



The Rehabilitator

The British Wildlife Rehabilitation Council Newsletter

No. 90



**Welcome to
the winter
edition of our
newsletter!**

Inside:

The Darwin Tree of Life
Project
Page 4

Inside:

The UK Bat Care
Network
Page 8

Inside:

From Spines to Signs:
Salmonella Indicators
Page 18



Contents



A Word From The Chair <i>Paul Reynolds</i>	03
The Darwin Tree of Life Project <i>Ava Jenkins</i>	04
The UK BatCare Network and Other Resources for Bats in Care <i>Maggie Brown</i>	08
Book Review: Deer Veterinary Medicine, by Aiden P Foster <i>Paul Reynolds</i>	10
Unravelling the Mystery of Mouth Rot in Common Seals <i>Em Mayman</i>	11
Meet a Wildlife Professional <i>Katie Gibbs</i>	15
Observing Hedgehog Faeces for Salmonella Indicators <i>Simon Allen, Sian Mitchell</i>	18
Contacting The BWRC	27



A word from the Chair

Dear Members,

As we move into the colder months, I'm sure many of us across the UK are feeling a sense of relief as the busy season finally begins to ease. After the intensity of spring and summer, this quieter spell offers a much-needed breather, though for many rescues, admissions will still be high with hedgehogs and wood pigeons continuing to arrive in large numbers. And of course, for those involved in grey seal rehabilitation, the next wave of pups will soon be filling every available pen and pool!

This time of year provides a valuable opportunity to pause and reflect. Whether you manage a busy centre, coordinate a small volunteer network, or work independently, it's the perfect time to review your policies and procedures, sit down with your team or volunteers (or take time for personal reflection), and consider what went well this year, and what could be improved for the next.

At BWRC, we are also using this time to strengthen the foundations of our organisation. We will soon be publishing our updated membership terms and conditions, which will formally set out that our [10 Principles of Wildlife Rehabilitation](#) are an expectation of associate membership. As we head into winter, I would encourage all members to revisit these principles, and if you haven't already done so, begin writing and formalising the policy documents that align with them. They not only support good governance and best practice but also ensure that we are collectively raising the standard of care that wildlife casualties deserve.

As we look ahead to the coming year, it's impossible to ignore the growing uncertainties our sector faces. The effects of climate change are becoming increasingly evident, with unpredictable weather patterns, prolonged periods of heat, drought, cold, or rain all affecting the number and type of casualties entering care. These shifts heighten the risk of mass wildlife casualty events, which can

quickly overwhelm even the most established rescues. Alongside this sits the ever-present threat of avian influenza incursions into wildlife centres, and the ongoing challenges of securing funding to meet the rising costs of operations, facilities, and basic care.

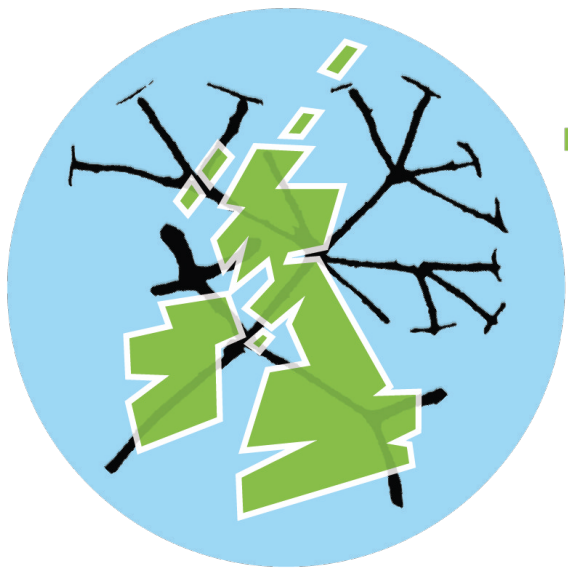
I am acutely aware of these challenges, not only through my role with BWRC but also in managing my own wildlife rescue centre. Please remember that BWRC is here to support you, whether by providing guidance, connecting you with experts, or advocating for the wider recognition and resources that our sector urgently needs.

On a more positive note, I am delighted to share that I will be speaking at the International Conference of Hedgehog Professionals in Denmark this January, where I will be presenting on the 10 Principles of Wildlife Rehabilitation. This is a fantastic opportunity to promote BWRC's approach internationally, as well as to raise awareness here in the UK among rehabilitators who may not yet be familiar with our work. If you are attending, please do come and say hello, it would be wonderful to meet some of our members in person.

As we move towards the end of the year, I hope that this winter remains quiet and uneventful for all of us, allowing the time and space we need to recover from the chaos of the busy season, to regroup, and to prepare for another year of protecting and caring for our wildlife.

With best wishes,

Paul Reynolds



Darwin TREE *of* LIFE

Ava Jenkins MRCVS – Wildlife Veterinarian and Research Associate at the Institute of Zoology at conservation charity ZSL (Zoological Society of London)

Bio: Having studied zoology before heading to veterinary school, I've always had a passion for wild animals and the diversity of life. I worked on various research projects through university and spent 18 months in small animal practice, before landing this fantastic job working at ZSL's Institute of Zoology as a wildlife vet.

The Darwin Tree of Life project

The UK and Ireland are among the most nature-depleted countries in the world, and at ZSL's Institute of Zoology, we're part of a cutting-edge project to create a library of the DNA of every living thing – but we need the help of the nation's wildlife rehabilitators. Sadly, despite every effort, not every animal admitted to a rehabilitation centre makes it through to release. These animals can still play a vital role in helping researchers recover and protect native wildlife - through the Darwin Tree of Life project. The Darwin Tree of Life project is an ambitious and exciting collaboration between multiple world-leading institutions around the UK and Ireland led by the Wellcome Sanger Institute. It aims to sample, sequence and publish the DNA of every living thing in Britain and Ireland – an estimated 70,000 species in total, from the largest whale to the smallest, single-celled organism, and every plant, animal and fungus in between.

The project is part of a global initiative called the Earth BioGenome Project – with the eventual objective to sequence all life on the planet.

The DNA sequences represent the genetic makeup – or genome – of a species. Having this available for all life on Earth will contribute to a new wave of science called biodiversity genomics (Figure 1).

The DNA is carefully sequenced using advanced computational tools and bioinformatics to generate high quality, fully annotated reference genomes. These will be published online, freely available for all researchers to use.



Reference genomes provide detailed genetic information for a species and enhance current DNA analysis methods. For example, insights from the White-tailed sea eagle genome is being used to monitor re-introduction programmes and track migration patterns, whilst the Fenn raft spider genome is being used to inform the conservation of this Vulnerable UK species.

As well as conservation efforts, the genomes are vital tools to improve our understanding of topics increasingly important in a modern era of global change, including evolution, the biology of organisms and ecosystem function, medicine, veterinary medicine and biotechnology.

Project collaborators are sampling land and sea, with material being sent to the Sanger Institute near Cambridge to have their DNA extracted, sequenced and annotated by an expert team.

At the Institute of Zoology, we're collecting samples of British wild vertebrates for the project – starting with birds. Much of this work is done in partnership with the British Trust for Ornithology (BTO) through their Ringing Scheme. Before their release, a small blood sample is taken from an individual of each species. This requires a Home Office license under the Animals (Scientific Procedures) Act 1986. It has already opened the door to a whole host of new bird species to the project – but what about other ways of obtaining samples from birds and other animals?

