*BASTERIA, 52: 3-7, 1988*

# An unusual phenomenon observed in Epitonium clathratulum (Kanmacher, 1797) (Prosobranchia: Epitoniidae): live snails becoming separated from their shells

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Data are presented relative to an epidemic die-off of wentletraps, *Epitonium clathratulum*, under aquarium conditions. Snails, each connected to the end of a self-produced elastic filament uniting a bunch of egg capsules, were observed to become separated from their shells, implicating detachment/atrophy of the columellar muscle. This phenomenon, as well as the die-off itself might represent a normal post-reproductive event, *E. clathratulum* possibly being an annual species.

Key words: Gastropoda, Prosobranchia, Epitoniidae, *Epitonium clathratulum*, epidemic die-off, detachment of columellar muscle, reproduction.

## INTRODUCTION

In a recent paper (Den Hartog, 1987) I described field and aquarium observations on the associated occurrence of the wentletrap *Epitonium clathratulum* (Kanmacher, 1797) and the sea anemone *Bunodosoma biscayensis* (Fischer, 1874). Over 30 individuals of a sample of some 40 to 50 live wentletraps (shell size-range about 4-13 mm) collected at Plage d'Ilbarritz near Biarritz, France, on 1 August 1987, were transferred to an aquarium tank in Leiden on 8 August. During September 1987, an epidemic die-off occurred and no less than 25 dead specimens were removed from the tank. A few more specimens died in October, and by mid-November no live snails were noted any more, except for a single individual (8 mm long) that was seen three times between 5 and 9 December. A total of 29 wentletrap shells was removed from the aquarium: 13 clean and completely empty (size range 6.5-17 mm; average 12.3 mm), and 16 with remains of flesh (size range 4.5-16 mm; average 9 mm). A few snails, presumably small individuals, must have died unnoticed.

## POSSIBILITIES CONSIDERED RELATIVE TO THE EPIDEMIC DIE-OFF

In relation to the die-off, the following plausible factors/explanations were initially considered.

— (1). The quality of the water. The aquarium tank contained North Sea water (collected on 6 August at Katwijk aan Zee, a coastal village near Leiden) of relatively low salinity (S = c. 30‰) compared to Bay of Biscay water (S = c. 35‰), eutrophicating due to regular feeding of sea anemones in the tank. However, initially water quality can hardly have been a paramount factor as the first snails had died within a month in the first week of September, whereas the last individual was seen alive as late as 9 December of the same year.

— (2). The presence of an unobserved predator. This possibility would explain why almost half of the shells were found to be completely empty, whereas some were occupied by a live snail shortly before. Even after careful searching no predator or other suspect could be detected.

— (3). Snails might have fallen victim to their host anemones. Previously I suggested that *E. clathratulum* when feeding in the mouth slit of a host anemone might occasionally fall victim to this host (Den Hartog, l.c.: 105). However, the epidemic character of the die-off excludes the possibility that this phenomenon can be attributed to such hypothetical accidents. If such large scale fatalities were a normal phenomenon, this method of feeding could never have evolved. The significant number of clean, empty shells also does not match this hypothesis. Besides, it remains to be seen whether a prolonged stay in the host's coelenteron is fatal. So far I have neglected to test this experimentally, but a wentletrap found on 4 October, thickly covered with mucus and apparently expelled by an anemone, proved to be alive after I had cleaned it, and entrenched itself quickly in the bottom sand.

— (4). A correlation with reproduction, notably oviposition. The species may be short-lived and die after the reproductive period. This could explain why some small (possibly non-reproductive) individuals were the last to be seen alive. However, this explanation too, would not seem to account for the significant number of (relatively large) empty shells.

## FURTHER OBSERVATIONS

As none of the plausible possibilities discussed above seemed to provide a satisfactory explanation, observations were focussed on the considerable number of completely empty shells that were found.

On 20 September I found one wentletrap ovipositing, the snail being connected to the end of the elastic filament which united the egg-capsules. It seemed rather lethargic. The next day I found its empty shell and close to it the snail itself, crawling around rather sluggishly and seemingly helpless. On 23 September a second individual similarly connected to a bunch of egg-capsules, was actually observed in the act of leaving its shell. Both snails and their shells (14 and 17 mm long, respectively) were preserved in 70% alcohol as reference material (RMNH Mollusca alc. 9212a). On 26 September I noted another rather lethargic wentletrap, again attached to a bunch of egg-capsules. Suspecting that this individual too was about to leave its shell, I tried to transfer it to a small dish with sea water to observe this act at close range and under low magnification. When being lifted, however, the snail immediately slipped out of its shell. Transferred to the dish it seemed far from comfortable, making unco-ordinate movements and suffering convulsions, but occasionally the foot would get hold of the substrate, and the snail would crawl around a little (fig. 1). Four days later, on 30 September it was still alive, but only barely so. Therefore, to prevent it from dying and desintegrating unnoticed, it was preserved in 4% formalin-sea water, and subsequently transferred to 70% alcohol (RMNH Mollusca alc. 9212b).

