

QUARTERLY PUBLICATION OF THE EUROPEAN ASSOCIATION OF ZOOS AND AQUARIA

ZOOQUARIA

AUTUMN 2017

ISSUE 98

FANTASTIC BEASTS

THE FASCINATING WORLD OF INVERTEBRATE CONSERVATION



Insects in the citadel
INSIDE BESANCON'S STUNNING INSECTARIUM



Our duty of care
ADDRESSING THE ISSUES OF INVERTEBRATE WELFARE



*Some passengers need a
special travel agency*

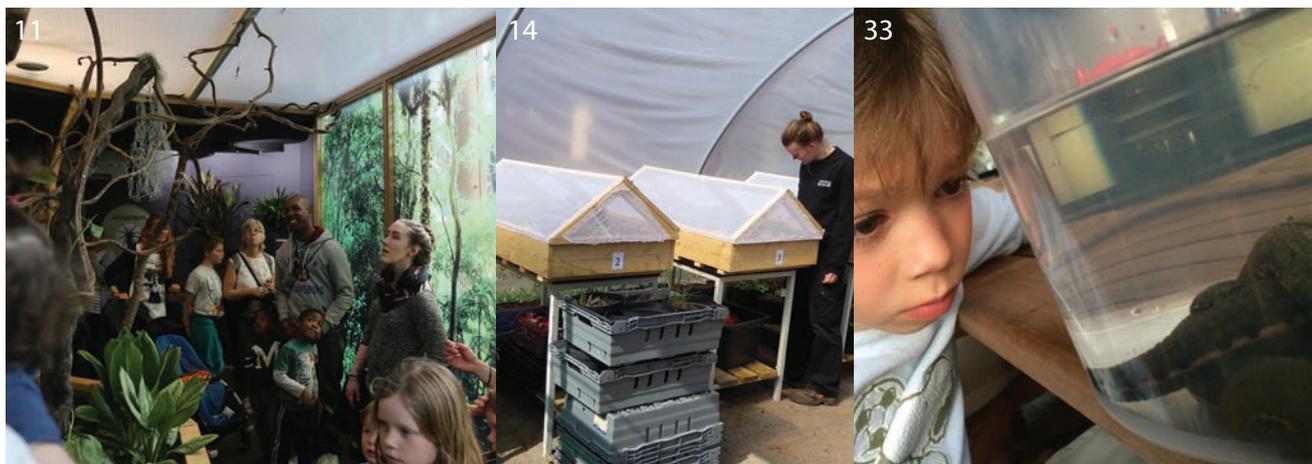
**ZOO
LOGISTICS**

Amsterdam Airport
ZooLogistics BV
Hoeksteen 155
2132 MX Hoofddorp
info@zoologistics.com
www.zoologistics.com
+31 (0)20 / 31 65 090



**ANIMAL
LOGISTICS**

Frankfurt Airport
AnimalLogistics FRA GmbH
Langer Kornweg 34 K
65451 Kelsterbach
michael@animallogistics.de
www.animallogistics.de
+49 (0)6107 / 40 779 -21



4 From the Director's chair

EAZA's Director pays tribute to the amazing work being done to support invertebrate conservation

5 Noticeboard

The latest news from EAZA Council

7 The rise of the invertebrates

An update on the current activities of the Terrestrial Invertebrate TAG

8 The invertebrate conservation challenge

With millions of species in existence, how do we tackle the challenge of invertebrate conservation?

11 Conservation data

A visual summary of the current state of funding for invertebrate conservation

12 A hive of activity

The brand new Atlas Theatre at Wildlands Zoo was the setting for an inspiring EAZA Annual Conference

14 Breeding butterflies and beetles

Nordens Ark demonstrates the rewards to be had from invertebrate breeding programmes

16 Saving the grasshopper

How expert collaboration can aid the survival of a critically endangered species

18 Fantastic phasmids

The Lord Howe Island stick insect continues to evade extinction thanks to the EEP's teamwork

19 Spider plan

How Bristol Zoo is working to ensure breeding success for the Desertas wolf spider

20 The snail's story

After a 30-year breeding programme, the reintroduction of the Partula snail has begun

22 The insect man

Zooquaria talks to Mark Bushell of Bristol Zoo

25 A vet's life

EAZA's Veterinary Advisor to the TITAG discusses the challenges of his role

27 Marvellous monsters

The EAZA TITAG and BIAZA TIWG joint conference proved to be a fertile breeding ground for ideas

29 Insects in the citadel

Inside Besançon's stunning insectarium

30 A duty of care

How should we manage invertebrate welfare?

31 In with the spiders

ZSL London Zoo's imaginative exhibit gives visitors a close-up experience of a huge range of spiders

33 The main attraction

How Chester Zoo succeeded in making its tarantulas and leeches more appealing to visitors

34 A bug in the system

Helping visitors to learn to love invertebrates

Zooquaria

EDITORIAL BOARD:

Executive Director Myfanwy Griffith (Myfanwy.Griffith@eaza.net)

Managing Editor David Williams-Mitchell (David.Williams-Mitchell@eaza.net)

Editor Joanna Swinnerton

Editorial Staff Danny de Man, William van Lint

Designer Louise Tait

Zooquaria is the quarterly magazine of the European Association of Zoos and Aquaria (EAZA).



EAZA Executive Office, PO Box 20164, 1000 HD Amsterdam, The Netherlands.

Email: info@eaza.net ISSN 2210-3392

Cover image: Gooty ornamental spider © Mark Bushell

For information on print subscriptions to Zooquaria visit:

<http://www.eaza.net/about-us/communications>

The views expressed in this magazine are not necessarily those of EAZA. The paper used for printing is FSC quality (sustainable). Organic inks are used. Plates for printing are free of chemicals. All waste is disposed of in an environmentally friendly manner. Printed by Euro Mail BV.



FROM THE DIRECTOR'S CHAIR

It is with great pleasure that we share with you this special issue on terrestrial invertebrates. I hope that upon reading it you will be as fascinated and inspired as I was by all the wonderful conservation efforts and other activities that are taking place. Last year we had a Zooquaria special issue reviewing 30 years of our EEP programmes and looking ahead to future developments. By comparison, terrestrial invertebrate programmes are still relatively new within EAZA history however, as Axel Hochkirch, Chair of SSC Invertebrate Conservation Sub-Committee, highlights in his thought provoking article, about 1.4 million invertebrate species have been described so far, with many more still likely to be discovered. This means that invertebrate programmes and conservation will play an ever-increasing part of our work going forwards. This work will be guided by the dedicated and passionate members of the Terrestrial Invertebrate Taxon Advisory Group (TITAG). The article on page 7 provides a great overview of recent work, collaborations, and ambitions of the TITAG. This is a TAG that is gaining momentum and looking to bring as many people as possible along with them. I am pleased to see that the TITAG is keen to be one of the first in line to undergo the new style Regional Collection Planning process due to roll out from 2018 (though not at all envious of the decisions they will need to make to help prioritise so many species!).

I would like to give special thanks to the Chair, Mark Bushell, and members of the TITAG for helping contribute and coordinate the high-quality range of articles provided. What becomes clear upon reading this special issue is that there are numerous opportunities to get involved in terrestrial invertebrate conservation; from innovative communication ideas and exhibits, to learning husbandry techniques and devoting space in your collection to house one (or more!) of the programme species, to getting involved in collaborative reintroduction efforts. The recently published research showing a 75 percent decline in flying insects present in protected areas across Germany over the last 27 years is exceedingly worrying. Hallmann *et al.* (2017) attest that this decline is apparent regardless of habitat type, and cannot be explained by changes in weather or land use. Research into these declines is yet another way our community can be part of ensuring this valuable invertebrate biodiversity continues to underpin ecosystem functioning across our European landscape. What is abundantly clear is that whatever aspect of invertebrate conservation you choose you are likely to make a big difference to these small individuals in need; I wholeheartedly encourage you to become involved if you are not already.

In this issue, we only deviate from our invertebrate

focus to provide updates on our highly successful EAZA Annual Conference, hosted by Wildlands Adventure Zoo, Emmen. You can find the decisions made by EAZA Council on page 5 and a summary of the conference on pages 12-13. As always, it was with immense pride that in the opening plenary I had the opportunity to present on the past 12 months of EAZA activities. Every year it becomes more and more difficult to keep to my allocated timeslot as our achievements continue to expand. I'd like to take this opportunity to thank everyone involved in making these achievements possible. Without your knowledge, experience, and 'EAZA spirit' we wouldn't be the thriving, visionary association that we are today.

Myfanwy Griffith
Executive Director, EAZA

Hallmann CA, Sorg M, Jongejans E, Siepel H, Hofland N, Schwan H, *et al.* (2017) More than 75 percent decline over 27 years in total flying insect biomass in protected areas. PLoS ONE12(10): e0185809. <https://doi.org/10.1371/journal.pone.0185809>

NOTICEBOARD

DECISIONS BY COUNCIL

The EAZA Council met at Emmen, the Netherlands, on 22 September 2017 as part of the EAZA Annual Conference (see pages 12–13). The following decisions were taken at the meeting:

MEMBERSHIP

New Applicants:

- Biotropica, France, was awarded Temporary Membership for two years.
- Wild Acres, UK, was awarded Associate Membership – Holding Animals (this category reflects the fact that Wild Acres is not open to public visitation).
- Casablanca Zoo, Morocco, and Fife Zoo, UK, were awarded Temporary Membership Under Construction, reflecting the fact that both sites are currently under development and not open to the public.
- Zoodyssée, France, and Zoo Dvůr Králové, Czech Republic, were upgraded from Temporary Membership to Full Membership of EAZA.
- Zoo Sibiu, Romania, was accepted as a Candidate for Membership of EAZA under the mentorship of the Technical Assistance Committee, giving the zoo a five-year period in which to attain EAZA Standards.
- Lion House, the Netherlands, and PGAV, USA, were approved to become Corporate Members of EAZA.
- The British Association for Shooting and Conservation, UK, was denied Corporate Membership. Rocas and Design withdrew from Corporate Membership.

EAZA Accreditation Programme

Orsa Predator Park, Sweden, moved from Full Membership of EAZA to a two-year period of Temporary Membership.

Antwerp Zoo, Belgium, Attica Zoo, Greece, Jersey Zoo, UK, Ouwehands Dierenpark, the Netherlands, Nyíregyházi Állatpark, Hungary, Bioparc Doué la Fontaine, France, and Furuvikspark, Sweden, all retained Full Membership of EAZA following screening inspections in 2017.

Other decisions of Council

EAZA Council approved the EAZA Position Statement on the EU Regulation on the prevention and management of the introduction and spread of invasive alien species (1143/2014) that calls for the

Regulation to be applied in a way that does not have a negative impact on the role of zoos and aquariums as organisations for conservation, education and research. The position statement can be found at the EAZA website at: <http://eaza.net/assets/Uploads/Position-statements/EAZA-Position-Statement-IAS-Regulation-2017-09-FINAL.pdf>

Memoranda of Understanding were approved between EAZA and TRAFFIC, BirdLife International and the IUCN SSC Asian Songbird Trade Specialist Group as part of the launch of the joint Conservation Campaign Silent Forest (see below). The MoUs outline the terms of the cooperation between the partners in the campaign. The existing Memorandum of Understanding between EAZA and the Russian Federation's Ministry of Natural Resources and the Environment and IUCN SSC on cooperation for the Restoration of the Persian Leopard in the Western Caucasus was also approved for renewal. The MoU has seen EAZA involvement in the reintroduction of the Persian leopard in the Sochi region of Russia.

Council also discussed several proposed changes to the EAZA Constitution, aimed at harmonising the language of the document with the evolving role of the Association and its connections to bodies including the European Union. The changes will come to the Annual General Meeting in April 2018 (to be held at Antwerp Zoo) for approval by the Membership.

SILENT FOREST LAUNCHED

The EAZA/TRAFFIC/BirdLife International/IUCN SSC Asian Songbird Trade SG two-year joint campaign for the conservation of threatened Southeast Asian songbirds was launched at a special plenary session of the EAZA Conference on 23 September.

The campaign aims to raise awareness of the serious threat to six flagship species from the traditional regional practice of capturing songbirds for sale in markets across Southeast Asia, and will also raise funds for conservation projects. With several of the species on the campaign's list of flagship species classified by IUCN as Critically Endangered, the timing of the campaign is crucial. From the EAZA side, the campaign is being led by Thomas Ouhel and a team from Liberec Zoo in the

EAZA CORPORATE MEMBERS

a. hartrodt	www.hartrodt.com
Aqua Medic	www.aqua-medice.de
Aqua-Teknik A/S	www.aqua-technik.com
Arie Blok Animal Nutrition	www.arielok.nl
Beresford	www.beresford.fr
Billings Productions, Inc	www.billingsproductions.com
Brogardien	www.brogardien.eu
Carl Stahl	www.carlstahl.com
Clax Italia	www.claxitalia.com
Crossborder Animal Services	www.crossborderanimalservices.com
Deerns	www.deerns.com
EKIPA	www.ekipa.nl
Fachjan	www.fachjan.nl
Fox Consulting	www.fox-zooconsulting.com
HMJ Design	www.hmj-design.dk
IC Eau SA	www.iceau.ch
KaGo & Hammerschmidt	www.felsen.de
Kiezebrink International	www.kiezebrink.eu
Lamartine Construction	www.lamartine-construction.com
Lionhouse	www.lionhouse.eu
Marine Nutrition	www.marinenutrition.com
Mazuri	www.mazuri.eu
Nieuwkoop Europe	www.nieuwkoop-europe.com
Pangea Rocks	www.pangea.dk
PGAV Destinations	www.pgav.com
PJA Architects	www.pjarchitects.com
Ralf Imagen y Comunicación S.L.	www.ralfnature.com
Rasbach Architekten	www.rasbacharchitekten.de
Ravensden	www.ravensden.co.uk
Ray Hole Architects	www.rayhole-architects.com
St Laurent	www.st-laurent.fr
TAA Group	www.taa-group.com
TVK ZooDesign	www.tvkzoodesign.nl
Zoological Adviser	www.zoologicaladviser.com
Zoologistics	www.zoologistics.nl
Zooprofis	www.zooprofessionals.de

Czech Republic, with support from Cologne Zoo and Heidelberg Zoo in Germany.

For more details of the campaign, visit www.silentforest.eu and look for an article in the next issue of *Zooquaria*.