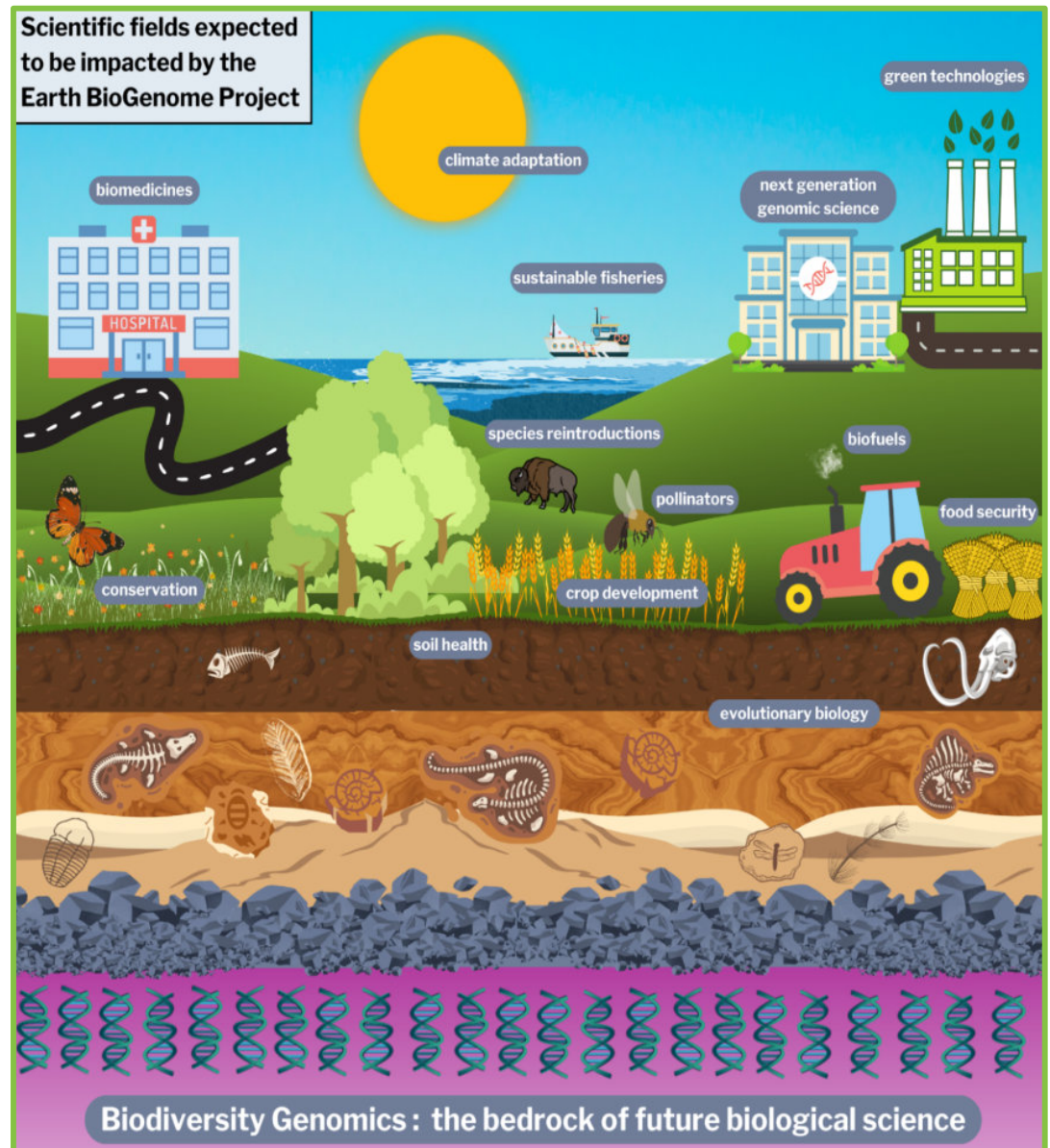


Figure 1: How genomics can inform different areas of biological science (Wellcome Sanger Institute)

This is where wildlife hospitals and rehabilitators come in. While not every animal that comes through the doors of a wildlife hospital will survive and be released, those individuals can still help us better understand and protect UK wildlife, as we can use tissue samples from them to sequence their genome. This is especially useful for rarer or less commonly ringed species of bird - and also for our native mammals, amphibians and reptiles.

Wildlife hospitals have already been a major contributor to the project. Through a small network of larger wildlife hospital collaborators, we have already collected samples from a range of species such as raven, roe deer, harbour seal and even a kingfisher (Figure 3). Utilising samples collected this way also removes the need for species to be sampled live in the wild, thus reducing any welfare impacts it may have on our wildlife.

Wildlife hospitals are a potential hive of untapped biological information, so it's fantastic to be able to work with veterinary staff and rehabilitators in order to contribute to such an important and impactful project.

Many of our more common native species have had their full genomes sequenced already, including red squirrel, robin, badger, blue tit, hedgehog and red fox – so these aren't needed. However, there are still many more species left to sample including migratory and vagrant species of bird, plus some extremely rare or introduced species of mammals like the Greater white-toothed shrew, Hoary bat and Bechstein's bat. Smooth snake and marsh frog samples also haven't been collected yet, and the list of fish is long.



Figure 2: Cetti's warbler blood sampled for the Darwin Tree of Life project during a ringing session in September 2024 (Ava Jenkins)



Figure 3: Kingfisher at post-mortem sample collection. This animal was euthanised at a wildlife hospital on welfare grounds, placed in a -20°C freezer and collected several days later before it was defrosted and dissected (Ava Jenkins).

If your centre is interested in supporting the project, then please get in touch. The more centres involved, the more genomes we will be able to sequence – and the sooner this information can be used to help protect and recover wildlife across the country and beyond. We'd like to increase these opportunistic collections in order to maximise the chances of coming across any rare or difficult to catch species. You never know what might turn up!

All samples undergo thorough checks before being onboarded by the team at Wellcome Sanger, to ensure that samples are legally and ethically sourced and are of suitable quality to be sent to the lab. If the difficult decision has been made that it is best for an animal to be euthanised, or an animal dies in care, please do get in touch with us as early as possible so we can make suitable arrangements. The tissue needs to be in good condition to be able to collect the highest quality DNA for whole genome sequencing, so should be sampled as fresh as possible or frozen immediately, with time stored at -20°C kept to a minimum before collection. Samples are then transported in liquid nitrogen in order to retain the integrity of the DNA as much as possible. The most reliable tissues for whole genome sequencing include blood, muscle, heart and liver. Feather and hair samples, whilst easy to collect, do not have a sufficient amount of DNA required for the high-quality reference genomes being produced.

By the end of this project, researchers from the UK and the rest of the world will have free access to high-quality reference genomes of all wildlife species sampled – helping them better understand and protect these species. In August 2025 the Tree of Life programme celebrated its 3000th genome sequenced – with the wonderful Smew – a migratory duck!

You can check out the live target species list (QR code below) for an idea of which species are still required.

Thank you to all the centres that have been involved so far, your enthusiasm and diligence to the Darwin Tree of Life project makes a huge difference!



Figure 4: QR code for the Darwin Tree of Life Wildlife Target List.

Contact details:

Ava Jenkins – ava.jenkins@ioz.ac.uk

Darwin Tree of Life website: [Darwin Tree of Life – Reading the genomes of all life: a new platform for understanding our biodiversity](#)

The Bat Conservation Trust: the UK Bat Care Network and other resources for bats in care.

Maggie Brown

Maggie and her husband rescued a grounded bat in 1985, joined their local bat group and found themselves rescuing bats on a regular basis, later becoming known for establishing the 'West Yorkshire Bat Hospital'. Maggie's search for useful information to back up their rescue activities led to them publishing a newsletter to share useful tips and ideas, which later led to the publication of the Bat Rescue Manual. After forty years of bat care and bat conservation, Maggie has closed the bat hospital, being no longer able to see well enough to work with the bats. She has however continued to train new bat carers and worked with the Bat Conservation Trust to develop a basic e-learning course in bat care.

In 1981 the Wildlife and Countryside Act was passed and gave new protection to some of our wildlife. As the public became more aware of the protection given to species, including bats, assumptions began to be made that help would be available for failing animals, particularly as the Act specifically allowed for animals to be taken into care for the purpose of tending them until they could be released, and for euthanasia where appropriate. There was of course no provision other than the legal defence written into the Act.

The act did however consequently encourage the formation of conservation organisations, like local badger and bat groups. As there were not at that time many organisations that specifically rescued wild animals, members of these new conservation groups often got asked for help as members of the public, becoming more aware of protection and conservation, assumed help would be available for casualties that they found. Frequently bat group volunteers got involved with rescuing these bats starting, at first, with very little expertise and with only limited knowledge of bat ecology. So even before the Bat Conservation Trust was formally established bat groups became involved not just in conservation activities but also in bat rescue. Many of these bat groups are now partners with, or part of the Network of BCT.

As the Trust has grown it has become a go to resource for anything to do with bats, including where to ask for help with injured and grounded bats. Dealing with requests from the public for help with bat casualties is a major part of what the BCT's National Helpline does. The helpline can supply contact details for local bat carers where they are available or give advice on how to secure a bat, and offer first aid, before taking the casualty to a vet. To support this service, the trust keep a register of trained and vaccinated volunteers, the UK Bat Care Network. Consequently, many volunteers rescuing bats are likely to be members of bat groups rather than wildlife rehabbers, though people working in the broader field of wildlife rehabilitation may also be part of the Network.



