div. 3LNO) in October of 2001-2003, during the fall Div. 2J3KLNO multispecies bottom trawl survey (Fig. 6). It is not possible to compare these size distributions across years because of sample size limitations as well as annual differences in time and location of sample acquisition.

The length distributions for late October 2003 were bimodal for both sexes (Fig. 6). The modal group of small immature squid that predominated inshore was well-represented, with modal lengths of 18 cm and 19 cm for males and females respectively. However, a group of larger maturing squid was predominant offshore, with modal lengths of about 22 and 23 cm for males and females respectively. This larger group was virtually absent from inshore samples. Its stronger representation in offshore than in inshore samples during October likely reflects late-season offshore migration of larger maturing squid (Dawe and Hendrickson, 1998; Dawe *et al*., 1999).

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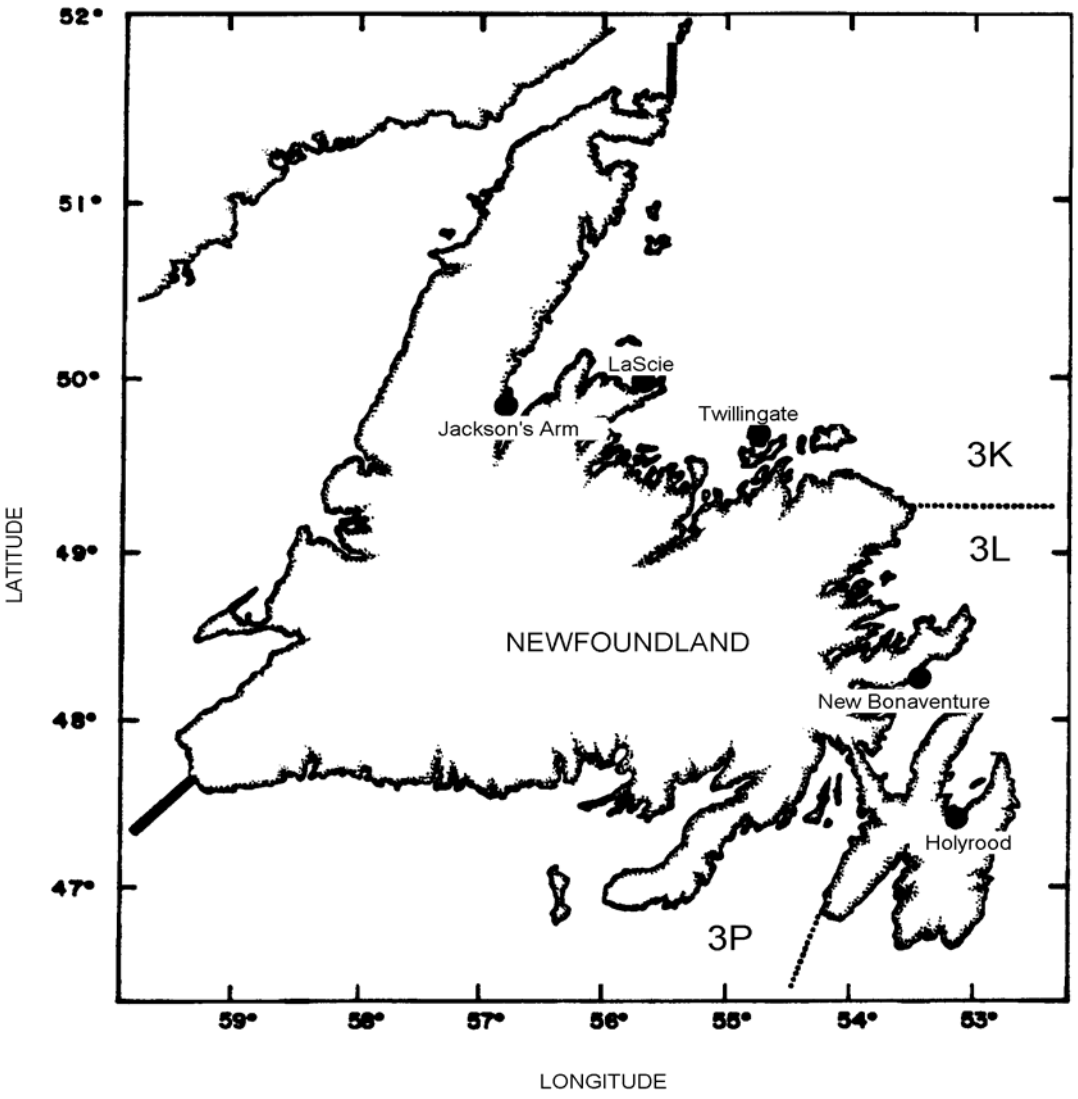

