



**VETERINARY INVERTEBRATE
SOCIETY JOURNAL**

ISSUE 4 | SPRING | 2020

CONTENTS

From the Editors	Page 1
The Veterinary Invertebrate Society Steering Committee	Page 2
Trade Show Representation	Page 3
Invertebrate-Friendly Accreditation Scheme Announcement	Page 3
Articles of Interest	Page 3
Shell Deformities in the European Edible Snail (<i>Cornu aspersum</i>) and the Giant African Snail (<i>Achatina achatina</i>) Peer Zwart and John E.Cooper	Page 5
Tribute to Martin Cooke	Page 11
Guidelines for Authors	Page 13

This issue of the *Veterinary Invertebrate Society Journal* is dedicated to Martin Cooke, in recognition of his extensive work with the VIS and towards invertebrate health.

From the Editors

Hello VISJ readers! It is wonderful to be back alive and kicking after our hiatus. Much like a beetle in hibernation, we have revived in the winter and are looking forward to an exciting year ahead.

The journal is run by volunteers who balance hectic lives along with creating and editing this journal. Despite this, the editors here at VISJ strongly believe in the ethos behind the publication. The Veterinary Invertebrate Society Steering Committee also believes that this journal is important to allow an avenue for invertebrate research to be disseminated, especially in such a passionate and active community. We will renew our efforts and continue to publish this journal, bringing case studies and invertebrate expertise to a wider audience.

To this end we have diversified and brought in additional volunteers to help with the journal going forward. We hope these positive steps will allow this publication to improve over time and expand into a much more collaborative endeavour.

Since our previous issue invertebrate medicine has been well represented at several exotic and general veterinary meetings and conferences. Veterinary Invertebrate Society (VIS) members Sarah Pellet and Michelle O'Brien ran a master class at the 2019 ICARE meeting in London. They also lectured at the PALS exotic animal health conference on the topic of invertebrates in general practice. VIS members Steve Trim, Mark Naguib and Benjamin Kennedy presented several lectures at the 2019 BVZS conference. Benjamin also presented a talk on invertebrate medicine at the London Vet Show.

The VIS has extended their involvement in trade shows such as the British Tarantula Society Exhibition and the Southern Invertebrate Show. This highlighted invertebrate medicine and invertebrate vets directly to keepers.



Co-Editor Benjamin



Co-Editor Anne-Sophie

There will be a new edition of “Gregory Lewbart’s Invertebrate Medicine” expected next year, multiple members of the VIS are contributing. This textbook has been the seminal resource for the invertebrate medicine field thus it is exciting to see another edition be published.

In this issue we have a peer-reviewed article by Professor Peer Zwart and Professor John E. Cooper. We would like to take this opportunity to highlight the great work of Peer Zwart of The Netherlands and his dedication over many decades. He has made enormous contributions to our knowledge and understanding of invertebrates.

Since the previous issue, we have sadly lost a member of the VIS Steering Committee, Martin Cooke. We very much mourn his loss as he had a unique influence on our society throughout his life.

Benjamin and Anne-Sophie
VISJ Editors
visjeditor@gmail.com

The Veterinary Invertebrate Society Steering Committee

President	John E Cooper	ngagi2@gmail.com
Secretary	Sarah Pellett	sarah_pellett@hotmail.com
Treasurer	David McHattie	david.mchattie@btconnect.com
Webpage/Academic Liaison	Carol Trim	carol.trim@canterbury.ac.uk
Chairman and Social Media/Industry Liaison	Steve Trim	s.trim@venomtech.co.uk
Membership Secretary/ Nurse Liaison	Emily Draper	emilydraper@icloud.com
Communications	Michelle O'Brien	michelle.obrien@wwt.org.uk
Student Liaison	Tom Bunn	tbunn2@rvc.ac.uk
Science Co-Ordinator	David Williams	dlw33@cam.ac.uk
Co-Editor and Communications	Benjamin Kennedy	bkennedy2@rvc.ac.uk

The Steering Committee are happy to provide advice. Please contact us through the communication channels shown below.



vetinvertsociety@gmail.com



<http://www.facebook.com/vetinvertsoc>



<http://www.linkedin.com/groups8586084>



@vetinvertsoc

Veterinary Invertebrate Society Representation at Trade Shows

We have increased our presence at invertebrate trade shows across the United Kingdom. These events represent an opportunity for the society to highlight invertebrate medicine directly to traders and keepers. Although we do not practice any clinical work at shows we talk extensively about medicine and welfare with owners. There are often significant barriers to open dialogue within the community. This means that commonly known diseases of invertebrates have little to no veterinary representation. 'Black eye' in mantids, for example, is a regularly identified disease presentation within the trade and zoological worlds, however there is very little published on this topic. Discussion at these events helps the flow of important information and identifies specific areas of concern.

Shows are attended by a surprising number of vets and vet nurses thus our presence has also helped to increase our impact within the veterinary profession.

Our society shares its membership with many of the academic and amateur societies. Some of the largest exhibitions, for example the Amateur Entomological Society Exhibition in November and the British Tarantula Society Exhibition in April, are frequently attended by our members. Establishing an official VIS presence at these meetings is therefore quite a straightforward process.

There are unsurprisingly concerns with any exhibition where animals are displayed and sold. We do generally find that show organisers are aware of the problems that can occur and are policing the shows. Many trade shows specifically require 'care sheets' to be given out with animals when sold, however these can be variable in their quality. Fortunately many traders do

take animal husbandry very seriously and will insist on handing out detailed and comprehensive 'care sheets' which the society strongly encourages and applauds.

We encourage members who wish to help at any events attended by the VIS to contact the committee. We love having members hosting the table to show the attendees how passionate we are about invertebrate medicine!

The VIS has been warmly welcomed at all the trade shows attended.



Benjamin Kennedy, Emily Draper, Steve Trim and Carol Trim all representing the society at the British Tarantula Society Exhibition 2019. Image Credit: Steve Trim



Several of our members at the Southern Invertebrate Show in late 2019. Image Credit: John and Margaret Cooper

VIS Practice Accreditation Scheme Announcement

The VIS are excited to announce the production of an Invertebrate-Friendly Practice Accreditation Scheme. This aims to produce a list of veterinary practices that are willing and able to see commonly kept invertebrate species as first opinion or referral.