To support the volunteer bat carers, the Trust have produced publications with advice about managing disease risk, vaccination and general management of bat casualties, and an e-learning course for new carers. They update information through the Bat Care Bulletin emailed to members of the network. Every few years they run a Bat Care Conference.

While bats may often be only a small part of the casualties that come into the centres run by members of BWRC, BCT resources are readily available to everybody through the BCT website, just google '[Resources for bat carers.](#)'

Finally, having been a bat carer for forty years, starting as a member of the public coming across a grounded bat, becoming a bat group member, and becoming deeply involved in both bat rescue and bat conservation, I know the importance of understanding how a bat exists in the wild to how I treat a bat in need of help. Those of you working in wildlife rescue might find local bat groups and local bat carers can help you with their knowledge of bat biology and local ecology, species identification and distribution and potential for release.

Most importantly, please remember that bats are just like other mammals that come into care, they just have a few very special adaptations which can be accommodated with the right knowledge and resources.



Pipistrelle bat undergoing rehabilitation

Book Review: Deer Veterinary Medicine, by Aiden P Foster

Paul Michael Reynolds MSc, New Arc Wildlife Rescue
co-manager and BWRC Chair

As someone who frequently works with deer in a wildlife rescue capacity, I found this book to be an incredibly valuable resource. Deer Veterinary Medicine deserves a place in the library of anyone working with deer, whether veterinary professionals or lay people, because the content has relevance for both.

Particularly appreciated is the section on notifiable diseases in deer, which is supported by excellent, clear imagery, including photographs of *Mycobacterium bovis* infection. The book is packed with annotated diagrams covering deer life cycles, disease life cycles, and anatomy, making complex information accessible and easy to understand. For veterinary professionals, the referenced drug formulary and detailed guide to post-mortem examination and pathology will be especially useful. At the same time, these sections also offer great value to lay professionals who may be involved in collecting samples from deer for research projects.

The references throughout are comprehensive, which enhances the book's credibility as a go-to text. In British wildlife care, we often lack detailed veterinary literature for many native species, but thanks to this volume, that is no longer the case for deer!

Overall, this is a clear, well-structured, and indispensable guide for anyone with a professional or practical interest in deer health and welfare.



Unravelling the Mystery of Mouth Rot in Common Seals

By Em Mayman, British Divers Marine Life Rescue

About Me

Hello - my name is Em Mayman, and I'm a Rescue Coordinator with British Divers Marine Life Rescue (BDMLR) in the UK. I've been involved with BDMLR for ten years, coordinating rescues of seals, dolphins, and whales, training Marine Mammal Medics nationwide, and attending callouts in my home region of Yorkshire & Lincolnshire, as well as a member with the Large Whale Disentanglement Team.

I have a strong interest in disease surveillance and post-rescue outcomes, particularly in pinniped health and welfare, which led me to become part of the Common Seal Mouth Rot Project - a collaborative investigation into a severe and poorly understood disease increasingly affecting common seal pups (*Phoca vitulina*) around UK coastlines.

In recent years, BDMLR's Medics, veterinary clinics and partner rehabilitation centres have reported an increasing number of weaned common seal pups presenting with unusual and severe oral lesions — a condition that has since become known as 'mouth rot' (MR).

These pups typically are first seen with swollen muzzles and jawlines, infected wounds around the lips and face, and ulceration of the hard palate. In the most advanced cases, there may be extensive tissue loss, bone exposure, necrosis, and oro-nasal fistula formation, leaving the pups reluctant to feed. Such cases represent significant welfare concerns. Those with early signs of the condition are often able to be treated, but sadly euthanasia is often the only humane option for those with severe disease.

Although occasional oral infections have long been noted in common seals, the rise in both frequency and severity since the mid 2010's prompted BDMLR to formally investigate.

Why We're Investigating

The scale of the problem has raised several urgent questions:

- What is the underlying cause of mouth rot?
- Why are we seeing more cases now?
- What factors are contributing?
- And, crucially, can anything be done to prevent or manage it?

Many of the affected pups show significant symptoms, suggesting an underlying issue and the investigation aims to answer these questions through structured sampling and metagenomic analysis (searching for the genetic material of pathogens, such as viruses and bacteria).



Unwell common seal pup

The BDMLR Mouth Rot Project

Formally established in 2021, the **Common Seal Mouth Rot Project** brings together a team of specialists: Dr Jamie Bojko, Dr Natalie Arrow, Dr Devon Lycette, and myself (Em Mayman), with the study supported by hundreds of BDMLR Medics, veterinary teams, Cetacean Strandings Investigation Programme, DEFRA, and rehabilitation centres nationwide. A true testament to citizen science!

The project was launched after a small number of pilot samples were collected in 2020 and revealed worrying results, prompting a far larger, multi-year research effort. The official investigation spans 2021–2025, with further sampling to be carried out each year.

Every confirmed case contributes to a growing database, documenting:

- Location, date and condition of the pup
- Clinical signs and photographs
- Tissue samples for laboratory analysis (ethanol and formalin-fixed)
- Rehabilitation outcome if applicable

This unified approach has generated an unprecedented dataset on the health of wild UK common seal pups.

Findings So Far

When and Where

Between 2020 and 2024, confirmed cases have been recorded from Cornwall to Scotland, primarily along the east coast of the UK with the Norfolk coast remaining the area with the most cases reported. There have been over 500 recorded mouth rot cases nationally so far in the project.

Mouth rot appears seasonal, with the highest number of cases occurring in August each year, coinciding with the common seal weaning period. Interestingly, 2024 saw a slight shift towards September, indicating a possible change in the timing of emergence.

Severity and Outcomes

A standardised severity grading scale (0–4) has been established:

- **0:** No visible signs
- **1–2:** Early or mild lesions
- **3–4:** Advanced, often involving exposed bone or necrosis



Oral lesions on a common seal pup

In 2024 alone:

- Of 62 pups that died or were euthanized, 56% were graded 3–4 (severe).
- Of 17 pups successfully released, 82% were mild (grade 1–2) - none were severe cases.

Of 15 pups that died during rehab, most had early-stage lesions, suggesting other complications or delayed progression.

Overall, around 30–40% of BDMLR’s common seal call-outs now involve pups with signs consistent with mouth rot, and 40–50% of those reported with mouth rot have bone exposure on the roof of their mouth.

Encouragingly, early-stage cases can and do recover, especially when identified promptly and treated following our treatment guidelines. Even some showing limited bone exposure have healed successfully in rehabilitation facilities, demonstrating the importance of early recognition and supportive care.

Management of cases would include:

- **Veterinary-prescribed antibiotics** to address infection.
- **Anti-inflammatory or pain-relief medication**, where appropriate, and only if advised by a vet.
- **Supportive care**, such as gently rinsing the mouth with a **veterinary-approved chlorhexidine oral solution**, to help keep oral lesions clean and reduce bacterial build-up.

What the Lab Work Reveals

Over five years, the research team has analysed 63 seals in detail so far, with more than 160 additional samples awaiting sequencing. The data points towards a complex infectious disease process rather than a single causative agent.

These findings suggest a multi-agent infection, possibly initiated by viral damage to the oral mucosa that allows bacterial colonisation. Advanced metagenomic sequencing, histopathology, and comparative tissue analysis are ongoing to clarify which agents play primary versus secondary roles.

A Growing Concern

The condition’s increasing prevalence and severity are cause for concern - not only for welfare, but potentially for population health and species conservation. While common seal numbers are either declining or stable in various parts of the UK, any emerging disease affecting juvenile seal survival could have serious long-term implications. It’s still too early to know whether environmental pressures, pollution, or stressors such as disturbance and malnutrition are compounding factors, but the patterns suggest a complex interplay of biological and ecological triggers.

Future Directions

The next phase of the project includes:

- Continued yearly sampling
- Refining diagnostic tools
- Comparing affected pups with clinically unaffected seals as controls
- Expanding molecular analyses to identify viral–bacterial interactions
- Exploring the development of rapid “beachside diagnostics” to aid early detection

A Collective Effort

None of this work would be possible without the tireless effort of the volunteers and professionals across the UK who respond to call-outs, record observations, and collect samples. Each case, every photo, data form, and tissue sample all contributes to our research to uncover vital information about this emerging disease.

