VETERINARY INVERTEBRATE SOCIETY JOURNAL

ISSUE 2 | SPRING | 2018

CONTENTS

Cover Image Credit:
Octopus tetricus (common Sydney octopus)
Author: Sylke Rohrlach

End page Credit:
Giant African Land Snail
http://sonelcorner.wordpress.com/

Journal proof-reader:
Anne-Sophie Warner

From the Editor

Welcome to the second issue of the Journal of the Veterinary Invertebrate Society. We would like to thank all of you that sent messages of support following the first issue. It is encouraging to see that our work is being well received. We as a society are proud to be putting a spotlight on the work that is being done within invertebrate medicine.

The new year is going very well for the society with a joint meeting with the British Bee Veterinary Association going ahead on Saturday 19th May 2018. This has already produced a good response with some exciting lectures and speakers lined-up. Please see the provisional program later on in this issue for more details.

The Veterinary Invertebrate Society is now officially affiliated with the Amateur Entomologists' Society. The two societies hope to work together to improve knowledge on maintaining good invertebrate health.

Academic work continues within the membership. Sarah Pellet, Steve Trim and Benjamin Kennedy are undertaking various projects including:

- Faecal analysis of a variety of invertebrate species.
- Establishing normal invertebrate histology.
- Establishing safe and effective doses of veterinary medicines in food invertebrates.

If anyone has some resources that may be helpful for one of these projects then please do get in touch.

The Society was recently represented at the Royal Entomological Society meeting on entomophagy where we developed links within the insect farming community and the different stake holders in food arthropod care.

This industry has grown rapidly in recent years due to the potential of insect proteins within agricultual animal feeds and for human consumption.

The steering committee through Martin Cooke supported a petition by The Crustacean Alliance for improved consideration of their welfare under law. It is encouraging to see invertebrate welfare receiving more attention within the media.

The introduction of membership fees has gone smoothly, providing our society with enough revenue to support this publication, as well as providing a buffer for running lectures and meetings.

In this issue we have a fascinating review of octopus autophagy. We have a short report on the Kipepeo workshop on invertebrate health. We have a case report of a theraphosid spider and an article on the impact of invertebrates on mortality data of zoological collections.

We continue to welcome new articles involving invertebrates seen in practice and academia. If anyone would like to submit an article then we welcome your involvement.

Please e-mail any submissions or queries to bkennedy2@rvc.ac.uk.

Veterinary Invertebrate Society Steering Committee

President	John E Cooper	ngagi2@gmail.com
Secretary	Sarah Pellett	sarah_pellett@hotmail.com
Treasurer	Martin Cooke	martin@ocatra.com
Webpage/Academic Liaison	Carol Trim	carol.trim@canterbury.ac.uk
Social Media, Industry Liaison and Chairman	Steve Trim	s.trim@venomtech.co.uk
Membership Secretary/ Nurse Liaison	Emily Draper	emilydraper@icloud.com
Meeting Co-ordinator	Chris Palgrave	c.palgrave@surrey.ac.uk
Zoo Liaison	Marie Kubiak	kubiakvet@gmail.com
Student Liaison	Tom Bunn	tbunn2@rvc.ac.uk
Committee Member	David Williams	dlw33@cam.ac.uk
Journal and Communications	Benjamin Kennedy	bkennedy2@rvc.ac.uk

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

Vetinvertsoc@gmail.com

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

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

@vetinvertesoc

Kipepeo Workshop on Health and Welfare of Invertebrates

John E Cooper, DTVM, FRCPath, FRSB, CBiol, FRCVS
Margaret E Cooper, LLB, FLS

A One-Day Workshop on the Health and Welfare of Invertebrates, particularly butterflies, was held at Kipepeo, situated at Gedi Historical Site, a village near the coastal town of Malindi in Kenya, on Wednesday 21st February 2018. The Kipepeo Project involves communities who live on the margins of the Arabuko-Sokoke Forest. Local people rear butterflies of certain species, using eggs from females that have been collected in the forest. The Kipepeo Project at Gedi then packs these as pupae and sends them to butterfly houses in Europe and North America. This arrangement not only assists local people to earn an income but also provides an incentive for them to protect the Arabuko-Sokoke Forest and its various endemic and endangered species of fauna and flora.

