

**Radular teeth development and wear in *Allaegopsis spec. A*
(Gastropoda Pulmonata: Zonitidae)**

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The radula of a specimen of *Allaegopsis spec. A* was studied. Some detailed photographs could be made, illustrating that many rows of young teeth cannot function because they are not yet fully developed, whereas many rows at the opposite end of the radular ribbon are eroded, the last ones to such an extent that they cannot possibly fulfil a scraping function optimally any more.

Key words: Gastropoda, Pulmonata, Zonitidae, radula, development, wear.

INTRODUCTION

The radular membrane is provided with rows of teeth; new rows are continuously formed at its posterior end, whereas worn teeth drop off at the anterior end and are usually swallowed by the snail. According to Runham & Isarankura (1966), who investigated twelve gastropod species, belonging to both Pulmonata and Prosobranchiata, the radula is replaced at a rate of one to five rows a day; this speed is species-specific to some extent and may be affected by temperature, age of the animal, and the 'depth of sleep' in hibernation. It is not clearly influenced by starvation or aestivation.

In the early days of scanning electron microscopy in malacological research, various papers were published on radula structure and functioning (Isarankura & Runham, 1969; Runham, 1969; Runham & Isarankura, 1966; Solem, 1972, 1973). In two publications (Runham & Thornton, 1967; Solem, 1974) the wear pattern that can be observed on radular teeth was described and illustrated.

In this paper we provide additional data concerning a radula of *Allaegopsis spec. A* from near Vrossina, Ipiros, Greece (Pulmonata: Zonitidae), that was routinely studied in a search for diagnostic characters (this new species will be described in the near future). The state of preservation of this specimen enabled us to gather some data on the formation and the wear of the teeth, that might be worth publishing, not in the least because some illustrative SEM-photographs became available.

MATERIAL AND METHODS

The buccal mass of the snail, initially kept in 70% ethyl alcohol, was macerated in a KOH solution at c. 20° C for c. 24 hours. After this it was cleaned from remains of tissue under a dissecting microscope, carefully rinsed in water, and treated in an ultrasonic cleaner for 30 seconds. The radular ribbon was then spread over a transverse glass capillary, fixed on a cover glass, and flattened at both sides of this bar by glass splinters, and dried. After removal of the glass splinters, the cover glass with the specimen was mounted on a SEM-stub (see Ploeger & Breure, 1977, for details on this and other methods).