As a community of rescuers, rehabilitators, veterinarians, and scientists, we're united by one goal: to reduce suffering and protect the welfare of these charismatic marine mammals.

If you find yourself involved with a case where a seal pup shows signs of facial swelling, lip wounds or palatal ulcers - please photograph the lesions and contact BDMLR for guidance, we are happy to advise!



Common seal pup with oral lesions in transport

Learn More and Get Involved

You can read more and access the project resources here:

[BDMLR Common Seal Mouth Rot Project](https://www.bdmlr.org.uk/mouthrotproject)
mouthrotproject@bdmlr.org.uk

If you work in wildlife rehabilitation or veterinary practice, your participation in reporting, photographing, or sampling suspected cases can make a significant difference. Together, we can continue to understand mouth rot.

Acknowledgements

With sincere thanks and recognition to: Dr Jamie Bojko, Dr Natalie Arrow, Dr Devon Lycette, Dr Rory Thomson, Dr James Barnett, Mr Rob Deaville, Mr Ian Bond, and Mr Dan Jarvis, the rehabilitation centres, the veterinary clinics, DEFRA, CSIP, Teesside University, and to the countless volunteers whose dedication on the shoreline makes this research possible.



Meet a wildlife professional: Katie Gibbs

WILDLIFE CARE AND RESCUE DEPARTMENT MANAGER AT SECRET WORLD WILDLIFE RESCUE CENTRE

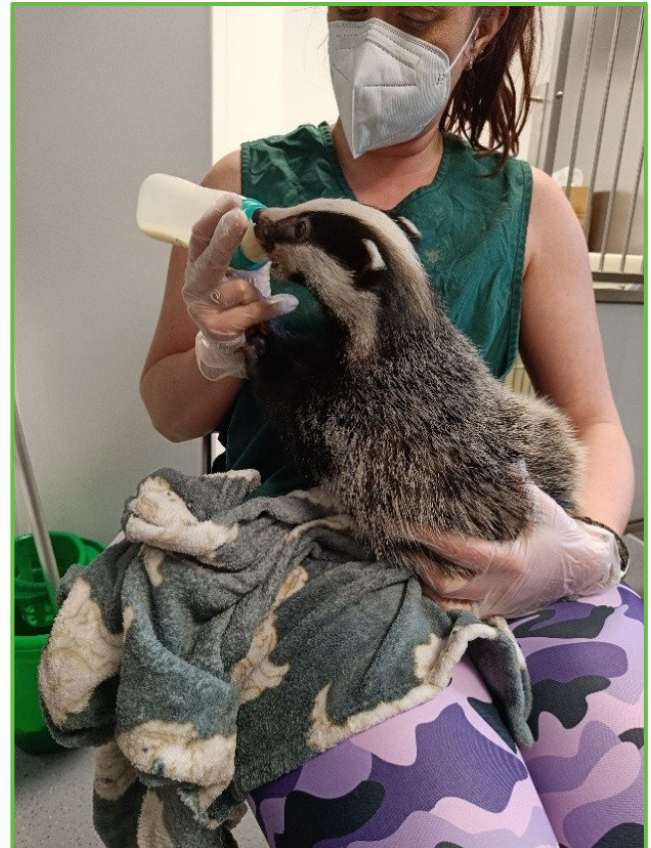
Tell us a little about yourself... I have worked in wildlife rehabilitation for almost 20 years and am a manager at Secret World Wildlife Rescue running the wildlife care & rescue department along with 2 other managers. We line manage a team of 26 staff which is made up of wildlife rescue co-ordinators (our reception staff) and wildlife care staff and a large team of volunteers. I specialise in the hand rearing of badgers, bats and swifts.

A typical day for me, is likely to be hitting the ground running! I arrive at work, often greeted by staff trying to sort out a deer or badger rescue and I'm always having to think on my feet. I usually have to co-ordinate staff, volunteers to ensure all wildlife onsite is cared for as a priority, whilst trying to sort out rescues with our reception team. I am often running a wildlife section onsite, for example, assessing the wildlife admitted to the centre or caring for the wildlife in the hospital. In addition to this I have an office job where I routinely create rotas, approve expenses, order essential stock and equipment to keep the department going, designing new facilities, writing policies and training staff, delivering courses, among many other things.

I have recently began providing additional support to swifts in my local area to get these specialist birds to an approved rehabber as soon as possible. Yatton & Congresbury Swifts was founded to provide even 'swifter' help for these awesome birds.

How did you first find your way into wildlife rehabilitation and what was it that pulled you towards rehabilitation work?

I was first drawn to working with wildlife due to the kindness my own family showed towards injured birds when I was a child. I often would sit in an old Willow tree watching a clan of badgers most evenings.



Katie hand-feeding a badger cub

I guess working with wildlife makes me feel at home and I have always wanted to give back to the world, rather than take. I first started rescuing wildlife when I initially worked with domestic animals 20 years ago, with birds and small mammals often being handed to me to triage and get to a bigger facility.

Over the years how do you think your views on animal welfare have evolved through your work in wildlife rescue?

Working at a charity that strives to evolve, adapt and work with evidence-based science has really helped me to understand animal welfare.

A multi-disciplinary team with specialisms in various species & specific animal behaviour has helped us to develop policies & procedures that champion high quality welfare. I have always had a thirst to read scientific journals, study animal behaviour and remain open minded to new ideas so that rehab centres can move forward positively.

Compassion fatigue is something a lot of wildlife professionals talk about. How do you keep your empathy and energy topped up in a job that can be both physically and emotionally draining?

Honestly, empathy is a real challenge for me. I cannot help but feel the pain of others, however I do believe that this is a strength in many ways, but it does make me acutely aware of taking care of your own mental wellbeing. How do I manage this? Living with a primary school teacher, who reflects every day – has taught me that reflection is very important in processing difficult experiences. Communication is key with colleagues and checking in with your team regularly. Personally, I cold water swim – I find this completely resets the brain ready for more wildlife action!

What are some of the biggest myths or misconceptions people have about rescuing or handling injured wildlife?



Grey long eared bat release



RTC badger rescue

One of the biggest misconceptions I come across working in wildlife rehabilitation is that there is often a perception that we can save them all. There are often worries expressed by members of public around wildlife returning to where they have come from due to the risks in the local area, for example, a hedgehog that lives by a road – which is a perfectly natural occurrence for a fit & healthy hedgehog in many scenarios.

If you could give one piece of advice to someone just starting out in wildlife care, what skill or mindset would you tell them to focus on first?

Wildlife rehabilitation can be an emotive sector & for those people just starting out in wildlife care, I often advise to remain open minded and to always strive to research and improve welfare. It's not an easy job and requires patience, resilience and determination.

Theres that old stereotype that “animal people” aren’t great with people: what do you make of that?

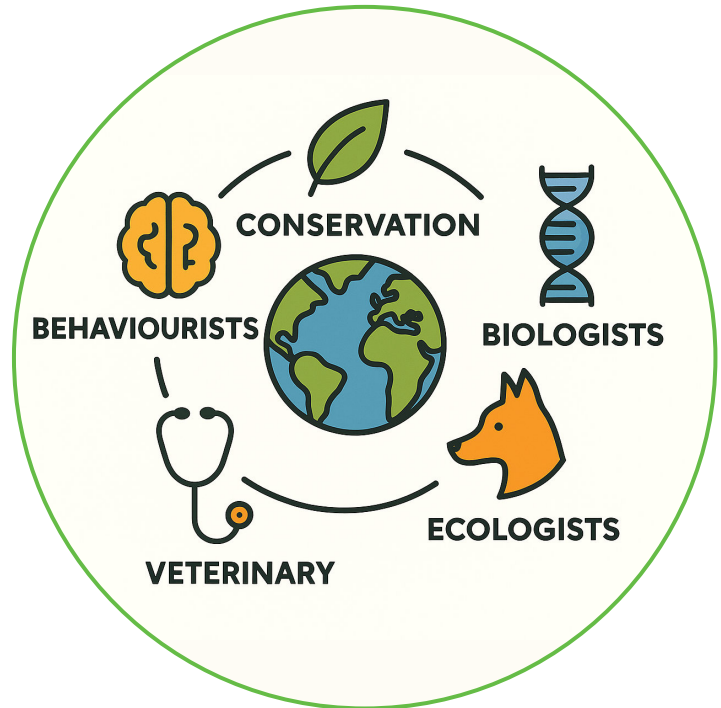
I do not believe that this is true. It is important to be able to effectively communicate with the public, educate and be able to reassure a member of the public to sign over an animal in need. To ensure a charity can survive, people skills are super important and ultimately, we want the public to learn about wildlife and work with us. This also applies to staff and volunteers; good communication skills are essential to ensure a team can work together effectively.