Successful practices and vets will be listed on our website, there is no application fee however approved vets must be members of the VIS. If you have any questions or comments regarding the scheme or the questionnaire itself, please contact the society at vetinvertsociety@gmail.com

The application form is available on our website:
<https://veterinaryinvertebratesociety.wordpress.com>



Above: Logo that can be used by practices that are accredited with the Veterinary Invertebrate Society.

Articles of Interest

Pellett S & O' Brien M (2019) Exoskeleton Repair in Invertebrates. Veterinary Clinics Exotic Animal Practice 22(2), 315-330

This article provides a comprehensive overview of exoskeleton repair options in different invertebrate species, including gastropods, phasmids and theraphosids.

Pellett S, O'Brien M & Kennedy B (2020) Geriatric Invertebrates. Veterinary Clinics Exotic Animal Practice (in press)

This article provides a review of what is known in regards to geriatric medicine in invertebrate species. This has not previously been covered in great detail within the veterinary field so this article provides a good overview when considering geriatric care in invertebrates.

B. Larouche, Cédric & Beeler-Marfisi, Janet & Attard, Lydia & Nemeth, Nicole & Beaufre, Hugues. (2019). Hemolymph cytology, hemocyte count, glucose, and electrolyte reference intervals in 93 Cameroon red tarantulas (*Hysterocrates gigas*). Veterinary Clinical Pathology. 48. 461-468. 10.1111/vcp.12778.

This article represents a significant step in establishing what is normal in theraphosid haematology, including the different cell types.

Shell deformities in the European edible snail (*Cornu aspersum*) and the giant African snail (*Achatina achatina*)

Peer Zwart¹ and John E. Cooper²¹Department of Veterinary Pathology (Head Prof. Dr. A. Gröne), Utrecht University, Yalelaan 1, NL-3508 TD Utrecht, The Netherlands²Faculty of Veterinary Medicine, Sokoine University of Agriculture, P.O. Box 3000, Morogoro, Tanzania (Present address: Department of Veterinary of Medicine, University of Cambridge, Madingley Road, Cambridge CB3 0ES, UK)

Abstract

Developmental abnormalities, characterised by shell irregularities, occurred in two species of gastropod molluscs, the European edible garden snail (*Cornu aspersum*, (formerly *Helix aspersa*)) in the Netherlands and the African giant land snail (*Achatina achatina*) in Kenya. The lesions are described, both grossly and histologically, discussed and compared. It was concluded that non-infectious stressors were responsible for these abnormalities.

INTRODUCTION

The structure and tensile strength of the mollusc shell have long attracted scientific interest. Such characteristics are important in terms of survival, especially protection against predators, parasites and desiccation. Even the colour of the shell may have an influence on feeding success, as demonstrated in studies on morphs of the land snail *Arianta arbustorum* (Abdel-Rehim, 1987).

The corollary to the above is that pathological changes in the shell can have a markedly deleterious effect on the viability of snails. This in turn can affect profitability when snails are reared in captivity for food (heliculture) or for other purposes.

Numerous traumatic conditions have been reported (Cooper and Knowler, 1991), ranging from minor cracks and (usually only in captivity) gnawing of the shell by mice or snails in their search for calcium, to multiple fractures following falls or damage by birds. The healing of the shell has therefore attracted considerable scientific and lay interest.

Deformities in the shells of snails have long been recognised (Butot, 1976). Such deformities can be divided into 1) hereditary, and 2) acquired. Deformities classified as hereditary can be further split into 1a) morphological abnormalities such as giant- and dwarf-forms, wrong direction of winding, inversodonty and variations in pigment production, and 1b) functional abnormalities, such as albinism, melanism, aphallism, diphallism and parthenogenesis.

Non-hereditary (acquired) deformations are categorised as 2a) abnormalities related to the environment: 2a1) poor growth due to poor environmental factors, 2a2) ecotypes: when snails occur in abnormal places: brackish water, stagnant water, soft soil, 2a3) rich environment: often producing thick shells. 2b) teratological abnormalities such as: unicornia, synophthalmia, incidental giantism, absence of a shell and sudden change in direction of winding (heterostrophia). 2c) accidental deformities such as: formation of pearls, gaping, disruption in colour-pattern, repaired fracture, double mouth (*apertura* = aperture) due to trauma, etc (Butot, 1976; Preston *et al*, 1993).

In this paper we describe a non-hereditary functional abnormality, characterised by shell lesions, in two species and genera of gastropod snail, the European edible snail (*Cornu aspersum*, (formerly *Helix aspersa*)) and the African giant land snail (*Achatina achatina*), on two different continents.

MATERIAL AND METHODS

Cornu aspersum (formerly Helix aspersa)

Fully-grown European edible snails (*C. aspersum*), one year of age, were reared from the egg on a Dutch snail farm. During the summer they had been kept outdoors in raising pens and, when large enough, were transferred to a clover field. At the end of the summer, these animals were collected and

housed indoors during wintertime at 18 °C. The cages were positioned on a carousel, which turned around over a period of 24 hours. At a given place in this circuit, faeces and remains of food were removed by hosing, using water directly from the tap (10 °C). Then they were fed a mixture of equal parts of calf starter- and piglet starter-meal to which soya meal was added. According to the owner, the animals were severely distressed by the management procedure and many refused to feed. After several months, a high percentage of the snails developed irregularities on the shell, which rendered them commercially worthless.

Eight specimens were obtained for study. Four normal animals from the same source were used as controls. Snails were killed with T61® (Hoechst, Germany), injected into the haemocoel. After death, the shell of four of each of abnormal and control specimens was roughly crushed, to allow rapid diffusion of the fixative in the tissues. The shell of the remaining four abnormal animals was left intact. From the latter, soft tissues were pulled out of the shell. Fixation was in 10% neutral buffered formalin. After fixation, remnants of the shells were carefully removed manually and the specimens were longitudinally cut in slices, each 3-4 mm in thickness. Paraffin-sections (5µm) were prepared using standard techniques and stained with haematoxylin and eosin (H & E), von Kossa and other stains as necessary.

Achatina achatina

Four specimens of African giant land snails (*A. achatina*), approximately six months old, were examined initially.

