The biology of *Jaera* spp. (Crustacea, Isopoda) in the northwestern Atlantic. 1. *Jaera ischiosetosa*[1,2]

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Oogonia of female *Jaera ischiosetosa* begin to enlarge in April and the first hatched young appear in June. Reproduction continues until August. From September to March the females lack oostegites and are in a resting stage. Females do not produce continuous broods during the season, but lose their oostegites after every brood. Individuals survive for 1 year at the most. In August the population consists almost entirely of young of the year, some of which may breed in the same year. Egg size is small and the fecundity relatively high.

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Chez les femelles de *Jaera ischiosetosa*, les oogonies commencent à croître en avril, et en juin les oeufs se mettent à éclore. La saison de la reproduction se poursuit jusqu'en août. De septembre à mars, les femelles sont dépourvues d'oostégites et traversent une période de repos. Elles ne produisent pas leurs petits de façon continue durant la saison, mais perdent leurs oostégites après chaque portée. La durée maximale de survie est d'un an. En août, la population se compose presqu'entièrement de jeunes de l'année; certains d'entre eux se reproduisent même avant la fin de l'été. Les oeufs sont petits et le taux de fécondité relativement élevé.

Introduction

Some aspects of the biology of a population of *Jaera ischiosetosa* from the northwestern Atlantic were studied from 1968 to 1971 as part of a larger comparative study of the species of this genus.

Isopods of the genus *Jaera* are abundant under rocks and algae in the intertidal zone in the northwestern Atlantic. They have usually been identified as either *Jaera marina* or *Jaera albifrons* and considered to be identical by Bate and Westwood (1868) who listed them as *Jaera albifrons*. In the past 30 years, however, this species was shown to be composed of a number of forms designated as races and subspecies by Forsman (1944, 1949), and species of a superspecies of *Jaera marina* by Bocquet (1953), who employed a trinomial nomenclature. Naylor and Haahtela (1966), however, concluded they were sympatric species and recommended the use of the binomial system, and this practice is followed here. The species are known as *Jaera albifrons*,[3] *ischiosetosa, praehirsuta, posthirsuta, forsmani,* and *syei*. *Jaera syei* is considered by some investigators to be only a subspecies of *J. albifrons* (Harvey and Naylor 1968). All six have been reported from eastern North America by Bocquet and Prunus (1963).

Materials and Methods

The population of *Jaera ischiosetosa* studied inhabits the area inside the cobble bar at the mouth of the brook in the south arm at Holyrood, Conception Bay. It was collected together with *Gammarus duebeni* and the remarks pertaining to the collections of that species (Steele and Steele 1969) also apply to *Jaera ischiosetosa*. The collections analyzed here were made between November 1967 and October 1968, with additional ones in July 1966 and May–June 1970.

Only males can be distinguished with certainty as to species, but since males of *Jaera ischiosetosa* only have been collected inside the bar at Holyrood, it is assumed that all of the females collected there were of this species.

Specimens were measured, to the nearest 0.1 mm using an eyepiece micrometer, from the anterior edge of the head to the distal end of the telson. Sex was determined

TABLE 1
Jaera ischiosetosa: size classes of oogonia and oocytes

Class	Mean size range, mm	Description
1 (oogonia)	0.079	Colorless
2 (oocytes)	0.080–0.159	Colorless
3 (oocytes)	0.160–0.239	Greenish
4 (oocytes)	0.240–	Light green

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[2]Contribution No. 96 from the Marine Sciences Research Laboratory.

[3]Assuming Bate and Westwood (1868) were correct, the designation *Jaera marina* should have priority, but modern usage employs *Jaera albifrons* almost entirely.

