Decay rate of shells in aquatic and terrestrial habitats, some comments

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Measuring decay rates of shells in a terrestrial environment should also take into account the bioeroding effects of land snails that use empty shells as a source of calcium for their own shell formation. This amounted to 30% shell weight loss in only two months in my experiment published earlier and was much higher than the 2 to 10% decay in one year measured in nylon mesh bags published recently (Ilarri et al. 2015). This bioerosion is not measured when shell decay on land is studied by placing the decaying shells in nylon mesh bags which living gastropods cannot enter freely. Moreover, shell crushing predators (birds, rats) also play an important role in shell decay. That decay in aquatic environments is 6-12 times higher than on land as published by Ilarri et al. (2015) can be questioned.

Key words: shell decay, terrestrial shells, bioerosion, experiments

Introduction

In an interesting experiment Ilarri et al. (2015) compared decay rates of freshwater bivalve shells in an aquatic and a terrestrial habitat. They sealed 64 single freshwater bivalve shells each in a nylon mesh bag (mesh size 10 mm), tied these to a stake and placed them for one year under circa 70 cm of water 10 m away from the margin of the river Minho (NW Iberian Peninsula). A similar amount of bags with shells was left on land for one year "shells deposited in the sediment surface". (Is it not quite clear whether they were left on the surface or buried in the surface layer). In this paper I compare their data with older studies, partly not mentioned by these authors or cited wrongly, and come to different conclusions.

History of shell decay studies

Already Lyell (1863: 146) wrote that it was not the plan of nature to store animal and plant remains: "it seems to be her chief care to provide the means of disencumbering the habitable areas lying above and below the waters of those myriads of solid skeletons of animals." Deecke (1923: 52) gave some quantitative remarks on decay of shells of terrestrial gastropods: "im Wasser oder auf dem Lande vergeht rasch die Epidermis, dann die Farbe, die Schale wird weiß, matt und brüchig, kreidig, abfärbend und ist schließlich ein Häuflein von Bruchstücken oder ein Pulver. Die Schnecken auf dem Erdboden sind binnen 2-3 Jahren alle verschwunden; im Wasser halten sich die Schalen unter umständen länger, wenn sie in Ruhe bleiben und stärker zusammengehäuft sind." So, in summary, Deecke reported decay of shells on land to be more rapid than under water. Keulen (1998) wrote that empty shells of terrestrial gastropods that remain on the surface become brittle in a few months and have disappeared after about one year. Shell crushing predators (rats, birds) play an important role in removal of shells and fragmentation will also increase dissolution. Graveland et al. (1994) mentioned another factor

in the removal of empty gastropod shells: birds use empty shells as an extra source of calcium in the period of egg-laying. They observed that great tits *Parus major* produced eggs with thin and porous shells caused by calcium deficiency in acidified forests. Snails had become scarce to absent in these forests due to acid rain. Great tits laying eggs with defective shells increased from 10% in 1983-84 to 40% in 1987-88.

Experiment

Being interested in shell decay as a paleontologist, I studied shell taphonomy mainly in the marine environment (e.g. Cadée, 1968), which inspired me to a lifelong research in this field, summarized in Cadée & Wesselingh (2009) and still continuing. However, I did also a decay experiment with terrestrial gastropod shells (*Helix aspersa*) left for several months in a nylon mesh bag on land and following their weight loss. Contrary to what Ilarri et al., (2015) state, these experiments were not done with freshwater shells. I was convinced that this should be a rapid process, otherwise the earth would be littered with empty shells of terrestrial gastropods, which is not the case (Cadée, 1998). A full account of this experiment was published (Cadée, 1999). The result was a weight loss of the separate shells in the nylon mesh bags of 2 -10% in one year. However, shells deposited on the sediment, but not confined to a nylon mesh bag, were disappearing much more rapidly: 30 % weight loss in 2 months. This rapid decay was due to other terrestrial gastropods (*Cepaea nemoralis*) scraping the shells, to get carbonate to construct their own shell. The shells were broken due to this activity and the fragments became too small and therefore difficult to collect quantitatively after already 2 months. I had to finish this part of the experiment. Moreover rats had found my experimental plot and crushed and consumed the *Cepaea*'s feeding there.

Conclusion

Decay rate experiments in nylon mesh bags do mimic only partly what is going on in nature. In the terrestrial environment the decay rate measured by Ilarri et al. (2015) may by a serious underestimate, also mentioned, but not measured, by Pearce (2008). I have no idea whether this shell scraping for collecting carbonate also occurs in the aquatic environment. Certainly we have to take into account that empty shells exposed on the bottom may be invaded by microboring organisms such as cyanophyta and algae, and bacteria feeding on the organic conchioline in the shells. These microboring organisms are better studied in marine environments than in freshwater (Wisshak & Tapanilla, 2008).

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References

Cadée, G.C., 1968. Molluscan biocoenoses and thanatocoenoses in the Ria de Arosa, Galicia, Spain. — Zoologische Verhandelingen, Leiden 95: 1-121.

Cadée, G.C., 1998. Waarom ligt de aarde niet bezaaid met lege schelpen van landslakken? — Correspondentieblad Nederlandse Malacologische Vereniging 304: 111-113. In Dutch, with English summary.

Cadée, G.C., 1999. Bioerosion of shells by terrestrial gastropods. — Lethaia 32: 253-260.

Cadée, G.C. & F.P. Wesselingh, F.P., 2009. Van levend schelpdier naar fossiele schelp: tafonomie van Nederlandse strandschelpen. — Informatieblad Nederlandse Malacologische Vereniging 13: 1-20.

Deecke, W. 1923. Die Fossilisation: 1-216. Borntraeger, Berlin.

Graveland, J., Wal, R. van der, Balen, J.H. van & Noordwijk, A.J. van, 1994. Poor reproduction in forest passerines from decline of snail abundance on acidified soils. — Nature 368: 446-448.

Ilarri, M.I., Souza, A.T. & Sousa, R., 2015. Contrasting decay rates of freshwater bivalves' shells: Aquatic versus terrestrial habitats. — Limnologica 51: 8-14.

Keulen, S.M.A., 1998. Recente en fossiele mollusken van Weustenrade. — Correspondentieblad Nederlandse Malacologische Vereniging 302: 59-63.

Lyell, C., 1863. The geological evidences of the antiquity of man, 2nd ed. rev.: 1-528. John Murray, London.

Pearce, T.A., 2008. When a snail dies in the forest, how long will the shell persist? Effect of dissolution and micro-bioerosion. — American Malacological Bulletin 26: 111-117.

Wisshak, M. & Tapanila, L., eds, 2008. Current developments in bioerosion: 1-499, Springer Verlag, Berlin.