They originated from a commercial snail farm in Kenya, East Africa, where they were reared from the egg, first indoors, then out-of-doors in open enclosures, at ambient temperatures (27- 34 °C) and fed on a locally mixed concentrate diet (12% calcium). After an initially good start, the farm had encountered problems: only 45% of eggs were hatching and of these only 20% reached the stage at which they could be harvested. The main presenting features of affected snails were stunting and abnormal, thickened, shell growth.

Affected and normal *Achatina* snails were subsequently obtained in substantial numbers for clinical, gross *post-mortem* and histopathological examination, as described by Cooper and Knowler (1991). Clinical investigation of live snails included observation of locomotion and assessment of responses to stimuli, comparing affected and apparently normal snails. Snails from both groups were also radiographed. Swabs of external tissues were taken for bacteriological examination before euthanasia.

Gross *post-mortem* examination followed euthanasia using pentobarbitone sodium injected into the haemocoel or placing the snails in a shallow bowl of water containing benzocaine, dissolved in acetone. Once snails were dead, the shells were opened using strong scissors or bone forceps and the internal tissues carefully dissected following the techniques described by Cooper and Knowler (1991). Fixation was in 10% neutral buffered formol saline. Histological sections were prepared as described above but (for reasons of cost) using only H & E and PAS stains.

RESULTS

Cornu aspersum (formerly *Helix aspersa*)

The shells (maximum length 3.4 cm, maximum width 2.5 cm) showed a discoloration and irregularity of the outer aspect of the aperture extending over a distance of 13-17mm (Fig. 1). The abnormal growth mimicked the normal growth of the shell in that the



Figure 1 An affected shell of *Cornu aspersum*.

broadest rim of alteration was generally at the fusion of the windings and the narrowest rim near the columella. In one specimen the change, at its origin, was of a blunt wedge-shaped form; on both sides of the wedge the production of normal shell had continued over a width of 3-5 mm. In a second animal the changes had obviously started on both sides of the aperture i.e. near the columella on one side and near the fusion of windings on the other side, while in the central area normal growth extended over 4 mm in width. The fourth specimen was abnormal in that the apex was slightly flattened with a distinctly thin shell. Irregularity of the surface of the shell in this latter case had probably started shortly after birth. This specimen exhibited four violet-stained longitudinal bands. It was only in the last period that changes of the shell became more severe and were comparable to those in the other specimen over a distance of (at its greatest width) 14 mm, with loss of the violet bands shortly after the most severe alterations had started.

The outer surface of the characteristically altered area was rough, with elevated, irregular rims parallel to the aperture. Over the affected areas, the periostracum was missing. The inner surface was smooth, covered by nacre, slightly irregular with low, parallel ripples, and

elevated islets. The margin between the normal and the affected part was abrupt (Fig. 3.B). It must be noted here that, with minor exceptions, the thickness and density of the shell was normal as demonstrated in transillumination and in radiography. When examined by transillumination, it could be seen that in two specimens the original colour pattern, consisting of four longitudinal violet-stained bands, had persisted over a distance of 3-5 mm to end well before the rim of the aperture. In the other two, the production of violet pigment had stopped simultaneously with the abnormal surface. The lip of the aperture was slightly irregular and thinner than in controls. At the transition of the shell to the aperture, the shell was less curved than in control animals.

A. achatina

Clinical investigations showed that affected *A. achatina* were more sluggish and disinclined to move than their normal counterparts. At an ambient temperature of 26°C normal *A. achatina* placed on a board started to emerge from their shells within 30 seconds; affected snails required, on average, between 1-3 minutes.

The alterations were essentially comparable to those described above, in *C. aspersum*. In one animal changes had started when it had produced four whorls. Then irregularities, parallel to the aperture, developed revealing a rough surface (Fig. 2.). Thick rims occasionally were seen to be stratified when they terminated, much like broken slate. The production of brownish-violet pigment had continued, though in an irregular fashion. These transverse colour-bands were partly broader, partly absent, over a considerable distance. On the inner side, irregularities were especially marked in areas of the thick outer rim. The edge of the aperture was irregular, with alternating thick and thin areas. The form of the aperture itself was also abnormal; irregular, flattened and narrowed. Two specimens were relatively normal in appearance but showed a band, 3 mm in width, of irregularities at some distance from the aperture, before resumption of normal production of shell. Along the aperture there was another 2-3 mm band of irregularity. The fourth specimen had an irregular band only along the aperture, with an irregularly thickened lip to the aperture.

Plain radiography showed no evidence of generalised demineralisation in affected snails but, in some, their more stunted appearance, with thickened rims, was clearly apparent (Fig. 3B).



Figure 2 An affected shell of *Achatina achatina*.

HISTOLOGY

The lesions in the *C. aspersum* and the *A. achatina* were identical. In all pathological cases the mantle, as well as the belt and the groove, showed abnormalities (Fig. 4. and 5.). There was a distinct irregularity in the calcium content of the glands. In some areas, over the full thickness of the mucosa, as demonstrated in the von Kossa stains, the calciferous glands were either free of calcospherites or (rarely) contained only a small number. The transition in the tissues from normal

calcium-containing glands to calcium-free glands was abrupt. In most areas where the glands were free of calcium, the deeper glands, which normally embrace a homogeneous eosinophilic material, contained less protein, this being inferred from the fainter staining of the material.

In the mantle, the belt and the groove, as well as in the foot, irregularly distributed lakes of oedema were subepithelially present. These bulged above the normal surface and were characterised by circumscribed areas,