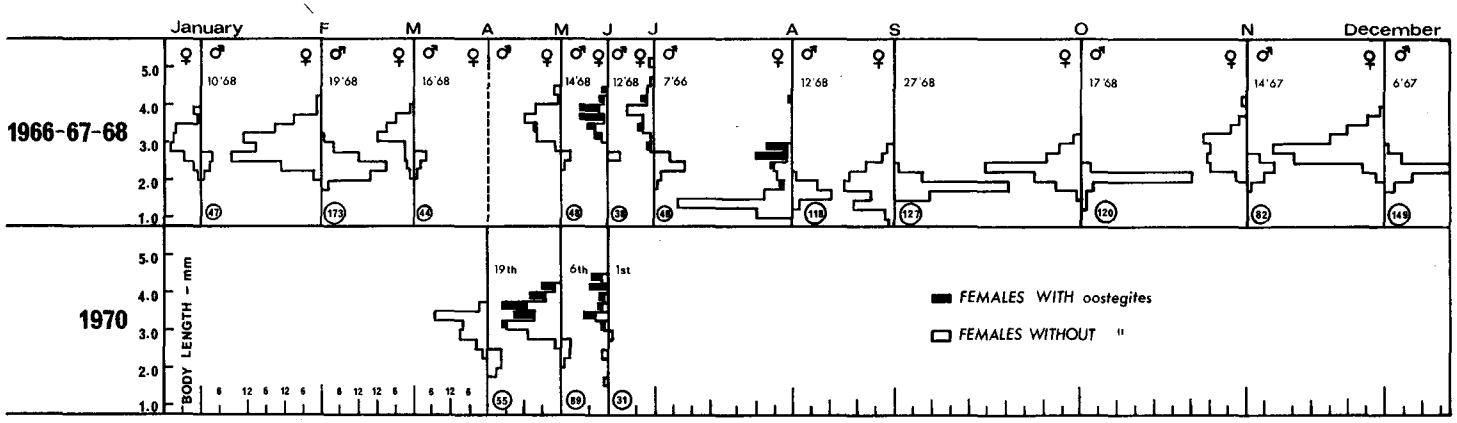


FIG. 1. Size compositions of *Jaera ischiosetosa* collections. The numbers of specimens examined are shown in circles.