WAZA CONFERENCE

The 72nd Annual Conference of WAZA took place from 15–19 October in Berlin. WAZA has chosen the theme of 'Our Time Is Now' to emphasise the pivotal role that zoos and aquariums play in the global fight to protect wildlife and wild spaces.

'WAZA and its members are uniquely poised to influence major issues going forward,' said Doug Cress, WAZA's chief executive officer. 'We receive 700 million visitors each year, we're the third-largest funder of global conservation, and our captive breeding programmes have saved dozens of species from extinction. We're already addressing issues such as marine litter and climate change on a daily basis, and it's time for zoos and aquariums to move to the forefront on these and other environmental concerns.'

DINOSAURS!

ACHIEVE A BLOCKBUSTER
SUMMER WITH OUR
LIFE-SIZE, LIFE-LIKE
ANIMATRONIC DINOSAURS!



BILLINGS PRODUCTIONS, INC.

1277 Andrews Parkway, Allen, TX 75002, U.S.A. 📞 +1 972-562-7265 🌐 www.billingsproductions.com

For sales and leasing enquiries, contact Christopher Chew at ✉️ chrishew@billingsproductions.com

The rise of the invertebrates

AS THE POPULARITY OF TERRESTRIAL INVERTEBRATES INCREASES ACROSS THE EAZA COMMUNITY, THE TITAG IS HARD AT WORK CREATING NEW OPPORTUNITIES FOR CONSERVATION WORK

Mark Bushell, EAZA TITAG Chair, Bristol Zoo Gardens, UK; Tamás Papp, EAZA TITAG Vice-Chair, Chester Zoo, UK; and Vít Lukáš, EAZA TITAG Vice-Chair, Zoo Praha, Czech Republic

It is clear to those of us who specialise in invertebrate conservation that they are slowly becoming more popular in EAZA collections. More and more collections are building dedicated invertebrate displays, as you'll see in this magazine, and more collections are introducing more species to their existing displays. Conservation actions with invertebrate species are on the rise also, and several collections across Europe are now participating in native and overseas species work: everything from translocations to full-on reintroductions to native ranges.

The Terrestrial Invertebrate TAG (TITAG) has, on the surface, been rather quiet of late – but that's not to say that there isn't a great deal bubbling away under the surface! We're continuing to strengthen ties with the IUCN, and in particular the Grasshopper Specialist Group and the Spider and Scorpion Specialist Group of the IUCN SSC. We have also made sure to maintain close ties with our colleagues in relevant TAGs in the BIAZA and AZA to see where we can best collaborate on forthcoming projects and understand the challenges we face globally as a community.

We have also added another body to our group; Vít Lukáš (Zoo Praha) has recently joined Tamás Papp (Chester) as our second Vice-Chair. Vít is passionate about invertebrates, and has spent time in South America researching them, so his and Tamás' joint enthusiasm will probably be quite hard to contain! I am both proud and pleased to have them as not only TAG members, but also Vice-Chairs; I'm sure their guidance and hard work will pay dividends now and in the TAG's future.

The number of conservation programmes falling under the TAG has increased significantly in the last two years, and now comprises a total of four EEPs: Partula snail (*Partula spp.*), Frigate Island beetle (*Polposipus herculeanus*), Lord Howe Island stick insect (*Dryococcus australis*) and

FREGATE ISLAND BEETLE (*POLPOSIPUS HERCULEANUS*)



GOOTY ORNAMENTAL SPIDER (*POECILOThERIA METALLICA*)



Desertas wolf spider (*Hognas ingens*). It also includes one ESB, the Gooty ornamental spider (*Poecilotheria metallica*). A growing number of collections have been participating in these programmes, and they are doing rather well. In particular the Gooty ornamental ESB and Partula EEP have seen some excellent examples of collaboration work between EAZA Members and it has been a pleasure to see this happening. We are discussing a number of future EEPs, particularly for the Crau Plain grasshopper (*Prionotropis rhodanica*, see page 16). In addition, a MON-P is currently being researched with the giant centipede genus *Scolopendra* as its focus; one of the aims is to produce Best Practice Guidelines for these animals, something that we are aiming to do for many of the taxa that fall under the TAG.

As a follow-up from the first Invertebrate Conference in Amsterdam in July 2015, we have also been working together with the BIAZA Terrestrial Invertebrate Working Group on the organisation of a joint Invertebrate Conference; for more results see page 27. I am very excited that we now have this special issue of *Zooquaria*, which is a spin-off from this first conference.

One thing that will definitely help with our current and future work is for collections to input all of their invertebrate data into ZIMS. Species360 has produced an amazing tool for us to use, which makes population analysis

and trend monitoring quite easy, but we can only work with the data we have – so please do keep yours updated!

All of this work will help to feed into the brand new RCP. With the new format being discussed, and as our current remit of species is in the millions, the TAG felt it was time for a serious overhaul of our RCP and has volunteered to be in the first wave. We know that this will help to produce a concise, easy-to-use document that will help EAZA Members to decide which invertebrate species to work on in their collections.

As you can see, we have a lot planned; so how are we going to achieve all of this? We've been working hard to kickstart what we hope will be an excellent period of activity within the TAG, although of course this will rely entirely on EAZA Members getting behind the TAG as best they can and helping out; collaboration and cooperation is the key to success, and we need more help from anyone who is willing and able, from keepers to curators. If you or someone who works at your collection can spare some time to help the TAG – for example, writing Best Practice Guidelines, monitoring a species that you're really interested in, getting involved with the IUCN and other relevant NGOs, or perhaps even proposing a conservation breeding programme – then we'd love to hear from you! Simply contact the TAG via the EAZA Member Area website.

The invertebrate conservation challenge

INVERTEBRATES ARE OFTEN OVERLOOKED WHEN IT COMES TO CONSERVATION, BUT THEY PLAY A VITAL ROLE IN OUR GLOBAL ECOSYSTEM

Axel Hochkirch, Chair, IUCN SSC Sub-committee on Invertebrate Conservation

It is impressive to note that about 1.4 million invertebrate species have been described so far, and estimates of global species numbers vary between five million and 30 million. Currently, invertebrates represent three-quarters of all hitherto described species on our planet, and the real figure is probably more than 95 per cent. How will we ever be able to describe all these species – let alone preserve all of them?

Three years ago I had a discussion with the head of a large conservation NGO and he told me that he was convinced that it is impossible to preserve all invertebrate species. I must admit that he is probably right. We are in the middle of the sixth mass extinction and we have not even understood how many species exist on our planet. Biogeographic models suggest that we lose between 11,000 and 36,000 species per day (assuming that just five million species exist on earth) and it is likely that most of them are invertebrates. Engaging in invertebrate conservation is like standing in front of a house on fire without knowing how many people are inside. This metaphor, however, does help me to realise why I am engaging in invertebrate conservation. Because even without knowing how many people are in a burning building, you would still try to rescue as many of them as possible.

Due to the enormous diversity of invertebrate species, it is important to focus on subsets, just as vertebrate specialists usually focus on smaller groups, such as birds, amphibians or mammals. You might be able to cover several invertebrate groups within some species-poor northern European countries, but as soon as you start working in species-rich regions, such as the tropics or Mediterranean, it becomes challenging to get a

good overview of a beetle family or smaller insect order. Invertebrate conservation needs to proceed step by step; saving every species at once is impossible, but if you pick a single species or habitat and set a good example of how to manage its habitat or defeat its threats, you may inspire similar projects that help to preserve our invertebrate diversity.

When I was working for a nature conservation NGO in Germany in 1989/90, I had to make an inventory of grasshoppers, crickets and bush-crickets (Orthoptera) for a management plan of a new nature reserve. At this time I already had quite a good knowledge of birds, amphibians and reptiles, so adding another group was interesting. I realised that a field cricket population within our region was close to extinction and wrote a small management plan, which was then implemented. The population increased within a couple of years and in 2001, the head of the conservation project decided to translocate some individuals to another nature reserve. As a PhD student, I was involved

in preparing the translocation plan, which we based upon some successful projects in the UK. We monitored both populations until 2007 and both continued to increase. The source population had a minimum number of 32 singing males in 1991, but reached 2,363 singing males in 2007, and the translocated population reached 226 singing males in the same year. This example shows how quickly insect conservation can lead to success. The main reason is that the generation times of most invertebrate species are quite short. As soon as you apply an appropriate (and adaptive) management, you can reap the fruits of your efforts within a couple of years.

When I look back, this successful project is still among the best things I have achieved, even though I saved just one single population of a species that is not even threatened globally (but of course regionally). Successful conservation engagement makes you happy. And invertebrate conservation can make you happy in a short period of time. Unlike working with large mammals, you have a good chance of completing a couple of successful

LARGE PINCERTAIL DRAGONFLY
(*ONYCHOGOMPHUS UNCATUS*),
© AXEL HOCHKIRCH



invertebrate conservation projects within your lifetime.

One reason for choosing the field cricket was that it is listed as Critically Endangered in the state of Lower Saxony in northern Germany. So the regional Red List was an important tool for defining the need for its conservation. At the global scale, the IUCN Red List of Threatened Species is, of course, the most important source of information regarding the conservation status of species. About 19,000 invertebrate species have been assessed for the IUCN Red List and the number is steadily increasing. However, assessing the Red List status is quite difficult if data is scarce – and for many invertebrate taxa we have very little information. We recently started to assess Orthoptera species for a Sampled Red List Index (SRLI). This is a random sample of species to obtain an overview of the general conservation status of this insect group. When we assessed the

MASPALOMUS BOW-LEGGED GRASSHOPPER (*DERICORYS MINUTUS*) © AXEL HOCHKIRCH



first 15 species of Orthoptera, six of them were known only from the type material. And even for those, where a little bit more information was available, the experts usually asked me, 'Why did you choose this species? We don't know anything about it.' This shows how little we know about invertebrates, and the lack of knowledge probably leads to some erroneous Red List assessments. However, the IUCN Red List is flexible and can be updated as soon as new information becomes available. In fact, the Red List assessment often prompts increased research efforts and thus facilitates improvements.

After we assessed the conservation status of the European Orthoptera, several new conservation projects were started. Conservation strategies have been developed for the Singapore crab (*Johora singaporensis*), the Crau Plain grasshopper (*Prionotropis rhodanica*), the Desertas Wolf spider (*Hogna ingens*) and the Adriatic marbled bush-cricket (*Zeuneriana marmorata*). It is worth noting that whenever I attended the conservation planning workshops for these species, I was

surprised how supportive the local authorities and other stakeholders were. My impression is that many people really want to engage in invertebrate conservation, but they simply lack the expertise.

The power of the IUCN Red List may be proven by another recent experience. During the IUCN SSC Steering Committee Meeting in Cartagena, Colombia, in August 2017, we had a Seminar Day at a local university. For my talk on invertebrate conservation I searched for a threatened species example from Colombia and used the advanced search function of the IUCN Red List. I just chose the first threatened invertebrate species in the alphabet – the Mana Dulce damselfly (*Acanthagrion williamsoni*), which is listed as Endangered (I invented the common name as I was speaking to the audience). This species is possibly extinct at its type locality and is only known from one other locality – the private Mana Dulce Nature Reserve. When I then searched for a photo of this species (without success), I came across an Instagram and Facebook post of the Mana Dulce Nature Reserve summarising the IUCN Red List profile of this species. This shows that the Red List helps to make local managers of protected areas aware of their responsibility for threatened species. And if people are aware or even proud of a threatened species in 'their' protected area, it will be a very small step to implement conservation action for a species – in the case of the Mana Dulce damselfly, this meant monitoring its population and fencing off streams to protect it from negative impacts caused by cattle grazing.

In summary, this shows that the most important thing hampering conservation of invertebrates is lack of knowledge. Field guides for invertebrates are available in the UK and some other northern European countries, but even in the Mediterranean, not to mention the tropics, these are usually lacking (except for butterflies). If people are not able to identify invertebrate species, they will not be able to preserve them, as you can only preserve what you know. Naturalists, rangers or managers of protected areas are often extremely interested in the



FIELD CRICKET (*GRYLLUS CAMPESTRIS*) © AXEL HOCHKIRCH

species they encounter. Therefore, capacity building and publication of easy-to-use field guides are quite important for instigating conservation action on the ground.

Due to the lack of knowledge, invertebrate conservation often starts with some explorative research. It took us four years of research in the Seychelles to understand that the invasive soapbush is the major threat to the endemic Orthoptera species. Now we can start conservation action on the ground and develop a control programme to prevent this plant deteriorating the habitat of many species that inhabit the ground layer of the mist forests in the Seychelles.

Unfortunately, it is particularly difficult to obtain funding for the basic research necessary to instigate conservation. Research funds typically focus on hypothesis-driven basic research rather than on explorative studies, and conservation funds focus on practical conservation action rather than research. Hence, invertebrate conservation finds itself in a challenging funding gap.

What does this mean for the zoo

community? Whichever action you start on invertebrate conservation, you are very likely to become a pioneer. The IUCN Red List can help you to identify species with a high extinction risk that need conservation action. With the information provided on the IUCN Red List it is usually also easy to identify the necessary steps to preserve a species.

The Red List assessors or IUCN Specialist Group chairs will certainly be able to guide you in the right direction, and most experts on invertebrates will greatly appreciate any help to obtain more knowledge or facilitate conservation action for a species. There are too few *in situ* conservation projects for invertebrates, particularly in the species-rich regions of the world. Therefore, the zoo community can help to instigate such projects by:

- supporting or conducting the necessary research to gather knowledge on the taxonomy, ecology and conservation biology of invertebrate species,
- conducting assessments of the conservation status of invertebrates

for the IUCN Red List of Threatened Species,

- building capacity in invertebrate conservation in tropical countries,
- raising awareness for the importance of invertebrates for ecosystems and humans, their amazing diversity as well as the threats they are facing,
- developing and conducting monitoring programmes for threatened invertebrate species or groups,
- helping to develop conservation strategies for threatened species both *in situ* and *ex situ*, and
- supporting the implementation of conservation action on the ground.

Whenever you start to observe invertebrate species, you will be surprised by their amazing diversity of life histories and behaviours. Each species is unique and, in my opinion, each species has the right to exist. People may be more attracted to tigers than to tiger beetles, but while it takes a lot of money and effort to preserve the tiger, it may be much easier to preserve a tiger beetle – and from a certain angle, tiger beetles are probably just as attractive as tigers.

