LIFE CYCLE OF *CYAMUS SCAMMONI* (AMPHIPODA: CYAMIDAE), ECTOPARASITE OF GRAY WHALE, WITH A REMARK ON THE ASSOCIATED SPECIES

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ABSTRACT

Cyamus scammoni, parasitic exclusively on gray whale, was studied under the provision of special scientific permit. Its life cycle was completed during the journey of winter migration. *C. ceti* and *C. kessleri*, messmates of *C. scammoni*, followed the same pattern in many respects. Significantly, the whale-lice can survive out of water for several days though other amphipods are poorly adapted for terrestrial life. The cyamid causes certain damage to the cutaneous tissue of the host when the juvenile begins its livelihood.

INTRODUCTION

The whale-louse, ectoparasite of mysticete and odontocete, has been recognized ever since *Oniscus ceti* of the bowhead whale recorded by Linnaeus in 1758. Although scores of papers on taxonomy have elaborately been published, yet many facets are still unexplored. This accounts for the fact that systematic investigation is not always feasible, not only because the population of the whale species is widely distributed in different hemispheres, but the cyamids are often discarded by the commercial whalers. Moreover, the whales are legally protected so that collecting is no longer available.

The gray whale, *Eschrichtius robustus*, summers in Chukchi, Beaufort, and western Bering Seas for food, and in winter it migrates along the Californian coast to the lagoons of Baja California, Mexico, for breeding and calving. As the herd travels along a defined course in definite seasons, the life cycle of the cyamid may well be traced through a successive survey during the entire journey. Under the provision of the specific scientific permit, the author was privileged to participate the whaling expedition on several occasions, and visited the shore station at intervals to collect series of samples of which the accumative data were of significance to make this study possible.

MATERIAL AND METHOD

This study was based on series of *Cyamus scammoni* and the associated species, *C. ceti* and *C. kessleri*, taken aboard the catcher boat off central Cali-

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fornia during 1966–1967 season, and in the shore station at Pt. San Pablo, California in 1963–1964 and 1968–1969 seasons. Included were both individuals migrating southward and homeward bound in the months of December to April. It also covered the material collected at Pt. Barrow, Alaska in the summer months of 1954, 1959 and 1961 (Leung 1965).

Some 85 males, 200 ovigerous females, and 250 juveniles were studied, of which the total length of each stage, and the number of eggs and young in the ovary and brood-pouch were recorded. The stage of development was examined from some 4000 individuals taken at Pt. Barrow, and the living specimens were studied at sea and at the shore station.

LIFE HISTORY

Cyamus scammoni (Fig. 1) is the largest species of the family as the male is ranging up to 27 mm, and the female to 16 mm. Its double cock-screw gills and the unevenly purple coloration on the dorsal somites constitute unique features of the species. The development, alike other amphipods, is direct. The brood was apparently full-grown in summer before migrating southwards, and mating began when it reached sexual maturity (Fig. 2). An ovigerous female carried a clutch of 980–1078 eggs in the brood-pouch, and the eggs, spherical, creamy white, measuring 325–420 μ, were fertilized when the whale