The Workshop in February was organised under the auspices of the National Museums of Kenya (NMK) and was run by the staff of Kipepeo and Mombasa Butterfly House (MBH). The tutors and demonstrators were Mr Hussein Aden, Mr Laban Njoroge, Prof. John E Cooper and Mrs Margaret E Cooper. This intensive training day was primarily intended for the staff of Kipepeo and the Mombasa Butterfly House but it also attracted some others who work with Invertebrates or have an interest in their care in captivity and their conservation in the wild. These included two Kenyan registered veterinary surgeons involved in the licensing of animals and animal products. A total of 41 people participated in the day's activities, including 25 involved locally in the "farming/breeding" of butterflies.

In his opening remarks, Hussein Aden gave a welcome to Kipepeo and the workshop. John and Margaret Cooper then led the preliminary session. Amongst those welcomed as guests were Dr Ian Gordon, now resident in Rwanda, who had started the Kipepeo Project in 1993. He outlined its history, aims and achievements. Another invited guest was Mr Mike Clifton, an experienced entomologist who has lived and worked in Kenya for many years.

The bulk of the morning consisted of lectures, delivered in a mixture of English and Swahili. The topics covered were "Introduction to invertebrates "(Laban Njoroge), "Legal and ethical aspects of keeping invertebrates in captivity" (Margaret E Cooper), "Invertebrate health" (John E Cooper), and a description of the work of Kipepeo and the Mombasa Butterfly House (Hussein Aden). The last of these was combined with an opportunity for the farmers/breeders to discuss their work and problems they encounter in respect of butterfly health.

The afternoon comprised practical work. Participants looked at live butterflies and viewed enclosures under the guidance of Hussein Aden and other Kipepeo staff and with input from Ian Gordon and Mike Clifton. The tour of the facilities was followed by a "hands-on" session in which Laban Njoroge and John Cooper demonstrated the gross examination of different stages of Lepidoptera and taught methods of dissection and investigation - including the taking of samples from butterflies for microscopy. Portable field equipment was used for this work, to illustrate how such procedures do not initially depend on sophisticated laboratory facilities. The day finished with a discussion period, after which certificates were presented by Margaret Cooper to all registrants and those who assisted in the organisation.

This workshop at Kipepeo has been a success with much learned by all parties. It was almost certainly the first time in Kenya, probably in Africa, that such a workshop, discussing the health of butterflies and linking this with welfare, conservation and sustainable use, had taken place. Discussions are underway as to how the workshop could be developed and enhanced, not only so that it might benefit the work of Kipepeo and the Mombasa Butterfly House but also to its contributing to the scope of Kenyan entomology and the promotion of the country's ecosystem health. One proposal is to organise a more in-depth, scientific, training session on invertebrate health and diseases in Nairobi, probably in the Entomology Section of the National Museums of Kenya. Further information about this will be announced in due course.

We are grateful to the Zoological Society of London (ZSL), the Veterinary Invertebrate Society (VIS), Dr John Ballany, Mr Paul Pearce-Kelly and Mrs Jeannie Knocker for their support and encouragement and to the Director-General of the National Museums of Kenya, Dr Mzalendo Kibunjia, for authorising the workshop.

VIS and BBVA Joint Spring Scientific Meeting
Saturday 19th May 2018
University of Surrey

Provisional Program

Kindly sponsored by

Kindly sponsored by

10.00 Arrival. Coffee. Viewing of literature.

10.30 Welcome to Surrey University
Dr Chris Palgrave
Welcome to the VIS Meeting
Steven Trim
Welcome to the BBVA Meeting
Dr John Hill

Session 1:
BBVA Chairman: Dr John Hill

11.00 Keynote speaker: Foul Brood disease.
Giles Budge

12.00 Keynote speaker: Chronic Bee Paralysis Virus.
Giles Budge

13.00 Lunch

Session 2:
VIS Chairman: Steven Trim

14.15 Keynote speaker: Leaf cutter ants and colony collapse.
Andrew Stephenson

15.00 Invertebrate sentience: Exploring the minds of invertebrates.
Helen Lambert

15.30 The approach to common conditions in pet invertebrates.
Marie Kubiak

15.45 Insects as feed for livestock - Perspectives from a new industry
Joe Halstead

16.00 Invertebrate faecal microbes and parasites: a pilot study
Sarah Pellet (Co-Authors:

16.15 Tea. Final discussion. Close of meeting.

Tickets are available for £80 for 6 hours of CPD. This will include lunch and parking at the venue. Veterinary student tickets are free but registration is required.