JAPANESE TIGER BEETLE
(*CICINDELA CHINENSIS JAPONICA*)
© ALPSDAKE CC



Terrestrial Invertebrate Conservation



Focus Supported Projects

Species and Populations



Restoring Habitats

Research



Conservation education and Capacity building

Raising Funds



2014 - 2016 Contributions



230,829

2014

492,150

2015

1,450,893

2016



2,1 Million Euro



6272 Staff hours

in 8 Countries



14 Projects
Includes projects with a multi-taxa/habitat focus

Highlighted species

Data Source: EAZA Conservation Database - 17 July 2017



Polynesian tree snail
(*Partula* spp.)

Captive breeding and reintroduction



Greater capricorn beetle
(*Caremyx cerdo*)

Captive breeding and reintroduction

Large heath
(*Coenonympha tullia*)

Habitat restoration, reintroduction and monitoring



Fisher's estuarine moth
(*Gortyna borelii*)

Habitat restoration, captive breeding and reintroduction



A hive of activity

ZOOQUARIA REPORTS BACK FROM ANOTHER SUCCESSFUL EAZA ANNUAL CONFERENCE

David Williams-Mitchell, EAZA Communications and Membership Manager

This year's EAZA Annual Conference was held from 19–23 September at the Atlas Theatre in Emmen, the Netherlands. The theatre, which is brand new, is part of the new Wildlands Adventure Zoo complex, and this conference was only the second such event it has ever hosted. Needless to say, the facilities were state-of-the-art, with a huge main auditorium, a second, smaller auditorium, and conference and meeting rooms for the parallel sessions.

The conference started on Tuesday 19 September with the by-now familiar TAG Chairs' and EEP Coordinators' meetings. The TAG meeting focused on the new population management structure (launched in the Friday plenary – see below), and especially some of its more technical challenges. These included discussions on the new Regional Collection Plan templates, the role of non-EAZA EEP participants, and how TAG and EEP evaluations will be carried out under the new structure. These vital questions and their answers will inform the revision of the Population Management Manual, a key EAZA document and the cornerstone of the theory and practice of maintaining small *ex situ* populations. The EEP meeting invited speakers to provide context on the new EAZA Biobank, guidelines on the use of social media by TAGs and programmes, the new studbooks module of ZIMS, and an update on the Species Conservation Toolkit Initiative (SCTI).

In the evening, delegates were welcomed to Emmen by the mayor of the city, Eric van Oosterhout, and EAZA Chair Thomas Kauffels, at an outdoor reception on the Compass Square, the main 'jumping-off' point for the four differently themed areas of the new zoo.

The main activity of the conference kicked off on Wednesday morning. The first plenary of the day featured a welcome from the new CEO of Wildlands, the appropriately named Frankwin van Beers (beer is Dutch for bear!), an introductory address from the EAZA Chair and a summary of the

last 12 months' activity from EAZA Executive Director Myfanwy Griffith.

POPULATION MANAGEMENT

Keynote speaker Dr Mark Barone from EngenderHealth then addressed the plenary session on the subject of human population, its impact on nature conservation, and whether or not zoos should implicate themselves in the effort to educate and influence visitors on this topic. Dr Barone found it striking that conservation planning conversations rarely seem to touch on human population and its effect on nature; while he welcomed initiatives by zoos to engender behavioural change to mitigate the effect of human technological and population change, he challenged zoos and aquariums to think bigger and focus on more effective action. His talk, while full of sobering facts regarding the extraordinary growth of the human population globally, took an optimistic tone, pointing out that zoos can indeed play a strong role in educating the public, especially through the empowerment of women; research shows that women are among the most important audiences for family planning, and even if measured by reach alone, zoos are ideally placed to provide information on reproductive rights and strategies, and thereby make a greater difference than they are currently able to effect.

After the first plenary, the conference broke up into TAG and Committee meetings; these meetings are a crucial part of the event, and define much of the activity of the Association over the coming year. This year's planning included a great deal of preparation for the implementation of the new population management structure, as well as the more habitual elements of reporting on programmes and their continued development. This first parallel session also included the first of three screenings of the documentary film 'Waiting for Giraffes', a reportage on the quest of Qalqilya Zoo in the West Bank of Palestine to become a candidate for EAZA Membership



under the mentorship of Jerusalem Zoo. The presence of the vice-mayor of the municipality and the CEO of the zoo as well as the film's central protagonist, veterinarian Dr Sami Khader, highlighted that the work of the Technical Assistance Committee, mentor zoos and the candidates themselves depends on regular interactions between zoological professionals and their institutions at all stages of the process, interactions that are embodied in the very concept of the Annual Conference.

LOBBYING AND LEGISLATION

The Wednesday afternoon plenary looked at lobbying, and featured four speakers from the community. Jacques Kaandorp presented a brief history of EAZA's lobbying, illustrating the talk with his experiences of engaging with the European Union on the Balai regulations. Martín Zordan of ALPZA, the Latin American Association of Zoos and Aquaria, highlighted a major problem for zoos: namely the disconnect between legal action aimed at protecting the welfare of individual animals, and the way that these cases have been reported in the media; he believes strongly that we need to do more to counter the sensationalist reporting of such cases to ensure that misreporting does not lead to ever more extreme legislation. Davorka Majlković of Zagreb Zoo provided an account of how her institution has been successful in engaging with Croatian authorities, and encouraged zoos of all sizes to get involved in lobbying – pressure from even small zoos can help shape substantively the legislation that affects us all. Finally, Volker Homes of the German zoo association VdZ made the point that lobbying at national and



European levels is essentially indivisible; without good local engagement, lobbying at the European Union is necessarily less effective, and vice versa. The plenary showed clearly that the legislative process is fluid, and the protection of the rights of zoological institutions requires full engagement from us all.

Thursday continued with TAG and Committee meetings in the morning and a guided tour behind the scenes of Wildlands in the afternoon. It was fascinating to see the facilities that a new-build zoo can include, and many colleagues seemed particularly envious of the kitchen and veterinary facilities.

NEW DIRECTIONS

Friday's plenary marked the official launch of the new EAZA population management structure. The structure, four years in the making with the involvement of much of the community, is a significant departure from the breeding programmes established in 1985, and marries imaginative theoretical principle to solid practical implementation. On the theoretical side, Kristin Leus and Bengt Holst outlined the vision for EEPs (now standing for European Ex situ Programmes) to be defined by individual goals fulfilled by clearly defined roles for participants; 'one size fits all' programmes will now be phased out, with the full structure to be implemented by the end of 2022. Raymond van der Meer showed how this process has started already, with a review of the Regional Collection Planning process of the Canid and Hyaenid TAG.

This marriage of the theoretical and the practical continued with presentations from EAZA Population Biologist Elmar Fienieg and

representatives of six programmes, outlining the process of designing Long-term Management Plans for species including Komodo dragon, Lar gibbon, chimpanzee and others. The new structure, however, will not focus merely on demographics and genetics: Stephanie Sanderson of EAZWV showed how it will also prioritise the health of populations, and EAZA Biobank Working Group Chair Christina Hvilsom and Research Committee Chair Zjef Pereboom introduced the role of the new Biobank project in protecting and documenting the advances of the new structure.

Saturday's plenary closed off the two-year local biodiversity campaign Let It Grow with a call for continued cooperation between zoos, science centres, botanical gardens and municipalities. Local biodiversity remains a key point of public engagement with nature, as well as helping us to maintain urban green space and protecting the species it contains. With further resources to be developed, the campaign team of EAZA, BGCI and Ecsite aim to leave a lasting educational and engagement legacy for use by their Members over the long term. The effectiveness of such cooperations was highlighted by Katia Dell'Aria of Parco Natura Viva, whose institution worked closely with Padua's science museum and botanical garden on the campaign. Marta Zajac-Ossowska of Wroclaw Zoo showed how the campaign allowed them to engage with middle school students of the pre-teen demographic, via summer camps and special installations at the zoo.

SILENT FOREST LAUNCH

With Let It Grow officially closed,

the second half of the plenary was dedicated to the launch of the new joint campaign by EAZA, TRAFFIC, BirdLife International and the IUCN SSC Asian Songbird Trade Specialist Group. The two-year campaign, called Silent Forest, was introduced by Theo Pagel, CEO of Cologne Zoo and the first EEP Coordinator for Bali myna, one of the 12 bird species highlighted by the campaign. That Southeast Asia is in the midst of a genuine crisis of biodiversity amongst its exotic songbirds was demonstrated clearly by Acting Regional Director of TRAFFIC in Southeast Asia, Kanitha Krishnasamy and BirdLife International's Dr Nigel Collar, drawing on both personal experience and peer-reviewed scientific studies. Campaign Chair Tomas Ouhel and Vice-Chair Simon Brusland then outlined the goals of the campaign (to raise awareness of the issue and funds for its solution) and how zoos can participate effectively. For more details on the campaign, visit the website www.silentforest.eu.

Saturday's meetings finished with a final plenary that reflected the success of Emmen's hosting of the event, and the traditional handing over of the flag to next year's host, Attica Zoo in Greece. With the business of the conference finished, delegates convened in the Jungola tropical house for a well-earned gala dinner.

EAZA would like to extend its heartfelt thanks to Wildlands and its dedicated and efficient staff, to the city of Emmen, to all delegates, to the Corporate Members and exhibitors without whom the conference would not take place, and to the highly efficient organising company Conference by Design. We look forward to seeing you next year in Athens!

Breeding butterflies and beetles

SUCCESSFUL BREEDING PROGRAMMES AT NORDENS ARK PROVE HOW REWARDING INVERTEBRATE CONSERVATION CAN BE

Christer Larsson and Jimmy Helgesson, Nordens Ark, Sweden

Insects are all around us. Whether you live in the countryside or in a large, modern city, the invertebrates always seem to invite themselves in.

Some species of insect are of great value for humans and offer us important ecosystem services. The bee pollinates our crops and give us food and honey, the earthworm eats and dissolves our debris. Other species, however, such as longhorn beetles or centipedes, do not seem to have a direct and important role for us humans, and are often forgotten and considered to be 'useless'. The question is, are they actually useless or do they bring something good to mankind? Some insects are even worse than 'useless'; they eat and destroy our plantations, invade our houses, bite and sting us and some even suck our blood! Why do we need them? Well, the answer is simple: all species, no matter how large or small, belong to a complex ecosystem and have evolved over thousands of years to fulfil a certain ecological niche and purpose in life. That is why we have such a great diversity of insects in the world.

Across the world, some 900,000 insect species are known to us. Some researchers believe that there may be up to five million insect species! But whichever figure is true, insects represent a very large part of the total number of species in the world. However, in the world of conservation, insects are easily forgotten and the focus is more often on conservation projects linked to birds, primates or big carnivores. All creatures are equally important, but these projects often require a lot of money if they are to have any positive impact. Conservation projects for insects, however, can be run quite easily for various reasons. Such projects also bring other positive effects to the zoo community as we take responsibility for a wider range of species, not just in

tropical countries around the world but also in our own backyard.

For more than 10 years Nordens Ark has been involved in conservation projects for different insect species native to Sweden. These projects have a national action plan prepared by the Swedish Environmental Protection Agency and are carried out by various county administrative boards in cooperation with Nordens Ark. A small selection is detailed here as an example of what we do and the impact it can have.

THE LONGHORN BEETLE (*PLAGIONOTUS DETRITUS*)

The conservation work with insects at Nordens Ark started with this small longhorn beetle, which is among the rarest beetles in Sweden and is classified as Endangered (EN) on the Swedish Red List. The species was once found in large parts of southern Sweden but today exists at only a few sites in the area round Stockholm. The reason for the decline is the massive clear-cutting of the country's oak forests, which has been going on for hundreds of years, in combination with overgrowing.

In the spring of 2006, Nordens Ark was given a commission by Stockholm county administrative board to attempt to breed the species. The aim of the project was to develop breeding methods and mass-produce beetles for large-scale release.

Adult individuals (imagoes) were collected during the hatching season in late June and early July at Djurgården in Stockholm. The imagoes were taken to new breeding facilities at Nordens Ark and placed in outdoor cages for mating and egg-laying. The cages were furnished with logs and thick branches of newly dead oak for the egg-laying. Mating and egg-laying started quickly and a long and uncertain waiting took place because the larvae live for one to



two years under the bark inside the logs and branches. It is not easy to monitor what is going on inside an oak tree trunk!

However, everything worked well and the following year a large number of beetles were hatched and the procedure was repeated. The keepers collect the beetles as soon as they hatch and move them to a new cage. The newly hatched beetles are very lively and quickly start to mate. The longhorn beetle lives for just one or two weeks as imago, but we have managed to extend the active time they lay eggs by feeding with nutritional solution and pollen.

A similar breeding method has now been developed with smaller pieces of oak in indoor terrariums. The larvae inside the wood undergo the same treatment as the outside breeding stock but under more controlled conditions. This now gives us the advantage of producing more individuals per square metre of wood.

This rearing technique has been very successful and is now being used to produce both beetles and colonised wood for reintroduction each year. So far Nordens Ark have sent 60 colonised oak logs and around 500 beetles for reintroduction at two different sites in Sweden. The reintroductions will continue for another five years and will then be evaluated.

THE GREAT CAPRICORN BEETLE (*CERAMBYX CERDO*)

In 2012, Nordens Ark was commissioned by Kalmar county administrative board to develop and implement a method of breeding the great Capricorn beetle. This beetle is the largest longhorn beetle in Sweden and can grow up to 5cm, not including the long antennae. The species is classed as Critically Endangered (CR)

and remains in only a single site in Sweden, in the Halltorp nature reserve on the island of Öland. The great Capricorn beetle depends on old oak trees with rough bark that are exposed to the sun, and the reason for the decline of the species is the same as for the *Plagionotus*.

Thanks to a cooperative agreement between the Kalmar county administrative board and the Polish authorities, Nordens Ark was given permission to collect 30 pairs of great Capricorn beetles from the strong population in Rogalin in Poland. The collection was carried out over three years, from 2012 to 2014. The reason for taking beetles from Poland was that the Swedish population is extremely vulnerable, with a very small number of remaining individuals, so we wanted to have more knowledge and experience of breeding it before starting a breeding and reinforcement/ reintroduction programme with the Swedish population. After three years of trial and error using the Polish beetles, we were able to breed the species fully out in a second generation. We now felt confident enough to implement our breeding techniques on the Swedish population.

After collecting a small number of beetles from Halltorp nature reserve, we brought them to Nordens Ark's breeding centre for a few days for mating and egg-laying. The beetles were then released back into the nature reserve to continue the egg-laying there. This is important with such a vulnerable small population; we only 'borrow' some of the specimens for a short time in order to get some eggs.