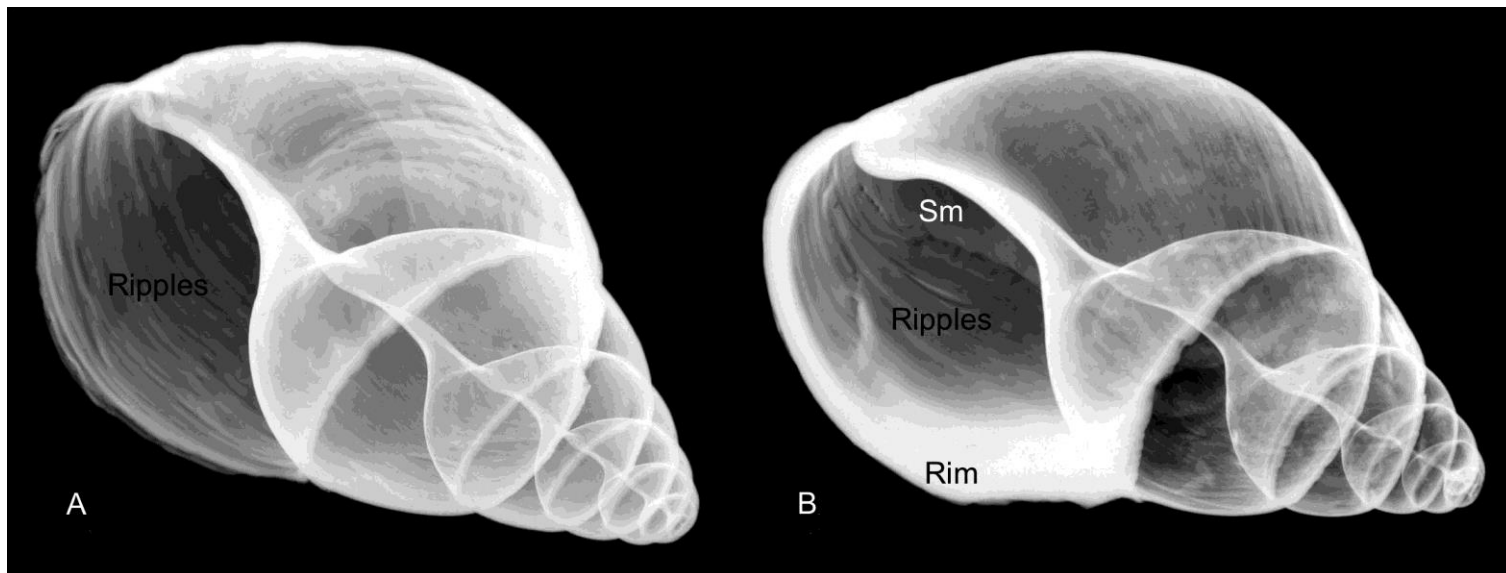


Figure 3 *Achatina achatina*. Plain radiograph showing altered (A) and stunted (B) specimen. Plain radiograph of affected *Achatina achatina*, showing irregularities on the inner side of the shell (A) and stunted appearance, with thickened rims as well as the margin between the smooth (upper right corner) and the ripples produced at the affected inside (B).

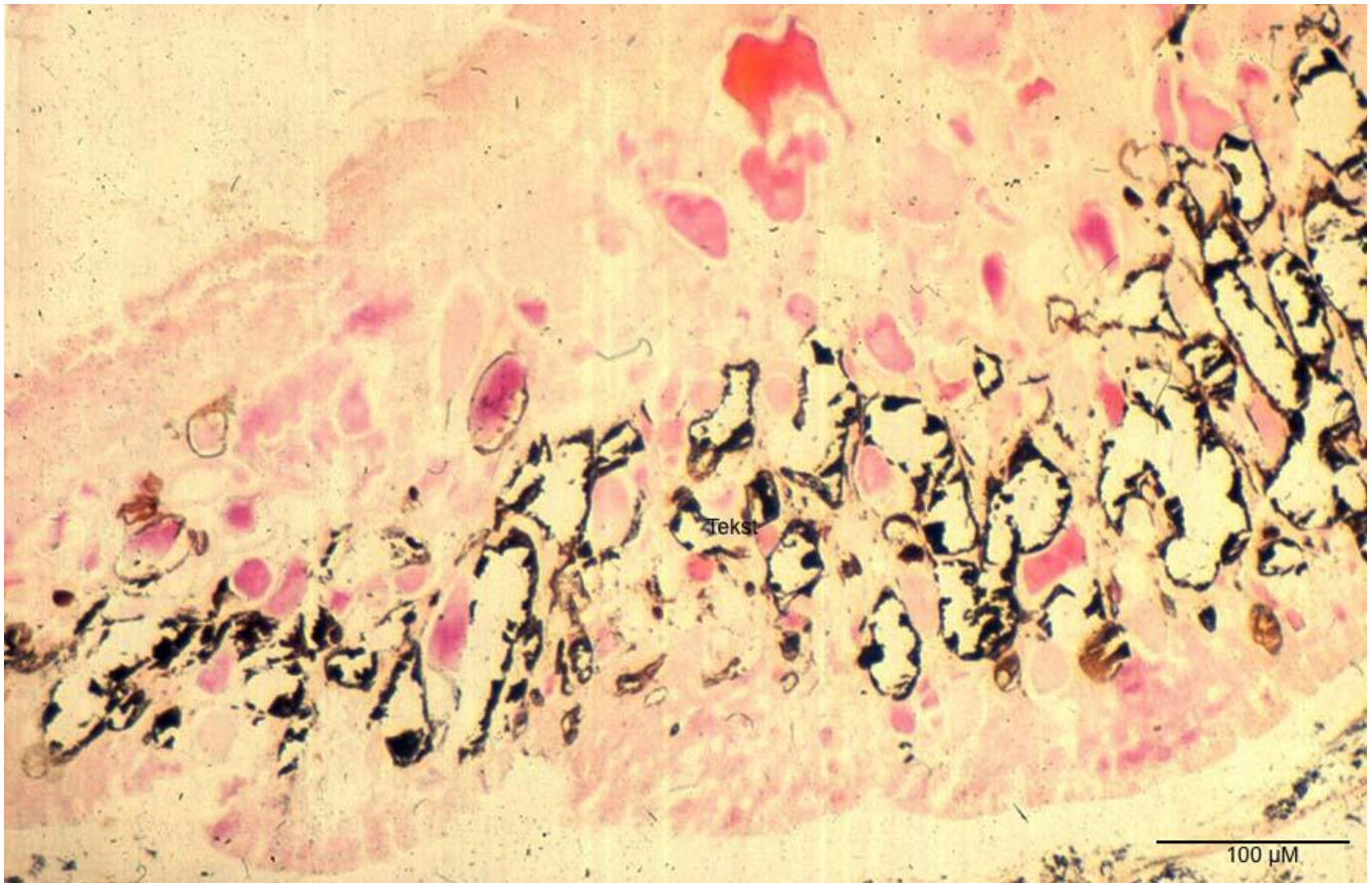


Figure 4 *Cornu aspersum* (normal). All glands contain calcium. Von Kossa. Moderate enlargement.

