



HUNGARIAN
MEADOW VIPER
PROJECT

ABSTRACT BOOK

REPTILE TELEMETRY WORKSHOP

19 March 2024
Budapest, Hungary



BUDAPEST
ZOO



Reptile Telemetry Workshop

Agenda – 19 March 2024

Budapest Zoo & Botanical Garden, Cave Hall

Online participation via Zoom:

<https://us02web.zoom.us/j/83210994972?pwd=dVJNMnNFVHZuNHpIVWdGWERlbnVlbnQ0OT09>

8:00 - 9:00	REGISTRATION	
9:00 - 9:30		Opening ceremony
9:30 - 9:50	Endre Sós	Veterinary aspects of radiotelemetry in the Hungarian meadow viper (<i>Vipera ursinii rakosiensis</i>) and the Caspian whipsnake (<i>dolichophis caspius</i>)
9:50 - 10:10	Nick Clemann	Effects of relocation on an Australian snake in conflict with humans. (online)
10:10 - 10:40	Paul Sinclair	Advances in drone radio-telemetry for the detection of endangered and invasive species management across meadow ecosystems. (online)
10:40 - 11:00	COFFEE BREAK	
11:00 - 12:00	Steve Thompson	Limiting transmitter associated morbidity and mortality in snakes.
12:00 - 12:20	Bálint Halpern	Spatio-temporal analysis of post-release movements of reintroduced Hungarian Meadow Vipers' (<i>Vipera ursinii rakosiensis</i>).
12:20 - 13:00	Richárd Wohlfart	A novel automated radio-tracking system for biological research.
13:00 - 14:30	LUNCH BREAK	
14:30 - 14:50	Oscar Hadj-Bachir, Marc-Antoine Marchand,	The harmonic radar as a tracking technique for the Meadow viper 2009-2010-2012.
14:50 - 15:10	Dennis Rödder	Beyond mcps and density kernels: implementing high-resolution microhabitat use in home range analyses
15:10 - 15:30	Robert Ward	Habitat use and coexistence between grass snakes (<i>Natrix helvetica</i>) and people in a fragmented island landscape (online)
15:30 - 16:00	COFFEE BREAK	
16:00 - 16:20	Bryan Maritz	Lessons from radio tracking cape cobras in the Kalahari Desert. (online)
16:20 - 16:40	Konrad Mebert	Between forest and plantations: movement and habitat of Bushmaster (<i>Lachesis muta</i>) in the Brazilian Atlantic Forest. (online)
16:40 - 17:00	Bálint Halpern	Unexpected consequences of tracking Caspian whipsnakes (<i>Dolichophis caspius</i>) in the Buda-hills.
18:30 - 22:00	DINNER	

VETERINARY ASPECTS OF RADIOTELEMETRY IN THE HUNGARIAN MEADOW VIPER (*VIPERA URSINII RAKOSIENSIS*) AND THE CASPIAN WHIPSNAKE (*DOLICHOPHIS CASPIUS*)

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The presentation gives a detailed overview of the surgical implantation process of radiotelemetric devices in two snake species in Hungary. Both the Hungarian meadow viper (*Vipera ursinii rakosiensis*) and the Caspian whipsnake (*Dolichophis caspius*) are the subjects of long term conservation efforts and our special veterinary knowledge can be applied to gain information from genuinely wild animals and released individuals.

The presentation describes the following topics in more detail:

1. Device development (the goal here is functionality, weight optimization and fixability/implantability). In our case, we are dealing with animal species where the partly underground lifestyle would make the devices attached to the body dangerous, so in the case of both species, the solution was implantation into the coelomic cavity.