For more information and to buy tickets, please visit the VIS website:
https://veterinaryinvertebratesociety.wordpress.com/

Treatment of traumatic conspecific bite in *Poecilotheria regalis*

Steve Trim BSc (Hons) CBiol MRSB

Abstract

Captive breeding is an important part of maintaining Theraphosid spiders in captivity. As obligate predators there is a high risk of cannibalism, before, during or after copulation. This case study documents the successful treatment of a traumatic bite wound to the dorsal prosoma of a male Indian Ornamental Spider (*Poecilotheria regalis*). The male was bitten by a larger female as a result of a failed mating attempt. The wound was sealed with commercial superglue and resulted in a successful recovery and return to normal behaviours. One month post treatment the male was ready for further mating attempts.

Introduction

Trauma treatment in arthropods is always challenging as the exoskeleton has low flexibility in many regions. In theraphosid spiders (commonly called tarantulas) the dorsal prosoma is particularly rigid and thus traumatic injury has a high likelihood of leaving an open would which could lead to life threatening haemolymph loss. The prosoma also contains the neuronal ganglia, eyes and pumping stomach which could also lead to life threatening injuries. Arthropod haemolymph clots through proteolytic cascades that lead to conversion of coagulogen into insoluble coagulin. However, this process is inefficient at closing large wounds. In veterinary clinics sterile tissue glue is used for wound closure in invertebrates (Pellet, 2015). These glues are based on cyanoacrylate with butly or octyl groups which are weaker but less toxic that standard superglue with methyl or ethyl groups (Ayyıldız, 2017). Outside of the veterinary surgery these tissue glues are rarely available and thus standard superglue appears to be well tolerated, although full studies have not been performed.

Theraphosid spiders are obligate predators and thus any interaction between two spiders has a high chance of fatal injury, even breeding. Successful breeding attempts involve well fed females and a period of protected acclimatisation such that both spiders are aware of the other but unable to make contact. Following this protocol the author has successfully bred several species, including *Poecilotheria regalis*. Even after careful observations of behaviour any incompatibility is usually met with a feeding response from the female.

Case Study

The patient was a 13 cm legspan male Indian Ornamental spider (*Poecilotheria regalis*) presenting with two large puncture wounds in the dorsal prosoma, proximal to the eye turret.

History – A male and large juvenile female *P. regalis* were acquired for breeding project in February 2017. They were housed in 20cm x 20cm x 30cm (w x l x h) glass terraria with wire mesh top (Exo Terra), hide internal décor, water bowl as described in Bennie, 2011, and moist coir used as substrate. Vertical heatmat (Habistat) with thermostat was used to maintain 25°C ambient temperature in both enclosures. During the previous 12 months the female had completed ecdysis twice and was deemed to be adult at 15 cm leg span, i.e. larger than the adult male. On the evening of the 23rdJanuary 2018 the glass fronts of the two enclosures were opened and the enclosures placed together for mating (figure 1).

After about 30 minutes the male started drumming his palpal balbs on the sides of the enclosure and the female responded by drumming a quieter reply, as expected (figure 2). After two hours and several mating attempts the male still hadn't been successful. The female then struck from beside the male, her fangs pierced the dorsal prosoma of the male with an audible crunch. The female was quickly removed from the male with rubber tipped forceps and both spiders were restrained in plastic spider catchers (top 20 cm from two litre soda bottles). The male was inspected, and haemolymph was seen leaking from the prosoma injury and single drops were also noticed on the 2nd joints of the pedipalps but these were not increasing in size. The patient was still maintaining a normal posture however was slow to move. Cyanoacrylate glue (Bostick) was applied directly to the haemolymph leak which sealed the wound and stopped the haemolymph leakage. Less than 10 minutes elapsed between bite and photo of closed wound (figure 3). Both spiders were returned to their home enclosures for monitoring. Initially the patient was hunched up in the corner of the enclosure but after two hours had climbed up the side of the enclosure and was seen resting in a normal posture. After five days the patient was offered food (medium locust) but did not feed, this is usual for older males and this specimen was feeding bi-monthly prior to injury.

