THE LIFE CYCLE OF OITHONA NANA, REARED EXPERIMENTALLY

BY

HELEN E. MURPHY

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(Contribution from the Scripps Institution for Biological Research)

CONTENTS

I. INTRODUCTION

An examination of a series of surface collections of zooplankton made at the pier of the Scripps Institution, La Jolla, California, indicates that *Oithona nana* is numerically the dominant Copepod throughout the year. The possibility that this is a hardy species, together with the fact that no single specimen of marine copepod has been bred through the successive stages from egg to adult, led to rearing experiments, the results of which are summarized in the present paper.

II. REARING EXPERIMENTS

Rearing jars.—Flat-bottomed glass stender dishes 60 mm. in diameter and 30 mm. high were used as rearing jars. These proved to be large enough for proper growth of the specimens, and were easily oriented on the stage of the binocular microscope. Unnecessary handling of specimens was thus eliminated. The containers were two-thirds filled with unfiltered ocean water and placed in indirect north light. Except for a slight addition to compensate for evaporation, the water was unchanged during the entire experiments. Fungus growth was controlled by increasing the intensity of light. Strong light caused the specimens to become very agitated. To prevent this, a portion of the jar was always kept shaded. A piece of fresh kelp about 1 mm. square was added to each jar and allowed to remain for

a week. Then it was removed, and a fresh bit added. There was a fair growth of the diatom of the genus *Navicula* throughout the experiment, as well as of small Protozoa, in the aquaria.

Food.—Several specimens of *Oithona nana* collected at 8 A.M. showed yellowish brown organic débris, similar in color to kelp, in the stomach. A few pieces of the diatom *Thallasiothrix* were found. In two cases bits of copepod nauplii were recognizable.

In the laboratory, adult specimens ate freely of the small bits of fresh and decaying kelp, and also fed somewhat—though far less than of the kelp, on the diatom *Navicula.* Nauplii began eating this kelp almost as soon as hatched.

TABLE 1

SUMMARY OF RESULTS OF REARING EXPERIMENTS, OITHONA NANA, IN 60 MM. STENDER DISHES, UNFILTERED OCEAN WATER

Exp. A 1♀ with eggs	Exp. B 1♀ 1♂	Exp. C 1♀ with spermatophores	Exp. D 1♀ 1♂	Exp. E 1♀ 1♂	Week
Eggs thrown off	Eggs	Eggs	dead	Eggs	1
					2
		11 Nauplii	dead		3
No results	18 Nauplii		No results	18 Nauplii	4
					5
					6
		9 Copepodid I			7
	11 Copepodid I			8 Copepodid I	8
					9
					10
		3♀ 4♂			11
	6♀ 3♂			3♀ 2♂	12

Material.—Specimens sorted from the 8 A.M. surface collection at the pier were left in a large finger bowl of ocean water for twenty-four hours. Individuals in good condition were then transferred by means of a capillary pipette to rearing jars that had been previously prepared.

Each specimen was examined daily in the stender dish under a binocular microscope, and the results recorded. As soon as hatched, the nauplii were transferred to separate jars. After each molt the cast skin was removed, measured, and put into a vial with corresponding number. In this manner a complete record was kept of each specimen.

Table 1 is a summary of the results of the rearing experiments with *Oithona nana,* first cycle.

A second cycle was then started from reared adults. Two females, B7 and B9, were transferred to a finger bowl with two males, E7 and E13 (table 1). Eight days later one female was carrying egg masses. From these, nine nauplii hatched, and two females and two males reached maturity. The life cycle from adult to adult was completed in ten weeks.

III. STAGES OF DEVELOPMENT

The eggs of *Oithona nana* are carried by the female in two sacs until the nauplii hatch. The number of eggs to a mass ranges from 5 to 11. In experimental jars the nauplii appeared in 11 to 18 days.

TABLE 2

SUMMARY OF LENGTH OF STAGES AND BODY LENGTH, OITHONA NANA, REARED SPECIMENS

	Stage	Av. Length, Days	Average length body	
			♀ mm.	♂ mm.
Nauplius	1	1	0.04	0.04
	2	4	0.075	0.075
	3	6	0.097	0.09
	4	4	0.12	0.11
	5	5	0.15	0.13
	6	6	0.19	0.15
Copepodid	1	5	0.20	0.19
	2	6	0.32	0.26
	3	5	0.38	0.34
	4	6	0.48	0.40
	5	6	0.52	0.45
Adult		(54 total)	0.55	0.48

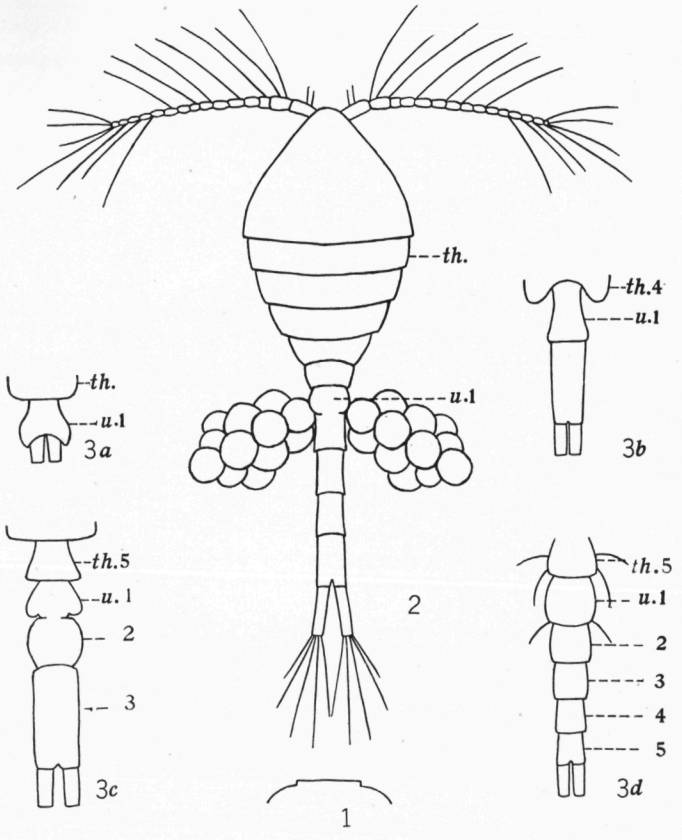
There are six naupliar, and five copepodid, stages before the animal is fully formed. The complete number was recorded for 12 females and 9 males, as shown in table 1.