After the egg-laying and during the metamorphosis to the imago stage, each specimen needs to be kept in a separate plastic box, otherwise they will predate on each other. The full life cycle in natural conditions from egg to reproductive beetle takes four or five years in Sweden. But when the larvae are offered more nutritious food and are



CLOUDED APOLLO BUTTERFLY
(*PARNASSIUS MNEMOSYNE*)
© NORDENS ARK

kept at a slightly higher temperature, the lifecycle of the captive population can be brought down to about two years. With this method we now expect to produce 150–200 beetles for release each year.

The long-term goal is to re-establish a viable population of great Capricorn beetles in restored and protected areas on the mainland of Sweden where the beetles historically used to occur.

CLOUDED APOLLO BUTTERFLY (*PARNASSIUS MNEMOSYNE*)

The clouded Apollo butterfly is the newest conservation project at Nordens Ark. The clouded Apollo butterfly has been recorded in 25 European countries and is regarded as Endangered almost throughout its European range. In Sweden the species is listed as Endangered (EN) and is known from around 40 localities in three regions isolated from one another. The clouded Apollo occurs as imago in the early summer, in June and July, and is restricted to richer land with mosaics of deciduous forest and scrubby verges of fresh meadows that contain suitable nectar-bearing flowers for the fully formed butterflies. An absolute requirement for a potential locality is the presence of *Corydalis* spp., which is the only host plant that the caterpillars feed on. The main threats to the species are overgrowth and excessively heavy and intensive grazing and development of the localities.

In 2016, a modified greenhouse was constructed at Nordens Ark's breeding centre. This greenhouse gives us space to grow the host and nectar plants for caterpillars and butterflies as well as

space to breed and rear the species. Eggs were collected from the wild population in Blekinge by the local county administration and brought to Nordens Ark.

When the eggs started to hatch, the caterpillars were placed in small cages on hotbeds planted with *Corydalis solida*. The caterpillars eat intensively and grow very fast. After about three weeks they start to pupate. The caterpillar weaves a cocoon inside dry leaves and after three to four weeks the first butterflies start to emerge. They quickly climb up on twigs and start unfolding their wings. As soon as they are fully developed, the butterflies are moved to new cages and placed in pairs. Each pair and cage is given a potted nectar plant to feed on and the butterflies almost instantly start to mate and lay eggs. The butterfly lives for only a couple of weeks. The eggs are then carefully collected and placed in small textile bags in which they will stay for about nine months until the following spring when it's time to hatch.

The aim of the project is to keep an assurance breeding colony of the species at Nordens Ark and, when restorations have been done, to reintroduce the clouded Apollo in areas where it once thrived. Reinforcement of small existing populations may also be relevant in the future.

More zoos, big and small, should get involved in species conservation actions for invertebrates. Wherever you are in the world, there are invertebrate and mollusc species that are threatened by extinction – so just choose one and get started!



Saving the grasshopper

THE FUTURE OF THE CRAU PLAIN GRASSHOPPER COULD BE TRANSFORMED THANKS TO A TEAM OF EXPERTS AND AN INTENSIVE CONSERVATION STRATEGY

Cathy Gibault, DVM – Curator, Thoiry Zoo, France; Laurent Tatin, Wildlife Biologist, Réserve Naturelle des Coussouls de Crau, France; Mark Bushell, Curator of Invertebrates, Bristol Zoological Society, UK and Co-Chair of the Grasshopper Specialist Group; Linda Bröder, PhD student, Trier University, Germany; and Axel Hochkirch, Co-Chair of the Grasshopper Specialist Group and Chair of the Invertebrate Conservation Sub-committee, Trier University, Germany

Although insects represent the most species-rich animal group, providing valuable ecosystem functions and services, their consideration in nature conservation is scarce. However, one Mediterranean insect species has recently benefited from conservation attention: the Crau Plain grasshopper (*Prionotropis rhodanica*). In 2014, a conservation strategy for the species was developed under the supervision of the Species Conservation Planning Sub-committee (SCPSC) and the Invertebrate Conservation Sub-committee (ICSC) of the International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC) involving *in situ* and *ex situ* actions. The Crau Plain grasshopper conservation programme is an illustrative example of collaboration between zoological institutions, field biologists and conservationists for the survival of a critically endangered species.

STATUS OF THE SPECIES IN THE WILD

The Crau Plain Grasshopper is a large flightless grasshopper endemic to the Crau Steppe area of southern France, a unique Mediterranean dry steppe habitat. The landscape is a semi-arid pasture similar to the dry grasslands of southern Spain and North Africa. This region has been grazed by sheep for centuries, and nowadays about 40,000 sheep are grazing from February or March to mid-June in nomadic flocks before they move to the Alps.

The species is large; females are 4–5cm long and males 3–4cm, but it has a very good camouflage and is therefore very difficult to find.

Due to its large body size, the Crau Plain grasshopper is an important primary consumer and also a part of the diet of several threatened steppe-bird species, such as little bustard, lesser kestrel, stone curlew and others. Contrary to some other grasshoppers, its fecundity is not very strong: only 15–18 eggs per egg pod are produced and females are considered to lay about four or five egg pods in the wild.

Its natural habitat is fragmented in several patches that cover a total of 11,000 ha out of the 500,000 ha that existed in the sixteenth century. This fragmentation is the result of the transformation of the original habitat into meadows, orchards, olive yards or industrial areas. From the remaining habitat, 7,500 ha are protected and managed in the Réserve Naturelle des Coussouls de Crau. But 24 per cent of the land inside the reserve still belongs to private owners, and habitat destruction still occurs (mainly outside the reserve). Consequently, the species has completely disappeared from many sites in the last 50 years and a recent survey has shown that only three small isolated subpopulations still exist. The



CRAU PLAIN GRASSHOPPER
(*PRIONOTROPIS RHODANICA*)

extent of occurrence for the species is around 40 km² and its area of occupancy is around 12–16 km². Therefore, the Crau Plain grasshopper is listed as a Critically Endangered Species (CR) on the IUCN Red List of Threatened Species as well as on the European Red List and the French national Red List.

As the species has declined dramatically within the nature reserve as well, it is very likely to be also affected by other threats, which are currently under study and include predators, climate change, impact of chemicals, diseases and other factors.

PUBLICATION OF THE FIRST CONSERVATION STRATEGY FOR A GRASSHOPPER SPECIES

The extreme decline of the species and the strong need for conservation prompted the development of a conservation strategy for the grasshopper species. Field biologists, the IUCN SSC Grasshopper Specialist Group and the IUCN SSC Species Conservation Planning Sub-committee were involved from the early stages. In June 2014 a three-day workshop in Saint-Martin-de-Crau took place in order to prepare the strategic conservation plan for this species, involving members from the IUCN and representatives of Bristol Zoo Gardens and Thoiry Zoo as well as key stakeholders in the area such as shepherds, landowners, NGOs, military personnel and governmental staff. This

meeting was of key importance, as it was one of the first to focus purely on invertebrate conservation.

The Conservation Strategy for the Crau Plain Grasshopper 2015–2020 was developed under the guidance of the IUCN Species Survival Commission and published in October 2014. The strategy covers three major fields: research, population and habitat management, and public awareness.

FIELD STUDIES AND RESEARCHES

Field studies and field research are being led by Laurent Tatin (Réserve Naturelle de Crau) in collaboration with Axel Hochkirch from Trier University in Germany, who is also Co-Chair of the IUCN Grasshopper Specialist Group. From 2016 to 2019, Linda Bröder is running a PhD on the Crau Plain grasshopper, focusing on population ecology (microhabitat preferences, population dynamics and population genetics) and threats analysis (the impact of predation, grazing and population fragmentation). In addition, two scientific papers have been submitted recently suggesting a negative effect of intensive grazing on the habitat structure, which might have facilitated extinction in some habitats.

EX SITU BREEDING

As scheduled in the Conservation Strategy, an *ex situ* conservation programme started in 2015. The aim is to learn as much as possible about the life history of the species to encourage the conservation efforts in the *in situ* populations and increase the chance of persisting. Thoiry Zoo (France) was appointed to coordinate this breeding programme; in the future, a more formal EAZA EEP is planned, although it is still in its early stages.

In the wild, young Crau Plain grasshoppers hatch in April and become adult at the end of May. Eggs are produced throughout June and the beginning of July. Adults usually die subsequently. Eggs are thought to diapause until the next spring, but the total duration of the cycle of development is still unknown, as are the factors responsible for breaking the diapause. In many grasshopper species the eggs hibernate once and nymphs hatch in the following year, but in some species the cycle can be two years or even longer.

The main objectives of the *ex situ* breeding project are as follows:

- to complete the lifecycle in human care in order to establish a self-sustaining viable *ex situ* population and to produce animals for potential reintroductions into the wild;
- to learn as much as possible about the biology of the juveniles and adults, particularly about factors responsible for the egg development; and
- to learn more about the disease and pathogen status of the grasshoppers in the wild.

In 2015, the French authorities gave their official agreement for Thoiry to capture a small number of juveniles in the field in collaboration with biologists of the Réserve Naturelle des Coussouls de Crau. The number of juveniles captured in 2015, 2016 and 2017 were 26, 22 and 21, respectively. To aid the breeding programme, Thoiry and Bristol Zoo produced in 2014 a disease risk management assessment, and for biosecurity reasons the grasshoppers are housed in a dedicated room so that they will not be in contact with other insects.

Alongside this, a necropsy protocol has been developed in Thoiry since 2015 and internal and external parasitology is performed when the grasshoppers first arrive at the zoo and throughout their lifetime there.

Temperatures have been recorded in the wild using data loggers, and this information is used to manage the natural temperature gradients in the zoo.

Thanks to abundant and ever-fresh food (dandelion and plantago) and the absence of predators, we observed that the lifespan of the animals is much longer in the zoo than it is in the wild; four to five months in the wild versus seven months in our care. This is caused by a much longer adult lifespan, whereas juveniles' development is similar to the wild.

Each female produced on average 13 egg pods in 2015 and 12 in 2016, which is much higher compared to the four or five egg pods they lay in the wild. As an egg pod contains 15–18 eggs, the potential of breeding within zoos to produce an *ex situ* population is obvious. Thus, during those first two years of the breeding programme, a total of 340 egg pods were produced (179 and 161 respectively in 2015 and 2016) from 48 adults (13 females in 2015 and 2016). Because of the high number of egg pods laid, it was decided not to incubate all of them in Thoiry but to test the translocation into the natural habitat, based on four testing groups with differing conditions.

No hatching was observed in spring 2016, neither in the transferred egg pods nor in the ones kept in the laboratory. Dissection of 43 egg pods (32 and 11 from 2015 and 2016 respectively) showed that most of the embryos from the transferred egg pods were still developing and might hatch in spring 2017. With regard to egg pods reared in the lab, only those from 2016 showed some embryo still alive but developing slowly compared to the transferred egg pods.

In March 2017 the first nymphs hatched from the eggs laid in Thoiry in 2016 and were transferred to Crau for incubation under natural conditions. Unfortunately, 15 of the 20 juveniles died after about a week. Some analyses were positive for Iridovirus, but it remains unknown if this was the cause of death. Research into this virus is still in progress. The surviving individuals were raised and contributed to the upcoming breeding cycle. For the first time the lifecycle was completed in the framework of the breeding project (reproduction in zoo surroundings, egg development in the natural habitat and subsequent reproduction at the zoo), but was accompanied by a high mortality in the early nymph stages. Improvements still have to be made in order to produce more juveniles, including an earlier transfer of egg pods to the wild, improved monitoring of hatching in the Crau, the development of a new design for rearing juveniles and other measures.

This conservation programme is following the One Plan approach, and *ex situ* and *in situ* populations are considered as a single meta-population. Plans currently allow individuals and/or eggs from both populations to flow back and forth to ensure adequate genetic flow between them and to ensure healthy populations.

When more animals become available as a result of the breeding programme, further *ex situ* subpopulations will be established at other EAZA institutions to create a wider population, which will be less susceptible to population collapse and loss during this part of the programme.

Fantastic phasmids

THE REDISCOVERY OF THE LORD HOWE STICK INSECT IS A WELL-KNOWN CONSERVATION STORY – AND IT IS CONTINUING TO THRIVE THANKS TO THE EEP

Mark Bushell, Bristol Zoo Gardens, UK, EAZA EEP Coordinator for *Dryococelus australis*



ADULT FEMALE LORD HOWE
ISLAND STICK INSECT
(*DRYOCOCELUS AUSTRALIS*)

The Lord Howe Island stick insect (*Dryococelus australis*) is probably one of the most famous species of phasmid known, with an incredible back-story. Originally from the island of Lord Howe, they were thought to have been made extinct after a ship ran aground in 1918 and black rats made it on to the island with devastating results. However, in 2001 it was rediscovered on Balls Pyramid, a rat-free volcanic outcrop 23km off the coast of Lord Howe Island, and in 2003 a team of researchers brought back two pairs to Melbourne Zoo in an attempt to establish a population managed in human care. Thankfully they succeeded and the population in Australia now stands at some 650 individuals, in addition to several hundreds of eggs being incubated.

In 2012 an attempt was made to establish colonies at Zoo Budapest and also San Diego Zoo; it had limited success, but it did produce some important information about what did and didn't work for this species in human care, and helped to lay the foundations for a second attempt in 2015. Bristol Zoo Gardens, San Diego and Toronto Zoo were selected for the next attempt and in November

2015 300 eggs were sent to Bristol Zoo Gardens to begin what was hoped to be the European population for the species, managed closely under an EAZA breeding programme. A dedicated climate-controlled rearing room was established, and several hundred plants (tree lucerne) were grown to feed the resultant nymphs.

The first insects hatched in December, and although we had an excellent hatch rate of over 70 per cent, the nymphs proved very hard to keep alive. After a lot of trial and error involving enclosure changes and additions to the food plant we finally succeeded in rearing just six individuals to adult – three pairs, thankfully! From these we produced just over 400 eggs. Unfortunately one of our females died quite early on from what appears to be a bacterial infection, but we are currently researching this alongside Melbourne Zoo to see if it is a bigger issue with the management of this species in human care. Even though this was not the success we were hoping for, it did give us a lot of useful information for future attempts; for a phasmid it is a lot harder than any other species that I and the team at Bristol Zoo Gardens have ever worked with.

From this small batch of eggs we started seeing hatches in March 2017; not as many as we had hoped, but this followed the pattern that Melbourne Zoo saw when they had the first few generations of a lower hatch rate – hopefully this will increase as we go forward. After a few shaky starts we now have a small group of nymphs feeding well, and three confirmed females who we hope to rear to adult some time in November. We are also in talks with Melbourne Zoo about the possibility of importing another group of eggs to help bolster the population here and, we hope, expedite the process of getting this species established in Europe at EAZA Member collections.