Approximately one month post injury the male was once again given the opportunity to mate. The enclosures were put together at 12:55 on 26th Feb 2018, the male immediately started drumming as before and the female replied with softer beats, she followed him around the enclosure as expected. The female presented her ventral side and the male approached but clearly made some undetectable error and was attacked a second time, this was terminal and the patient was eaten. Thus the body was not available for post-mortem analysis.

Discussion

Unlike snakes, there are no studies on whether spiders are immune to the effects of their own venom. It is expected that, as female spiders have attacked males and usually proceed to

eat their conspecifics, they envenom their prey. Prior to this case it is unclear whether a male has survived a feeding bite from a female before. In humans *P. regalis* venom causes spastic muscle contractions and intense pain (Ahmed, 2009), thus if the males were susceptible to the female's venom similar neuromuscular signs would be apparent, assuming envenomation had occurred.

Formaldehyde toxicity in arthropods also causes neurotoxic signs with a median lethal dose of 1.54mg/g (Elmore, 1936), it is not expected that commercial superglue used in wound closure would reach this concentration. No toxicity was observed in the patient, either from envenomation or glue toxicity.

It is impossible without post-mortem to determine if the patient's anorexia was due to traumatic injury to the pumping stomach, stress or just old age.

Conclusion

Cyanoacrylate glue is sufficient to close major prosoma trauma in Theraphosidae spiders. In emergencies, small amounts of commercial superglue are useful alternatives to tissue glue.

References

Ahmed, N., Pinkham, M. & Warrell, D. Symptom in search of a toxin: muscle spasms following bites by Old World tarantula spiders (Lampropelma nigerrimum, Pterinochilus murinus, Poecilotheria regalis) with review. QJM 102, 851–857 (2009).

Ayyıldız, S.N and Ayyıldız, A. Cyanoacrylic tissue glues: Biochemical properties and their usage in urology. Turk J Urol. 43(1): 14–24 (2017).

Bennie, M., Loaring, C. & Trim, S. Laboratory husbandry of arboreal tarantulas (Theraphosidae) and evaluation of environmental enrichment. Animal Technology and Welfare 10, 163–169 (2011).

Elmore, J. C. & Richardson, C. H. Toxic Action of Formaldehyde on the Adult House Fly Musca domestica L. Journal of Economic Entomology; 29(2) 426-433 (1936).

Loof, T.G., Schmidt, O., Herwald, H. & Theopold, U. Coagulation Systems of Invertebrates and Vertebrates and Their Roles in Innate Immunity: The Same Side of Two Coins? J Innate Immun 3:34–40 (2011).

Pellet, S., Bushell, M. & Trim, S. A. Tarantula husbandry and critical care. Companion Animal 20, 54–60 (2015).

Figure 2 - Enclosure placed together for breeding

Figure 1 – Male approaching the female as part of the mating behaviour

Figure 3 - Dorsal prosoma wound closed with cyanoacrylate glue.

A Review of the Aetiology, Prevention and Treatment of Autophagy in Different Octopus Species.

Heather Coupe

Heather Coupe is a 3rd year veterinary student at the University of Bristol. Interests include zoological and wildlife medicine.
Email - heathercoupe@outlook.com

Introduction

Autophagy, a form of automutilation, is a behaviour distinct from cannibalism that causes various octopod species to eat parts of their own arms (Budelmann 1998). Research into the aetiology of this phenomenon is in its infancy, with limited data currently available. Suggested causes have included stress, hunger and endogenously produced chemicals released by those affected, but recent research is now suggesting an infectious cause.