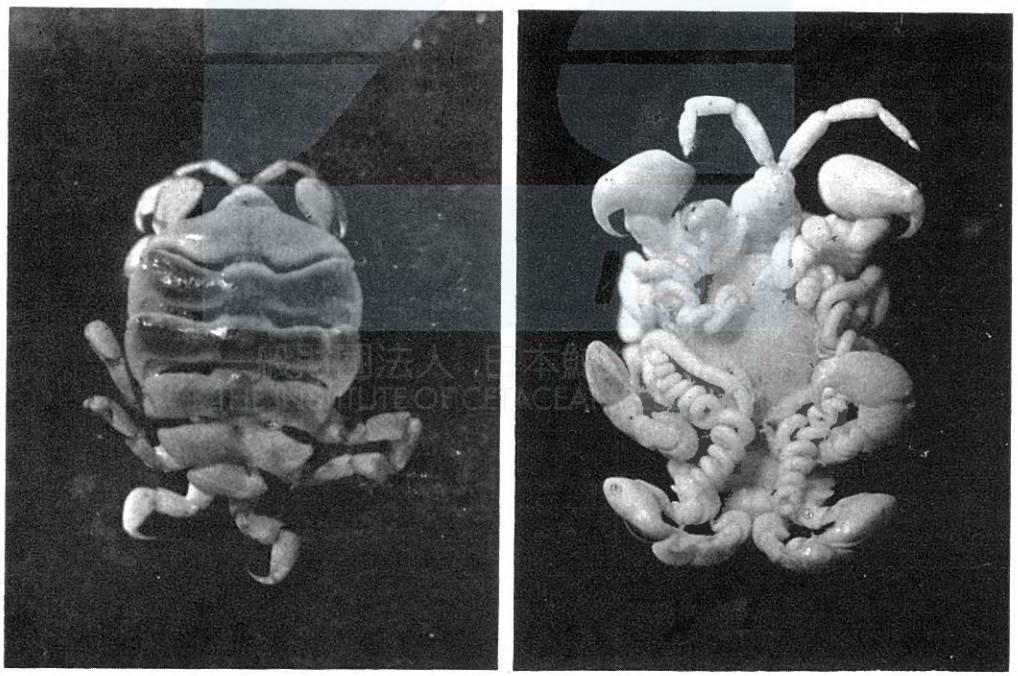

Fig. 1. *Cyamus scammoni* Dall, male, dorsal view (left) ×6; female, ventral view (right) ×10.

Fig. 2. *C. ceti*, mating on side of the jaw of the host. ×10

arrived in central California in October. Although the female carried a considerable number of eggs in a clutch, only 450–760 (about 60%) were fertilized. The young, measuring about 0.5 mm, resembled the parent except that the gills, instead of double and spirally coiled, were single and knobshaped, and there was no trace of genital appendages in both male and female (Fig. 3). Being not a free-swimming amphipod, the vulnerable young retained in the brood-pouch for two to three months until it reached the stage of miniature adult. Those arriving in December and January the juveniles had been released from the brood-pouch to maintain life independently. The free juvenile, measuring 1.0–1.5 mm, fastened itself with peavey hook-like ungulae in the soft skin tissue of the belly of the host (Fig. 4 and 5), or shielded itself in the scar or orifice of the endemic cirriped (*Cryptolepas rachianecti*) along both jaws of the whale. Subsequently, the young was able to cover itself for protection against the turbulent current (Fig. 6). After remaining in the recess of the corium of the host and crevice of the cirriped for some time, the juvenile began to set foot on the cuticle of the host with its strong peraeopoded claws. At this stage, the knob-shaped gills began to expand and curve in, and bifurcate when the young attained 4 mm in length; at full growth the number of coils of the second branch was almost double the number of the first one. When the individual measured about 6 mm, the oostegites of the female projected inwardly on the gill-bearing somites (3rd and 4th body segments), and the purple coloration of both male and female appeared gradually on the dorsum. In February when the host was returning to the habitat from the south, the miniature male adult attained 8–10 mm, and the female from 6–8 mm; the male accessory gills (absent in female) and the genital appendages began to appear; the paired