Fig. 1: Map showing location of inshore Newfoundland sampling sites.

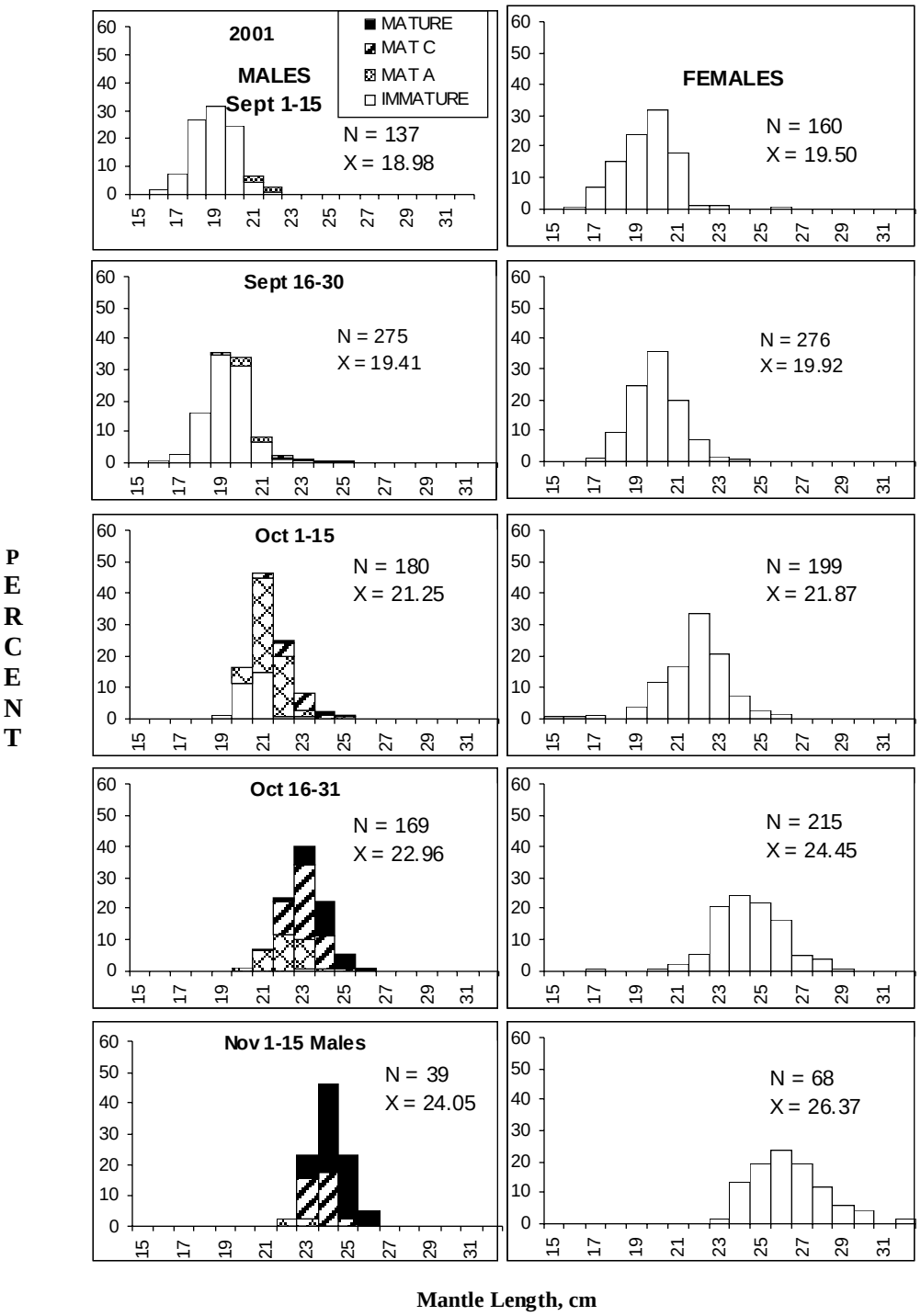

Fig. 2. Mantle length frequency distributions for males with maturity stages overlain (left), and for females (right), for biweekly periods, from New Bonaventure in 2001.