A study of 161 cases in *Octopus vulgaris* (Common Octopus) indicates that autophagy is caused by an infectious syndrome. Observations suggest that autophagy takes 5-17 days to become apparent in closed seawater systems, with an assumed incubation period of between 1-2 weeks, and death occurring 1-2 days after onset of clinical signs (Budelmann 1998). Hunger has been rejected as the primary cause as animals were seen feeding regularly until the day before autophagy was observed. Further to this, larger sections of the arm that were bitten off remained uneaten (Budelmann 1998). This data indicates that the causative agent bypasses both biological and sand filters in closed seawater systems, hypothesising the cause as either an endogenous chemical released by infected individuals or a pathogenic microorganism.

Another report furthers this theory, suggesting that bacterial/viral entry into the skin, exacerbated by stress, elicits biting behaviour to alleviate irritation of the epidermis (Dunlop 2013). It theorises that by biting off the infected arm, the individual loses the infected arm with the aim of re-growing a healthier one in its place. Captive octopods are thought to remain infected, seemingly due to poor water quality, and die for this reason.

A clear correlation between senescence and autophagy of the arms has also been observed in *Enteroctopus dolfeini* (Giant Pacific Octopus), especially in males (Anderson et al., 2002). Captive cephalopods have poor capacity to recover from minor epidermal injuries (Hulet et al. 1979) occurring in autophagy, possibly due to the normal epidermal bacterial flora of their wild counterparts being over 100 times less than that of captive bred animals (Oestmann et al. 1997). Damage to the octopus epidermis requires monitoring with medical intervention being necessary if autophagy is observed and immediate healing is not seen.

Various aquaria have considered the effects of oxygen deprivation that could be experienced during shipping on autophagy (Barrett et al. 2014). The theory is that the individuals appear 'brain dead' and may lose the ability to recognise their own arms, leading to attempts to eat them.

Common beliefs that stress and hunger lead to self-eating behaviour are now being challenged by scientists. Further research is needed to determine the factors that may predispose individuals to infection and death.

Clinical Signs and Pathophysiology

Although the causes of this condition still need to be fully elucidated, observation of octopods has revealed several distinct manifestations that may indicate an individual is about to self-mutilate. Manifestations including incoordination, ataxia and arm tremors indicating that particular parts of the arm nerve cords and/or the central nervous system are impaired (Budelmann 1998).

Experimentation has shown that an octopus' central brain is able to override local inhibition of suction when feeding. This concept can be applied to autophagy, and it is thought that release of this local inhibition of chemical recognition of "self" skin by the suckers occurs (Crook and Walters 2014).

During the auto-mutilation process, lesions of both axial nerve and brachial artery have been recognised in the captive octopus species *O. dolfeini, O. bimaculoides* and *O. maya*. Vascular lesions and mantle ulcerations were also noted (Reimschuessel and Stoskopf 1990). This suggests a relationship between dysaesthesias as a result of neural or vascular pathology and autophagy in these species.

Arm bases are held in close proximity to one another in a 'stiff and stalky way' and the arm is bitten off as close to the body as is anatomically possible. No obvious muscular skin contraction occurs to begin the wound healing process, as would be seen in healthy octopuses (Budelmann 1998). No bleeding has ever been detected, however considerable quantities of protein foam are seen to aggregate on the surface of tanks of infected individuals (Budelmann 1998) both throughout and after autophagy.

There appears to be no clear preference with regards to which arms are affected; the first left arm may be more likely auto-mutilated than others (Budelmann 1998) but evidence for this is lacking. Number of arms affected by autophagy varies, but in most cases, it seems to be only one arm and no cases have ever been reported with more than four arms affected (Budelmann 1998).

Treatment

No treatment currently exists for autophagy and individuals die shortly after onset of clinical signs. Current suggestions are to euthanise affected individuals to keep suffering to a minimum. Techniques for cephalopod euthanasia vary depending on size and species but use of Magnesium Chloride or Tricaine Methanesulfonate are the most widely accepted methods (Messenger et al. 1985). Once determined non-responsive, freezing, boiling or immersion in alcohol should be performed (Lewbart 2012). Death should be confirmed with separation of the brain by use of a blade between the eyes (Lewbart 2012).