2. Use of model species. In the case of the Hungarian meadow viper, a species with merely 500-1000 wild specimens in Hungary, where the loss of even a few individuals is unacceptable, any such process must be preceded by a serious authorization from the authorities. Fortunately, the model species is a species with a similar lifestyle and similar size, but in a much less critical situation from a conservation point of view. During the involvement of these species and individuals, anesthesia and surgical techniques can be practiced, and the short- and long-term physiological effects can also be measured (whether molting is affected, if there is a passage disorder, whether there is a long-term deterioration of condition and if pregnancy is effected). These questions can be answered much better in a zoo, and for some of our model species, e.g. for the Milos viper (*Macrovipera schweizeri*), this period could be as long as half a year, in order to obtain the answers to the questions raised.

3. Appropriate anesthesia and surgical technique (Figure 1). The two aforementioned species are very different from each other. The Hungarian meadow viper is a small venomous snake, with a weight range between 50-100 grams, and the operated individuals and work safety aspects were important considerations. The Caspian whipsnake is a significantly larger species, where the sharing of experiences gained during anesthesia (e.g. relatively small amounts of anesthetics, "spinning" movement under inhalation anesthesia, avoiding injury to the snake) are the main elements worth mentioning.

The aim of this presentation is to demonstrate the special knowledge of the zoo and wildlife veterinarians contributing to species survival programs.

EFFECTS OF RELOCATION ON AN AUSTRALIAN SNAKE IN CONFLICT WITH HUMANS

Nick Clemann

Wildlife Conservation & Science - Zoos Victoria

Since European people arrived in Australia over 200 years ago, the island continent's snakes have generated fear. Several species of large elapid snakes occur close to Australian cities, and, although bites are rare and fatalities even rarer, most people do not want snakes near their homes. The most common strategy to address these concerns is relocation of snakes by snake catchers. I conducted preliminary questionnaire surveys of people who call on snake catchers, and the snake catchers themselves, to examine their practices, showing that urban parklands are frequently used as release sites. Residents who have had a snake removed frequently report later finding other snakes on their property. We used radiotelemetry to compare the spatial ecology of resident Tiger Snakes (*Notechis scutatus*) with conspecifics released into a large urban parkland. Relocated snakes had home ranges around 6 times as large as resident snakes, and their movements were much larger. Although the release site was larger than many release sites used by snake catchers, several relocated snakes moved into the backyards of homes bordering the park. Where human and snake populations co-occur, relocation is rarely a long-term solution. Relocated snakes are likely to suffer higher mortality from predators, vehicle strike, and killing by humans. Alternative strategies, such as learning to live with snakes, are needed.

ADVANCES IN DRONE RADIO-TELEMETRY FOR THE DETECTION OF ENDANGERED AND INVASIVE SPECIES MANAGEMENT ACROSS MEADOW ECOSYSTEMS

Paul Sinclair

Wildlife Drones

The introduction of mechanised farming techniques and burning of meadowlands introduced to agricultural practices over the last 100 years has negatively influenced the survival of many species, and all too often driven them to or near extinction. Effectively understanding and managing the distribution of the meadow viper across their release sites in National Parks or other sites they are known to exist is crucial to their survival. Radio-telemetry is often the best way to shed light on their movements, distribution and habitat use, but can also be invaluable in managing any invasive non native animals predated the viper. Radio-telemetry can be important in quickly recognising areas where human-wildlife conflict requires immediate management action on the ground. Traditional ground based VHF tag tracking methods have been utilised to track the viper, however, detecting radio-tag signals in very flat landscapes can be problematic and so hit and miss, and is very time consuming. It can also disturb the animals being tracked and alter their behaviour or drive them underground, making them very difficult to locate. Therefore, meadowlands and snake focused biologists, amongst many others, are increasingly turning to drone-based technologies to assist with collecting data on a range of species. This includes those that are often well camouflaged, submerged, very mobile, or hidden in tree canopies and otherwise prohibitively difficult to locate. We provide examples of how advances in innovative drone radio-telemetry technology are enabling an increasingly diverse array of native and invasive species to be efficiently tracked, across some of the most challenging landscapes in different areas of the world.