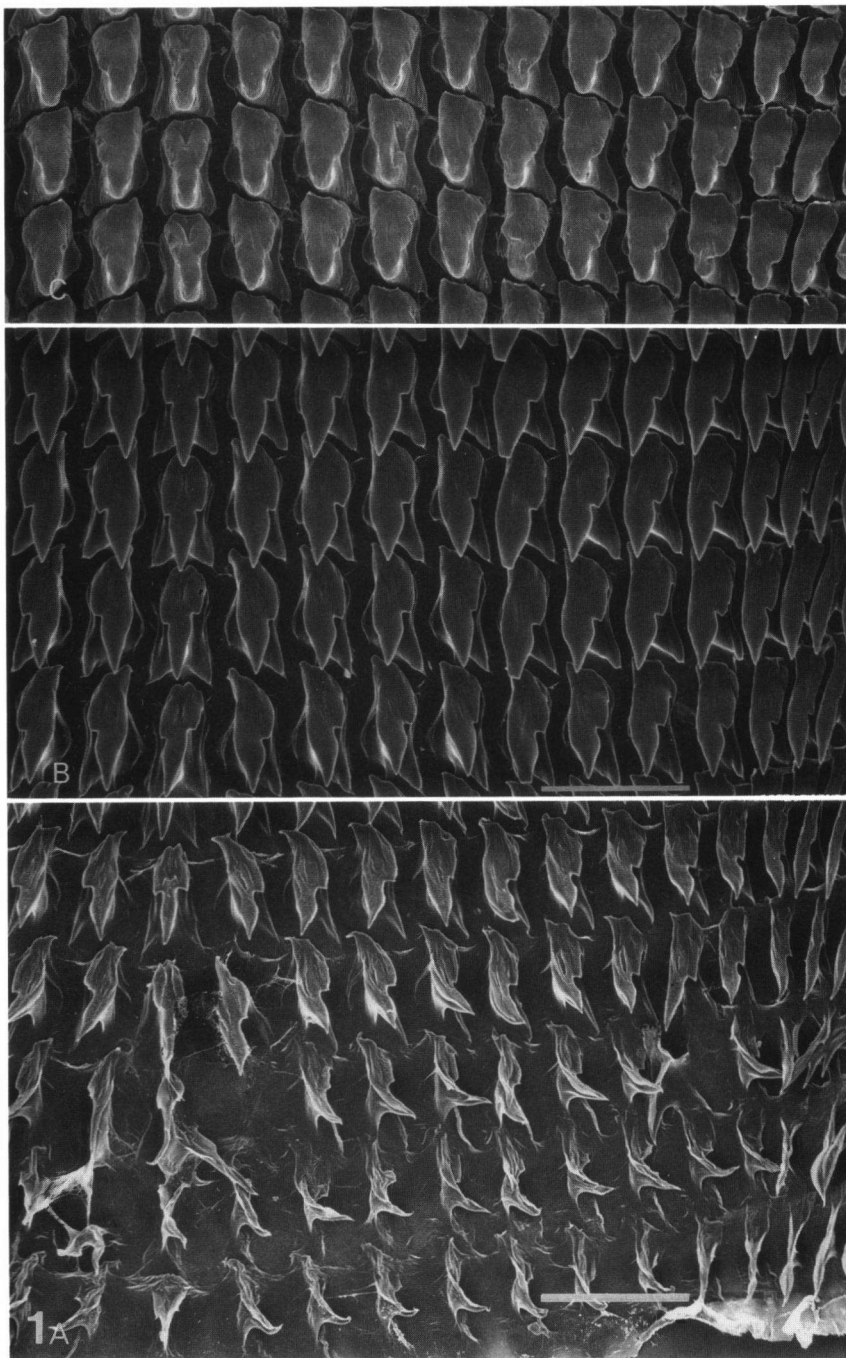
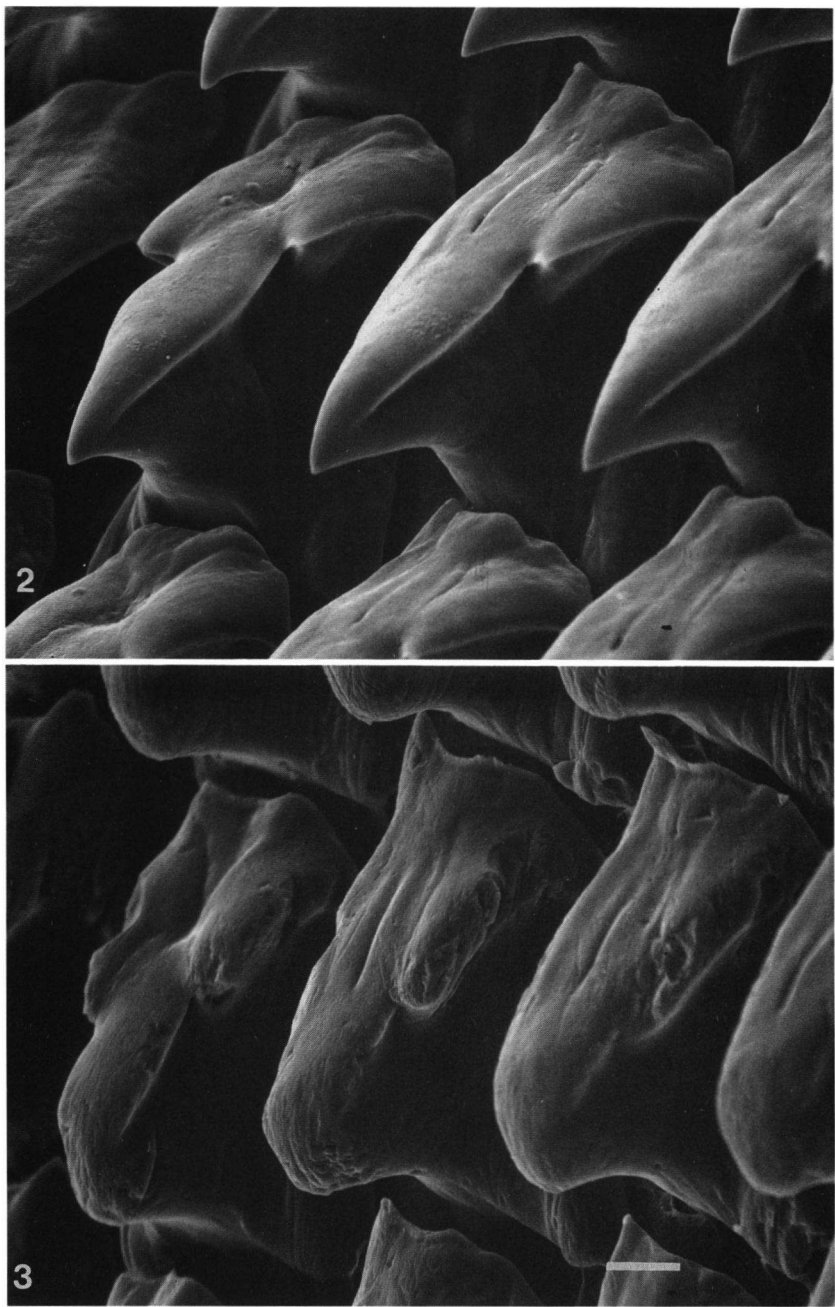