Although it is still early days, we are looking for EAZA Members who might be interested in participating in the EEP; there are several things that need to be done to make collections ready to receive the species, and the sooner it can be accomplished the better. Please do get in touch with me if you would like some more information on these truly remarkable animals.

If you can participate in this EEP, please contact Mark and his colleagues through the TITAG pages on the EAZA Member Area website.

Spider plan

THE DESERTAS WOLF SPIDER EEP HAS HAD A PROMISING START, BUT MORE INPUT IS NEEDED TO SAVE THIS REMARKABLE CREATURE

Mark Bushell, Bristol Zoo Gardens, UK, EAZA EEP Coordinator for *Hogna ingens*

The Desertas wolf spider (*Hogna ingens*) is the largest known species of wolf spider and is a strict endemic, being found only in a single valley on Desertas Grande, an island found off the east coast of Madeira. It is classed as Critically Endangered by the IUCN Red List of Threatened Species due to habitat loss caused by a floral imbalance in grasses. This incursion of invasive grass has caused massive shrinkage of its habitat, reducing the extent of its occurrence by more than 70 per cent in less than a decade.

In May 2016, Richard Saunders (Bristol Zoo's veterinarian) and I attended a three-day meeting and workshop in Funchal, Madeira, alongside experts from the IUCN Species Survival Commission, Madeira University and the Institute of Forest and Conservation of Nature. The strategy we helped to develop follows a holistic view of the conservation programme, including an *ex situ* programme focused on rearing spiders in human care, and an *in situ* habitat restoration plan, beginning in 2018, where volunteers from zoological collections will work alongside park rangers on Desertas Grande. The whole 'project' will run from 2017–2022 and the official strategy is to be published imminently.

As part of the strategy, 25 individual spiders were collected from the island to form the founder population for the wolf spiders at Bristol Zoo and the process for creating a formal EEP for the species was begun, becoming fully realised in September 2016. The plan for the EEP was to increase the number of holders of the species in Europe over time, with both *in situ* and *ex situ* populations considered as a single metapopulation, and transfers would be made between the two, depending on the success of rearing the species at Bristol.

I am delighted to say that although we managed to rear only nine of the animals to adult (this species was trickier than we initially thought and we learnt a lot along the way!), we did



produce three males and six females. From these we had four successful egg-sacs, which hatched in July, and some 1500 spiderlings were produced. We have split these into two groups: a less intensely managed population of four separate tanks, which are reared communally depending on which egg-sac they came from, and four groups of individually contained animals that are monitored closely for diet, development and health. The former are being used for research into burrow construction, group behaviour and dietary preferences,

and the latter will form part of the release population, which we hope will occur in 2018.

We have a couple of small spiderling groups moving to UK collections to help spread the load (ZSL London, ZSL Whipsnade and The Deep) and a couple of others are also in discussion, but we are still looking for new holders for the species. We are anticipating that as it progresses, the potential to produce large numbers of animals for release will probably be needed, so we need to secure as many volunteers as we can for habitat work. The aim is to restore the whole valley by the end of the project, so the more hands, the better!

If you are interested and wish to know more, please don't hesitate to get in touch with me via the EAZA Member Area website. The species is probably one of the most stunning spiders I have had the pleasure to work with, and they are an excellent ambassador for European invertebrate conservation programmes and for educating visitors on the positive differences that zoos and aquariums can make, especially when we all work together.



A snail's story

THE REINTRODUCTION OF THE PARTULA SNAIL IS UNDERWAY, THANKS TO THE ONE PLAN APPROACH

PARTULA BIOLOGIST DR TREVOR COOTE'S ESSENTIAL CONSERVATION FIELDWORK IS MADE POSSIBLE BY A SUPPORT CONSORTIUM OF EAZA AND AZA ZOOS AND THE FRENCH POLYNESIAN GOVERNMENT

Paul Pearce-Kelly, EEP & International Coordinator, ZSL London Zoo, UK

The 30th anniversary of the international Partula snail conservation breeding initiative and the 21st anniversary of the Partula EEP were both celebrated by the full implementation of the reintroduction phase of the programme. Building on an initial shipment and field release trial in 2015, between mid-September and early November 2016, 11 species and sub-species of Partula (totalling 3,073 snails) from EAZA and AZA zoos were shipped to Tahiti and released into a dozen sites on three islands (Tahiti, Moorea and Raiatea) in the Society group.

After excellent transportation, quarantine and initial reintroduction survival results, follow-up monitoring by the programme's field biologist, Dr Trevor Coote, suggests that our long-term human-bred populations have responded well to wild conditions and quickly reverted to ancestral behaviour. Rapid dispersal (an encouraging sign) into

complex forest habitat makes observations very difficult, and the monitoring strategy is being adapted to address these challenges as much as possible.

LIVING WITH THE ENEMY

Like all species reintroduction initiatives, we have to balance the many advantages of re-establishment with ensuring that the released populations are sufficiently resilient to any threat factors. For Partula, the threat has always been the introduced rosy wolfsnail (*Euglandina rosea*). Once established, it's effectively impossible to totally eradicate such robust invasive species, but long-term monitoring has confirmed that *E. rosea* has followed the classic invasive species pattern of initially flourishing in a highly favourable environment (high prey availability, absent or low competitors, etc.) before declining to more

PARTULA SNAIL REINTRODUCTIONS 2016

Species	Red Listing	Island	No. released
Partula mooreana	(EW)	Moorea	592
Partula suturalis vexillum	(EW)	Moorea	374
Partula taeniata simulans	(CR)	Moorea	67
Partula taeniata nucleola	(CR)	Moorea	100
Partula tohiveana	(EW)	Moorea	639
Partula affinis	(CR)	Tahiti	201
Partula hyalina	(VU)	Tahiti	8
Partula nodosa	(EW)	Tahiti	877
Partula dentifera	(EW)	Raiatea	96
Partula hebe bella	(EW)	Raiatea	81
Partula tristis	(EW)	Raiatea	38

The insect man

ZOOQUARIA'S DAVID WILLIAMS-MITCHELL TALKS TO MARK BUSHELL, CURATOR OF INVERTEBRATES AT BRISTOL ZOO AND TITAG CHAIR, ABOUT HIS CAREER IN CONSERVATION

DWM: Mark, can you tell us a little about your background and how you developed a passion for terrestrial invertebrates?

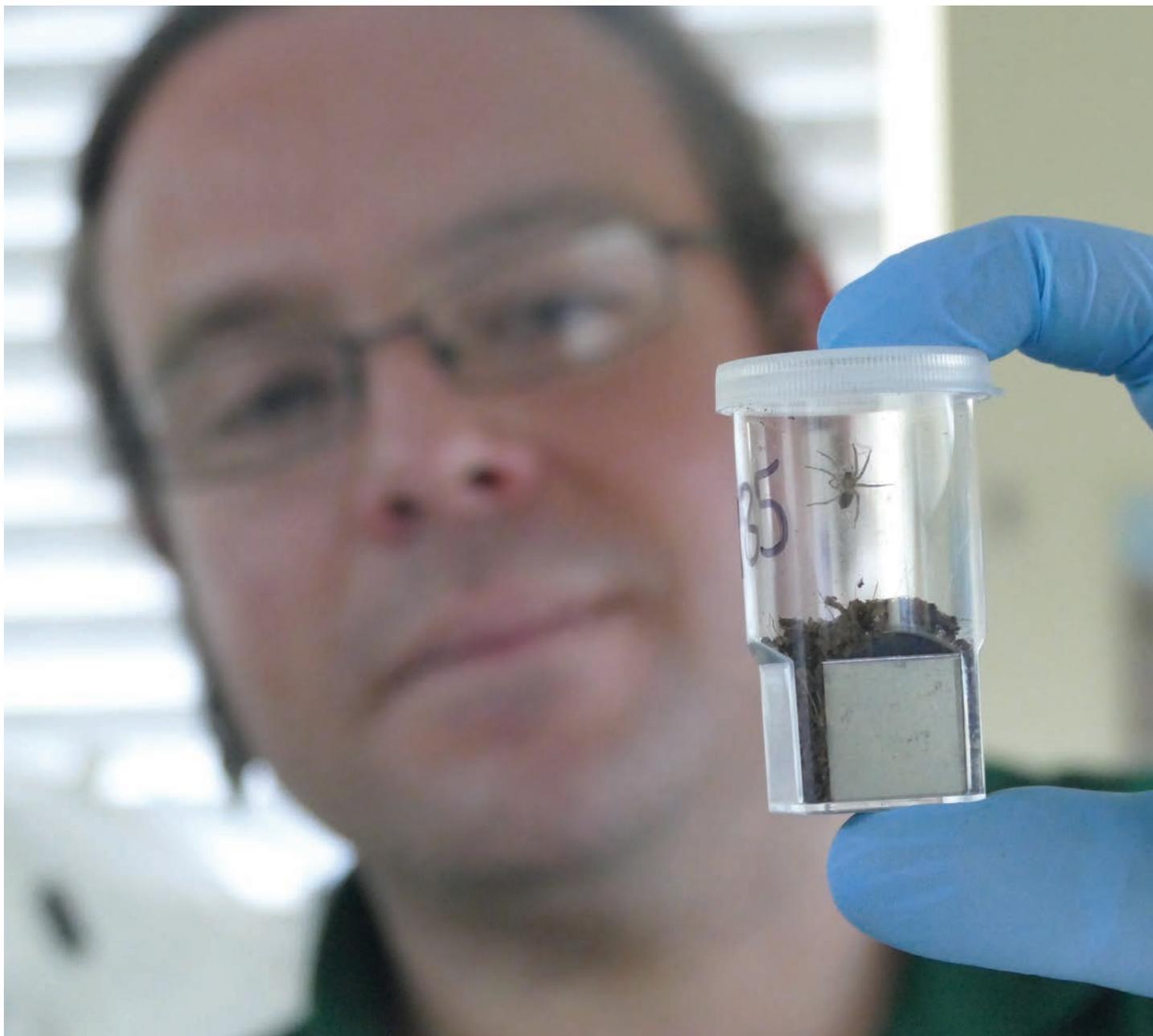
MB: I've been interested in natural history from a very young age; I spent the first six years of my life in Brunei, so I saw a vast wealth of animal and plant life at an early stage in my life. I was always taken by invertebrates, though, as there seemed to be no limit to their differing shapes, sizes and forms. Also, no one else liked

them as much, preferring monkeys and their ilk, so I kind of felt sorry for them and championed them wherever I could. Fast forward to 2010 and I'd been using various jobs after leaving university (my main career was in pub management!) to fund trips out to Southeast Asia to study insects (specifically stick and leaf insects) in the field and participate in associated research. I was even lucky enough to have a species of stick insect named after me in 2005 after a particularly

successful research trip. I managed to find myself a position at Bristol Zoo Gardens and the rest is history! I've essentially become one of those lucky people who are paid to do their hobby and passion.

DWM: Is there one species that particularly attracted you, and if so, which one and why?

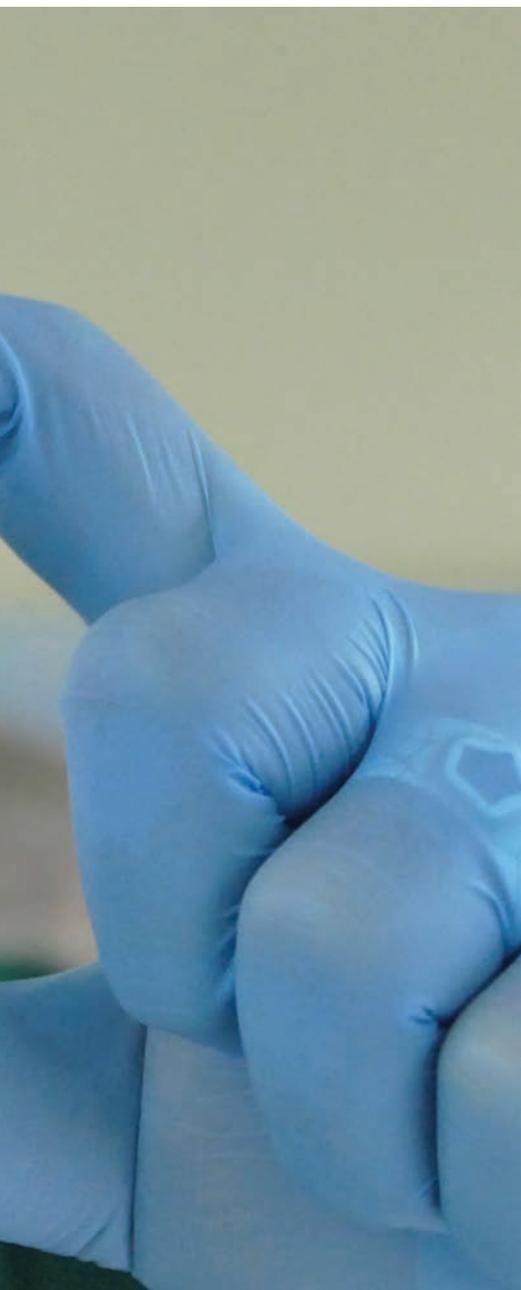
MB: There are so many species I'm fond of that I couldn't possibly single one out! Growing up in Brunei meant



I was exposed to many weird and wonderful species of invertebrate; one of my earliest memories is of a stick insect in our garden that must have been at least 30cm long. I've always had a soft spot for stick insects, being the first invertebrates I really kept as a pet, back when I was about six, so I guess the Lord Howe Island stick insect (*Dryococelus australis*) is definitely a contender. When I read about it in the early 1990s and learned that it was extinct, I never thought I'd see a live one – how wrong can you be?!

DWM: What achievement in the field of invertebrate zoology are you most proud of?

MB: I think one of my proudest achievements has been the work



I have put into the Desertas wolf spider (*Hogna ingens*) conservation programme. I have been involved since February 2013 and it has been a long process, and difficult in places. But to now be in a position where an official strategy has been realised and the *ex situ* work has begun is an incredible feeling! The team at Bristol has been crucial in the work and it couldn't have happened without their support, as well as, of course, the IUCN SSC and the various key NGOs and staff in Madeira.

In general, though, I am always proud if I can convert someone from not liking invertebrates to being interested in them. It's crucial to ensure that the next generation can pick up the baton when we pass it to them, so to know that there are people out there willing to do it because of the work we have done is a great feeling.

