Why are beached *Acanthochitona fascicularis* (Linnaeus, 1767) (Mollusca: Polyplacophora) from Italy missing their dorsal girdle elements?

¿Por qué los ejemplares de *Acanthochitona fascicularis* (Linnaeus, 1767) (Mollusca: Polyplacophora) encontrados en una playa de Italia pierden los elementos del perinoto?

Bruno DELL'ANGELO*, Bruno ANSEEUW**, Yves TERRYN*** and Antonio BONFITTO****

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ABSTRACT

An unusual form with reduced dorsal girdle of the well known and extremely variable European chiton *Acanthochitona fascicularis* (Linnaeus, 1767) is hereby illustrated, discussed, and compared with the regular form. Hundreds of beached specimens and several live found specimens with similar dorsal girdle were studied and compared. Different theories and hypothesis are proposed as an explanation for this unusual form and as a conclusion we finish with some open questions.

RESUMEN

En el presente trabajo se estudia una forma inusual con reducción de elementos del perinoto del poliplacóforo *Acanthochitona fascicularis* (Linnaeus, 1767). Se compara, se ilustra y se discuten los datos obtenidos con la forma regular de esta especie. Los autores aportan su hipótesis sobre la presencia de esta inusual forma y concluyen que hay algunas cuestiones abiertas.

KEY WORDS: Polyplacophora, *Acanthochitona fascicularis*, Mediterranean Sea, girdle.
PALABRAS CLAVE: Polyplacophora, *Acanthochitona fascicularis*, Mediterráneo, perinoto.

INTRODUCTION

Many years ago, a great number of specimens of *Acanthochitona fascicularis* (Linnaeus, 1767) were beached after a storm at "Calambrone", a locality near Livorno (Tuscany, Italy). A friend of the first author picked up many of these and prepared part of them in an alcohol/glycerine solution, the rest were preserved in alcohol. All collected specimens had an unusual feature in common: a "smooth" dorsal girdle with reduced sutural tufts. Later on, similar

* Via Mugellese 66D, 59100 Prato, Italy; bruno.dellangelo@elsag.it
** Mispelstraat 18, 9820 Merelbeke, Belgium; chiton@pandora.be
*** Kortrijksepoortstraat 109, 9000 Gent, Belgium; loricata@pandora.be
**** Museo di Zoologia dell'Universita' di Bologna, Via Selmi 3, 40126 Bologna, Italy; bonfitto@alma.unibo.it

living specimens were found at two localities in Italy, which made a comparative study possible.

Abbreviations:
BDA Private Collection of Bruno Dell'Angelo, Italy.
BA Private Collection Bruno Anseeuw, Belgium.
YT Private Collection Yves Terryn, Belgium.

MATERIAL AND METHODS

Material examined: *Acanthochitona fascicularis* (Linnaeus, 1767)

• Calambrone, Livorno prov., Italy, 56 specimens beached in Feb. 1991 (BDA, Fig.7), including 21 preserved in alcohol (Fig.6). The dimensions vary from 28 x 15 mm to 40.5 x 18.5 mm. Only one spm is of smaller dimensions, 13 x 6.8 mm.

• Calambrone, Livorno prov., Italy, 5 specimens beached on Feb. 1991 (BDA), about 28.5 x 14 mm, with plates covered with Bryozoa and other organisms (Fig.5).

• Punta Faro, Messina Strait, Italy, under rocks at 2-3 m: 2 specimens, about 25 x 14 mm (estimated) strongly curled and 18 x 12 mm curled (BDA).

• Off Capraia Isl., Italy, dredged at about -200 m, inside a large semi porous rock (about 70 x 70 cm): 5 specimens live taken (S. Savona collection, Italy).