It has been reported that octopus are able to regenerate whole limbs, but this does not occur in autophagy. It has now been suggested that acetylcholinesterase has non-cholinergic functions in the regenerative ability in *Octopus vulgaris* with regards to regulation of cell proliferation, differentiation and apoptosis (Fossati et al. 2013). Activity of this enzyme is correlated with the proliferative stage of arm regeneration, with concentrations rising markedly during morphogenesis when active myogenesis was observed (Fossati et al. 2013). There is potential for this enzyme to be a target of regeneration treatment. Further studies are required to identify why limbs do not regrow in autophagy.

Prevention

The best way of controlling autophagy is not through treatment but through prevention. With the hypothesis of a bacterial or viral causative agent, it has been shown that high-performance protein skimming potentially delays transmission in closed seawater systems (Budelmann 1998). Doing this for 2-3 weeks following transfer ensures that 'wet foam' is replaced daily by fresh artificial seawater. It is also recommended to quarantine these animals where possible (Budelmann 1998). This works on the basis that if the cause is an infectious agent or chemical, risk of transmission to further individuals would be reduced.

Stress during senescence in the Giant Pacific octopus has been correlated with autophagy. Rapid changes in temperature and chemical pollution with copper and other metals have been associated with increased stress (Slater and Buttling 2011).

Optimum handling and husbandry can help prevent development of autophagy (Beigel and Boal, 2006). Enrichment is vital to keep stress to a minimum and maintain a robust immune system. Housing systems should acknowledge the importance of exploration, incorporating a variety of toys, challenges and hiding places to keep animals interested. Live prey is invaluable both nutritionally and behaviourally thus providing an abundance of crustaceans periodically ensures adequate stimulation. Other options include novel feeding practices, such as using a bamboo skewer through a cork to feed fresh shrimp. Captive tanks without sufficient stimulation have been correlated heavily with increased stress and by extension autophagy (Wood and Wood 1999).

Much is yet to be discovered about autophagy in octopods. By targeting research efforts towards discovering the causative processes of this condition, effective treatment and management can be implemented. Current measures are insufficient to treat the disease and euthanasia is the only option. However understanding of preventative measures is slowly developing with the hope that this disease will reduce in both morbidity and mortality.

References

Budelmann, B. (1998) "Autophagy In Octopus". *South African Journal Of Marine Science*[online] 20 (1), 101-108. available from <http://www.tandfonline.com/doi/abs/10.2989/02577161987841265 02> [27 January 2018]

Dunlop, C. (2013) "Do Octopuses Commit Suicide?". *The Octopus News Magazine Online* [online] available from <https://www.tonmo.com/pages/octopus-suicide/> [26 January 2018]

Anderson, R. C., Wood, J. B., & Byrne, R. A. (2002). "Octopus senescence—the beginning of the end". *Journal of Applied Animal Welfare Science*, *5*(4), 275–283.

Messenger JB, Nixon M, and Ryan KP (1985). "Magnesium chloride as an anesthetic for cephalopods". Comp Biochem Physiol [C] 82:203–205. available from < https://www.ncbi.nlm.nih.gov/pubmed/2865063> [08 February 2018]

Lewbart, G. (2012) *Invertebrate Medicine.* 2nd edn. Oxford: Wiley-Blackwell

Barrett, C., Peters, A., Barord, G., Rehling, M. and Anderson, R. (2014) *Giant Pacific Octopus (Enteroctopus Dofleini) Care Manual* [online]

Silver Spring, MD: Association of Zoos and Aquariums. available from <https://www.speakcdn.com/assets/2332/giant_pacific_octopus_care_manual_final_9514.pdf> [3 February 2018]

Fossati, S., Carella, F., De Vico, G., Benfenati, F. and Zullo, L. (2013) "Octopus Arm Regeneration: Role Of Acetylcholinesterase During Morphological Modification". *Journal Of Experimental Marine Biology And Ecology* [online] 447, 93-99. available from <https://www.sciencedirect.com/science/article/pii/S0022098113000671> [28 January 2018]