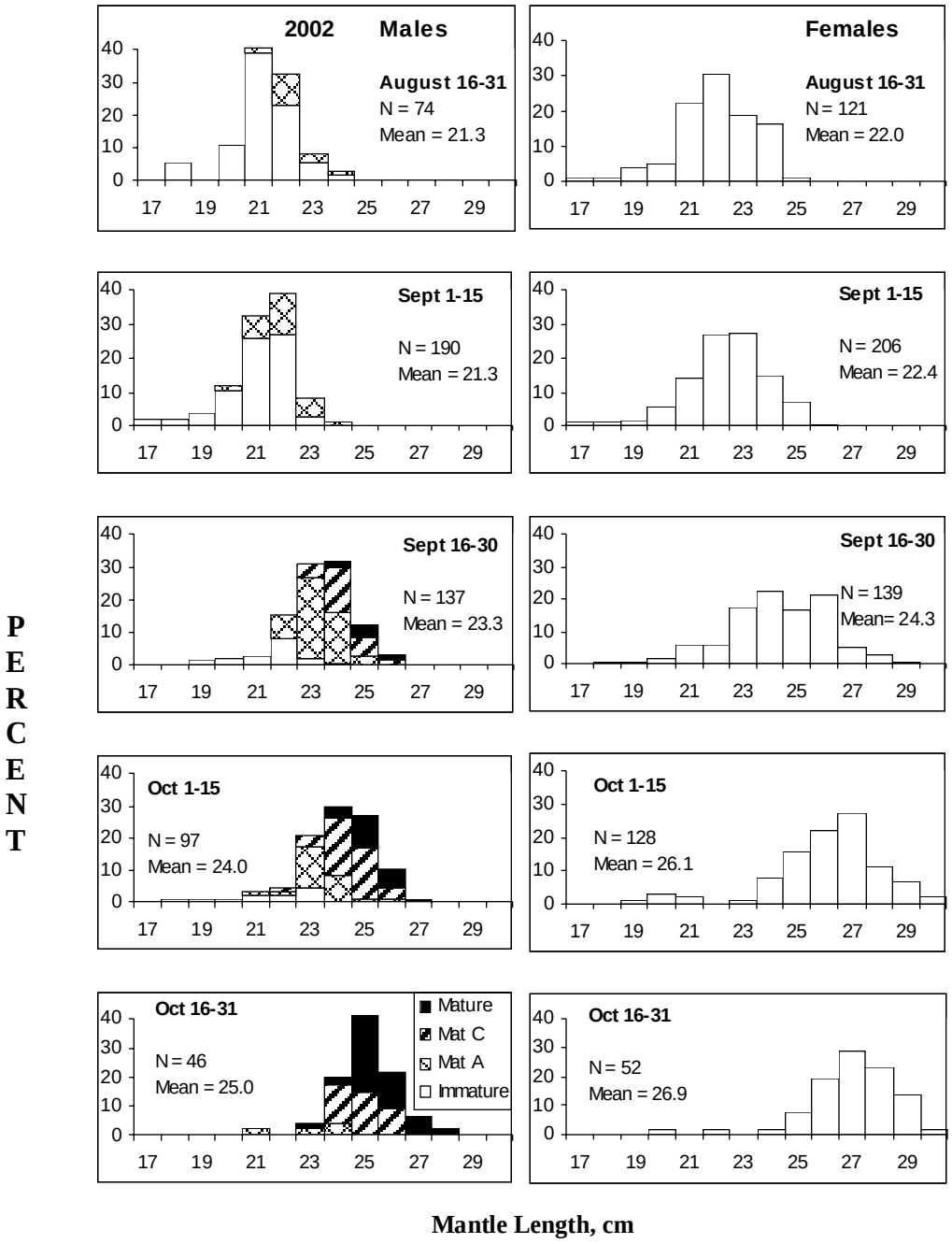

Fig. 3. Mantle length frequency distributions for males, with maturity stages overlain (left), and for females (right), for biweekly periods, from New Bonaventure in 2002.