Looking ahead, what changes or improvements would you love to see in the wildlife rehabilitation world over the next decade?

I would really like to see wildlife rehabilitators to be widely recognised as professionals. It is a multi-disciplinary sector that combines conservationists, biologists, ecologists, behaviourists & veterinary professionals that should be contributing equally to decisions. I am proud to be part of a team that does this. For those non veterinary staff, a veterinary approved qualification that would allow those lay professionals to be able to provide alternative euthanasia methods when vets are not available but under veterinary direction. Of course – the licensing of rescue centres across the whole of the UK.

Finally, would you rather spend an hour scrubbing a filthy gull enclosure, or try to convince a caller to hand over a badly injured hedgehog that they're determined to treat at home?

I'd probably be on the phone to the member of public trying to prevent an animal from potential suffering with my left hand. With my right hand I would have my work mobile, attempting to get in a helper to sort the gulls asap! Can't have them messing up those feathers and neglecting those hungry mouths



From Spines to Signs: Observing hedgehog faeces for salmonella indicators

**Simon Allen MSc (R), Siân Mitchell BVMS PhD MRCVS
Gower Bird Hospital**

Introduction

Hedgehogs (*Erinaceus europaeus*) are small nocturnal insectivores that have experienced population declines in Great Britain due to various factors, including habitat fragmentation, food shortages, and road traffic collisions (1–6). The possible role of infectious diseases in this decline is not well understood, but recent studies have highlighted the potential impact of *Salmonella* infections on hedgehog health and public health (7–11).

Salmonella enterica serovar Enteritidis (*S. Enteritidis*) is one of the most common types of *Salmonella* affecting both humans and animals (a 'zoonosis'). In Great Britain, the majority of human *S. Enteritidis* infections are due to sequence type (ST)11, but a less common sequence type, ST183, has been identified in both hedgehogs and humans (9,12,13). Previous studies have also found that hedgehogs can harbour *S. Enteritidis* phage types (PT) 11 and 66, with PT11 being endemic and PT66 potentially emerging in certain regions.

The objectives of this study were to:

1. Identify characteristics of hedgehog faeces indicative of salmonellosis: Investigate and document specific characteristics of hedgehog faeces, such as colour, consistency, and content, that might indicate the presence of *Salmonella*. This objective aims to establish a correlation (relationship) between these faecal characteristics and the potential shedding of *Salmonella*.
2. Confirm presence of *S. Enteritidis* in South Wales: Determine the presence of *Salmonella* Enteritidis in hedgehog populations in South Wales, addressing the gap in previous UK studies.
3. Investigate potential causes of salmonellosis during hospitalisation: Examine the potential causes of salmonellosis in hedgehogs during hospitalisation, focusing on anecdotal observations of stress and the potential for nosocomial (hospital-acquired) infection. This objective aims to understand how stress and hospital conditions may contribute to the shedding and transmission of *Salmonella* Enteritidis.
4. Promote good hygiene practices: Advocate for effective hygiene measures among the public and wildlife rehabilitators to prevent transmission of *Salmonella* from hedgehogs to humans and humans to hedgehogs.

Clinical Signs

The clinical signs of salmonellosis in hedgehogs can vary widely, ranging from mild to severe. Mild cases often present as gastroenteritis, characterised by symptoms such as diarrhoea, weight loss, and inappetence. In more severe cases, hedgehogs may develop systemic infections leading to neurological symptoms such as paresis (weakness), lethargy, and death (14). The variability in clinical presentation underscores the need for thorough diagnostic testing to confirm *Salmonella* infection. While observable characteristics of hedgehog faeces can provide valuable preliminary indicators of potential *Salmonella* infection, they should be used as an aid rather than a complete diagnostic tool.

Method

Study Period and Subjects

The study was conducted using hedgehogs admitted to Gower Bird Hospital (Swansea, Wales) from August 2021 to November 2022, involving 18 hedgehogs divided into two groups: control (n=9) and treatment (n=9). The hedgehogs came from Swansea and Cardiff postcode areas in South Wales (see Fig. 1).

Selection Criteria

Hedgehogs were selected for the study based on their clinical signs, faecal characteristics, duration of hospitalisation, and age. The treatment group consisted of hedgehogs showing mild clinical signs of salmonellosis and abnormal faeces. The faeces were notably green and jelly-like in consistency, with bright red blood often spread throughout in small foci or localised spots. The control group comprised hedgehogs with no clinical signs and normal faeces reflective of their captive diet, apart from one hedgehog with normally formed faeces with bright red blood spread throughout in small foci or localised spots, and another had green jelly-like faeces without blood present. Both groups were matched for similar hospitalisation times.

The average hospitalisation time for the control group was 15 weeks (range: 1 to 62 days), while the treatment group had an average of 19 weeks (range: 1 to 55 days). To confirm that the groups were comparable in terms of hospitalisation duration, we used a nonparametric statistical method called the Wilcoxon rank-sum test, conducted in R (15). The results ($W = 38$, $p = 0.86$) showed no significant difference between the two groups in hospitalisation duration. This indicates that the groups were well-matched and suitable for

comparison. All subsequent statistical analyses in this study were also carried out using R.

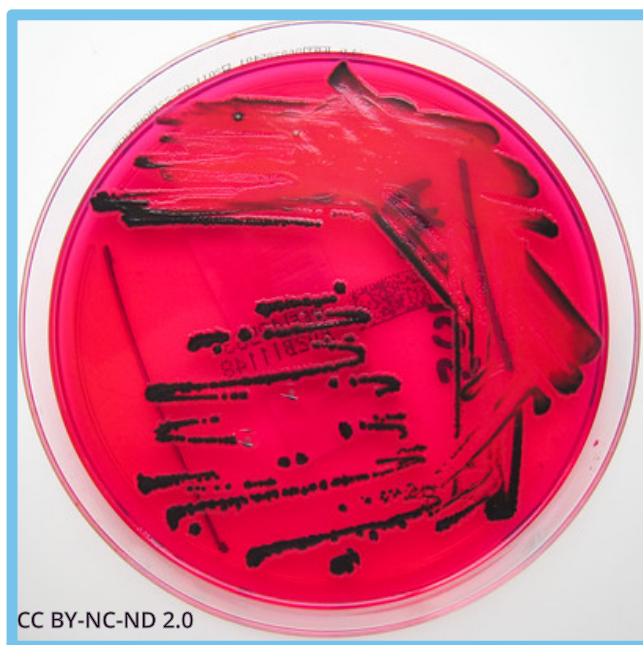
Group Composition

The control group comprised four females and five males, while the treatment group included six females and three males. (See Table 1.)

Sample collection and processing

Hedgehog faeces were collected using leak-proof 30ml sterile containers, which included an integral spoon for cleanly taking a small sample of faeces to avoid contamination. The pots were labelled with a unique identifying number, dated and placed in a fridge and stored at 4 degrees Celsius until posted to the Animal and Plant Health Agency (APHA) Penrith for microbiology testing.

When the samples arrived at APHA they underwent primary bacterial culture and specialised enrichment culture for *Salmonella*. If *Salmonella* was detected, further tests were conducted to identify the specific strain and phage type.



Salmonella species growing on X.L.D. agar.