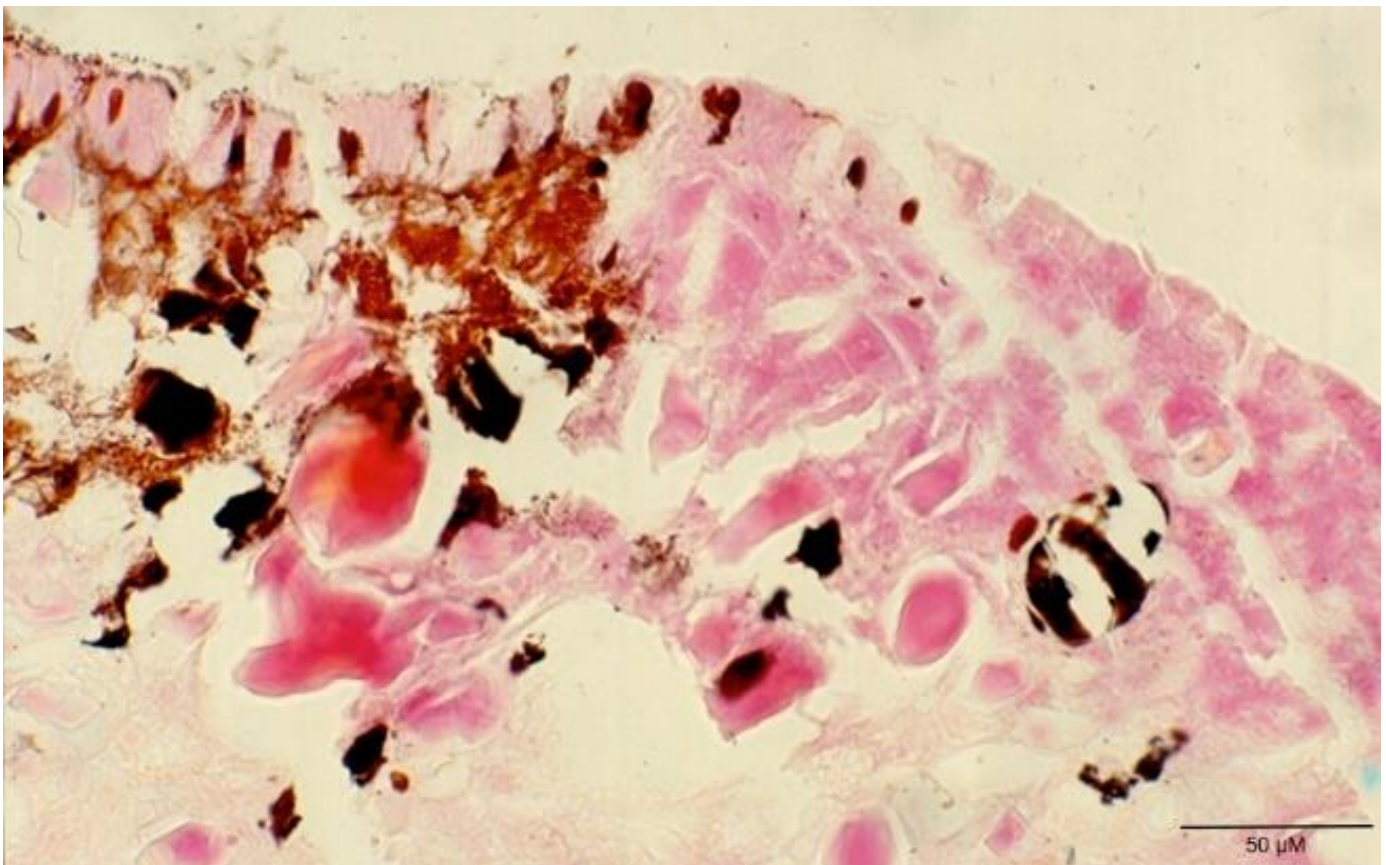


Figure 5 *Cornu aspersum* (affected). Histological section of part of mantle of an abnormal specimen. The glands are partly and irregularly empty; these contain no calcium. Von Kossa. Moderate enlargement.

where cellular elements were pressed apart by the fluid. Changes in the dermal epithelium were related to the extent of the oedema. In less affected areas the epithelium was flatter than normal and cuboidal; the distance between nuclei had increased – indicating a stretching of the epithelium. In pronounced areas, the epithelial cells of the surface were flattened, to the extent that they resembled endothelium. In some places disintegration of the epithelial lining was seen. Within the lakes of oedema, the changes were also related to the amount of fluid. Minimal changes were characterized by a slight increase in the distance between nuclei of interstitial cells. In pronounced areas, only an isolated nucleus of a fibrocyte, thread-like, compressed mucus-secreting cells and an isolated macrophage-like cell could be recognised.

The deposited material was homogeneous. The colour varied. In some locations there was almost no staining reaction with either H & E or PAS, while elsewhere the material was distinctly eosinophilic, and faintly PAS-positive.

DISCUSSION

The shell of land snails comprises three layers. There is an outer organic layer, the periostracum, and two calcareous layers, which consist mainly of calcium carbonate (CaCO₃). The periostracum protects the shell against influences from outside, especially the leaching-out of calcium from the shell (Timmermans, 1969).

The mantle completely covers the inner surface of the shell and surrounds the visceral sac.

Both the periostracum and the calcareous shell are products of the mantle. The periostracum is produced by specific parts of the mantle, namely the posterior (caudal) part of the groove and the belt (Timmermans, 1969). The calcareous shell is generated by the epithelial cells of the remainder of the mantle. The presence of calcium in epithelial cells of the mantle of *Helix pomatia* was demonstrated by Guardabassi and Piacenza (1958). Detailed studies of the mantle in the freshwater snail *Biomphalaria glabrata*

revealed vesicles in the epithelium of all parts of the the outer mantle. These vacuoles contained an ATPase with low affinity to Ca²⁺ and Mg²⁺ ions, while in the cell membranes and membranes of the rER, a high affinity Ca²⁺/Mg²⁺ ATPase was present (Bielefeld *et al*, 1993). This suggests a role of the epithelium in the production of the calciferous shell. Studies on shell repair in the green ormer, *Haliothis tuberculata*, suggested that the epithelium of the calcifying mantle elaborated a complex secreting regime (Fleury *et al*, 2008).