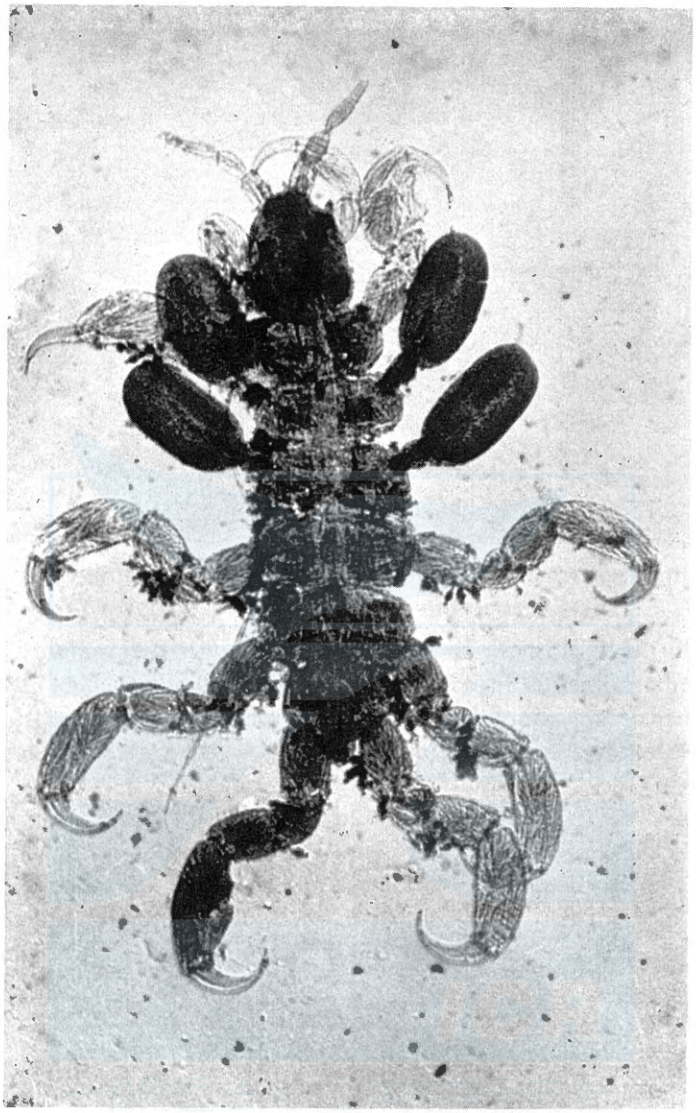

Fig. 3. Micrograph of a juvenile *C. scammoni*, ventral view, showing the knob-shaped gills before bifurcating. ×45. Note the unnamed chonotrichous ciliates infesting the ventral surface of the body.

genital valves on the 5th somite of the female could be traced. In March most of the individuals reached maturity measuring 14–18 mm in male, and 10–12 mm in female; the gills, accessory gills and the genital appendages of the male were fully developed; whereas the oostegites of the female had shaped to form a brood-pouch, of which the posterior plates extended over the anterior ones. The elaborate overlapping arrangement of the oostegites sheltered the eggs and the young in the brood-pouch throughout the incubation period, but

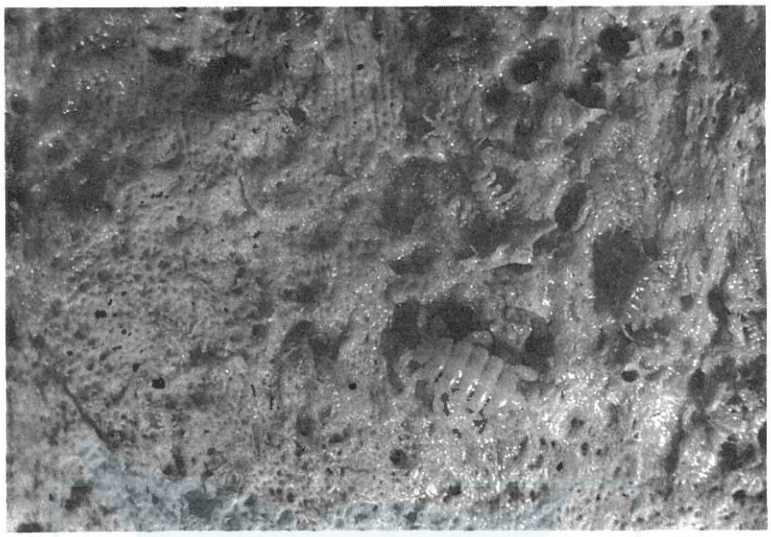

Fig. 4. Young *C. scammoni* boring holes on the belly of the host. ×25.