Hulet, H., Villoch, M., Hixon, R. and Hanlon, R. (1979) "Fin Damage In Captured And Reared Squids.". *Laboratory Animal Science* [online] 29 (4), 528-533. available from <https://www.ncbi.nlm.nih.gov/pubmed/513626> [4 February 2018]

Oestmann, DJ., Scimeca JM., Forsythe JW., Hanlon RT., and Lee PG. (1997) "Special Considerations For Keeping Cephalopods In Laboratory Facilities". *Contemp Top Assoc Lab Anim Sci* [online] 36(2):89-93. available from < https://www.ncbi.nlm.nih.gov/pubmed/16426030 . [6 February 2018]

Crook, R. and Walters, E. (2014) "Neuroethology: Self-Recognition Helps Octopuses Avoid Entanglement". *Current Biology* [online] 24 (11), 520-521. available from <https://www.sciencedirect.com/science/article/pii/S0960982214004746> [25 January 2018]

Reimschuessel, R. and Stoskopf, M. (1990) "Octopus Automutilation Syndrome". *Journal Of Invertebrate Pathology* [online] 55 (3), 394-400. available from <https://www.ncbi.nlm.nih.gov/pubmed/2351844 > [31 January 2018]

Slater, M. and Buttling, O. (2011) *Giant Pacific Octopus Husbandry Manual* [online] London: British and Irish Association for Zoos and Aquariums. available from <http://www.thecephalopodpage.org/_pdf/Giant%20Pacific%20Octopus%20husbandry%20BIAZA.pdf> [9 February 2018]

Beigel, M. & Boal, J. (2006). "The Effect Of Habitat Enrichment On The Mudflat Octopus". *Shape of Enrichment*, 15, 3–6.

Wood J., Wood D. (1999) "Enrichment For An Advanced Invertebrate". *The Shape of Enrichment* 8, 1-5

Assessment of Mortality in Invertebrate Collections

Marie Kubiak BVSc CertAVP(ZM) DZooMed MRCVS
RCVS Recognised Specialist in Zoo and Wildlife Medicine

Mortality within zoological collections has had a spike in interest recently with several high profile cases in the media in the last two years. There has been a flurry of Freedom of Information requests for zoological collection statistics, with subsequent articles in the mainstream media relating specifically to the animal losses (Perradin, 2017; Macaskill, 2017).

However, this data is not necessarily the best way to approach welfare and sustainability of invertebrates within zoo collections and this taxon can distort overall mortality rates significantly.

Invertebrate mortality is expected to be high in many species for a number of reasons:

Naturally short lifespan

Many invertebrate species have a limited lifespan as part of their normal life cycle and 100% mortality may be recorded annually as a normal incidence if lifespan is less than one year.

Although the queen can live for up to 8 years, worker honey bees (*Apis mellifera*) live for only 4-5 months on average (though a winter dormant state can extend this to 9 months) (Haddad et al, 2007). Foraging bees are exposed to predation, adverse weather and difficulties in navigating a successful return and mortality can exceed 15% of foragers daily (Dukas, 2008). With a mean colony size of 30,000 bees if individual mortality is recorded accurately on records there may be well in excess of 60,000 animal losses recorded over a year making for dramatic figures when interpreted without consideration of the natural cycle. The impracticalities of assessing individuals and treating colony species as an individual lifeform often means that the colony is treated as a single organism. On this basis, only the loss of the whole colony would be recorded within mortality statistics. This also avoids data becoming skewed and thereby mitigates the effects of high individual mortality rates.

For non-colony species it is more complicated as individuals are often recorded separately. Many butterflies will only exist in the adult stage for 1-4 weeks, with the full lifespan from egg to death being 2-3 months, and rarely more than 8 months (Scott, 1972; Oberhauserm 1997) . This can result in very high mortality rates on paper but reflect a natural and unavoidable life cycle for these species.