In land-snails the uptake of calcium is from the food. It is then stored in the digestive glands (Burton, 1972) and released, together with other substances, to the mantle.

A remarkable aspect of the shells of the European edible snails and the African giant snails in this study was that the older parts were normal and that there was a sudden transition to an irregular surface. This is suggestive of a change in response to an external factor during the life of the snails.

The changes observed in the mantle, such as complete lack of calcium in irregularly distributed areas of the mantle and the focal oedemata, were probably responsible for both the irregular production of the shell and the absence of the periostracum in the altered parts of the shells.

Prolonged starvation is known to result in alterations to the shell of *Cornu aspersum*. This is due to a release of (mainly) calcium and magnesium from the ostracum and hypostracum of the shell, thus causing a thinning of the shell. The periostracum is little affected by these processes (Porcel *et al*, 1996). The morphology of these physiological processes differs distinctly from our observations in *Cornu aspersum*. It is therefore probable that the irregular distribution of calcium and the oedema in the mantle are related to (if not responsible for) the irregularities in the production of the shell and the absence of the periostracum. A decrease in intracellular pH is a well-established phenomenon during normal dormancy in *Cornu aspersum* (Scholnick *et al*, 1994). In the land snail *Levantina*

hiersolima, nutrient and light restrictions lead to changes in vitamin D metabolism and a redistribution of calcium in the body of the snail (Kriajev and Edelstein, 1995). Stressors such as starvation and hibernation are known to cause significant histological changes in the digestive system of certain snails (Moschovaki-Filippidou *et al.*, 2013).

To the best of our knowledge, the observations detailed in this paper have not previously been described in snails.

The changes in the *C. aspersum* discussed in this study occurred when the animals were kept awake during winter, providing them with TL-light. As a result, the intensity of light was drastically diminished, compared with that of the sunlight during normal activity in summertime. In addition, the animals were severely stressed by the daily cleaning of the cages with cold tap-water, resulting in a diminished intake of food.

In the case of the farmed *A. achatina* the stressor may again have been cold water. The pens were cleaned each morning with water from a hose and this was cooler than the ambient temperature. At the time of investigation many of the snails were aestivating (dry season) but the owners stated that the problems occurred throughout the year.

We suggest that adverse management factors, more especially severe stressors, i.e. sudden cooling, led to a disturbance in the physiology of formation of the shell in farmed *C. aspersum* and *A. achatina*.

The pathogenesis of environmental stress mechanisms in terms of downregulation of protein synthesis was outlined over twenty years ago by Hand and Hardewig (1996).

Interest in environmental stressors and their effect on molluscs is growing apace. A recent paper, for example, described changes in the soft tissues (gills and haemolymph) of mussels together with changes in oxygen

consumption and filtration rate, as a result of noise (Wale *et al.* 2019).

As far as temperature changes are concerned, studies on heat tolerance in land snails by Dittbrenner *et al.* (2009) showed that observed differences in heat tolerance seemed to be connected to the ability for rapid and extreme proliferation of calcium cells in the digestive gland.

It is clear that the role of environmental stressors in molluscs – and the pathogenesis of associated lesions – warrants further detailed investigation.

ACKNOWLEDGEMENTS

We are grateful to Mr and Mrs Ken Oulton in Kenya for permission to report on the *A. achatina* and to colleagues at the Sokoine University of Agriculture, Faculty of Veterinary Medicine, Tanzania, for their assistance in radiographing, sampling and processing. We also thank the technical assistants from the Department of Veterinary Pathology, University of Utrecht for their skilful help in preparing the histological slides.

The background to this study - which dates back to a meeting in 1993 of PZ and JEC in Rome, just prior to the outbreak of genocide in Rwanda - will form the basis of a separate, largely historical, paper.

A number of people kindly read and commented on an earlier draft of this paper including Sarah Pellett, Dr. Bruce Belshaw and Margaret Cooper. The latter also assisted with the studies in Kenya and in the rescue and retrieval of material following its partial destruction in Rwanda.

REFERENCES

- Abdel-Rehim, A.H. (1987): Micro-climatic adaptation and differences in food consumption and assimilation efficiency of different shell colour morphs of the land snail *Arianta arbustorum*. *Journal of Zoology, London*. 211: 717-725.
- Bielefeld, U., Körtje, KH, Rahmann, H. and Becker, W. (1993): The shell-forming mantle epithelium of *Biophalaria glabrata* (pulmonata): ultrastructure, permeability and *Journal of Molluscan Studies* 59: 323-338.
- Burton, R.F. (1972): The storage of calcium and magnesium and of calcite in the digestive glands of the pulmonate (gastropoda). *Comparative Biochemistry and Physiology* 43A; 655-663.
- Butot, L.J.M. (1976): Afwijkingen bij molluscen (Dutch) (Deformities in molluscs). *De Kreukel* 12; 8-9 and 99-107.
- Cooper, J.E. and Knowler, C. (1991): Snails and snail farming: an introduction for the veterinary profession. *Veterinary Record* 129: 541-549.
- Dittbrenner, N., Lazzara, R., Köhler, HR., Mazzia, C., Capowiez, Y. and Triebkorn, R. (2009): Heat tolerance in Mediterranean land snails: histopathology after exposure to different temperature regimes. *Journal of Molluscan Studies* 75(1):9-18.
- Fleury, C., Marin, F., Marie, B., Luquet, G., Thomas, J., Serpentine, C.J.A., Lebel, J.M. (2008): Shell repair process in the green ormer *Haliotis tuberculata*: A histological and microstructural study. *Tissue and Cell* 40: 207-218.
- Guardabassi, A. and Piacenza, M.L. (1958): Le manteau de l'escargot *Helix pomatia*. étude cytologique et histochimique. *Archives d'anatomie microscopique et de morphologie experimentale* exp. 47: 25-46.
- Hand, S. C. and Hardewig, I. (1996): Downregulation of cellular metabolism during environmental stress: mechanisms and implications. *Annual Review of Physiology* 58: 539-563.
- Kriajev, L. and S. Edelstein (1995). Effect of light and nutrient restriction on the metabolism of calcium and vitamin D in land snails. *Journal of Experimental Zoology* 272(2); 153-158.
- Moschovaki-Filippidou, F., Itziou, A. and Dimitriadis, V.K. (2013). Effect of starvation and hibernation on the values of five biomarkers of general and specific stress using the land snail *Eobania vermiculata*. *Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology*. 165(4): 236-242.
- Porcel, D., Bueno, J.D., Almendros, A. (1996). Alterations in the digestive gland and shell of the snail *Helix aspersa* Muller (Gastropoda, Pulmonata) after prolonged starvation. *Comparative Biochemistry and Physiology A Physiology* 115(1): 11-17.
- Preston, S. J., Roberts, D., Montgomery, W.I. (1993): Shell scarring in *Calliostoma zizyphinum* (Prosobranchia: Trochidae) from Strangford lough, Northwest Ireland. *Journal of Molluscan Studies* 59: 211-222.
- Scholnick, D.A., Snyder, G.K., Spell, A.R. (1994). Acid-base status of a pulmonate land snail (*Helix aspersa*) and a prosobranch amphibious snail (*Pomacea bridgesi*) during dormancy. *Journal of Experimental Zoology* 268: 292-298.
- Timmermans, L.P.M. (1969). Studies in shell formation in molluscs. *Netherlands Journal of Zoology* 19(4); 417-523.
- Wale, M. A., Briers, R. A., Hart, M. G. J., Bryson, D. and Diele, K. (2019). From DNA to ecological performance: Effects of anthropogenic noise on a reef-building mussel. *Science of The Total Environment* 689: 126-132.