## DISCUSSION

In life, in the vast majority of gastropods, shell and snail are inseparably united by the columellar muscle. This muscle enables the snail to retract into the shell, and func-

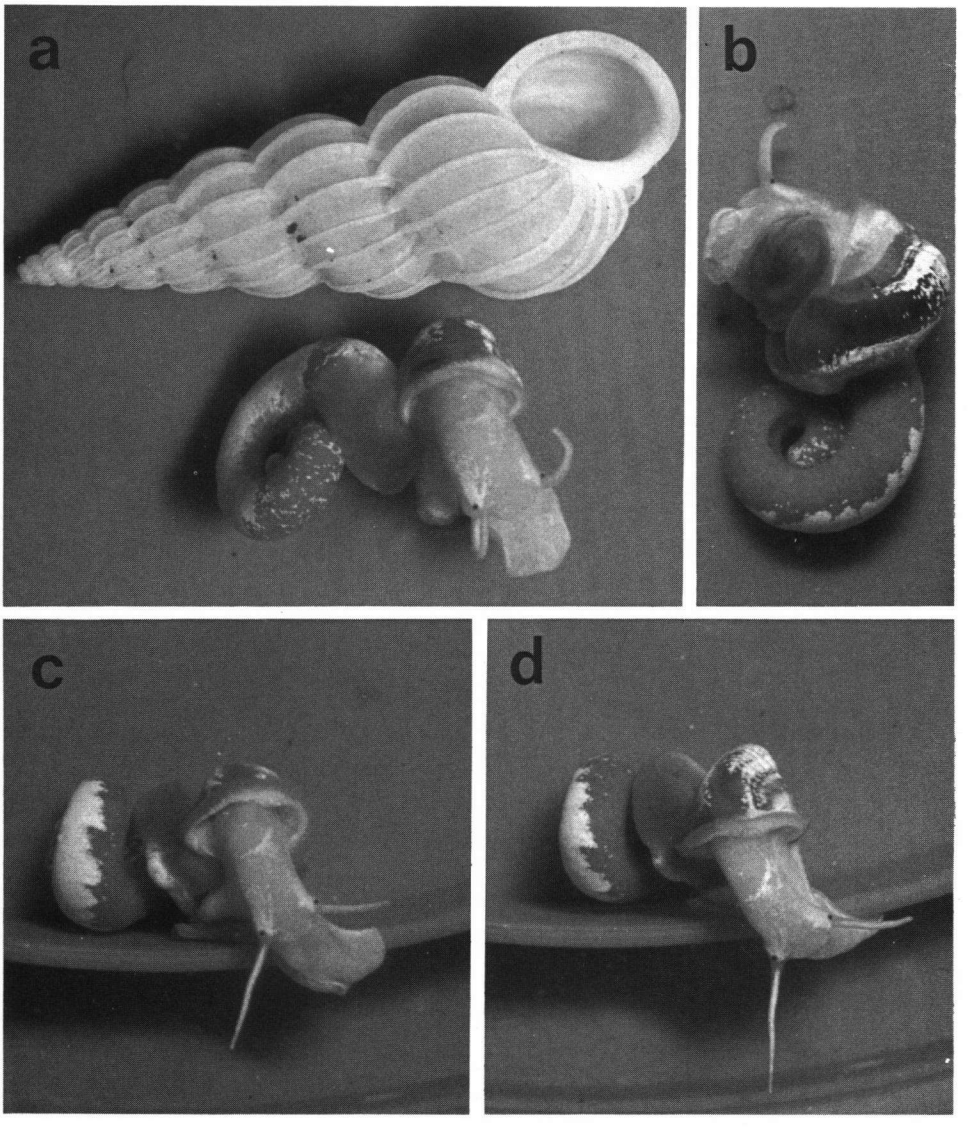


Fig. 1. *Epitonium clathratulum* (Kanmacher, 1797). a. Empty shell, 15 mm long, with "spontaneously" separated live snail; b. The same snail, showing operculum; c-d. Crawling activities of the same separated snail. Scale of b-d slightly different from that of a.