LIMITING TRANSMITTER ASSOCIATED MORBIDITY AND MORTALITY IN SNAKES

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Forty-seven timber rattlesnakes (*Crotalus horridus*) had 71 radio transmitters implanted surgically in the coelom during a five year study period (2007-2011) assessing habitat use in southern Indiana hardwood forests. An additional 6th year of movement data and hematology collection allowed for mortality assessment of the snakes after the final year of surgeries. General anesthesia with Isoflurane and regional nerve blocks were performed to accomplish surgical implantation of the radiotransmitters. Antibiotic injections were provided to all snakes during 48 hours in captivity post-operatively. Geographic information system (GIS) movement data for 22 snakes that received a replacement transmitter were compared 1 and 2 weeks pre- and post- surgery and found no statistical difference. Two post-surgical infections were observed yet both snakes survived and were identified alive outside their hibernacula the following spring. No acute mortality was noted in any of the snakes and only a single overwintering mortality observed in a large adult male. Two post- surgical infections were observed yet both snakes survived. One did not have any treatment and the other required transmitter removal and a month of topical and systemic wound therapy for an enrofloxacin resistant strain of Streptococcus. Both snakes were identified alive outside their hibernacula the following spring. Transmitter inflammation post-surgically could increase basking times and thus predation or ophidiophobic human induced mortality. The GIS movement data could not assess basking times but did not support any acute or chronic post-surgical changes in male or female snake movement. Further studies are warranted.

Acknowledgements

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SPATIO-TEMPORAL ANALYSIS OF POST-RELEASE MOVEMENTS OF REINTRODUCED HUNGARIAN MEADOW VIPERS (*VIPERA URSINII RAKOSIENSIS*)

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The Hungarian meadow viper (*Vipera ursinii rakosiensis*) conservation program started to reintroduce captive bred vipers in 2010. Over the past years altogether 918 vipers were released to twelve habitats in Kiskunság and Fertő-Hanság National Parks in Hungary. In order to apply a remote tracking method, pre-programmed radio-tags with a detection range of 100-300m were surgically implanted into the abdomen of selected vipers. Generally we tried to include tagged individuals in each released group, resulting the tracking of 62 snakes (28 males, 34 females) on 8 habitats (4 in Kiskunság and 4 in Hanság) between 2012 – 2023, on an average of 117 days (max. 370 days). Each snake was localized at least once a week and in case we detected weakening of the signal (tags operate for 18 months), we tried to recover the tagged snake to remove the implant (N=8). Only 12 snakes (19%) managed to overwinter. In 31 cases (50%) we found the remains of the snake or the tag, and in 27 cases (44%) the snakes were killed by predation, half of them by avian predators like Common buzzards or Harriers and one third by mammals, most likely red fox and badger, while 20% of the cases the predator was hard to determine. The most sensible periods to predation were the week after release and the early spring and late autumn periods., and periods after mowing.

Movements of the snakes can be generally described with an initial circular discovery period, usually arriving back to the release location. Their longer movements were many times initiated by disturbance like mechanical mowing or arrival of grazing herd, always avoiding low height grass stripes, rather staying in undisturbed stripes. Snakes had an average Minimum Convex Polygon of 0.43 ha (max. 1.51 ha), with an average cumulative distance of 324 m (longest 921 m). The implants also operate as temperature loggers, recording data every five minutes. We recovered temperature logs of 36 snakes. Six of them managed to overwinter in natural habitat, spending on average 131 days hibernated at a mean temperature of 5.3 °C.

A NOVEL AUTOMATED RADIO-TRACKING SYSTEM FOR BIOLOGICAL RESEARCH

Dr. Miklós Ákos – Wohlfart Richárd – Ifj. Wohlfart Richárd

Wohlfart Telemetry

Our presentation focuses on an innovative automated radio telemetry tracking system developed by us, which is capable of autonomously determining the positions of dozens of animals simultaneously with high accuracy (less than 1 meter). The system is primarily designed for monitoring small animals (e.g. small mammals, reptiles, birds) with small to medium home ranges, allowing logging of multiple positions and sensor data (e.g. temperature, light, humidity) per minute. It can be easily deployed, expanded, and adapted for different research purposes. The transmitters that are compatible with the system range in weight from 0.25 grams to double-digit grams, are reusable, and batteries are easy to replace in field conditions. We have also developed transmitters with tissue-friendly coating that can be implanted in the body cavities of animals. In each case, the transmitters are operated according to a specific program designed based on the research project's objectives. Optionally, the transmitters can be remotely controlled from long distances, resulting in a significantly improved battery life and a standby time of 10 years. We have also created a handheld receiver that integrates traditional radio-tracking techniques with cutting-edge solutions, making it compatible with our automated system.