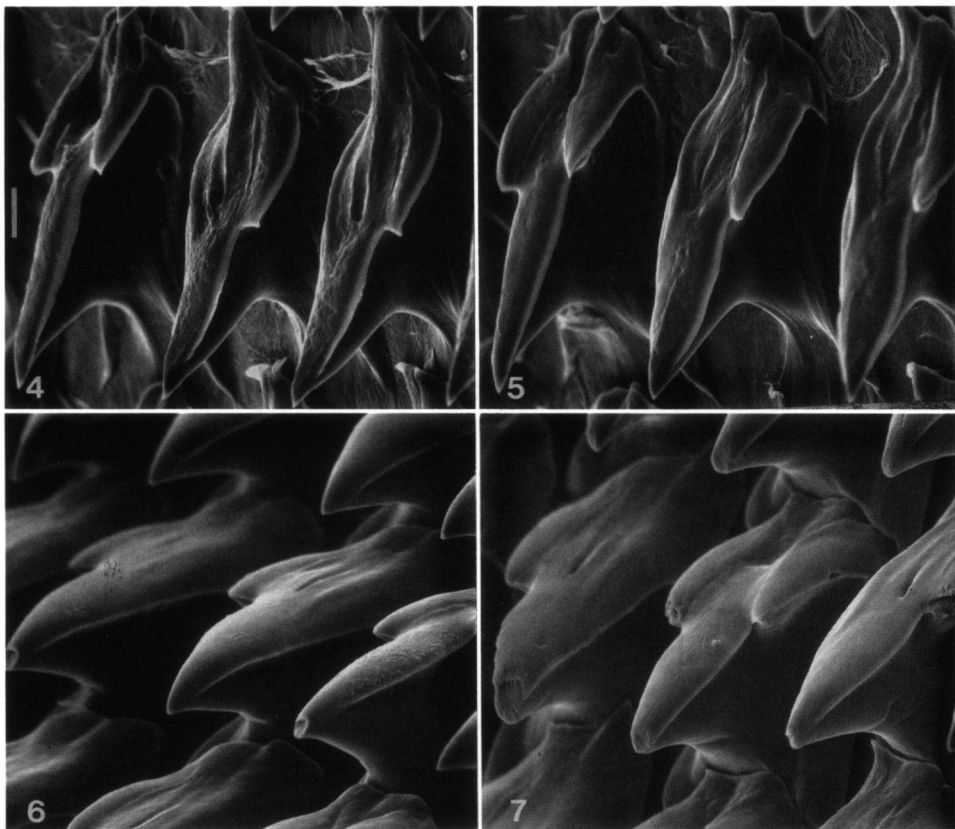