The need to cull a high proportion of offspring

Many species, particularly theraphosid spiders, are prolific when breeding is successful, with quantity of offspring exceeding available places available within collections. The commonly held *Brachypelma smithi* lays up to 1000 eggs, and *Lasiodora parahybana* is reported to lay up to 3000 eggs at a time (Marshall, 1996). Where hundreds or even thousands, of offspring are produced from a single pairing, it is not possible to maintain such numbers within zoological breeding programs due to both available enclosures and the lack of genetic diversity between individuals limiting their breeding potential. It may be necessary to cull a large proportion of animals to avoid overstocking, competition for resources and inbreeding and maintain only a small proportion of animals for breeding.

Acute group/colony loss

Many terrestrial invertebrate species are kept as large groups within a single enclosure. This enables a more engaging exhibit for visitors, allows efficient use of keepers' time and reduces space requirements. However, all animals that are sharing a single airspace, the same food source, substrate and environmental conditions are all exposed to the same risk factors. Presence of toxic or infectious disease then can then be catastrophic, with loss of an entire group rather than single individual cases of disease that may be seen in larger species housed separately or with greater variety of conditions.

Considering these situations it may be more practical to assess invertebrates separately to other taxa when reviewing mortality. It is prudent to focus not on the mortality rates and absolute numbers but on the causative factors in any deaths especially for multiple mortality events. This way any areas of concern, such as repeated causes of early mortality or specific disease entities can be identified, and management practice changed to reduce risk and impact.

References

Dukas, R., 2008. Mortality rates of honey bees in the wild. *Insectes Sociaux*, *55*(3), pp.252-255

Haddad, L.S., Kelbert, L. and Hulbert, A.J., 2007. Extended longevity of queen honey bees compared to workers is associated with peroxidation-resistant membranes. *Experimental gerontology*, *42*(7), pp.601-609.

Macaskill M, 2017, Rare animals among body count at Scottish zoos, *The Times,* 2 July
MARSHALL, S.D., 1996. Tarantulas and other arachnids: a complete pet owner's manual.

Oberhauser, K.S., 1997. Fecundity, lifespan and egg mass in butterflies: effects of male-derived nutrients and female size. *Functional Ecology*, *11*(2), pp.166-175

Perradin F, 2017, Calls for Cumbria zoo to be closed after 486 deaths, *The Guardian,* 28 Feb
Scott, J.A., 1973. Lifespan of butterflies. *Journal of Research on the Lepidoptera*, *12*(225), p 230

Adapted from a document originally commission by the Terrestrial Invertebrate Working Group for British and Irish Association of Zoos and Aquariums.

Henry Berman

We were all sad to hear of the passing of Mr. Henry Berman. Henry Berman was a teacher at St Ivo School, St Ives, Cambridgeshire, where he founded the St Ivo Entomological and Natural History Society ('Ent Soc'). It started modestly in 1957 with a small collection of invertebrate animals but quickly grew, as reptiles, amphibians and small mammals were added. It became a thriving collection and a whole raft of educational material and information leaflets were introduced for members. 'Ent Soc' attended and displayed its collection of animals at the annual Ameteur Entomologist' Society Exhibition for nearly forty years.

Through 'Ent Soc', Henry Berman mentored and educated many young entomologists over the course of his career, including our own president, John Cooper.

Henry Berman attended the VIS Summer meeting in July 2017 and was the oldest person at the meeting (to the right is a picture of him with the youngest attendee at the gathering).

Henry (and his late wife, Joan), were involved in a host of organisations and charities, including the Citizens' Advice Bureau, Mencap and Amnesty International.

The community around invertebrate medicine is small, but passionate; thus whenever we lose someone, it is always a very sombre occasion. Our thoughts go to Henry's family and friends. Through Henry's example, however, our society will carry on the important work of embracing our tiny neighbours and improving their care and welfare.

Image Credit:
John E Cooper and Margaret E Cooper

Article Submission – The Journal of the Veterinary Invertebrate Society 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 an reasonable academic standard. Peer review will be provided as appropriate to the article submitted. This journal is an english langauge journal. There are no submission fees for this journal.

Please do not hesitate to contact the editor for guidelines should you wish may wish to submit an article. Contact: **Bkennedy2@rvc.ac.uk** or **Vetinvertsoc@gmail.com**

JOURNAL OF THE VETERINARY INVERTEBRATE SOCIETY
ISSUE 2 | SPRING | 2018