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Shell repair after serious damage in *Ensis leei* (Bivalvia, Pharidae)

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Heavily damaged and malformed shells of *Ensis leei* found on the Dutch coast are suggested to be due to commercial fishery on this species with a specialized dredge. All specimens smaller than 10 cm length are discarded and returned to the sea. Some may survive the damage and scavengers and repair their shell.

Key words: *Ensis*, fishery, shell malformation, *Littorina*, The Netherlands.

Introduction

Repaired shell damage in mollusks is often due to failing shell crushing predators. For a review, see Vermeij (1987). Shell repair is often used as an indication of predation pressure. However, caution is necessary as other causes of shell damage and subsequent shell repair do occur. Van Nieulande (2017) explained shell damage and deformation of *Ensis leei* Huber, 2015, by the penetration of *Ensis* by an empty *Littorina* shell. There are more examples of similar deformed *Ensis leei* specimens and here I suggest another possible cause. The *Littorina* shell penetrated the empty *Ensis* shell on the beach where it was found.

Shell damage, causes and repair

Caused by a predator?

Van Nieulande's deformed *E. leei* (formely *E. directus* Conrad, 1840) shows traces of damage on the outer side of both valves, so the damage probably originates from the outside, not from within. On the inside they show repair indicating that locally the mantle had lost its contact with the shell and a hollow blister was formed. Hollow blisters I observed regularly at the posterior end of larger *Ensis leei* shells collected on the North Sea coast of Texel (Cadée, 2016). They can be filled with sediment.

If a predator were the cause of the damage to the shell, it is difficult to imagine that the prey would not have been consumed. Some bivalves such as *Ensis* have very few morphological adaptations against predation: they have gaping valves so they cannot close completely. Vermeij (1978: 80) writes "Such species are best regarded as weeds, which survive depredations of their enemies by high reproduction rates". The only defense mechanism in *Ensis* is rapid burrowing deep in the sediment.

Other causes of shell repair.

Van Nieulande (2017) suggested the ingestion of an empty *Littorina littorea* shell (diameter 11 mm), which then got stuck between mantle and valves during burrowing, when the *Ensis* had a length of 4 cm. Nevertheless, the *Ensis* was able to grow to a length of 12 cm and was found empty on the beach near Ritthem, with the *Littorina* shell (still) inside. Is this explanation probable? The L/H ratio in *Ensis leei* is approximately 6/1 (Moerdijk, 2000), thus the height of this small *Ensis leei* was ~7 mm, or much too small for a *Littorina* of 11 mm diameter to enter. Most 4 cm long shells of juvenile *E. leei* I collected in February/March 2002 on the beach of Texel were even less than 7 mm high (Cadée, 2002). Moreover, one would expect that the *Littorina* shell should become enclosed in carbonate by the *Ensis*. Van Nieulande's explanation seems to me improbable.

Van Nieulande also mentions that similar additional malformed *Ensis leei* shells are collected from the Dutch coast, some found between Katwijk and Noordwijk by Martin Cadée; others from the same tra-

Fig. 1a-c. Three pictures of a malformed *Ensis leei* from the coast of Texel

jectory are in the collection of Ellen van der Niet (Noordwijk). Also, some malformed specimens were collected on the North Sea Beach of Texel (Fig 1). I never collected such deformed *Ensis leei* along the Wadden sea coast of Texel.

Was *Ensis* fishery the cause?

Man is the only predator I can imagine that damages *Ensis leei* without consuming it. Since 2002, the fishing of *Ensis leei* is permitted in certain areas along the Dutch coast (Anonymous, 2014). For this fishery, a specialized slow-moving dredge is used (Heyer, 2014). Only specimens of >10 cm length are taken, which is the minimal size that may be fished for consumption, and all smaller ones are discarded. Moreover, the damaged specimens among the larger ones are discarded because they are unsuitable for the fishery market (Perdon et al., 2016).

The *Ensis* fishery method received a MSC Sustainable Fishery Certification (Anonymous, 2014). Fishery on *Ensis* is 'sustainable' because the population at that time did not decrease by collecting less than 10% of the biomass of *Ensis* >10 cm present. That so many smaller ones are 'discarded' is not taken into account for this certificate. What becomes of these discarded specimens is not well known; most will be consumed by scavengers, some might survive and re-burrow. It is well known that beam trawl fishery causes damage to bivalves and gastropods (Witbaard & Klein, 1994; Mensink et al., 2004).

The penetration of *Littorina*.

Weigelt (1919) and Wasmund (1926) were probably the first to notice how *Mytilus edulis* shells on the beach of the tidal Wadden Sea tend to form stable concentrations of shells whereby the still articulated valves form 'nests', one folded into the other. Since *E. leei* became abundant in the Wadden, we can observe here the same stable concentrations of 'nested' *E. leei* (De Wolf & Cadée, 1994, see also Fig. 2). I am convinced that the *Littorina* that is referred to by van Nieulande 'penetrated' an empty *Ensis* during such a stabilization process on the beach.

Conclusion

My suggestion is that the malformed specimens found on the Dutch North Sea coast might be fished but discarded as too small and/or damaged during fishing. They were able to repair the shell damage caused by this fishery. I did not find such repaired but malformed *E. leei* shells on the Wadden Sea coast of Texel where fishery on *Ensis* is forbidden. Van Nieulande's *Littorina* entered and empty, articulated *E. leei* on the beach, not during its life.

Fig. 2. Nested *E. leei* shells together with living and empty *Littorina littorea* on the Wadden Sea beach near The Royal Netherlands Institue for Sea Research, Texel.

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