Fig. 1. Various stages of radular teeth development in a single radula of *Allaegopsis spec.* A from near Vrossina, Ipiros, Greece. A, rows 1-5, with half-grown, not yet interlocking teeth; B, rows 13-16, illustrating the final stage of teeth-shaping; C, rows 64-66, with heavily eroded teeth. Note the inconspicuous, but constant, blunt-tip malformation in lateral 5. Scale 0.1 mm.



Figs. 2, 3. Comparable details of rows 40 [2] and 65 [3], with the tricuspid central and the first, left, bicuspid lateral tooth. The teeth are in optimal shape [2], and heavily eroded [3], respectively. Scale 10 μ m.



Figs. 4-7. Details of half-grown teeth of rows 6 [4] and 9 [5] and teeth with the initial stages of wearing of rows 44 [6] and 53 [7]. See the text. Scale 10 μ m.

RESULTS AND DISCUSSION

The specimen has 75 transverse rows of teeth with a tricuspid central tooth, accompanied at both sides by 10 bicuspid lateral and 35 unicuspid, very long and slender, marginal teeth. The mesocones are very clearly dominant in all teeth. Shortly after their formation, the cusps are very acute; they have become very blunt when the teeth are swallowed (fig. 1).

The initial c. 14 rows of teeth are not yet full-grown and cannot be functioning as do the adjoining older rows. These immature teeth are relatively small and apparently have not yet hardened completely; most clearly in the youngest rows, the tooth-surface is wrinkled and dorsally there is a furrow leading to a conspicuous hole. The teeth are also not in close contact with each other yet. Their basal plates are not partly free from the basal membrane and not interlocking (figs. 4, 5). Thus partly overlapping basal plates, functioning as described in much detail by Solem (1972, 1974), do not exist until about row 15.

Wearing of radular teeth becomes clearly discernible after row 42, when an increasing number of teeth is seen with the acute tips of the mesocone and the side-cusps chipped off (fig. 6). In older rows scratches become prominent as well (fig. 7), whereas teeth in the oldest rows are heavily worn all over (figs. 1, 3). Wear was observed over the entire width of the teeth rows, thus in the central, lateral and marginal teeth, not clearly starting in a particular type of teeth.

Thus a high percentage of radular teeth is suboptimal in shape in this snail. In 75 rows, only between about row 15 and row 42 nearly all teeth are full-grown, undamaged and supposedly functional. There is no reason to suppose that the specimen studied was abnormal in this respect.

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SAMENVATTING

Slakken produceren gedurende hun leven enorme hoeveelheden radulatandjes, die zijn opgebouwd uit een basale plaat, voorzien van één of meer spitsen. De tanden bevinden zich in rijen op een lintvormige basale membraan. Bij een twaalfstal soorten werd gevonden dat er één tot vijf rijen per dag worden gevormd, terwijl er aan de andere kant van de basale membraan weer tanden worden ingeslikt. Het lint schuift als het ware op en blijft daarbij ongeveer even lang.

Een rij telt 75 tandjes bij de in dit artikel beschreven slak. Pas vanaf ongeveer de 15e rij zijn de tandjes functioneel, ze zijn dan volgroeid en hun basale platen kunnen samen een scharnierend geheel vormen, waarin de krachten bij het voedsel schrapen optimaal worden verdeeld (zie Solem, 1972, 1974). Al kort na rij 40 worden beschadigingen zichtbaar, afgebroken spitsen aanvankelijk en later ook krassen. Vlak voor het inslikken zijn de tandspitsen tot stompjes versleten. Al met al blijkt dus dat minder dan de helft van de radulatandjes volgroeid en optimaal gevormd is. Er is geen reden om aan te nemen dat het onderzochte exemplaar in dit opzicht afwijkend was, al is nader onderzoek op dit punt wel gewenst.