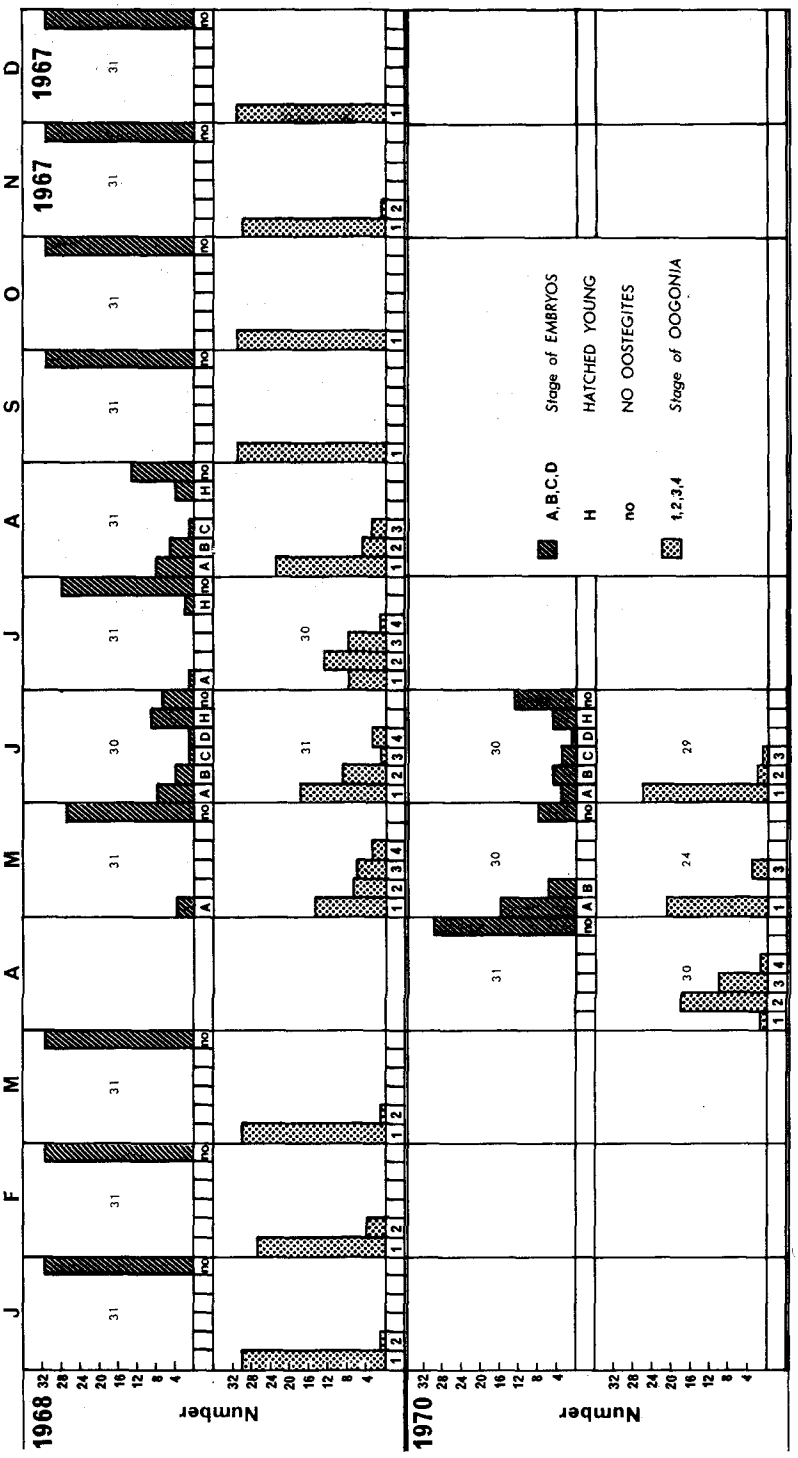


FIG. 2. Stages of the *Jaera ischioselosa* embryos and oogonia. The numbers examined are shown with the oogonia.

by the shape of the operculum (Haahtela 1965). The females were further classified according to the presence or absence of oostegites and the stage of the embryos in the brood pouch. The stage of the embryos was determined according to the criteria in Fig. 4. The ovaries were then removed and the oocytes classed by size according to the scale of Table 1. Those in which the oogonia were too small to be seen with a dissecting microscope were placed in class 1.

Results

Size at Maturity

Because of the fact that in each sample there were always some females without oostegites, often of large size, it was impossible to determine the onset of maturity from field collections alone. However, since the smallest ovigerous females were 2.0 mm in length, it has been assumed that females of this size and larger were mature in the subsequent analysis.

Embryonic Development

The sizes of the embryos were determined by measuring the dimensions (length + width/2) of 20 stage A embryos collected in July and preserved in 5% formalin. The mean size of the sample was calculated to be 0.254 mm (range = 0.230–0.270, S.E. = 0.002). The living embryos were of similar size (Fig. 4).

Embryonic development has been described by MacMurrich (1895) and Forsman (1944). The stages used in this study are illustrated and briefly described in Fig. 4. The embryos increase in size until hatching.

The newly hatched individual retains a large amount of yolk and while it flexes and straightens its body it is apparently incapable of locomotion. It undergoes one molt in the brood pouch. At this time the yolk is largely resorbed but still present in small amounts. Although it is now highly mobile and active it still lacks the last pair of legs and for this reason was termed a 'mancas-tadium' by Forsman (1944).

Life Cycle and Reproductive Cycle of the Female

The size compositions of the collections and the reproductive stages of the females are given in Figs. 1 and 2, respectively. From these and

