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Resting Stage in the Reproductive Cycles of *Gammarus*

WHEN mature, a female *Gammarus* has long oostegites fringed with setae which lock together to form a brood pouch where the fertilized eggs are incubated. The development of the setae coincides with the enlargement of oogonia and is presumably dependent on hormonal control. The setose oostegites may persist through several consecutive moults, provided a new brood is produced each time. If the development of oogonia is stopped either by removal of the ovary or by some external physical factor, the oostegite setae are lost at the next moult and the female is said to have entered a resting stage. The reappearance of the setae may be brought about by the subsequent enlargement of the oogonia[1,2]. It is apparent that the resting stage is a mechanism by which the reproductive cycle may be regulated.

During the past few years this mechanism has been studied in several marine amphipods of the intertidal region (*Gammarus duebeni*, *G. oceanicus*, *G. setosus* and *Marinogammarus obtusatus*) both in the field and in the laboratory. More detailed accounts of the reproductive cycles and their relationship to environmental factors will be published elsewhere. The present note discusses only the variations in the resting cycle mechanism in these species and their probable adaptive qualities.

Gammarus duebeni and *Marinogammarus obtusatus* are boreal Atlantic species found up to the north-eastern coast of Newfoundland. *G. oceanicus* extends farther north to Baffin Island but is confined to the Atlantic region. All three species begin to breed in the autumn and release the first brood in late winter or spring and the subsequent broods during the spring until the summer. In August the mature females, if they survive, stop breeding and enter the resting stage. This occurs after a variable number of broods in each individual, and because it takes place in different latitudes at approximately the same time it may be largely independent of temperature. Moreover, *G. oceanicus* maintained at constant temperatures of 3° and 13° C has a resting stage at the proper season. Prolonged exposure to temperatures above 13° C may initiate a resting stage, because oogonia and embryos fail to develop at 15° C in the laboratory. Few survive at 15° C, but the mature females will go into resting stage. It is quite probable that the resting stage in these species is normally induced by some environmental variable other than temperature. The effect of photoperiod is thought to be important and is being studied at present.

Gammarus setosus is a northern species, circumpolar in distribution and recorded from the northern limits of land (Ellesmere Island) south to the Gulf of Maine. It also begins to breed in the autumn, but, unlike the species already mentioned, each brood is followed by a resting stage which can be regarded as obligatory. In the laboratory this resting stage occurred whether the animals were maintained at 3° or 13° C and thus proved to be independent of temperature. At 3° C (which equals or exceeds the normal mean temperature which the species experiences in its northern range), months elapsed between successive broods. Collections of animals from high latitudes confirm that a single brood is produced each year in the north. At 13° C at least two cycles occurred in a single year, but it is not clear as yet whether this is true for southern populations living at temperatures comparable with an annual mean of 13° C.

While *Gammarus* species are not specialized feeders and consume living and dead plant and animal food, recent observations in Newfoundland suggest that the young benefit from a diet containing filamentous algae, which first appear during February and persist until August–September with a peak of development in late June.

The cycle shown by *G. oceanicus*, *G. duebeni* and *M. obtusatus* appears to be adapted to such conditions. Young are released in the spring and summer when food is available in large amounts, but stop in the autumn and winter when food in the form of filamentous algae is largely absent. The production of sequential broods can take advantage of the relatively long period of food availability.

Gammarus setosus, although it is similar in commencing the reproductive season during the autumn and releasing the majority of the young during the spring, would be at a disadvantage under the same conditions because of its obligatory resting stage which limits its productivity during the summer months. If, however, the production of ephemeral fine algae is more seasonally restricted at higher latitudes, the production of a single brood may be of advantage if it can be timed more precisely. This may explain at least in part the success of *G. setosus* in the Arctic.

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Association of Folin-positive Material with the Blood Proteins of the American Cockroach and the Oviposition Cycle

THE synthesis of blood proteins in the female adult *Periplaneta americana* has been described in relation to the ovarian cycle and its control by hormones[1]. Much of the interpretation rests on measurements of blood protein by the method of Lowry *et al.*[2], which suggest the existence of cyclical changes in the concentration of blood proteins. The purpose of the present communication is to show that these changes are probably artefacts, and to make it more widely known that this method for chemical estimation may be generally unsuited to the measurement of insect blood proteins.

The animals used in the present experiments had the following physiological properties: the mean time interval between the deposition of successive oothecae was 3·0 days, but each batch of oocytes spent 5·5 days in the state of active vitellogenesis, so that the ovarian cycles overlapped and growing oocytes were always present in the ovaries. By contrast, Mills *et al.*[1] report that their animals had a simple ovarian cycle lasting 6 days, with