In conservation biology, the system can be used to determine, for example, the habitat preference of a species, habitat selection, and changes in movement patterns in response to habitat narrowing. In agroecology, the monoculture preference of a pest species can be investigated, and the direction of dispersal during gradation can be determined, among other things. The system was successfully used in 6 national and international conservation and research projects throughout the second half of 2023.

THE HARMONIC RADAR AS A TRACKING TECHNIQUE FOR THE MEADOW VIPER 2009-2010-2012.

Marc-Antoine Marchand – Oscar Hadj-Bachir

CEN PACA - Pôle Biodiversité Régionale

Telemetry was conducted on *Vipera ursinii* in France during the LIFE Program 2006-2011. In 2010, 15 vipers were equipped with small chips protected by a plastic coating, connected to an antenna, and placed under the skin. A harmonic radar was used to detect vipers during a 14-day survey. Only 13 vipers were detected in the same year. In 2012, no vipers were detected by harmonic radar, but during the CMR study, two equipped vipers were recaptured after 2010. Distance detection was very low (average 3.75m). The results provide information about distance traveled and availability for detection. The very low detection of equipped vipers in the years following the chip implementation raises questions about the survival of vipers.

BEYOND MCPS AND DENSITY KERNELS: IMPLEMENTING HIGH-RESOLUTION MICROHABITAT USE IN HOME RANGE ANALYSES

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Understanding animal space use and habitat needs is a vital requirement for effective conservation and management measures. Considering the multiple instances in which landscapes are anthropogenically altered, it becomes increasingly important to understand what the spatial requirements of an animal are. However, smaller animals, like lizards, require finer-scale assessments, which cannot always be easily made based on commonly used home range estimators such as minimum convex polygons or density kernels. Herein, we calculated home ranges of *Lacerta agilis* using data collected by radio tracking. We then studied microhabitat preference using high-resolution potential habitat use maps generated by species distribution modelling techniques and multispectral images taken by unmanned aerial vehicles. Overall, lizards in the selected area seem to favour home ranges that include blackberry brush while avoiding high vegetation and sand. They use other structures according to individual preferences or unstudied factors. Our study portrays an efficient method with high spatial resolution to assess small-vertebrate habitat preferences, which can in turn be used in planning population-specific habitat management or compensatory measures.

HABITAT USE AND COEXISTENCE BETWEEN GRASS SNAKES (*NATRIX HELVETICA*) AND PEOPLE IN A FRAGMENTED ISLAND LANDSCAPE

Robert J. Ward

The Amphibian and Reptile Conservation Trust: Bournemouth, Dorset, GB

As habitats become further fragmented and eroded, nature reserves play increasingly important roles as wildlife refuges. However, reserves are often used for recreational activities, with management having to consider the needs of both humans and wildlife. We utilised short-term radio-telemetry of 16 grass snakes *Natrix helvetica* to study their habitat use at two spatial scales within reserves in a fragmented landscape on the island of Jersey. Our aims were to investigate how these reserves support vulnerable snake populations in the presence of human activity, and to inform site management. Structurally complex habitats, specifically rough grassland and dense scrub, were preferred over open and woodland habitats. Areas close to paths and compost heaps frequently occurred in home ranges, providing basking and potential nesting opportunities respectively. Snakes displayed site fidelity, and were not observed to cross tarmacked roads. Although snakes clearly move through areas subject to public pressure, they are rarely observed. Indeed, on over 83% of fixes snakes were not visible to the observer even when tracked to the nearest metre. Thus coexistence between snakes and people may rely on a high degree of crypsis and avoidance of the public. Reserve managers should consider unobservable species diversity in their plans. Maintaining areas of complex vegetation structure and intervening habitat that may otherwise appear to be of low value in addition to key habitat features (freshwater ponds for prey, hibernacula and suitable oviposition sites) should improve site suitability for grass snakes.