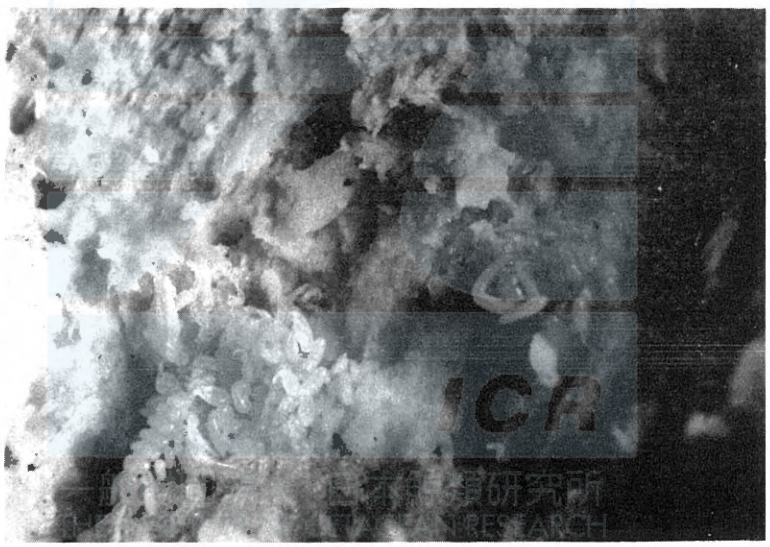

Fig. 5. The outermost skin tissue heavily damaged by young *C. scammoni* ×25

it was automatically opened when the young was full-grown. A female might deposit 350–380 eggs in the brood-pouch homewards, and the number would increase to its full capacity after some time. Finally, the brood was fully developed upon the arrival of the whale in the summer habitat, and it was estimated that it underwent eight to nine months to complete the life cycle.

C. scammoni was the counterpart of its messmates, *C. ceti* and *C. kessleri*, but the last matured more earlier since the eggs were hatched before the

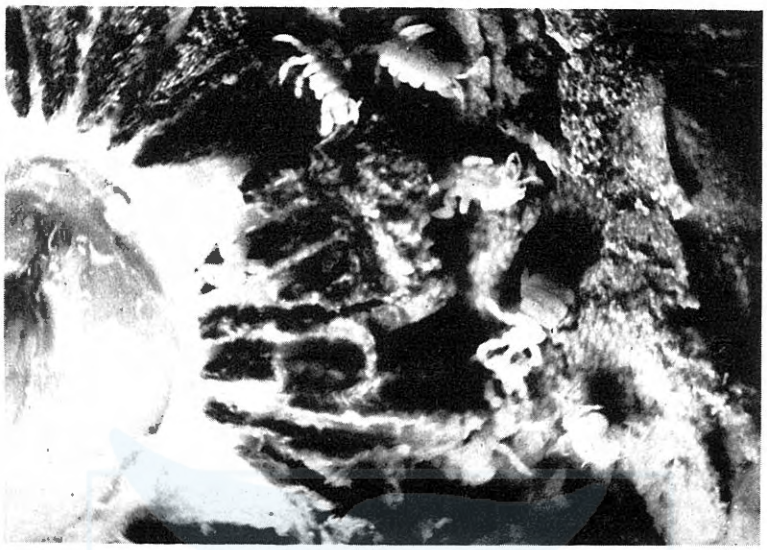

Fig. 6. Juveniles embedding in the clefts of the endemic cirripeds on the side of the lower jaw. ×25.

seasonal migration began. Of 3921 *C. kessleri* taken at Pt. Barrow in July and August, 3534 were juveniles, only 387 adults. When the host migrated southward passing central California in mid January, some of the females had already been depositing eggs in the brood-pouch. During the course of returning northward in late March, the new generation attained full maturity as among 58 females examined, 25 were carrying eggs, 18 with juveniles in the brood-pouch, and 15 having released their young. An ovigerous *C. kessleri* carried 215–300 eggs, only 150–260 (about 75–80%) were fertilized, whereas *C. ceti* carried 154–242 embryos, but 131–146 (about 70–75%) were fertilized. Obviously, the number of embryos produced is varied according to the species and the size of the female.

There is speculation as to the number of instars of *C. scammoni* and the associated species as the number of ecdysis is untraceable. However, it seems likely that there may be at least seven or eight stages as far as the range of size and the development of the morphological structures are concerned. Furthermore, it is probable that the cycle overlaps by reason that some juveniles are always present on each colony.