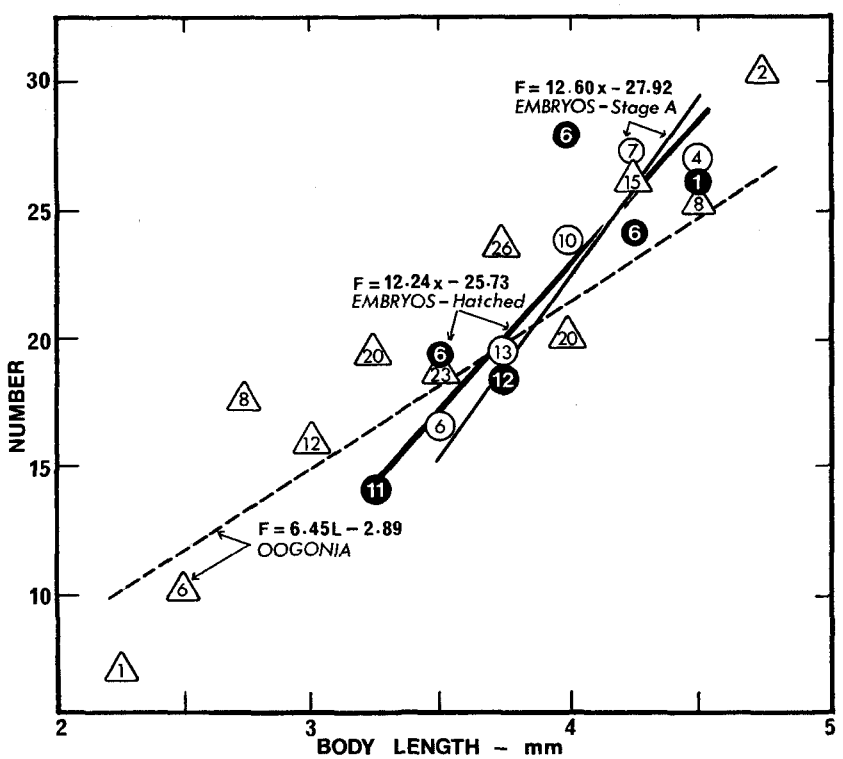
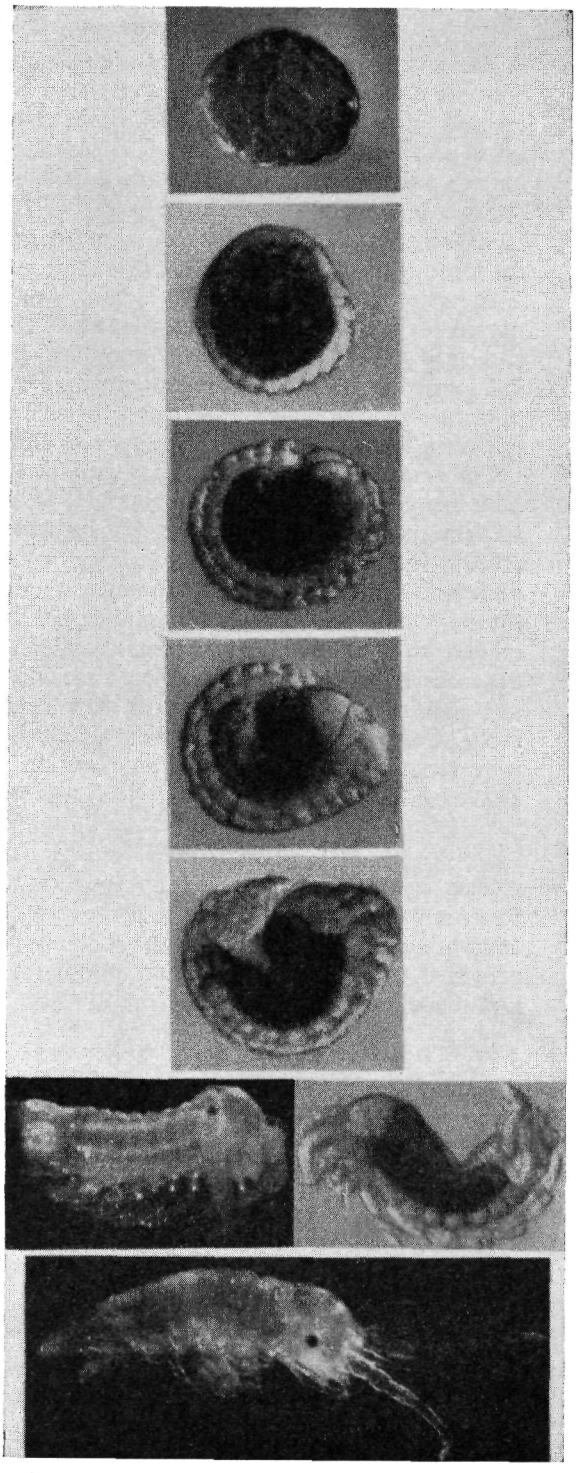


FIG. 3. Numbers of oogonia and embryos per female.