Tribute to Martin Cooke

Dr Martin Cooke MSc, MA, VetMB, MRCVS, CertVPH(MH)

We include here a tribute to our colleague and friend Martin, who was treasurer of this society until just before his passing. He ensured that this role was passed on to David McHattie, who penned this article in his memory (with editing provided by the VISJ editorial team).

Martin was born in Tunbridge, Kent in 1959, attending preparatory school locally before boarding at The Kings School, Canterbury. Martin would later graduate from Selwyn College, Cambridge in 1983. Martin took a broad view of the concept of animals committed to his care. He believed that to make things better for animals, you had to make things better for people too. In this respect it is no surprise that he would eventually become involved with invertebrates in addition to his many other interests.

Martin was driven by his desire to make a difference through his actions – to leave things better than he had found them. Martin's compulsion to fix things was evident to all of us who knew him. He never stopped trying to fix his model aeroplanes, which he loved flying, but invariably landed badly. This did not daunt him in his love of flying objects. Fireworks were another passion, which his grandchildren encouraged with their love of rockets.

Martin's first veterinary role was in mixed practice in Llangollen, Denbighshire, and from there he moved to the Towcester Veterinary Practice, Northamptonshire. It was here that he first took on the Official Veterinary Surgeon (Meat Hygiene) role. He was an OVS for the next ten years, all through the Bovine Spongiform Encephalopathy era. Martin Cooke Associates was created and was responsible for dozens of abattoirs in the UK, from the biggest to the smallest, and also the welfare of the millions of cattle, sheep, pigs and poultry they processed. During this time Martin became involved in veterinary politics. He was the president of the Veterinary Public Health Association and chair of the 'Under 35s' BVA group, which was trying to tackle the concerns of the younger members of the profession. Martin influenced the formation and early life of the Meat Hygiene Service, now the Food Standards Agency.

In 1994, Martin through his partner Christina became involved with Earthkind, an animal welfare, education and conservation charity. It had just acquired a 200 tonne former Norwegian whaler, renamed as Ocean Defender. This transformed whaler was now a platform for volunteer crews to recover and treat wildlife casualties, which were often inaccessible to land based teams. Martin was asked to design an on-board wildlife hospital and to train crews in wildlife rescue, care and rehabilitation. Alongside the volunteers he had trained they were deployed in four major oilspills and numerous minor pollution incidents over the next ten years, including the Sea Empress in Wales, the Erika in Brittany, the Pallas in Friesland and the Treasure in South Africa.

In 1996 Martin decided that he would have to go and learn how to do wildlife medicine properly and so enrolled on the MSc in Wild Animal Health at the Institute of Zoology. He thoroughly enjoyed his time working with the collections at London and Whipsnade zoos and this ultimately led to Martin becoming a Fellow, then election to the Council of Trustees of the Zoological Society of London. Martin was interested in the harm to wildlife caused through human activities, and so was accepted onto a PhD programme on exploitation of the Radiated Tortoise in Madagascar. At the same time he was recruited for a six month contract at Tesco, responsible for farm to fork animal welfare, husbandry, food safety and quality programmes across all animal derived foods, this was a great way to fund his PhD, or so he thought.

At the end of the six months he had to make a tough choice: to go back to the fascinating adventure of working in Madagascar or to stay at Tesco where his ability to drive improvement helped develop the policies and procedures for livestock production that underpin not only the company's position today, but also the development of standards such as Red Tractor and Global GAP. Whilst at Tesco's he was asked to lead the company's programme on ethical trade, which was about ensuring decent working conditions for the people who made the products the company sold. This led later to Martin becoming the Deputy Director of the Ethical Trading Initiative (ETI).



Martin would eventually join the WSPA, now World Animal Protection. Here he led their corporate engagement programme, influencing companies to improve animal welfare on a big scale. He developed partnerships for animal welfare with corporate giants, such as Nestlé, BRF, IKEA, Bayer Animal Health and Abbott Nutrition. He influenced their animal welfare policies, implementation and performance globally. He worked with farmers and others responsible for animal care from California to China, from Brazil to Tasmania, and conducted animal welfare workshops and provided support and advice in dozens of countries often where English was not the first language and cultural norms were very different from our own.

Martin was firstly involved in the Veterinary Invertebrate Society as the editor of the newsletter before it would be revitalised as the VISJ. Martin's interest in the unrepresented creatures around us was obvious, and it was no surprise that he was a long-time member of this society, and in many

respects his passion and friendly manner would reflect in some of the principles that make this society worthwhile. He continued to be involved when the society came out of its quiet period, offering to become its treasurer. He would become an invaluable part of the Steering Committee and would do much to bring the society into the 21st century. This has enabled this society to thrive and expand, including allowing payments to occur online, a real game changer. Martin was involved in many of the VIS conferences run in its modern era and would often be the first person that would welcome members when they arrived. We will sorely miss his direct presence within our society, but we know that Martin's efforts and values will continue to be felt for many years into the future.