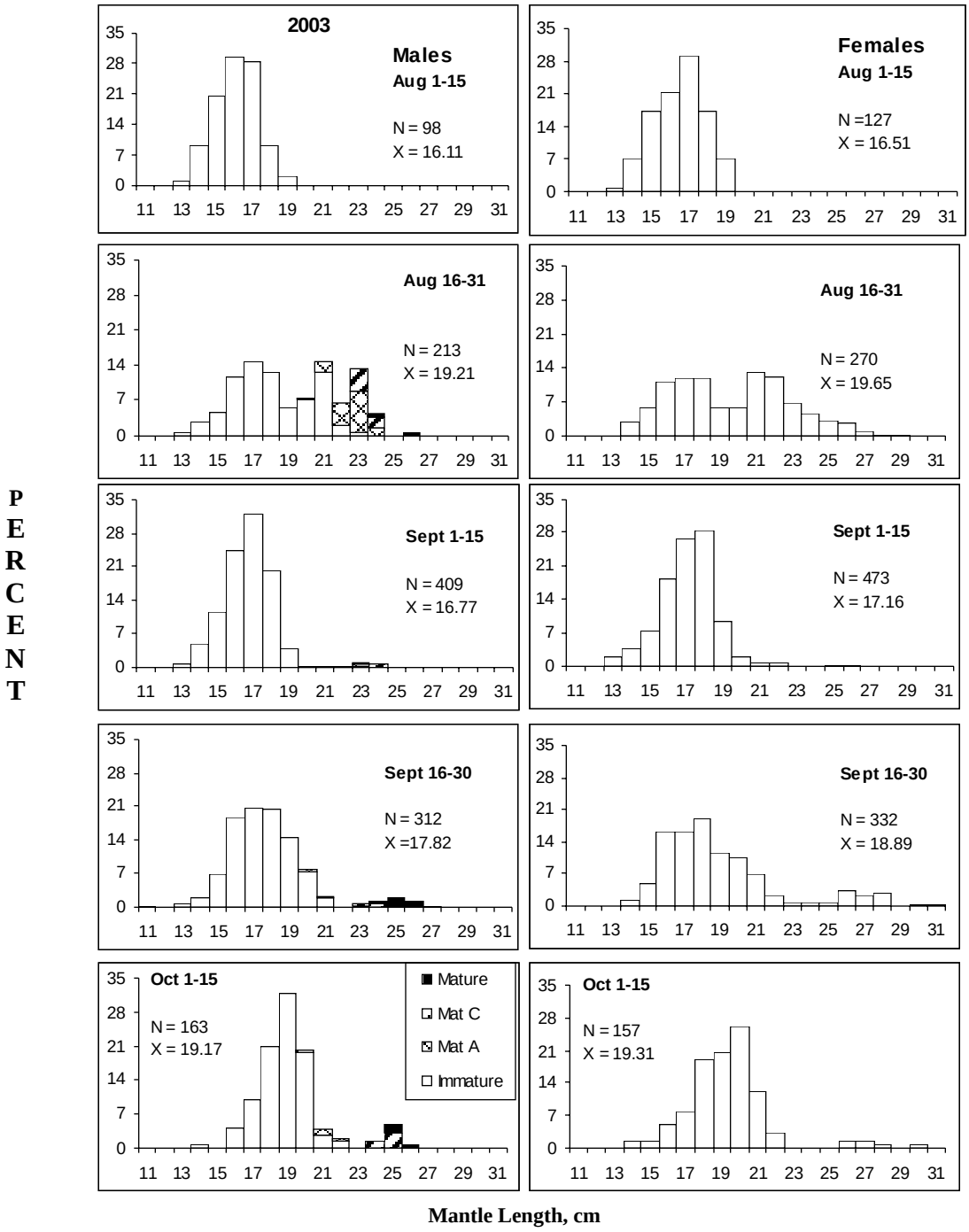

Fig. 4. Mantle length frequency distributions for males, with maturity stages overlain (left), and for females (right), for biweekly periods, from New Bonaventure in 2003.

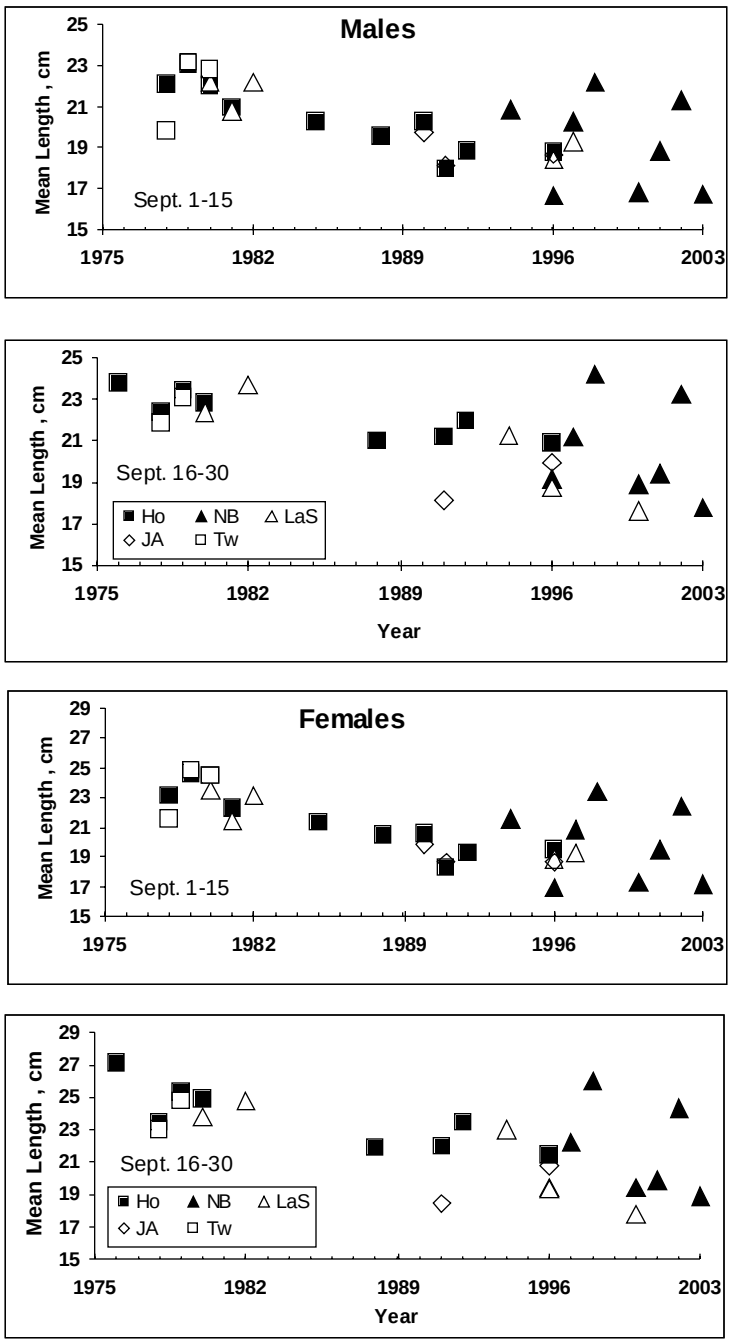

Fig. 5. Annual mean mantle length from each 2-week period of September for males (above) and females (below) by inshore sampling site (Ho= Holyrood, NB= New Bonaventure, LaS= LaScie, JA= Jackon's Arm, Tw= Twillingate).