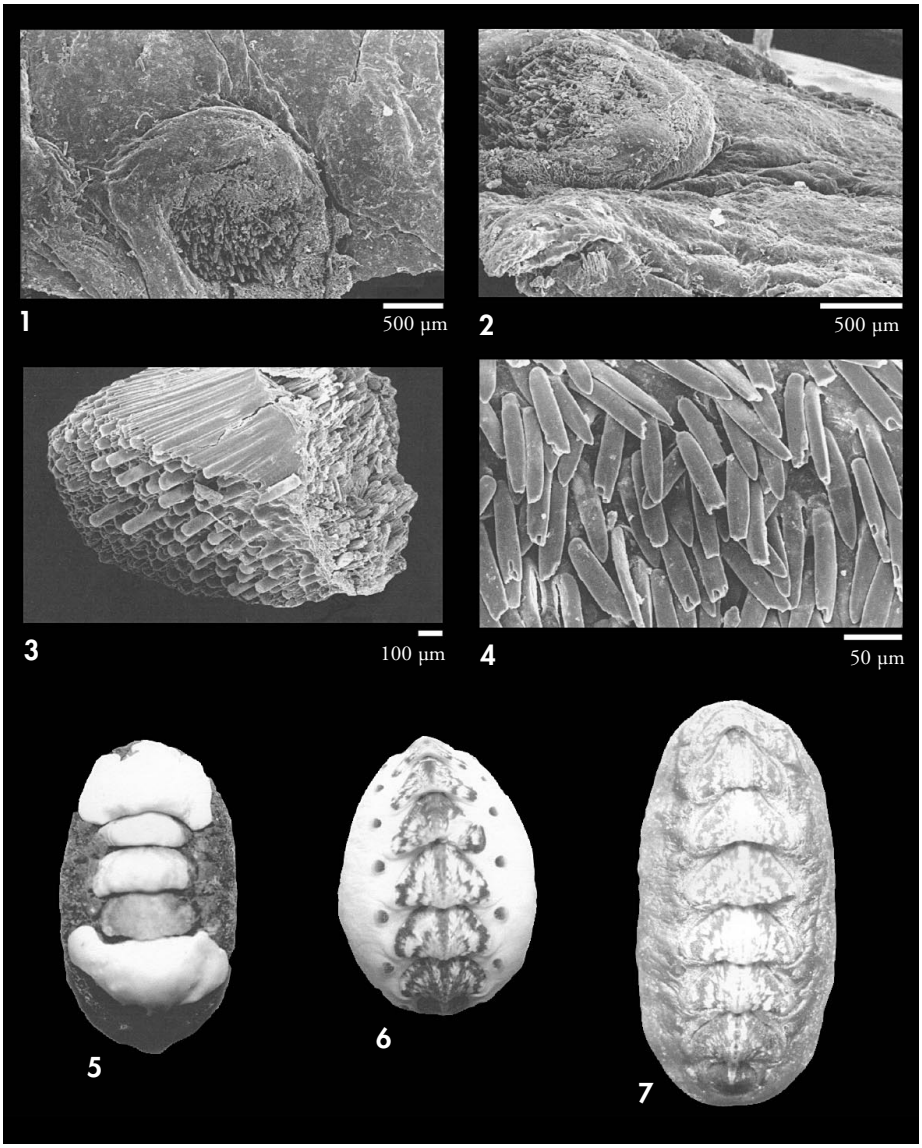
• Hundreds of specimens from diverse European (Portugal, Spain, France, Italy, Croatia, Greece) and African (Morocco, Algeria, Tunisia, Israel) localities (BDA, BA and YT collections).

SEM-images were made using a SEM *JEOL* mod. JSM-5200. Specimens were disarticulated by boiling in a KOH-solution until all soft parts were dissolved, followed by thorough rinsing.

RESULTS

The mollusc-beaching phenomenon at Calambrone is well known (CAMPANI, 1983), and the number of molluscs species beached over a period of several years is rather high (257 species). The beaching is caused by interaction between different sea currents and by the characteristic sea floor. Among these beached molluscs, three species of chitons have been reported: *Ischnochiton rissoi* (Payraudeau, 1826), *Chiton olivaceus* Spengler, 1797 and *Acanthochitona fascicularis* (Linnaeus, 1767) (reported in Campani's list as *Acanthochitona aenea*). The beaching of chitons is generally uncommon, and usually concerning few specimens. The beaching in February 1991 is therefore particularly significant especially as the features of the *A. fascicularis* beached are so different from typical shallow-water *A. fascicularis*. Some of these specimens have been illustrated in the book on chitons from the Mediterranean Sea (DELL'ANGELO AND SMRIGLIO, 2001).

When we first saw these beached "smooth" specimens, we thought they were regular *A. fascicularis* with damaged dorsal girdle. In fact, it seemed as if the dorsal girdle elements had been removed by some cause as all spicules were gone and the sutural tufts, which normally bear long spicules, were very short , almost truncate. Beside this, all other features looked macroscopically identical to normal *A. fascicularis*, i.e. general shape and tegmentum sculpture. As these specimens were dead, some external influence could have caused this phenomenon. For example the specimens could have died during the storm resulting in curled up specimens which could have been dorsally damaged by scraping and rolling upon rocks during the beaching process. This could explain why only the dorsal girdle was removed and not the ventral part which seemed to be intact. However, the tegmentum showed no obvious signs of damage. It was as if something had meticulously removed the dorsal girdle, without touching the rest of the animal. We deliberately removed the dorsal girdle elements (by scraping with a knife) from a similar "regular", alcohol/glycerine preserved specimen and the result was a specimen



Figures 1-4. *Acanthochitona fascicularis* beached, with "smooth" dorsal girdle. 1: girdle, tuft; 2: girdle, tuft, lateral view; 3: isolated tuft (right: top, left: inside the girdle); 4: girdle, ventral spicules. Figures 5-7. *Acanthochitona fascicularis* beached. 5: one of the five specimens with the plates covered with bryozoans and other organisms (28.2 x 14.3 mm); 6: one of the specimens preserved in alcohol (28.5 x 17.6 mm); 7: one of the specimens prepared in an alcohol/glycerine solution (38.7 x 17.5 mm).