Guidelines for Authors – Veterinary Invertebrate Society Journal

Aims and Scope of Journal

The Veterinary Invertebrate Society Journal endeavours to be a point of reference for vets and academics for current and upcoming research into invertebrate medicine, welfare and conservation. There will be a focus on the practical application of veterinary principles and research to invertebrate species. This journal is an open access journal with no publication or submission fees. Prior to open publication, the journal is accessible by members of the Veterinary Invertebrate Society.

The journal accepts submissions of clinical case reports, original research papers, review articles and short communications.

Authorship

Authors should only be listed if they have made a significant contribution to the data and work involved in any submission. One author should be nominated as the corresponding author. The contact details of this author will be present alongside the published paper. As a rough guide contributors should have contributed at least 15% of the work to be an author or else should be recognized in the acknowledgements. Authors may be asked to produce a short biography for the membership to go alongside the article.

The journal has a philosophy of promoting young authors and researchers so welcomes submissions from university students.

Authors should disclose if they have any conflicts of interest in regard to data expressed or conclusions taken.

Manuscript Submission and Peer Review

Manuscripts should be submitted directly to the editor via email at visjeditor@gmail.com. This journal does not have any submission fees. As this journal is primarily published online, there are no figure or table fees.

Type of submission (as detailed further on in this document) should be detailed during submission.

The editor has full responsibility for the review process. At least two academic or clinical reviewers will be selected should peer review be applicable to the article submitted.

The peer review process will be double blinded and authors may be required to revise the manuscript dependent on the comments made by reviewers. Additional reviewers may be utilised for additional review if revision involves significant change to the manuscript.

Readership

This journal will initially be published to paid members of the Veterinary Invertebrate Society. After a period of four months, the journal will be published online through social media, the society website and through a mailing list. Following this period, access to the journal will be free and not dependent on membership.

Manuscript Formatting

The manuscript font should be “Arial” of size 12 point with single spacing. Text should be aligned to the left. Formatting that may be used includes bold, italics, superscript and subscript. Avoidance of personal pronouns is expected (i.e. “We”, “I” and “Our”). American and British English may be used but it is expected that this be consistent throughout the manuscript. It is expected that submitted articles will be written in clear English and will be spell and grammar checked before submission.

The Harvard referencing style is used within this journal (e.g. Vega, F.E., 2008. Insect pathology and fungal endophytes. *Journal of invertebrate pathology*, 98(3), pp.277-279).

Abbreviations must be explained and elaborated on within the text. Numbers between one and nine should be expressed in words unless they are

used with respect to units or mathematical symbols (e.g. 3 grams or 2%).

Articles should be submitted with a title page. This should include the manuscript title, authors and organisation affiliations of all authors.

Tables and figures should be referenced in the text and have a descriptive legend that can be understood alone.

Drugs should be stated by their generic names with the trade formulation in brackets with the manufacturer (e.g. meloxicam (Metacam, oral suspension for cats, Boehringer Ingelheim)). This nomenclature will also apply to diagnostic tests and laboratory equipment where appropriate.

Genus and species names should be italicised when scientific names are used. Due to the variable and dynamic taxonomic status of invertebrates, it is recommended to cite the species authority when discussing taxa as this will make it clear which species is being discussed.

Apart from opinion/end piece articles, all submissions should include a 250 word abstract.

Article Types

The maximum length of articles are expressed below.

Article Type	Word Length
Original Research Paper	3000
Opinion/End Piece Article	700
Short Communication	1000
Case Reports and Series	1500
Review Article	3000

The following articles types will be included in the journal:

Opinion Pieces/End-piece Articles

These articles are more informal and opinion-based though appropriate references are expected when factual discussion is undertaken. These articles are designed to inform the journal readership on a specific area within invertebrate medicine.

Short Communication

Short communications should provide novel information on current research or clinical cases. They differ from original research papers in their scope and involvement. These submissions should typically involve some novel information or species which have not been reported on previously. New information should be placed in the context of existing literature. Headings should include: Short communication and references.

Case Reports and Series

Case reports will focus on a specific invertebrate species with a core clinical focus. This can involve a novel disease, treatment, diagnostic process or follow up of a previously reported presentation.

These should be formatted as: Initial Presentation, History and Clinical Exam, Diagnostics, Treatment, Discussion, Acknowledgements, and References.

Original Research Papers

Original research papers should report the results of original research that has not been reported elsewhere. Authors should contact the editor if there is a query to what constitutes existing preliminary reports (i.e. presentation or prior publication), though generally if research has been previously reported at a conference in preliminary form as an abstract of less than 250 words then it would still be acceptable for this research to be published in this journal.

Original research papers should be formatted as: Introduction, Materials and Methods, Results, Discussion, Conclusions, Acknowledgements and References.

Review Article

A review should report on the current research and discussion around a specific disease or relevant clinical area. It is advisable that a specific invertebrate family or species is the focus of an article, as the entirety of invertebrates as a group can be diverse and challenging to discuss easily. Their format will be similar to original research papers

Copyright

Unless stated otherwise, all articles published through this journal are published under the CC-BY creative commons license i.e. others may freely access, copy and use research, provided the author is correctly attributed, and the author retains copyright of the article.

Authors may modify the creative commons license through communication with the editor during acceptance of the article. This may be done with respect to previous copyright of data or images used in the article.

Article Submission – The Veterinary Invertebrate Society Journal welcomes articles on all aspects of invertebrate health, medicine and welfare. We favour articles that involve practical application of veterinary principles to invertebrates and their care.

We seek clinical case reports, original research findings, review articles, meeting reviews and short communications. We intend to produce a journal of a high standard and so we may choose to reject an article that is poorly written or not up to a reasonable academic standard. Peer review will be provided as appropriate to the article submitted. This journal is published in the English language thus submissions will need to be in English. **There are no submission fees for this journal.**

Please do not hesitate to contact the editor for guidelines (published in this issue) should you wish to submit an article. Contact: visjeditor@gmail.com

VETERINARY INVERTEBRATE SOCIETY JOURNAL
ISSUE 4 | SPRING | 2020



COVER IMAGE CREDIT: ULLEO PIXALBAY
END PAGE CREDIT: ABDUL MOMIN WIKIMEDIA