Table 1. Group Composition

GBH Number	Group	Sex	Approx age of animal (weeks)	Length of hospitalisation (days) when sampled	Observable faecal characteristics
31743	Treatment	M	8	≤ 1	Green jelly with blood
31880	Treatment	F	10	≤ 1	Green jelly with blood
31775	Treatment	F	6	≤ 1	Green jelly with blood
31854	Treatment	F	8	≤ 1	Green jelly with blood
31639	Treatment	M	6	17	Green jelly with blood
31600	Treatment	F	6	21	Green jelly with blood
31556	Treatment	M	6	35	Green jelly with blood
31555	Treatment	F	6	35	Green jelly with blood
31106	Treatment	F	9	55	Green jelly with blood
31926	Control	M	6	≤ 1	Normal
31942	Control	F	12	≤ 1	Normal
31945	Control	M	12	≤ 1	Green jelly no blood
31850	Control	M	17	3	Normal with blood
31923	Control	M	6	4	Normal
31905	Control	F	10	15	Normal
31893	Control	M	7	18	Normal
33244	Control	F	14	27	Normal
33158	Control	F	14	62	Normal

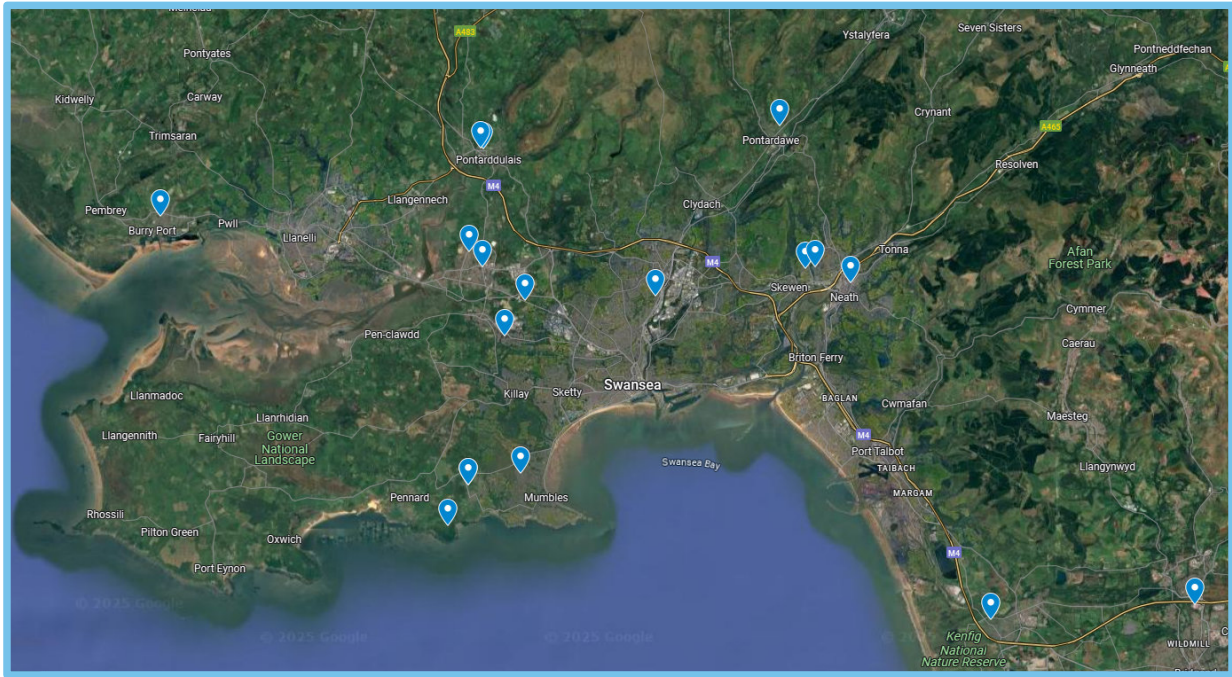


Figure 1. The original location of hedgehogs sampled in this study. Imagery ©2025 TerraMetrics, Map Data © 2025 Google

Results

In our study, we observed a significant difference in the incidence of salmonella between the treatment and control groups. In the treatment group, Salmonella was detected in 8 of the 9 hedgehogs (89%), whereas Salmonella was detected in only 1 of 9 hedgehogs (11%) in the control group (**see Table 2**).

To evaluate the statistical difference between the treatment and control groups, we applied Fisher's Exact Test for Count Data (frequency data), using the significance threshold of $\alpha = 0.05$. The analysis produced a p-value of 0.003, indicating a statistically significant difference between the groups (**see Fig. 2**).

Biologically, this result demonstrates a strong association between specific faecal characteristics and the presence of Salmonella in hedgehogs. Individuals whose faeces exhibited abnormal features—particularly the presence of blood and green, jelly-like material—were far more likely to test positive for Salmonella compared to those with normal faeces. These findings suggest that such abnormal faecal characteristics are strongly correlated with Salmonella shedding and may serve as useful indicators of infection in hedgehogs.

Fisher's Exact Test was chosen due to the small sample size of our study. Unlike the chi-squared test, which is more suitable for larger samples, Fisher's Exact Test is particularly effective for small sample sizes and provides an exact p-value rather than an approximation. This makes it a robust choice for our data, ensuring the reliability of our statistical inference.

Table 2. All the Salmonella isolates were of serotype Salmonella Enteritidis, subgenus 1, serogroup D1, phage type 11.

GBH No.	Group	Result	Salmonella culture result	Phage type	Date sampled	Date received at Laboratory	Days in transit
31743	Treatment	positive	S. Enteritidis	11	23/09/2021	24/09/2021	1
31880	Treatment	positive	S. Enteritidis	11	04/11/2021	08/11/2021	4
31775	Treatment	positive	S. Enteritidis	11	04/10/2021	05/10/2021	1
31854	Treatment	positive	S. Enteritidis	11	25/10/2021	26/10/2021	1
31639	Treatment	negative	Not Salmonella	-	15/09/2021	16/09/2021	1
31600	Treatment	positive	S. Enteritidis	11	12/09/2021	14/09/2021	2
31556	Treatment	positive	S. Enteritidis	11	18/09/2021	21/09/2021	3
31555	Treatment	positive	S. Enteritidis	11	18/09/2021	21/09/2021	3
31106	Treatment	positive	S. Enteritidis	-	15/08/2021	17/08/2021	2
31926	Control	negative	No Salmonella	-	24/11/2021	25/11/2021	1
31942	Control	negative	No Salmonella	-	30/11/2021	01/12/2021	1
31945	Control	negative	No Salmonella	-	30/11/2021	01/12/2021	1
31850	Control	negative	No Salmonella	-	25/10/2021	26/10/2021	1
31923	Control	negative	No Salmonella	-	24/11/2021	25/11/2021	1
31905	Control	negative	No Salmonella	-	24/11/2021	25/11/2021	1
31893	Control	positive	S. Enteritidis	11	24/11/2021	25/11/2021	1
33244	Control	negative	No Salmonella	-	22/11/2022	23/11/2022	1
33158	Control	negative	No Salmonella	-	22/11/2022	23/11/2022	1

The serogroup is a broad classification that groups together several serotypes based on shared antigens. Serogroup D1 indicates that the *Salmonella* isolates share specific antigens that place them within this group.

Serotyping differentiates bacterial strains by identifying specific antigenic structures, such as the somatic (O) and flagellar (H) antigens. *Salmonella* Enteritidis is a serotype (or serovar) within the species *Salmonella enterica*, defined by its unique combination of these surface antigens. This classification allows it to be distinguished from other serotypes within the same species.

Phage typing is a method used to classify bacteria further, based on their susceptibility to infection by different bacteriophages (viruses that infect bacteria). In this study, the *Salmonella* isolates were identified as phage type 11, meaning they have a unique pattern of being lysed (destroyed) by a particular set of bacteriophages.

