

NOTE

Cyclic occurrence of gregarine trophozoites (Apicomplexa) in the burrowing echinoid *Echinocardium cordatum* (Echinodermata, Spatangoidea)

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ABSTRACT: The occurrence of the gregarine *Urospora neapolitana* in the spatangoid echinoid *Echinocardium cordatum* was followed monthly over a 1 yr period. Infesting stages (sporozoites) were seen only in the digestive cells of the hosts' gastric caecum while growing stages (trophozoites) only occurred in the hosts' body cavity. Sporozoites showed no variation in abundance over the investigated period. The number of trophozoites, however, clearly varied with a minimum in summer and early autumn. Trophozoite variation appears to be related to the gonadal cycle of the host.

Up to 5 species of urosporid gregarines may occur concurrently in the spatangoid echinoid *Echinocardium cordatum* Pennant, 1777 from North Sea coasts (Coulon & Jangoux 1987). *E. cordatum* becomes infested by swallowing sediment containing ripe gametocysts. Sporozoites released from ripe gametocysts penetrate the digestive cells of the gastric caecum. Depending on the gregarine species, trophozoites reach either the host's hemal lacunae or the host's body cavity where growth, pairing of gamonts and encystment take place. Whether the species is intrahemal or intracoelomic, gametocysts eventually accumulate in the echinoid body cavity where they presumably remain until the death of the host (Coulon & Jangoux 1987).

Urospora neapolitana Pixell-Goodrich, 1915 is the most abundant of the 5 gregarine species infesting *Echinocardium cordatum*. It follows a coelomic type of life-cycle with trophozoites and cysts exclusively located in the echinoid body cavity (Coulon & Jangoux 1987). Trophozoites are large worm-like cells from 120 to 320 µm long that swim actively in the coelomic fluid. Some of them are also found dead or necrotic (necrotic trophozoites are motionless rod-shaped cells, covered

by host's coelomocytes; see Coulon & Jangoux 1988). Gametocysts of *U. neapolitana* lie in the host body cavity, mixed with cysts from other species and embedded in peculiar nodules made of degenerated coelomocytes and peritoneal cells (the 'brown bodies'; De Ridder & Jangoux 1984).

The present note reports results from a 1 yr survey (monthly sampling) of the number of active and necrotic trophozoites of *Urospora neapolitana* occurring in the body cavity of *Echinocardium cordatum*. The aim was to determine whether or not there is a seasonal pattern of infestation.

Material and methods. From 25 to 30 *Echinocardium cordatum* were collected monthly from February 1986 to February 1987 (except in December 1986) on a sandy beach at Wimereux (Pas de Calais, France). Individuals were maintained for a maximum of 6 d in a closed-circuit marine aquarium (13 °C, 30 ‰ salinity) before examination. They were dissected and their coelomic fluid, digestive tube and gonads were collected. Active and necrotic (i.e. coelomocyte-covered) trophozoites of *Urospora neapolitana* were counted separately in the coelomic fluid using a dissecting microscope. Small pieces of gastric caecum and gonad were fixed in Bouin's fluid and prepared for light microscopy. Sections of caeca were examined to detect intracellular sporozoites. Sections of gonads allowed identification of hosts' sex and determination of whether or not their gonads were active (i.e. in the process of gametogenesis).

Results and discussion. The sporozoites observed in the digestive cells of the gastric caecum could not be

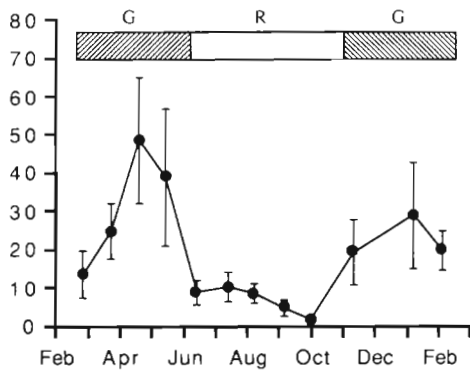


Fig. 1 Mean number of active trophozoites of *Urospora neapolitana* in the coelom of *Echinocardium cordatum* during a 1 yr cycle (February 1986 to February 1987). Vertical bars indicate 95% confidence limits. G-zones: hosts' gonads in the process of gametogenesis; R-zone: hosts' gonads at rest

identified to species level. They presumably belonged to the 5 urosporids parasiting *Echinocardium cordatum*, including *Urospora neapolitana* (see Coulon & Jangoux 1987). They were present all year round, with no obvious variation in abundance. This is consistent with the random mode of infestation of *E. cordatum* which swallows cysts mixed with sediment.

Active trophozoites of *Urospora neapolitana* showed an obvious variation in number with time of year. The lowest values were obtained from June to October (with a minimum of 1.8 trophozoites per host in October) and the highest from November to May (with a maximum of 48.7 in April) (Fig.1). The difference between minimum and maximum values was statistically significant (Student's *t*-test, $p < 0.05$). Whatever the collecting period there was no significant difference in infestation level between host sexes. Considering the reproductive cycle of *Echinocardium cordatum*, it appears that high numbers of *U. neapolitana* trophozoites

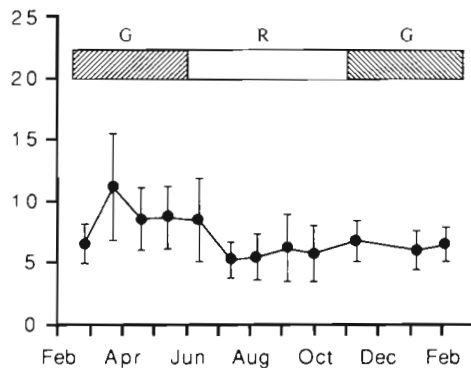


Fig. 2. Mean number of necrotic trophozoites of *Urospora neapolitana* in the coelom of *Echinocardium cordatum* during a 1 yr cycle (February 1986 to February 1987). Vertical bars indicate 95% confidence limits. G-zones: hosts' gonads in the process of gametogenesis; R-zone: hosts' gonads at rest

occur when the host is in the process of gametogenesis, and that the number drastically decreases when the gonads enter the resting stage (from the spawning that takes place in June to the next gametogenic cycle that starts in November; Fig.1).

The mean number of necrotic trophozoites of *Urospora neapolitana* per host showed only limited variations among months with a maximum of 11.2 trophozoites per host in March and a minimum of 5.3 in July (Fig. 2). These values were not statistically different (Student's *t*-test, $p < 0.05$).

Studies of the factors that rule gregarine cycles are rather scarce; they are non-existent for echinoderm gregarines. According to Schrével (1971), abiotic factors such as temperature may influence the gregarine cycle. Most authors, however, correlate gregarine cycles with host-dependent parameters such as the efficiency of the immune system (Corbel 1968) or the host reproductive cycle (Durchon & Vivier 1961, 1964). Variations in abundance of *Urospora neapolitana* trophozoites are seemingly not related to a weakening of the host's immune system as the number of coelomocyte-covered trophozoites remains fairly constant throughout the year (Fig. 2). Yet there is a clear coincidence between the occurrence of active trophozoites in the coelom and the activity of the gonads, the former being abundant only when the latter are in the process of gametogenesis. It has been demonstrated among polychaetes that the passage of gregarines from the digestive tube into the coelom is governed by the neurohormonal substance responsible for host epitoky (Durchon & Vivier 1961, 1964). Similarly, we hypothesize that a sexual hormone produced by *Echinocardium cordatum* would provoke the passage of *U. neapolitana* sporozoites into the coelom and their transformation into trophozoites.

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