Table 2 is a summary of the average length in days of each stage, and of the average body length for each stage of the males and females reared to maturity.

From this table it is clear that the difference in size between male and female is evident as early as naupliar stage 3. The adult measurements of the reared specimens are within the limits of the species as stated by Giesbrecht (0.5–0.65 mm.; 0.48–0.57 m.), though somewhat smaller than those of specimens taken from the pier collections.

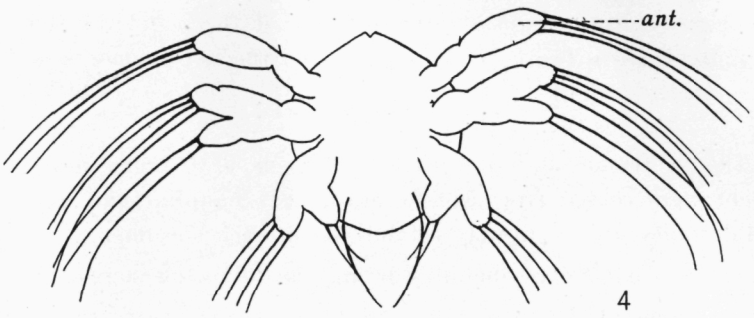
The square-cut front of the head of the male (fig. 1) as opposed to the bluntly rounded head of the female (fig. 2), is recognizable at

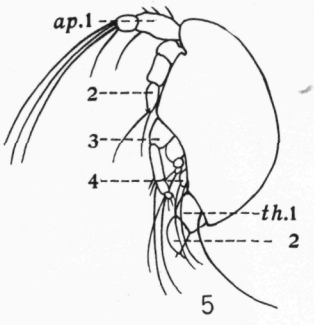
naupliar stage 3. Segments one and two of the female urosome are partially fused. The constriction between the two segments is, however, clearly visible.



Figs. 1–3, camera lucida drawings. Abbreviations: *th.*, thorax; *u.*, urosome. Fig. 1, front of head, male, × 250. Fig. 2, adult female, dorsal aspect, × 125. Fig. 3, Thorax and urosome in part, dorsal aspect: *a*, copepodid stage 1, male, × 250; *b*, copepodid stage 2, male, × 212; *c*, copepodid stage 3, female, × 212; *d*, adult, male, × 150.

A minute examination of specimens reveals differences in the segments of the appendages and number of bristles in the various stages, as well as in the more obvious characters of segmentation, and number of appendages. The following key summarizes the general diagnostic characters for the immature stages of this species, which are clearly evident in an enumeration of zooplankton organisms.





Figs. 4–5, camera lucida drawings. Abbreviations: *ant.*, anterior antenna; *ap.*, appendage. Fig. 4, nauplius stage 1, ventral aspect, × 700. Fig. 5, nauplius stage 5, lateral aspect, × 212.

KEY TO GENERAL DIAGNOSTIC CHARACTERS, IMMATURE STAGES, OITHONA NANA

A_1. Urosome present (fig. 2) ..... COPEPODID
- b_1. Urosome of 1 segment; 3 thoracic segments (fig. 3*a*) ..... Stage 1
- b_2. Urosome of 2 segments (partially fused in ♀, fig. 2); 4 thoracic segments (fig. 3*b*) ..... Stage 2
- b_3. Urosome of 3 segments; 5 thoracic segments (fig. 3*c*) ..... Stage 3
- b_4. Urosome of 4 segments ..... Stage 4
- b_5. Urosome of 5 segments.
  - c_1. Anterior antennae reaching to anterior margin of third thoracic segment ..... Stage 5
  - c_2. Anterior antennae reaching to posterior margin of third thoracic segment (fig. 2) ..... Adult

A_2. Urosome absent (figs. 4, 5) ..... NAUPLIS
- b_1. Body segmented.
  - c_1. Body with 3 pair of appendages ..... Stage 3
  - c_2. Body with 4 pair of appendages.
    - d_1. Thorax of 1 segment ..... Stage 4
    - d_2. Thorax of 2 segments (fig. 5) ..... Stage 5
  - c_3. Body with 6 pair of appendages, 3 thoracic segments ..... Stage 6
- b_2. Body not segmented.
  - c_1. Anterior antenna with 3 bristles on distal segment (fig. 4 ant.) ..... Stage 1
  - c_2. Anterior antenna with 4 bristles on distal segment ..... Stage 2

IV. CONCLUSION

Twelve female and nine male specimens of *Oithona nana* Giesbrecht were reared from egg to adult. Six naupliar and five copepodid stages were definitely established in each specimen.

These rearing experiments warrant the following suggestions:

(1) Some of the hardier marine copepods may be reared without expensive apparatus and methods.

(2) Accurate record may be kept of single individuals.

(3) Results may be given in form available for practical use in enumeration of the zooplankton.

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