tions to orientate the shell relative to the foot. Also, the muscular co-ordination of the snail would seem to be adjusted to a high extent to the presence of the shell as an integral part of the organism. However, the columellar muscle is only superficially attached to the smooth surface of the columella. After breaking a gastropod shell, the muscle may in fact be detached easily by pulling it in a direction parallel to the plane of attachment, as I checked in a series of dog-whelks, *Buccinum undatum* L., 1758, and periwinkles, *Littorina littorea* (L., 1758). This superficial attachment of the columellar muscle is further demonstrated by the fact that the completely intact snail can easily be extracted from the shell after cooking; and occasionally, completely live snails may be removed without any damage to the shell. In the Caribbean the queen conch, *Strombus gigas* L., 1758, has long been regarded as a delicacy. In Bonaire (Netherlands Antilles) the species used to be collected in considerable numbers, and to remove the snails from the shells, fishermen used to break a hole into the shell to detach the columellar muscle. In the early 1970's, when I visited the island, fully grown queen conchs had become uncommon, and, due to increasing tourism, the price of undamaged shells had already risen to a level far exceeding the price of the contents. The fishermen solved this problem by suspending the shells with the siphonal canal downwards, and in a day or so, due to the burden of the body weight, the columellar muscle would finally detach itself and the exhausted, dying snail would slip out.

Yet, "spontaneous" separation of snail and shell, as described in the present note for *E. clathratulum*, must be regarded as anomalous. In theory it would seem possible that detachment of the columellar muscle could result from unusually acid water conditions affecting the shell (which, otherwise, due to inherent toxic side effects, would also considerably affect the general condition of the organism). In reality this seems out of the question as during the period that most wentletraps died, the water in the tank was not older than four to eight weeks, and well buffered. Therefore, detachment of the columellar muscle would seem to implicate some form of atrophy of the muscle itself, either due to disease/deficiency, or to a general process of decay of the organism.

The three snails that were actually observed to separate from their shells, all happened to be connected to the end of self-produced elastic filament uniting the egg-capsules. Thus, given the condition of a detached/atrophied columellar muscle, any muscular contractions, such as unco-ordinated attempts to disconnect the filament or to withdraw the body into the shell, would seem rather to have the reverse effect, causing the snail to slip out of the shell. This same effect would be produced by a mechanical movement of the shell caused by an external factor (as actually happened when I lifted one of the wentletraps from the bottom of the aquarium). Either possibility may hold for the 13 shells that were found empty. The other wentletraps (16 individuals, presumably including some males) may in fact have suffered from the same muscular deficiency, but may have died and decomposed inside their shells because they were not at that time connected with egg-capsules.

In conclusion, having established a link between the deterioration of snails, the presence of egg-capsules, and the empty shells, and reconsidering the possibilities discussed previously, it would seem that the die-off in the aquarium may after all be regarded as a (normal?) post-reproductive phenomenon, *E. clathratulum* possibly being an annual species (cf. Den Hartog, 1987: 108). Admittedly, the observations, however interesting and suggestive, were made under rather artificial conditions and therefore definitely need further confirmation under more natural conditions. On the other hand, the value of aquarium observations should not be underrated. It seems very

unlikely that the separation of a gastropod snail from its shell, if indeed it is a normal phenomenon, could ever have been discovered in the field. Here, with so many potential predators around, empty shells would never raise suspicion, and any snail separating from its shell would presumably be consumed at once.

Dr. A.C. van Bruggen, Department of Systematic Zoology, Leiden University, made efforts on my behalf to trace any possible literature on the phenomenon of snails leaving their shells. Being unsuccessful, he stimulated me to produce the present note, which would probably not otherwise have been written. Thanks are also due to Dr. Gillian Mapstone, Wassenaar, for checking and improving the English text.

## REFERENCES

HARTOG, J.C. DEN, 1987. Observations on the wentletrap Epitonium clathratulum (Kanmacher, 1797) (Prosobranchia, Epitoniidae) and the sea anemone Bunodosoma biscayensis (Fischer, 1874) (Actiniaria, Actiniidae). — Basteria 51: 95-108.

## SAMENVATTING

Een merkwaardig verschijnsel waargenomen bij Epitonium clathratulum (Kanmacher, 1797) (Prosobranchia: Epitoniidae): levende slakken die hun schelp verlaten

Bovenstaand is een serie gegevens verzameld inzake een epidemisch sterven van het wenteltrapje *Epitonium clathratulum* in een aquarium. De slakken, elk verbonden met een bundel eikapsels door een door het dier zelf geproduceerde slijmdraad, geraakten los van hun schelpen, wat loslaten of reductie van de columellaspier impliceert. Dit verschijnsel en tevens het massaal sterven zou een normale gebeurtenis na afloop van de voortplanting kunnen zijn, omdat *E. clathratulum* waarschijnlijk een eenjarige soort is.