Stage	Mean size, mm	Range	S.E.	No.	Description
A	0.259	0.240–0.270	0.002	20	First cleavage stages and early development
B	0.308	0.250–0.380	0.006	23	Green yolk internal, rudiments of appendages at periphery
C	0.344	0.323–0.380	0.005	12	Body in the form of a 'C.' Head visible
D	0.340	0.314–0.380	0.003	10	Head well developed. Tail reaches front of head
					Tip of telson overlaps head. Eye visible
H_1	0.584	0.561–0.591	0.005	18	Embryo hatches. It contracts but is unable to walk. Yolk prominent
H_2	0.780	0.759–0.825	0.004	10	Young molts and is now very mobile. A small amount of yolk is still visible. This is the 'mancastadium' of Forsman (1944)

FIG. 4. *Jaera ischiosetosa*: stages and sizes of living embryos.

laboratory observations it is possible to determine the major features of the reproductive cycle.

The oogonia of the females begin to enlarge in April but embryos are not found in the brood pouch until May and do not hatch until June. Breeding continues until August and some of the larger young of the year produce a brood at this time. However, in September the oogonia are small and the females have all lost their oostegites and are in the resting stage, which continues until the following April when the cycle begins again.

Some females (2 mm) lack oostegites and have small oogonia and therefore are classed as being in the resting stage even in the summer months. Laboratory observations of individual females revealed that each female does not produce successive broods. Instead the oogonia fail to enlarge when the brood is developing in the brood pouch and the female loses her oostegites in the subsequent molt. Later the oogonia may enlarge and in the subsequent molt the female regains her oostegites and another brood of embryos is deposited in the brood pouch.

Individuals survive at the most for 1 year. After breeding in the spring and summer the adults disappear, so that in August the population consists almost entirely of young animals. This serves as the breeding population of the following spring.

Males are always less abundant than females in the collections and this is particularly true in the spring and summer months, suggesting that they die before the females. The females store sperm in receptacles and do not need to mate before every brood. Thus the presence of males is not necessary for reproduction in the summer months. Precopula behavior was observed infrequently.

Fecundity

The numbers of enlarged oogonia, stage A embryos, and hatched embryos were counted and regression lines fitted by least squares (Fig. 3). The line for the oogonia has been shifted 0.5 mm to the right to account for the increase in size of the females when the brood is released. The regression lines of the embryos have steeper slopes than those of the oogonia but this is probably due to the smaller size ranges and smaller numbers analyzed.

Summary and Discussion

Jaera ischiosetosa is a relatively small animal with small eggs and many of its characteristics are related to these properties. Its rapid embryonic development (unpublished observations) and growth to a small size at maturity enable it to ripen its gonads as late as the spring, but still have the eggs hatch and the young mature and for some of them to breed before the next winter.

A somewhat longer breeding season was reported for the Baltic region by Forsman (1944) and Jazdzewski (1969), but this may have been due to the fact that their samples contained more than one species. *Jaera albifrons* is reported to breed throughout the year by Naylor *et al.* (1961).

The occurrence of the resting stage following each brood is mentioned by Forsman (1944) and is demonstrated in the figures of Jazdzewski (1969). This stage is apparently obligatory and therefore comparable to that of *Gammarus setosus* (Steele 1967). The small size of the eggs is correlated with a relatively high fecundity, although the embryos hatch in an incomplete state and do not acquire the adult form until after several molts. Somewhat smaller numbers of embryos were reported for females of *Jaera* spp. in the Baltic by Jazdzewski (1969).

Acknowledgments

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