DWM: Invertebrates are probably not at the top of most visitors' must-see lists. How do you think we can change that, and do we need to?

MB: I think this question is a touch prejudiced – for example, butterfly houses are probably one of the most popular exhibits at zoological collections. ZSL Whipsnade recently built one that is now their highest scoring exhibit for visitors! They are often key exhibits and a great way of producing an immersive visitor experience; good examples that come to mind are the butterfly temple at Wildlands and the huge dome at Blijdorp. Visitors to zoos and aquariums do like seeing invertebrates; bear in mind the majority of visitors are children, and kids do love bugs! It's very common to hear lots of 'oohs' and 'aahs' when visitors see a particularly large spider, a group of beetles coloured like jewels or a swarm of locusts. To turn it round, I think that perhaps invertebrates are not as popular with directors; perhaps this is a good opportunity to highlight terrestrial invertebrates as an excellent, low-cost way of showcasing nature's diversity for our visitors and to educate them on the wonders of nature.

DWM: Terrestrial invertebrates play a vital role in our ecosystems. Do you think that the public

understands the role they play, and do you have any suggestions for EAZA educators for increasing public awareness?

MB: I think that visitors have a good overall appreciation of the role most species play in ecosystems, including invertebrates. However, the fact that you can get up close and personal with a cockroach and have visitors handle them does make it a much more powerful message – you couldn't do the same with a lion. It is very easy for the 'actors' to be the prime focus of the education sessions and quite often visitors come away feeling a certain attachment to the species when they've been able to get so close, which I think makes them ideal ambassadors for some of the conservation work EAZA collections participate in. My only suggestion would be to keep doing the amazing work you are already doing, and make terrestrial invertebrates an even bigger part of your sessions!

DWM: You've spoken elsewhere in the issue about the conservation status of terrestrial invertebrate species. How can EAZA Members help improve the prospects for these species, and do you think we need more programmes for terrestrial invertebrates? If so, which species would you like to see in the EEP structure?

MB: The beauty of terrestrial invertebrates is that generally they don't need as much space or money to have an effective conservation programme or focus; certainly less than would be required for a group of lions or tigers. The main issue is finding the species that require conservation actions the most and the best methods of applying them for maximum effect, in line with a laid-down strategy with a set guideline for events and goals to be met. The problem is that there are still many, many species that are yet to be assessed for the Red List of Threatened Species and some, even after assessment, are just not in a position for *ex situ* work. In these cases it's often best to concentrate on protecting, maintaining or restoring the habitat to help the species (and by proxy many others) survive. The TAG has been working closely with IUCN

specialist groups such as the Grasshopper SG and the Spider and Scorpion SG and has helped with the creation of two conservation strategies so far, the Crau Plain grasshopper (*Prionotropis rhodanica*) and the Desertas wolf spider (*Hogna ingens*), both of which are featured in this issue, and the former is a prime candidate for the new EEP structure. This is still very much the tip of the iceberg though and there's a lot more work to be done.

I think a lot of species can actually be helped outside the EEP structure with conservation programmes and strategies based on the local taxa; in the UK the tansy beetle (*Chrysolina graminis*) and the fen raft spider (*Dolomedes plantarius*) have been subject to some excellent and beneficial work with collections collaborating with local NGOs and experts to help realise the conservation potential of zoological collections. This was something I was really pleased to see highlighted by the Let It Grow campaign, and that it's not always the big and exotic species that need help – sometimes the most effective conservation work can be done on your doorstep.

DWM: We often speak about the reintroduction of Partula snails in the Pacific islands. Do you think it's easier or more difficult to reintroduce terrestrial invertebrates than other groups of species? Could we be doing more, and if so, where do you see the opportunities?

MB: I think it's exactly the same as for any taxa – just on a smaller physical scale! The Partula snails are a good example of this, as the consortium had to go through exactly the same rigmarole of tests, screening, paperwork and discussions that any other species of animal would have to for release back into their native environment; despite their much smaller size the importance of making sure that all of the 'i's are dotted and 't's crossed is just as crucial. ZSL's invertebrate department really does deserve a lot of credit for the hard work it's done on coordinating this important programme; it has effectively helped to create the blueprint for future work on invertebrate reintroductions.

EAZA collections can definitely achieve a lot with invertebrate conservation work, however. Although it presents the same level of difficulty as other taxa, the financial aspect is usually significantly smaller, the holding space required for a significant population is, of course, much smaller than for many other taxa, and, as a general rule, other than standard biosecurity requirements, they don't need as much financial input into their maintenance. In other words you can in most cases get significantly more bang for your buck by participating in terrestrial invertebrate conservation.

DWM: Many zoos worldwide hold sessions to help people get over their phobias, which involve the handling of invertebrates. Do you find this a useful way to get people interested in invertebrate species, and are there any unexpected welfare issues that Members should bear in mind?

MB: I think being able to get up close and personal with any species of animal can be a life-changing experience. Arachnophobia sessions are a particularly good focus and

can help not only to cure people of their fears, but also to educate them about the important role these fascinating creatures play in the ecosystem and why they are so crucial to the survival of a great many more species than people realise. 'Minibeast' sessions are also important and are usually one of the most popular sessions with children and adults alike, especially as it is usually possible to hold the subject of the discussion and get a really good look at them.

Of course, it is important to consider the welfare of the animals during these sessions, as with other taxa, and an increasing amount of work is being done on assessing welfare for the animals, with collections making sure there are sufficient rest periods for the animals used and maintaining several specimens to ensure the workload is spread. In a similar vein, more work is being done on environmental enrichment for various taxa and also training – a very new field, but one that is already throwing up some quite interesting results and which I am sure will be of great use to education and zoo staff in the near future.

DWM: You have four EEPs and one ESB that fall under the TAG. Given the number of offspring produced by some species (such as the Desertas wolf spider recently bred by Bristol, which had over 1000 spiderlings), can you tell us more about the challenges of coordinating these programmes?

MB: Terrestrial invertebrates as a rule do have large numbers of offspring, but this isn't the biggest issue with population management. As many species lay eggs or egg-masses, it is easy to control the number that hatch simply by disposing of the surplus before they even become a potential issue. With the Desertas wolf spiders this was a bit tricky, as it was the first time they had ever been bred in human care and we weren't sure what the success rate would be; but I'm delighted to say they proved to be very fecund!

The main challenges I have seen so far are that with some species it is very difficult to tell the sexes apart – Frégate beetles (*Polposipus herculeanus*) for example are almost impossible to differentiate – and in some species the males do not live long once they have reached maturity. Gooty ornamental spiders (*Poecilotheria metallica*) only live for about 12 months after maturing, so it can be a race against the clock to make sure they are in a breeding position at a collection. I have to say a huge thank you to all collections participating in the ESB for my very short-notice emails asking for transfers across Europe in some cases!

Some species aren't 'appropriate' for the EEP structure, usually because they are not of conservation concern that we know of, but the population still needs to be monitored *ex situ*. All collections want to have lovely big specimens available for display, but these have to come from somewhere and there needs to be a healthy sustainable population to achieve this. The American Zoo Association TITAG has been working hard on a very successful programme called 'S.W.A.R.M.' and the Vice-Chairs and I have been in discussions about implementing a similar system here, based on the MON-P level of programme, for various key display species that are held in EAZA Member collections. We're always on the lookout for willing participants, so please watch this space for updates!

A vet's life

EAZA'S VET ADVISOR FOR THE TERRESTRIAL INVERTEBRATE TAG DISCUSSES THE CHALLENGES OF HIS ROLE

Mark Eichelmann, Veterinarian and TITAG Veterinary Advisor

One of the most exciting aspects of my work as an exotic and zoo animal veterinary practitioner is the variety of species and issues that I work with on a daily basis. Since 2012 I have been the Veterinary Advisor for the EAZA Terrestrial Invertebrate Taxon Advisory Group, which offers me the opportunity to work with even more diversified cases, as this taxon group contains the most animal species on this planet.

Like many of my colleagues, I have been interested in wild animals for as long as I can remember. Long before I decided to become a vet, I started keeping Mantodea (Burmeister, 1838). My interest in husbandry, breeding and the taxonomy of other invertebrates and exotic vertebrates increased quickly and played a key role in my life long before my interest in medicine.

However, dealing with so many distinct species can sometimes be challenging, not least in the area of culling. Growing knowledge about the neurological physiology of invertebrates makes it more and more necessary to transfer this knowledge into a structure where these animals are treated in the most ethically correct way. The EAZA TITAG was able to establish culling guidelines for both aquatic and terrestrial invertebrates in cooperation with the EAZA Fish and Aquatic Invertebrate Taxon Advisory Group. Our purpose was to write not a strict credo, but a practical tool for the most ethically correct methods of culling.

During the process of a proper culling, there are many interfering factors which can be contrary to each other, especially in the set-up of a scientific study, or if invertebrates are used as food animals. Ideally, culling should consider the following aspects (Olfert, E. D. *et. al.* 1993). Death should occur without panic, pain or distress. The induction time to consciousness must be as short as possible and the culling should



be reliable and reproducible. Also, staff safety should not be underrated. Physiological and psychological effects on the specimen should be reduced as much as possible, and the location of the procedure must be separate from other animals. If specimens are to contribute to a scientific study, compatibility with the requirement and purpose of this study is very important. Finally, culling must follow economic considerations, and the ecological impact should be as low as possible.

Overall, it has been accepted that even lower invertebrates possess a physiological ability to collect, process and interpret stimuli. Whether this leads to a negative emotional stage that could be considered actual pain as we would interpret it is still in discussion (Bateson, P., 1991). Based on scientific literature, we give recommendations for practical culling techniques. The ideal culling technique consists of a first step, where nociception is deactivated, and a second step that leads to a stage incompatible with life. Sometimes it is possible to achieve this stage with just the first step.

The work of a vet advisor includes medical problems of specific taxa, such as husbandry and nutrition guidelines, protocols for hygiene, necropsy or health checks such as those that we produced for the potential *Ischnocolus* spp. (Ausserer, 1871) conservation project.

Invertebrate necropsy can be challenging, as carcasses degenerate quickly in the environment in which they are usually kept. Therefore, specimens must be fixed as soon as possible after death, and I am currently working on a protocol to optimise this procedure. The whole list of requirements and recommendations can be found in the EAZA Guidelines for Veterinary Advisors (EAZA 2011).

Furthermore, I feel responsible for the scientific development of invertebrate medicine, which includes scientific articles in the field of laboratory medicine and a book about general Theraphosid medicine. I have created an internet page (see www.arachnomedicine.de), which gives private owners and veterinarians with a 'positive invertebrate attitude' the opportunity to connect with each other and share their findings. I hope that our knowledge of invertebrate medicine will increase as more animals receive proper healthcare in this way.

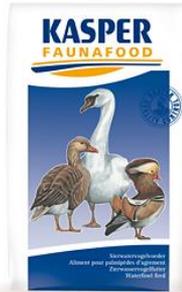
Networking is also part of the work of the EAZA TITAG, and it cannot be overrated. The sharing of current scientific work and discussions plays a very important role in the exchange of knowledge and the development of communication structures.

REFERENCES:

- Bateson, P. (1991). *Assessment of pain in animals*. *Anim. Behav.* (42) pp. 827–839.
- Olfert, E. D. *et. al.* (1993). *Guide to the care and use of experimental animals*. Canadian Council on Animal Care.
- EAZA 2011: *Guidelines for Veterinary Advisors appointed to EAZA TAGs, EEPs and ESBs*. Approved by EAZA Veterinary Committee, September 2011.

Dry food *St Laurent*

Lundi
Kasper
Nutrazu
St Laurent
Kaytee



Frozen food *St Laurent*

Frozen food for birds, large carnivores
Frozen meat for dogs, cats and ferrets
Frozen insects
Rodents



St Laurent

Food and equipment for wild and domestic animals



Equipment

Breeding
Capture
Transport
Equipment
Accessories
Enrichment



Vitamins

Vitamins for marine animals
Vitamins for birds, carnivores
Hygiene products
Supplements



SAS Saint Laurent

ZA du Bouillon - 79430 LA CHAPELLE SAINT LAURENT (France)

Tel: +33 (0) 549 720 920 - Fax: +33 (0) 549 721 112 - commercial@st-laurent.fr - www.st-laurent.fr



Marvellous monsters

JULY'S JOINT EAZA TITAG AND BIAZA TIWG CONFERENCE PROVED TO BE AN INSPIRING BREEDING GROUND FOR INFORMATION AND IDEAS

Alison Reynolds, Herpetologist and Invertebrate Keeper, Marwell Wildlife, UK

In July this year, the EAZA Terrestrial Invertebrate Taxon Advisory Group (TITAG) and the BIAZA Terrestrial Invertebrate Working Group (TIWG) combined for a joint conference at Longleat Safari Park in Wiltshire, UK. It was a well-attended conference, attracting more than 50 delegates from across the UK and from as far afield as Prague. Delegates ranged from zookeepers and curators to college and university staff, and individuals from private companies.

Longleat was the perfect venue for this conference as the park is currently showcasing invertebrates in its 'Marvellous Monsters' event. Larger-than-life models of beetles, spiders, mantids and other invertebrates have been installed around the attraction and are proving very popular.

There were a number of fascinating workshops, including a BIAZA accredited workshop on First Aid for Invertebrates, and a bee-keeping workshop in Longleat's new Bee Zone.

We were lucky enough to have three fantastic keynote speakers: Dr Sarah Beynon from The Bug Farm in St David's, Leslie Pattenden from Ryewater Nursery in Dorset and Paul Pearce-Kelly from ZSL London Zoo.

Dr Beynon gave an insight into the work she is currently undertaking at The Bug Farm on native species of dung beetles. The aim is to put an economic value on the presence of dung beetles on farms in an effort to discourage the use of wormers for hoofstock, which have a detrimental effect on beetle populations.

Leslie Pattenden spoke about the work being done for both native and non-native butterflies at Ryewater Nursery. The site covers 100 acres and is being actively managed for native wildlife. In addition, there are a number of glasshouses where non-native species of butterfly are displayed. Most of these butterflies are bred and reared on site, and the planting is managed specifically for the butterflies.

Paul Pearce-Kelly spoke about the



ATTENDEES AT THE BIAZA/TITAG CONFERENCE IN LONGLEAT, UK

role of zoos in the conservation of invertebrates, from collaboration on native projects such as the ladybird spider to international, long-term projects such as the Partula snail. These projects not only directly benefit the conservation of these species, but also enable us to gain knowledge in areas such as husbandry and reproductive behaviour, to acquire transferable skills and experience and to engage public support.