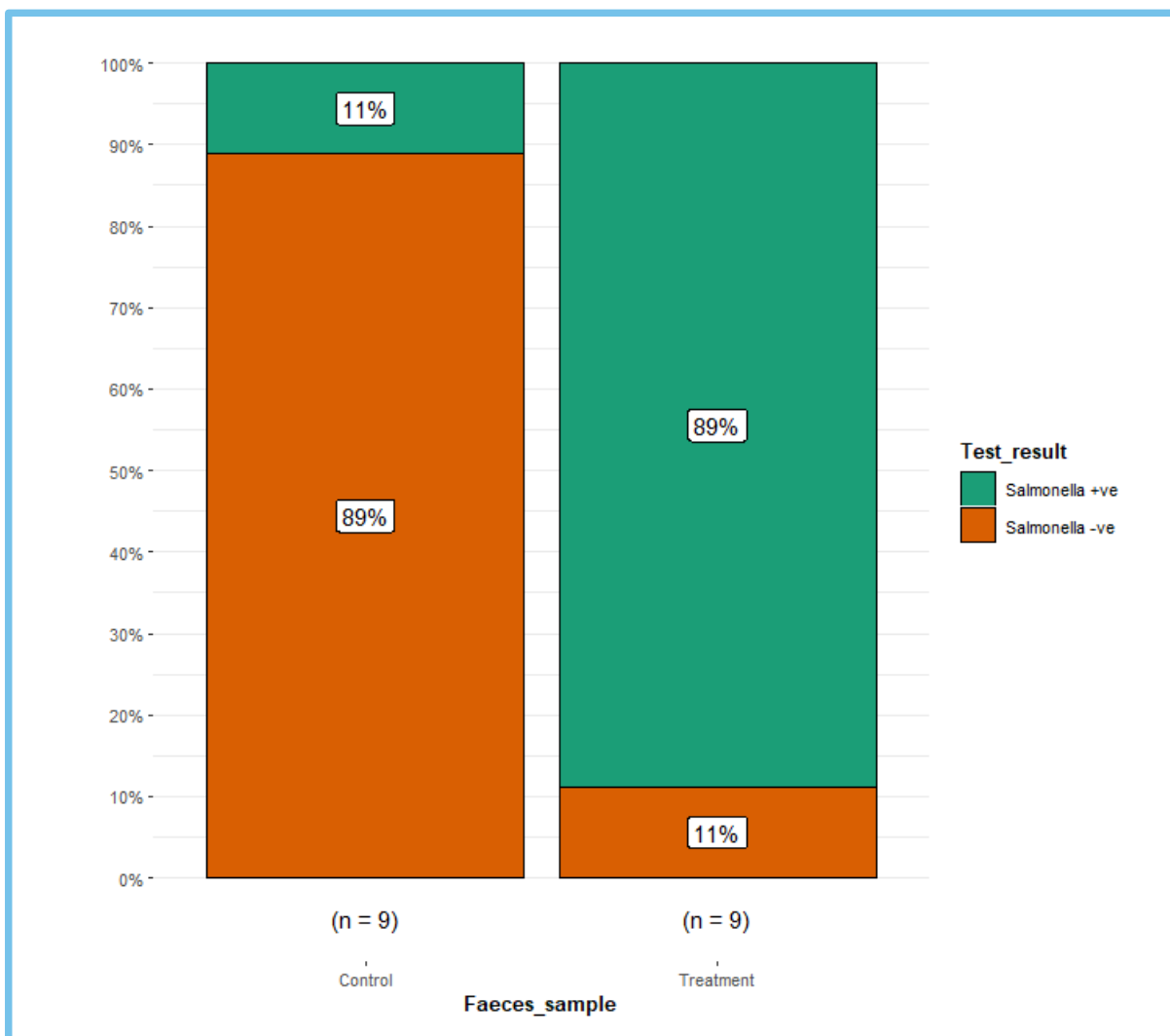


Figure 2. Proportion of *Salmonella* culture-positive and culture-negative samples in the control and treatment groups. The figure illustrates the results of Fisher’s Exact Test, visualised using the ggstatsplot package (16). Abbreviations: +ve = culture-positive; -ve = culture-negative.

Discussion

The appearance of blood can provide clues about the location of gastrointestinal inflammation. Bright red blood, known as hematochezia, typically indicates bleeding in the lower gastrointestinal tract, such as the colon or rectum. This type of bleeding is often fresh and may be associated with conditions like salmonellosis or other infections. In contrast, dark, tarry blood, known as melena, suggests bleeding higher up in the gastrointestinal tract, such as the stomach or small intestine. This blood has been partially digested, giving it a darker appearance and maybe associated with infections like cryptosporidiosis (17).

In this study, the presence of green jelly-like faeces with bright red blood in hedgehogs was statistically a strong indicator of salmonellosis (see Fig. 3). The jelly-like appearance, indicating mucus, is also associated with large intestinal inflammation. Salmonellae typically infect the large intestine, using inflammation to create a favourable environment for their growth and transmission via faeces to the next host (18).

Stress and Salmonella shedding

Most wildlife rehabilitators are now familiar with the concept that acute or chronic stress can compromise an animal's immune system, particularly in relation to the effect this may have on their macroparasite burdens, such as lungworms and other endoparasites. Microparasites on the other hand such as bacteria are often not discussed within this context, even though there is plenty of evidence in other animals for stress induced shedding of *Salmonella* (19–22). This study highlights that hedgehogs can produce such suspect faeces both upon admission and after prolonged care, suggesting that stress in the wild, and in captivity may exacerbate their condition (23–26). This underscores the need for greater attention to bacterial infections in stressed animals, as certain bacteria, such as *Salmonella*, can exploit the host's resources in a manner similar to macroparasites. It also highlights the importance of stress management in wild animal welfare establishments.

Effective stress management strategies should be integrated into every aspect of the rehabilitation process, including admission, veterinary intervention, handling, facility design, and release.

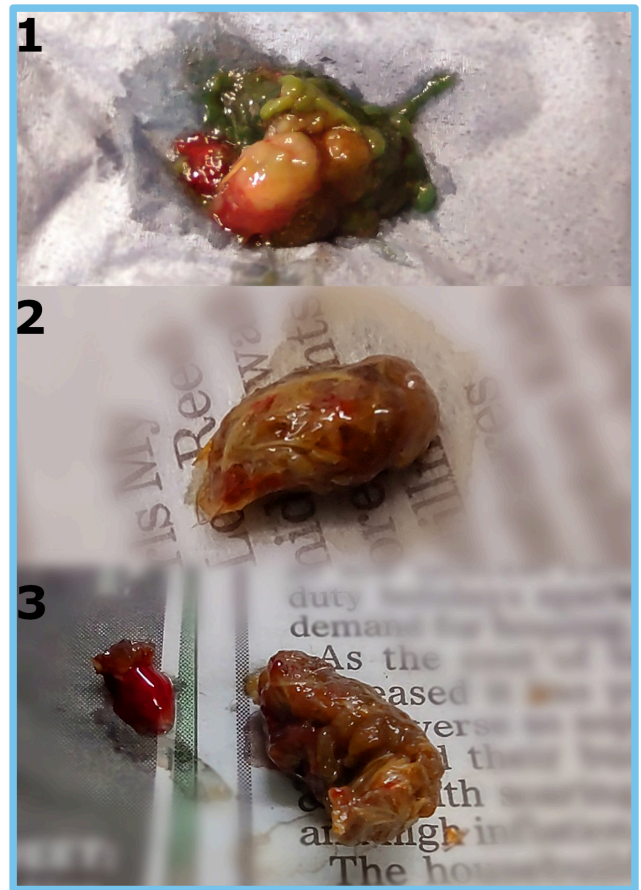


Figure 3. (1) Typical bright green colour with blood. (2) Red blood spots distributed through faeces. (3) Typical bright red colour of blood.

Transmission routes and mitigation

Salmonella can be transmitted through several routes within wildlife rehabilitation settings, including direct contact with infected animals, ingestion of contaminated food or water, and exposure to contaminated environments such as soil or bedding. In our study, the primary mode of transmission would be through faecal-oral routes, given the high prevalence of Salmonella in the faeces of the treatment group.

To mitigate the risk of transmission, it is crucial to implement stringent hygiene practices. These include:

- **Regular cleaning and disinfection:** Clean and disinfect enclosures and equipment regularly to prevent the spread of pathogens between facilities.
- **Use of personal protective equipment (PPE):** Wear disposable gloves and aprons during cleaning processes and when handling hedgehogs to prevent direct contact with contaminants.
- **Individual housing:** House hedgehogs individually, regardless of their disease status, unless it is a female with a litter.
- **Proper handling and disposal of faecal matter:** Ensure proper handling and disposal of faecal matter to prevent contamination.
- **Safe food and water sources:** Ensure that food and water sources are free from contamination.

Additionally, educating wildlife rehabilitators and the public about the risks and prevention

strategies for *Salmonella* transmission is essential in reducing the incidence of infection.

Studies have revealed that *Salmonella* and other bacteria can be transferred not only from hedgehogs to people but also from people to hedgehogs and other wildlife.

Research has shown that in areas with high human population density in Spain, antimicrobial-resistant (AMR) bacterial pathogens found in hedgehogs originated from human hospitals (27). Similarly, in Italy, multidrug-resistant (MDR) *Salmonella* from agricultural sources has been detected in other wildlife (28) and highlights the potential of hedgehogs as carriers of *Salmonella* and their role in the transmission of AMR and MDR pathogens.