GENERAL CONSIDERATION

Despite the cyamid belongs to the same group with the caprellid (Caprellidea), it has diverged from the general plan to a great extent inasmuch as the modified structure of the peraeopods and the possession of accessory gills are extraordinary in amphipod. Possessing these unique structures, the whale-louse is, so far as is known, the only true parasitic form among the amphipods. The

cyamids, particularly those of infesting larger mysticetes, have rigid host specificity and site restrictiveness (Leung 1970a) as *C. scammoni* occurs habitually either on the delicate skin tissue of the belly or on the scar of the endemic cirriped along both jaws of the whale; *C. ceti*, being received at the same table occasionally with *C. scammoni*, is found generally on the creases of the lips, flippers and flukes; whereas *C. kessleri* localizes only on the umbilicus, genital opening and anal aperture of the host. During the whaling seasons, nine whales had been inspected aboard the catcher boat and in the shore station, and all animals were heavily infested with cyamids of different stages. Among the three species, *C. scammoni* exceedingly predominated over the other two.

The cyamids breathe by means of gills, however, it is remarkable that they are able to exist beyond the environmental condition. At the shore station it was not uncommon to see the whale-lice crawling for many hours after the whale drawn from the sea. While cruising on the catcher boat, it was curious to observe three individuals of *C. scammoni* reposing on a steel cable of the winch in the late afternoon as no whale was taken during the day. Obviously, these individuals had survived from the catch of the previous day. Further surprising evidence was afforded by G. J. B. Ross of the Snake Parks and Oceanarium of S. Africa (per. comm.) who reported that the cyamids could outlive for three days on a stranded south right whale at Algoa Bay in 1971. Integumentary respiration of the whale-lice is of considerable significance, because they were able to survive for several days divorced from the aquatic environment even though the amphipods are poorly adapted for terrestrial life.

The mouth parts of the cyamid are for piercing. There is some likelihood that whale-lice are omnivorous feeding on the algal filaments and the outermost layer of skin tissue of the host. However, the bill of fare seems to be the cutaneous tissue of the host as the young customarily encases itself by piercing the delicate skin tissue or embedding itself in the cleavages of the sessile cirriped when it begins to maintain its livelihood. Since the host provides favorable sites and adequate food supplies, opportunity of building up large population is eminent. On the other hand, the small streamlined odontocete furnishes neither adequate accommodation nor profuse provisions, and the survival rate is therefore in a reverse direction (Leung 1970b).

Three species of cyamids occur on the gray whale. With the exception of *C. scammoni*, the systematic status of *C. kessleri* and *C. ceti* have long been bewildered. Although *C. kessleri* was recorded by E. Wosnessensky in 1864 at Metschigmensky in the vicinity of the Bering Strait, yet the host had not been identified. It did not come to light until 1954 when Mohr (Hurley and Mohr 1957) collected a few hundred individuals of this species from a gray whale killed by the Eskimos off Pt. Barrow, Alaska, and the host proper was finally justified. *C. ceti* was described from the bowhead or the Greenland right whale, but the association with the gray whale is poorly known. Since the bowhead and the gray whale inhabit in Arctic waters, the possibility of

accidental transfer by bodily contact is not unlikely to happen. However, it is seemingly not the case as our colleague, Dr. F. E. Durham, a bowhead biologist, reported that he found neither *C. scammoni* nor *C. kessleri* but *C. ceti* on the bowhead (per. comm.). For this reason, the likelihood of interchange seems unlikely. Virtually, *C. ceti* is akin to *C. monodontis* of the narwhal which Lutken (1873) described it as a "peculiar dwarf-form" of *C. ceti.* In view of *C. ceti* of the gray whale, there is reason to speculate that it may fall within the original description from the bowhead, and a concept of specific independent species has been conceived. Consequently, both species should be thoroughly reviewed.

There are various unnamed species of chonotrichous ciliates (Chonotricha) infesting the ventral surface of the young cyamids (Fig. 4). It is of interest that these collar ciliates, alike the cyamids, demonstrate an extraordinary mode of parasitism that shares on other congeners to occupy the same community, and the occurrence of interchange is uncommon even though the messmates are colonized at the adjoining locality. Accordingly, it is suggested that it may be a contributing factor to identify the whale-lice and the cetaceans in the presence of the ciliates.

Finally, the whale-lice cause certain damage to the whale skin when the young begin to maintain their livelihood, and the injury is a result of piercing the tissue in which they shelter for safety and for food. As a matter of fact, the outermost layer of whale skin is extremely thin and delicate in structure, hence it is no wonder that the unwelcome guests frequent these haunts for living.

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