The remainder of the conference comprised of short talks on a wide variety of subjects. Public engagement was a hot topic this year, and there were a number of talks on public perception – how to change pre-conceived ideas and engage people with invertebrates.

We were given updates on several conservation projects, such as the reddish buff moth (*Acosmetia caliginosa*), the River Barle crayfish project and the tansy beetle (*Chrysolina graminis*). We also had an update on the St Helena spiky yellow woodlouse (*Pseudolaureola atlantica*) from Amy Dutton, who has recently returned from the island. Husbandry-based presentations included breeding techniques for Hercules beetles (*Dynastes hercules*)

and butterfly management at ZSL Whipsnade, breeding dragon-headed katydids (*Eumegalodon blanchardi*) at the Berkshire College of Agriculture, displaying *Scolopendra* at The Deep, breeding of the Desertas wolf spider (*Hogna ingens*) at Bristol Zoo, and the development of a new leaf-cutter ant (*Atta cephalotes*) exhibit at Marwell Zoo.

There were a number of research presentations, beginning with Steve Trim from Venomtech, who spoke about some research on the use of RFID tags in invertebrates, namely cockroaches and theraphosids, to monitor body temperature. This research confirmed that these species are truly poikilothermic. Frances Baines and James Brereton gave a thought-provoking talk about how best to research full-spectrum lighting in invertebrates in such a way as to provide meaningful and useful data.

In all, it was a fascinating conference, full of engaging talks and workshops. Well done to the TIWG and TITAG committee, and a huge thank you must go to Graeme Dick and his team at Longleat for providing such a wonderful and well-organised venue. A high standard has certainly been set for next year!



JORAVISION

CREATING LEISURE

DESIGN & BUILD FOR IMMERSIVE EXPERIENCES

WWW.JORAVISION.COM

REQUEST@JORAVISION.COM

+31 71 40 26 747



Creatures in the citadel

WITHIN A UNESCO WORLD HERITAGE SITE, A STUNNING INSECTARIUM OFFERS VISITORS AN INSIGHT INTO THE LIFECYCLES OF HUNDREDS OF EXOTIC AND NATIVE SPECIES

Margaux Pizzo, Director, Besançon Citadelle Zoological Garden, France

The Citadelle of Besançon, a UNESCO World Heritage Site, hosts within its Vauban fortifications a museum composed of four animal areas: the Aquarium (freshwater fishes), the Noctarium (nocturnal mammals and amphibians), the Zoological Garden (mammals and exotic birds) and the Insectarium.

AN ECOSYSTEMIC PRESENTATION

Arthropods are presented in five major zones: species that live in 'open environments' (little or no vegetation cover), species that live in 'closed environments' (several layers of vegetation), insects in your home, insects from the aquatic environment and, lastly, social and colony insects.

The Insectarium contains a great diversity of arthropod species; ants, praying mantis, beetles, scorpions, dragonflies, tarantulas and more. A hundred species, exotic and native, are bred on site, from which more than 60 species are presented to visitors. There are also eight species of amphibian and three species of reptile (geckos, chameleons) that are predators of insects.

AN EDUCATIONAL SCENOGRAPHY

The central decoration represents a universe of 'books' more than two metres high, the pages of which are wide open and contain many vivariums. The history of the building is respected by retaining certain materials (parquet wood and ceilings 'à la française') but newer materials such as plexiglass and metal add a touch of modernity. Visitors can immerse themselves in the living spaces of insects in the kitchen and see bees active in their hive. Circular vivariums and small greenhouses of amphibians and reptiles, ant hills and freshwater insect modules animate visitors' itineraries. Terrariums with live animals alternate with display cases of set specimens illustrating features of the biology of arthropods and explain their evolution, adaptations and classification.



CHARISMATIC INVERTEBRATES PLAY A CENTRAL ROLE AT THE BESANCON FACILITY

INSECTS UP CLOSE

At the entrance, a large bay window reveals the breeding laboratory where the teams ensure the reproduction and development of the animals. It allows visitors to see behind the scenes at the Insectarium, a place of study and reproduction. On the ceiling, Malagasy golden silk spiders (*Nephila* sp.) play the role of a natural insecticide by catching the prey that occasionally escapes from the vivaria.

Two active ant colonies are on display, one behind glass in a whimsical layout, the other in a transparent arch overlooking the entrance of the Insectarium. Visitors can witness the daily life of these social insects living in colonies of thousands of individuals, the most striking of which are probably the mushroom ants or leafcutter ants (*Atta cephalotes*).

In the observation hive, the honey bees make their honey next to a reconstituted kitchen where the insects that are often found in our houses proliferate.

LIVESTOCK AND FLAGSHIP SPECIES

The challenge of breeding in the Insectarium laboratory is to guarantee autonomous reproduction in the long term while ensuring a permanent presentation of arthropods whose lifetime is short. Some species, such

as crickets, locusts, cockroaches and larvae of beetles, are produced to feed insectivorous animals, including spiders, scorpions, frogs, some rodents in the Noctarium and some mammals and birds in the zoological garden. Local species are also present, including freshwater species such as water boatmen and pond skaters, to make visitors aware of the diversity of arthropods in their immediate surroundings.

Some species have been chosen for their rarity and their conservation interest. Two are in EAZA breeding programmes; the Frégate Island giant beetle (*Polposipus herculeanus*) as an EEP and the Gooty sapphire ornamental tarantula (*Poecilotheria metallica*) as an ESB. The latter is particularly fragile during reproduction. Another species, the Lesser Antilles Hercules beetle (*Dynastes hercules hercules*), the impressive 'elephant' among insects, was managed as an ESB from 2006 to 2010 thanks to the initiative of Jean-Yves Robert, the previous scientific director. He was able to train institutions in his long and meticulous breeding: a cycle of two years, with 20 months in the larval stage and only six months as an adult beetle.

Finally, perhaps the most beautiful creature in the place remains the pink orchid mantis (*Hymenopus coronatus*), a particularly sensitive species. The animal team has used its considerable experience to develop a precise strategy and system for regulating temperature and humidity in its enclosure and to manage its long-term breeding.

The Insectarium of Besançon has amassed a rich diversity of species and presented it in a space ideally designed for the education of the public. Dedicated to the fascinating world of insects, the most important class of the animal kingdom, the animal team at Besançon is in continuous training to breed rare and threatened species to a very high standard, and is proud of its contribution to the world of conservation.

A duty of care

WHY TERRESTRIAL INVERTEBRATE WELFARE IS AN EVER-CHANGING AREA OF CONCERN

Luke Harding, Curator of Lower Vertebrates and Invertebrates, and Holly Farmer, Zoo Research Officer, WWCT, Paignton Zoo, UK; Mark Bushell, Curator of Invertebrates, Bristol Zoo, UK; and Sally Binding, Animal Welfare Training Officer, EAZA Executive Office

Invertebrates comprise approximately 95 per cent of all known animal species and are an important component in maintaining stable ecosystems through waste disposal and plant fertilisation, alongside their more recognised role as a major part of the food chain¹. A wide variety of species is kept in human care, but knowledge of species-typical behaviours and habitat preferences is often limited, and our ability to apply evidence-based husbandry and maintain appropriate welfare is therefore very restricted.

Current legislation in the UK states that the Cruelty to Animals Act of 1876 applies only to non-human vertebrates. More recently, changes to the EU Directive (2010) Article 1, 3b have broadened the protection of animals used for scientific purposes to include cover for some invertebrate species such as 'live cephalopods'². This more recent EU legislation reflects a growing change in concern about invertebrate welfare, as it had long been questioned whether invertebrates were sentient beings. However, there is now a wide body of evidence to suggest that invertebrate species, both aquatic and terrestrial, experience a diverse range of emotional states (affective states) as well as the capacity to, for example, experience pain.

RESEARCH REPORT

Evidence has suggested that a reduction in pain response has been reported when invertebrate species are given morphine (e.g. praying mantises, earthworms and land snails)³ and a release of anxiety-associated serotonin has been found in crayfish when exposed to negative stimuli⁴. In addition, the cognitive abilities of invertebrates in terms of social learning and memory have been reported for a range of species such as honeybees and desert locust¹, as well as the more commonly recognised intellectual abilities of octopus, including that of self-awareness⁵.

'All animals are equal, but some animals are more equal than others.'

GEORGE ORWELL, *ANIMAL FARM* (1945)

The published evidence supports the argument that invertebrates should be considered on a similar welfare level to vertebrate species.

THE WELFARE CHALLENGE

In human care, invertebrates play many roles; in *ex situ* breeding programmes, native species reintroduction, as live food and in educational displays, and all of these should maximise the welfare of the animals concerned. On a European level, only 0.05 per cent of species managed in zoos and other institutions are terrestrial invertebrates, with five managed breeding programmes (two providing published husbandry guidelines¹). Perhaps it is the difficulty of maintaining the records of species housed in large numbers or the difficulty of individual identification that limits the management of invertebrate species. Most likely it is due to differences in human attitudes towards how we value and care for invertebrates in comparison to vertebrates. Feelings of aversion or fear towards invertebrate species and such vast differences from human physiology and behavioural expression can contribute to reduced empathy and ultimately our comprehension of the taxa⁶.

Efforts to improve welfare for invertebrates may also be hindered by the vast number of species that need to be considered and a lack of

reliable data. Further complications arise when looking at applying a 'blanket' approach; for example, it would be extremely problematic for salmon fisheries if they had to consider the welfare of lice when treating their stock. Notwithstanding these difficulties, we should not be deterred in our efforts to improve the welfare of terrestrial invertebrates in our zoos and aquariums. We have an ethical responsibility to provide for the welfare needs of all animals held within zoological collections and thus more research into current husbandry practices could help to improve knowledge and welfare.

There is an ever-increasing need for more evidence-based studies and to share information between collections in an attempt to improve husbandry and promote changes in invertebrate welfare. Not only will this help to improve the keeping conditions of the animals in our care, but it will also have far-reaching implications in the approach to the conservation work of species *in situ*.

REFERENCES

- 1 European Association of Zoos and Aquaria [online]. Available from: www.eaza.net. [Accessed 3 September 2017.]
- 2 Andrews, P. L. (2011). *Laboratory invertebrates: only spineless, or spineless and painless?* ILAR (Institute for Laboratory Animal Research), Volume 52, 2, pp. 121–5.
- 3 Dunayer, J. (2013). *The rights of sentient beings: moving beyond old and new speciesism*. Corbey, R., & Lanjouw, A. (Eds.) *The Politics of Species: reshaping our relationships with other animals*, pp. 27–40. Cambridge University Press.
- 4 Fossat, P. (2014). *Anxiety-like behaviour in crayfish is controlled by serotonin*. *Science* 344, pp. 1293–1297.
- 5 Mather, J. A. (2008). *Cephalopod consciousness: behavioural evidence*. *Conscious Cognition* 17, Volume 1, pp. 37–48.
- 6 Horvath, K., Angeletti, D., Nascetti, G., & Carere, C. (2013). *Invertebrate welfare: an overlooked issue*. *Annali dell'Istituto superiore di sanità*, Volume 491, pp. 9–17.



In with the spiders



SPIDERS LIVE IN ALMOST EVERY HABITAT ON EARTH, INCLUDING OUR HOMES



SPIDERS IN THE BATH MEAN NO HARM! THEY HAVE FALLEN IN AND CAN'T CLIMB OUT.

In with the spiders

ZSL LONDON ZOO'S SPIDER EXHIBIT OFFERS CLOSE CONTACT WITH THIS FASCINATING SPECIES

Dave Clarke, Invertebrates Team Leader, ZSL London Zoo, UK

ZSL London Zoo has a proud history of working with invertebrates and creating ground-breaking displays. In late 2015 we started creating an intense new experience in an under-utilised corner of the current BUGS building. 'In with the Spiders' became an exemplary collaboration between the ZSL Animal Department, Interpretation, Projects and works contractor Brickwood. With a tight budget and a timetable of six weeks, the display area was transformed into an exhibit of 12 live display features with at least 18 species of arachnids. The first formal planning meeting took place on 24 October 2014, and physical works began the following year on 30 March. The works were completed on schedule for staff and press previews on 21 May, and the full public opening took place on 23 May.

'In with the Spiders' is designed to amaze visitors and inform them of the value of spiders in a creative way. It begins with spider phobia, highlighting our hugely successful Friendly Spider Programme, and features a real bath containing a live giant house spider (*Tegenaria gigantea*). Three live displays illustrate the arachnids as a group, with a white-kneed spider (*Acanthoscurria geniculata*), emperor scorpions (*Pandinus imperator*) and a tailless whip scorpion (*Damon diadema*). 'Spider venoms' features a large cabinet containing several species of black widow (*Latrodectus* sp.), and the story of the false widow (*Steatoda* sp.) in the UK. 'Hitchhikers' features huntsman spiders (*Heteropoda venatoria*), and

there is an on-show spider nursery breeding room.