Figuras 1-4. Acanthochitona fascicularis*, con el perinoto dorsal "liso". 1: perinoto, protuberancia; 2: perinoto, protuberancia, vista lateral; 3: protuberancia aislada (derecha: parte superior, izquierda: dentro del perinoto); 4: perinoto, espículas ventrales. Figuras 5-7.* Acanthochitona fascicularis*. 5: uno de los cinco especímenes con las paclas cubiertas por briozoos y otros organismos (28,2 x 14,3 mm); 6: especimen conservado en alcohol (28,5 x 17,6 mm); 7: especimen preparado en solución de alcohol/glicerina (38,7 x 17,5 mm).*

that looked almost identical to the beached ones. The external cause remains therefore a possible explanation of the phenomenon.

The disarticulation of one of the specimens was necessary for a complete analysis and comparison with a typical specimen of *A. fascicularis*. When disarticulated no dorsal girdle appeared. Normally, when submitting a chiton to this process, the soft parts of the animal will dissolve and it will result in the 8 isolated valves, the radula and a thin layer of dorsal and ventral girdle bearing the girdle elements. In the beached specimen, only the ventral layer was present. The sutural tufts, which are normally attached to the dorsal layer, were loose. We concluded that the specimen had no dorsal girdle, but what caused this lack of girdle?

Other material beached at Calambrone during February 1991 provided new insight into this problem. Among the molluscs beached were five specimens of *A. fascicularis* with valves severely covered with corals and/or eroded, but with the dorsal girdle in normal condition (Fig. 5). The only difference from regular *A. fascicularis* is the reduced tufts, but this is known to occur within members of this species. Also, several of the alcohol preserved specimens still have some of their dorsal girdle elements present (i.e. areas with fine and short spicules) and reduced tufts, which supported the notion that the lack of dorsal girdle in the previous material was, in fact, caused by external influences.

DISCUSSION

We have considered several hypotheses that might explain the phenomenon of beached *Acanthochitona "fascicularis"* with reduced or detached dorsal girdles. First, it is possible that the specimens were subjected to an acidic environment, either before or after their death. The problem is that this acidic environment would also "etch" the tegmentum and there is no evidence of this visible on the specimens. We consider this hypothesis unlikely. Another possible cause is that the specimens lived below the carbon compensation depth, where seawater dissolves calcareous material quite aggressively, but this is only known to appear at great depths (>4000 m) so this can be rejected, as the specimens were found on the shore and it is highly improbable that they were transported from great depths by the storm.

Could this phenomenon have been caused by polluted water? Is it perhaps caused by something similar as the "red tides" which are known to kill chitons in great numbers in South Africa for example? (*fide* A. Seccombe, *pers.com.* 1997; B. Anseeuw and Y. Terryn, *pers.obs.* 2002: beaching of *Dinoplax gigas* Gmelin, 1791). Has an animal removed the dorsal girdle?

One possible hypothesis is that the specimens could be a distinctive ecological form (ecotype) of *fascicularis*, i.e. with reduced dorsal girdle, or even an unknown species. We are unaware of any previous mention of this distinction in literature regarding chitons. In fact, it is highly improbable that a species could live without their protecting dorsal girdle, so this hypothesis was also considered as highly improbable. It is however known that the dorsal girdle elements can be quite variable, even within specimens from the same locality. For example specimens from a locality which are found on exposed habitats can have reduced dorsal girdle elements, but will also generally show eroded tegmentum, a feature that was not observed in the beached specimens.

The most logical remaining hypothesis for us was that some unknown posthumous process led to the removal of the dorsal girdle. However, we were then at a loss to explain our later observation of living specimens with similar "naked" appearance. This fact made everything much more complicated as these specimens were alive but without a dorsal girdle. Thus, we still do not have an explanation about why all these specimens have a reduced dorsal girdle. It is also possible that these specimens could represent a species or race that is distinct from typical *A. fascicularis* but the only

difference between both that we have observed so far is the absence of the dorsal girdle elements. On the other hand, it is highly improbable that a lineage of chitons would lose their dorsal girdle, as it would seem to make it quite unprotected and vulnerable. Perhaps a DNA analysis could test the "different species" hypothesis but this can only be done easily on fresh alcohol-preserved specimens. Perhaps the future will bring some fresh alcohol-preserved specimens but until then we can only speculate. We would be happy to hear of anyone who has observed similar specimens or of similar observations for other chiton species, as more information could eventually lead to a plausible explanation.

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