The additional risk of releasing hedgehogs that may be shedding *Salmonella* cannot be overlooked. Understanding the transmission dynamics of *Salmonella* — both from hedgehogs to humans (zoonosis) and from humans to hedgehogs (reverse zoonosis or anthroponosis) — is crucial for developing effective prevention and control strategies. The detection of hospital-acquired, antimicrobial-resistant pathogens in hedgehogs and other wildlife across parts of Europe further complicates this issue, underscoring the potential negative consequences of close human-animal contact, such as through garden feeding stations and rescue establishments. These concerns highlight the urgent need for a One Health approach that integrates human, animal, and environmental health. By adopting this holistic framework, we can better address the complexities of zoonotic and reverse zoonotic transmission and mitigate the risks associated with *Salmonella* in hedgehogs.

Awareness of *Salmonella* risks in hedgehogs reflects a professional, evidence-based approach to wildlife rehabilitation. Promoting best practice through a One Health lens builds trust with authorities and reinforces high standards of care.

Acknowledgements

The authors would like to thank the **Animal and Plant Health Agency (APHA)** for conducting the microbiological analyses, including Salmonella culture, serotyping, and phage typing, under the Diseases of Wildlife Scheme. We are also grateful to Associate **Professor Dan Forman**, Department of Biosciences, Swansea University, for his valuable feedback and for reviewing the manuscript.

References

1. Araguas RM, Vidal O, García S, Sanz N. Genetic diversity and population structure of the Western European hedgehog, *Erinaceus europaeus*: conservation status of populations in the Iberian Peninsula. *Mammalian Biology*. 2022 Apr 1;102(2):375–86.
2. Rondinini C, Doncaster CP. Roads as barriers to movement for hedgehogs. *Funct Ecol*. 2002;16(4):504–9.
3. Hof AR, Bright PW. The value of agri-environment schemes for macro-invertebrate feeders: Hedgehogs on arable farms in Britain. *Anim Conserv*. 2010;13(5):467–73.
4. Hof A, Bright P. The value of green-spaces in built-up areas. *Lutra*. 2009;52(2):69–82.
5. Taucher AL, Gloor S, Dietrich A, Geiger M, Hegglin D, Bontadina F. Decline in distribution and abundance: urban hedgehogs under pressure. *Animals*. 2020 Sep 1;10(9):1–22.
6. Wembridge D, Newman MR, Bright P, Morris P. An estimate of the annual number of hedgehog (*Erinaceus europaeus*) road casualties in Great Britain. *Mammal Society London, UK*; 2016.
7. EFSA (European Food Safety Authority). The European Union One Health 2021 Zoonoses Report. *EFSA Journal*. 2022 Dec 1;20(12).
8. Handeland K, Refsum T, Johansen BS, Holstad G, Knutsen G, Solberg I, et al. Prevalence of *Salmonella typhimurium* infection in Norwegian hedgehog populations associated with two human disease outbreaks. *Epidemiol Infect*. 2002;128(3):523–7.
9. Lawson B, Franklins LHV, Rodríguez-Ramos Fernandez J, Wend-Hansen C, Nair S, Macgregor SK, et al. *Salmonella* Enteritidis ST183: Emerging and endemic biotypes affecting western European hedgehogs (*Erinaceus europaeus*) and people in Great Britain. *Sci Rep*. 2018;8(1):1–11.
10. Keeble E, Koterwas B. *Salmonellosis in Hedgehogs*. *Veterinary Clinics of North America: Exotic Animal Practice*. 2020 May 1;23(2):459–70.
11. Galán-Relaño Á, Valero Díaz A, Huerta Lorenzo B, Gómez-Gascón L, Mena Rodríguez M^a. Á, Carrasco Jiménez E, et al. *Salmonella* and *Salmonellosis*: An Update on Public Health Implications and Control Strategies. Vol. 13, *Animals*. Multidisciplinary Digital Publishing Institute (MDPI); 2023.
12. Ruszkowski JJ, Hetman M, Turlewicz-Podbielska H, Pomorska-Mól M. Hedgehogs as a potential source of zoonotic pathogens—a review and an update of knowledge. *Animals*. 2021;11(6):1–13.
13. Nauerby B, Pedersen K, Dietz HH, Madsen M. Comparison of Danish Isolates of *Salmonella enterica* Serovar Enteritidis PT9a and PT11 from Hedgehogs (*Erinaceus europaeus*) and Humans by Plasmid Profiling and Pulsed-Field Gel Electrophoresis [Internet]. Vol. 38, *JOURNAL OF CLINICAL MICROBIOLOGY*. 2000. Available from: <https://journals.asm.org/journal/jcm>
14. Gavier-Widén D, Duff JP, Meredith A. *Infectious diseases of wild mammals and birds in Europe*. John Wiley & Sons; 2012.
15. R Core Team. *A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing; 2024.
16. Patil I. Visualizations with statistical details: The “ggstatsplot” approach. *J Open Source Softw*. 2021;6(61):1367.
17. Meredith AL, Milne EM. Cryptosporidial infection in a captive European hedgehog (*Erinaceus europaeus*). *Journal of Zoo and Wildlife Medicine*. 2009 Dec;40(4):809–11.
18. Radlinski LC, Rogers AWL, Bechtold L, Masson HLP, Nguyen H, Larabi AB, et al. *Salmonella* virulence factors induce amino acid malabsorption in the ileum to promote ecosystem invasion of the large intestine. *Proc Natl Acad Sci U S A*. 2024 Nov 19;121(47).
19. Demirbilek SK. *Salmonellosis in Animals*. In: *Salmonella - A Re-emerging Pathogen*. InTech; 2018.
20. Pees M, Brockmann M, Steiner N, Marschang RE. *Salmonella* in reptiles: a review of occurrence, interactions, shedding and risk factors for human infections. Vol. 11, *Frontiers in Cell and Developmental Biology*. Frontiers Media SA; 2023.
21. Carrier DE, Purdy ; C W, Deloach ; J R. Effects of marketing stress on fecal excretion of *Salmonella* spp in feeder calves.
22. Nakamura M, Nagamine N, Takahashi T, Suzuki S, Kijima M, Tamura Y, et al. Horizontal Transmission of *Salmonella enteritidis* and Effect of Stress on Shedding in Laying [Internet]. Vol. 38, *Source: Avian Diseases*. Available from: <http://www.jstor.org>URL:<http://www.jstor.org/stable/1591950>http://www.jstor.org/stable/1591950?seq=1&cid=pdf-reference#references_tab_contents
23. Hing S, Narayan EJ, Thompson RCA, Godfrey SS. The relationship between physiological stress and wildlife disease: Consequences for health and conservation. Vol. 43, *Wildlife Research*. CSIRO; 2016. p. 51–60.
24. Selye H. Stress and disease. *Science* (1979). 1955 Oct 7;122(3171):625–31.
25. Fischer CP, Romero LM. Chronic captivity stress in wild animals is highly species-specific. Vol. 7, *Conservation Physiology*. Oxford University Press; 2019.
26. Verbrugghe E, Boyen F, Gaastra W, Bekhuis L, Leyman B, Van Parys A, et al. The complex interplay between stress and bacterial infections in animals. Vol. 155, *Veterinary Microbiology*. 2012. p. 115–27.
27. Garcias B, Aguirre L, Seminati C, Reyes N, Allepuz A, Obón E, et al. Extended-spectrum β -lactam resistant *Klebsiella pneumoniae* and *Escherichia coli* in wild European hedgehogs (*Erinaceus europaeus*) living in populated areas. *Animals*. 2021 Oct 1;11(10).
28. Rubini S, Ravaioli C, Previato S, D'Incau M, Tassinari M, Guidi E, et al. Prevalence of *Salmonella* strains in wild animals from a highly populated area of north-eastern Italy. *Ann Ist Super Sanita*. 2016 Jan 1;52(2):277–80.



BWRC Trustees

Simon Allen

Lucy Bearman-Brown

Richard Edwards

Dan Forman

Emma Onyejekwe

Jason Palmer

Paul Reynolds

Sue Schwar

All photos are copyrighted and remain the property of their owners.

The views and opinions expressed in this newsletter are those of the authors and do not necessarily reflect the official policy or position of the British Wildlife Rehabilitation Council.

If you would like to submit an article or letter for publication or give a presentation at a future symposium please contact:

admin@bwrc.org.uk

Visit our website:

www.bwrc.org.uk

Follow us on Facebook:

 **British Wildlife
Rehabilitation Council**

Follow us on Twitter:

 **@bwrc_uk**



**British Wildlife
Rehabilitation Council**

Registered Charity Number 1157841