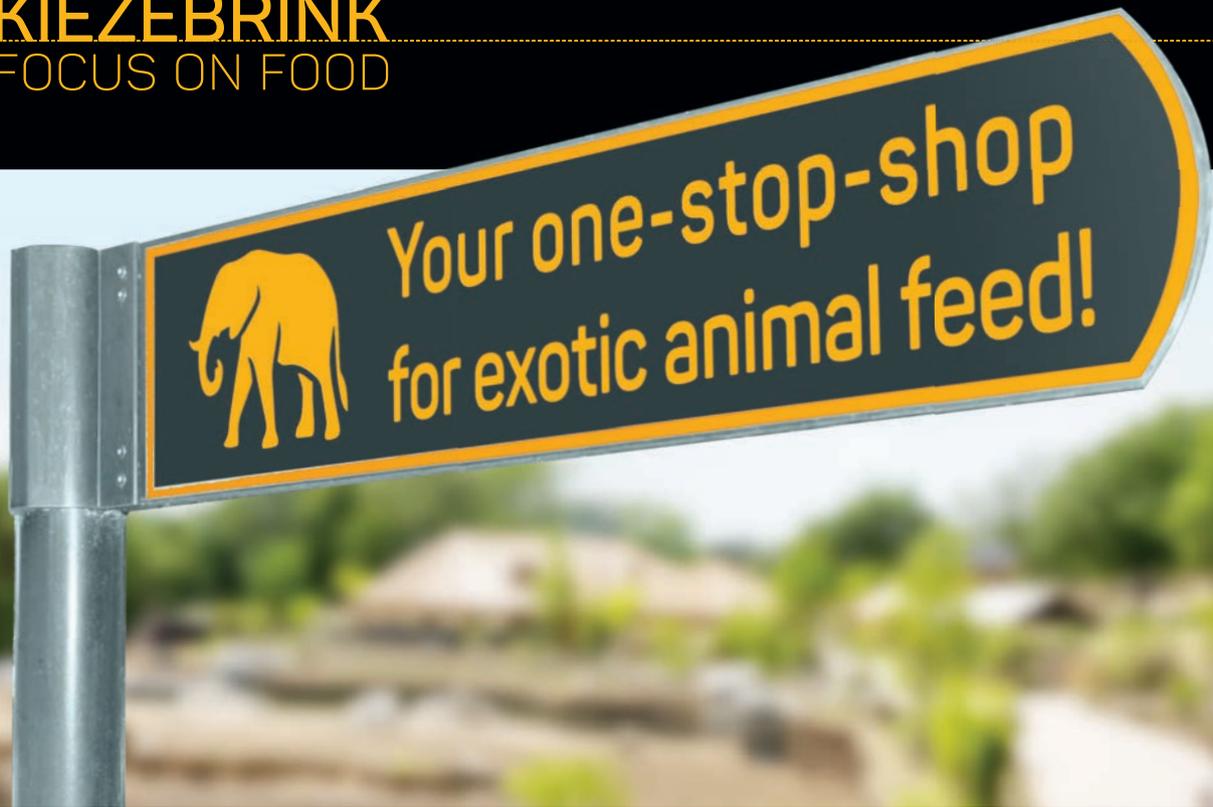
At the time of opening, the centrepiece was the only non-native spider walkthrough in the world, featuring tropical golden orb weavers, *Nephila edulis* and *Nephila inaurata madagascariensis*, in a lush forest setting. This is constantly staffed to allow direct interaction with visitors. There is also a 'spider selfie' mirror where visitors are prompted to post an image on Twitter. The spider walkthrough also features exhibits of a large bird-eating spider (*Lasiadora parahybana*) and social spiders (*Stegodyphus sarasinorum*).

The exhibit has its own distinctive interpretation compared to other parts of BUGS, with techniques including bespoke species labels, hand-painted caricatures, videos – including one of the amazing peacock spiders (which would be impossible to display live) – and even a 'talking' spider display voiced by British comedian Stewart Lee. The live animals are mostly long-term ZSL stock or came from other breeding sources, including UK zoos. A key feature is the fen raft spider (*Dolomedes plantarius*) conservation programme (which was a major BIAZA reintroduction project) for which live display animals were sourced under licence from Natural England to establish a captive colony. The redesigned exhibit area has created a new dedicated breeding room for spiders, particularly for species like the orbs and huntsman, and many species continue to breed well. We are also

expecting to display young from the recent Desertas wolf spider (*Hogna ingens*) EEP.

The exhibit was very well received when it opened, and featured in multiple press outlets. ZSL Marketing created a campaign to promote the exhibit, which included some amusing moving images of jumping spiders on London Underground. A formal visitor evaluation was carried out after the exhibit had been open a few months, and received very positive results. Eighty-six per cent of visitors rated the experience good or excellent, with the vast majority agreeing that spiders are beneficial to humans and that spiders are amazing. It continues to be a significant new exhibit at ZSL London Zoo and a much talked about feature in the BUGS building. It has also been an improvement for participants on our successful Friendly Spider Programme, many of whom have been able to go into the walkthrough and experience encountering spiders in a way they could only dream of before.

We must acknowledge the dedication and hard work of all ZSL staff involved, especially the Invertebrate section keepers, and the support of other institutions, in making this display a reality. Last year 'In with the Spiders' was awarded a BIAZA Silver Award for Exhibit Design, and was described by Sir David Attenborough as 'ingenious and innovative'. We hope that this improvement to the BUGS building is paving the way for further upgrades to the exhibit in the near future.



Kiezebrink believes in providing a European operated one-stop-shop facility for zoos offering a wide variety of high-quality products and brands. As a result, zoos can source the majority of their animal diets from one supplier. This makes the management of animal nutrition efficient and keeps it simple. We offer a wide range of both frozen and dry food products.



WHOLE PREY ITEMS

We have a broad range of whole prey items in our assortment, such as: day old chickens, rats and mice, rabbits, quails, pigeons, chickens and others.



MEAT PRODUCTS

Large chunks of meat on the bone from calves, cows and horses are available. We also have organ meat such as: beef heart and rumen.



FISH PRODUCTS

Our range of fish contains many species such as Smelt, Sprat, Herring, Mackerel and fresh water fish such as Roach, Carp and Goby.



INSECTS

We offer whole individually quickly frozen (IQF) insects that are frozen with the correct gut loading. A very convenient addition to the diet of (partly) insectivorous animals.



TROPICAL FRUITS

A range of fruits that are frozen at origin to maintain freshness. These fruits are IQF which makes them very practical to work with and store.



SELECTION OF DRY FOOD

- BOSKOS
- DK Zoological
- Dodson & Horrell
- Garvo
- Kasper Faunafood
- Versele Laga
- Wisbroek

The main attraction

CHESTER ZOO HAS TAKEN A CREATIVE APPROACH TO MAKING TARANTULAS AND LEECHES MORE ATTRACTIVE TO ITS VISITORS

Gerardo Garcia, Curator of Lower Vertebrates and Invertebrates and Sarah Bazley, Learning Manager, Chester Zoo, UK

It is easy to presume that the majority of zoo visitors are more interested in higher vertebrates than other taxa; so at Chester Zoo we have devised a number of strategies to ensure that our invertebrate collection gets just as much of our visitors' attention as do our birds, mammals, reptiles and fish.

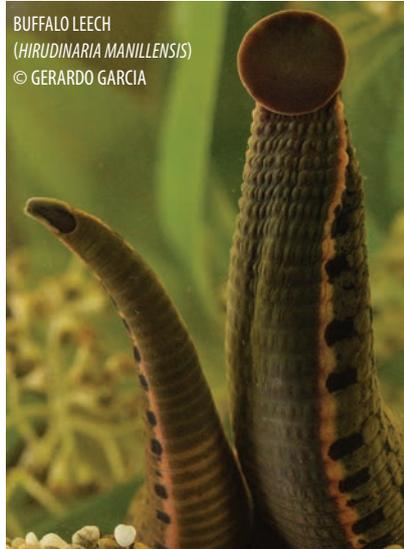
A strong relationship has been built between the Invertebrate, Discovery & Learning and Marketing teams, which has led to a number of interesting and highly creative initiatives being developed to connect our visitors to invertebrates and the important work we do with them. Here we present two recent case studies.

MONTSERRAT TARANTULA

The connection of one of our iconic species of amphibians, the mountain chicken frog (*Leptodactylus fallax*) to the Montserrat tarantula (*Cyrtopholis femoralis*) is an interesting story, especially with regards to endemic species and threatened habitats.

The connection was discovered thanks to the research developed in the field, where we recorded the largest predator on that island (the frog) feeding on one of the less popular species on earth (a spider). This immediately builds a connection between both species and two different taxa. The tarantula, although well known by the inhabitants of Montserrat, was only described by a single male species more than 100 years ago. So we started this species programme with pretty much no background on the biology.

We collected 50 specimens of all sizes in 2013, but none of them was sexually mature. We worked on rearing them and synchronised both sexes for the right period of mixing. Two years later, several tentative displays of mating between what looked like sexually mature females and males occurred over a number of months. Finally, one female started digging away the substrate and made a deep burrow that was big enough to turn around in (very similar to what



BUFFALO LEECH
(*HIRUDINARIA MANILLENSIS*)
© GERARDO GARCIA

we recorded when collecting them from the wild). She disappeared underground for five months and we observed no sign of activity. Eventually we were rewarded by the emergence of more than 100 spiderlings, which had already moulted inside the chamber before appearing on the surface.

Each spiderling is now being individually reared under different types of substrate and at different humidities and temperatures so that we can study their different growth rates.

Some of these were put on display, accompanied by interpretation describing the work that we are doing; they were also chosen to be one of the stars of our 'Enchantment of Chester Zoo' event that occurred over the Halloween period. We are always keen that all events celebrate and promote how amazing our different species are, and the idea behind Enchantment was that a sorcerer had cast a spell over the animals at Chester Zoo. We needed the visitors to break the spell and save the animals by visiting them to find out more about them while collecting ingredients for a potion!

We had some amazing contortionists representing the tarantulas, and the Discovery and Learning team organised many different activities around them. What was most striking about this event was how passionately our visitors

wanted to help to break the spell and save the spiders (despite admitting that they're not their favourite animals!).

BUFFALO LEECH

With all of the media attention that is devoted to threatened Asian mammal species (such as babirusa, anoa and saola), the challenge for the invertebrate component was to find a link that would give them the profile they deserve and make them more interesting to our visitors. Research on leeches feeding on secretive mammals shows that they retain DNA from their prey, and have become a key conservation tool for the monitoring of threatened biodiversity. Another link is the familiar European medicinal use.

We looked for one of the largest species to create a spectacular display, and found that, not far from us, buffalo leeches (*Hirudinaria manillensis*) were being farmed for veterinary purposes.

Creating the display was relatively straightforward, as the leeches live in warm temperatures and like the light (unlike European leeches); however, the twice-monthly feeding strategy was more challenging. The process requires fresh mammal blood prepared into sausage skins at 37C. These are submerged on the tank where the leeches swim, and they latch on until they are totally full. The process may sound disgusting, but it's a clean and attractive process that allows visitors to ask questions and learn more about a species that they were probably not expecting to see in a zoo.

We have strong relationships with a number of universities, so the Discovery and Learning team set a project for some Master's degree-level students who are studying wildlife documentary production. They filmed the leeches and were tasked with editing the footage together for a 360° projection piece.

We have bred this species on several occasions now (another fascinating aspect of the biology) and several institutions want to display in their collections, too.

A bug in the system

THE LET IT GROW CAMPAIGN HAS INSPIRED A WIDE RANGE OF INITIATIVES THAT ENCOURAGE VISITORS TO LEARN MORE – AND CARE MORE – ABOUT INVERTEBRATES

HUMMINGBIRD
HAWK-MOTH
(*MACROGLOSSUM
STELLATARUM*)



Danielle de Jong, EAZA Biodiversity Communications Coordinator

Invertebrates are a key element of any ecosystem, and most invertebrate species take up an almost unique role. For the Let It Grow campaign, therefore, it was essential to feature invertebrates in a biodiversity awareness campaign.

Amongst other things invertebrates are responsible for pollination, pest control, waste decomposition, soil aeration and nutrient recycling, not to mention the role they play as a food source for many plants and animals. Unfortunately, the status of European invertebrates is under pressure. The threats to European biodiversity, such as habitat fragmentation, intense agricultural practices, climate change and other human activities, are also damaging invertebrate populations. And as with many animal groups, the conservation of invertebrates poses some challenges.

One such challenge is simply the lack of knowledge. Not only have the majority of invertebrates not been identified, but also there are large gaps in our knowledge about the species that have been described. For most described species their distribution is unknown, as well as their ways of life and/or sensitivity to habitat change. This lack of knowledge also partially feeds into another challenge of invertebrate conservation, namely a lack of public concern. Unfortunately, invertebrates are slightly neglected when it comes to conservation studies and policies. This is somewhat understandable when you realise that most people consider insects as pests and are not aware of the significant roles that invertebrates play. Fortunately, there are a few ‘charismatics’ that are generally known

and liked by the public, such as bees and butterflies, that might be able to wave the invertebrate conservation flag. By using these species as an example, conservation institutions and initiatives can introduce the public to other invertebrate species and explain the importance of these creatures in their lives.

The lack of public concern regarding invertebrates is another example of why campaigns such as Let It Grow are so important. The participants have done the campaign proud by including and highlighting invertebrates in many of their initiatives and activities. For example, NEMO Science Museum in Amsterdam created a green roof on its building in 2013, to which various gardens have been added which are freely accessible to visitors. On 22 May 2017, the International Day for Biological Diversity, two bee colonies were placed in the gardens on the roof. Over the next three years, these bees will be carefully monitored and studied, researching the possibilities of measuring bee health with sensors. With bee populations in decline, any information on improving their wellbeing is essential. This initiative shows how we can improve public awareness while also closing a gap in our scientific knowledge.

Plock Zoo in Poland set aside some space and created a natural garden for butterflies. The gardens include signs informing visitors about the importance of invertebrates in their lives and the measures that they can take to help to protect them. Plock Zoo also created a giant insect hotel that spells the word ‘zoo’, proving that creativity and conservation often go hand in hand.

Most campaign participants made use of insect hotels to engage the public, offering DIY courses in insect hotel-building and selling hotels in the gift shop. The hotels proved to be an accessible way to get people involved in creating space for invertebrates around their homes. Copenhagen Zoo challenged its visitors to help create 500 new homes for local species, including invertebrates. You can see some creative results on Instagram at #zoo500boliger.

As well as building homes and leaving spaces for species, many campaign participants also organised activities to identify all the species of invertebrates living in their zoos. As described in *Zooquaria* 96, Africa Alive! has held an annual Bioblitz in the park since 2014. Such events not only provide valuable information on the status of biodiversity in an area, but also give visitors a chance to engage in science and conservation. Bioblitzes also create an opportunity to marvel at the rare species that one might find, such as the mining bee *Andrena fulvago*. As an example, this year was another successful Bioblitz year for Gaia Zoo, not least because it led to the discovery of a rare white-letter hairstreak moth (*Satyrrium w-album*).

Improving the public perception of invertebrates and their importance could be an essential step in invertebrate conservation. When visitors are engaged with activities such as those described above, they can get to know and understand the small creatures that live all around them. After all, as conservationist Daniel Janzen once said: ‘If you don’t know it, you can’t love it, if you don’t love it, you won’t save it.’



All of our models are
for sale, lease and rent



Ask for a non binding
offer today

bernd wolter
Design
GmbH


DINOSAURIER-PARK
INTERNATIONAL

Dinosaurier-Park International GmbH & Co. KG
Hannoversche Str. 23, 31547 Rehbrüg-Loccum
Tel.: +49 (0) 5037 - 96 99 99 - 80
e-mail: info@dinopark-international.de
homepage: www.dinopark-international.de



MazuriTM
Zoo Foods

*Leading
the way*

Email: info@mazurizoofoods.com Tel: +44 (0) 1376 511260 Fax: +44 (0) 1376 511247
www.mazuri.eu