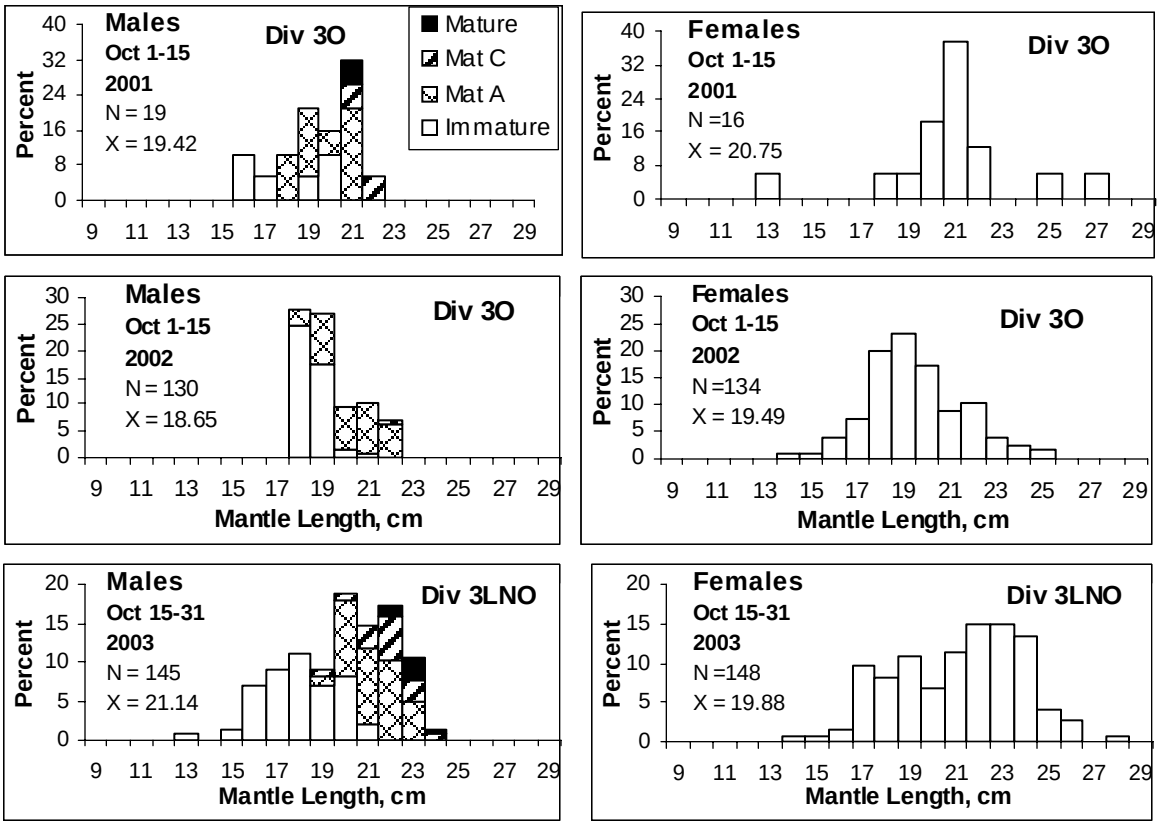

Fig. 6. Mantle length frequency distributions for males, with maturity stages overlain (left), and for females (right), for biweekly periods of October, from fall bottom trawl surveys in NAFO Div. 3LNO during 2001-2003.