LESSONS FROM RADIO-TRACKING CAPE COBRAS IN THE KALAHARI DESERT

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Since 2016, we have been conducting autecological and eco-physiological studies on Cape Cabras (*Naja nivea*) at Tswalu Kalahari Reserve, Northern Cape, South Africa. The region is characterized by hot, arid savanna habitat, interspersed with trees and shrubs. Over the years, we have implanted (Holohil SI-2 transmitters, intracoelomic implantation with subdermal placement of whip antenna) and tracked 30 snakes. Findings of these studies are not yet published, but analysis reveals important sex differences in home range size, and substantial sex and season effects on movement distances. Measures of body temperature have shown that environmental temperatures constantly challenge cobras and likely play a substantial role in when cobras perform certain behaviours.

BETWEEN FOREST AND PLANTATIONS: MOVEMENT AND HABITAT OF BUSHMASTER (*LACHESIS MUTA*) IN THE BRAZILIAN THE ATLANTIC FOREST

Konrad Mebert

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Bushmasters are the largest vipers on earth, known to be a “primary” forest species and particularly sensitive to handling. The populations from northeastern Brazil need to cope with particularly small and scattered forest patches within a mosaic of plantations, pastures, and suburban areas. In 2016/17, we initiated a small study on the activity pattern and habitat parameters of this iconic species. We radio tracked up to six individuals, native and translocated ones, to compare their movements and habitat selection within forest fragments and modified rubber plantations at the Reserva Ecologica Michelin in Bahia, Brazil. The average home range was 9.47 ha (MCP 95%) and 44.11 (Kernel 95%) for Bushmasters tracked for > 6 mos. They moved within a diameter of ca. 500-2000 m, and rarely stayed at the same location between two consecutive tracking events of 2-3 days. Macrohabitats consisted of disturbed primary (partially logged) and secondary (originally cleared) forests, but also of rubber tree plantations with a dense understory vegetation, while complex vegetation structures were selected for microhabitats. Bushmasters were mostly found “resting” on the forest floor during the day and ambushing at night in a more open understory space close to mammal trails. We found no evidence of substantial negative effects of individuals translocated by > 20 km from outside the study site, as all individuals grew impressively, and continued an apparently normal life by establishing a home range similar to native Bushmasters.

UNEXPECTED CONSEQUENCES OF TRACKING CASPIAN WHIPSNAKES (*DOLICOPHIS CASPIUS*) IN THE BUDA-HILLS

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Caspian whipsnakes (*Dolicophis caspius*) is strictly protected in Hungary, and we were determined to learn more about their distribution and conservation status of certain populations. After the discovery of a new population in Buda-Hills in 2012, we started to investigate the genetic origin, the population size and the spatial ecology of this elusive snake in a peri-urban habitat in Budapest. In May 2016 we started to use radiotelemetry to track five adult snakes and analyzed their microhabitat preferences, home range sizes and daily movements. The Caspian whipsnakes intensively utilized areas covered with woody vegetation, with a high density of hibernacula. The tracked snakes used an area of 40.15 ha during the activity period from spring to autumn, which was well exceeding the size of the 8 ha “core area”, that was known by visual encounter surveys. For the winter period the tracked snakes withdrew to a central area of 1.75 ha, abundant in hibernacula. During the activity period the individual home range sizes varied between 6.1 and 15.5 ha, using neighbouring grasslands to a large extent, probably as foraging grounds. We found that the average daily displacement for the different individuals ranged between 12.6 and 36.6 m during their main activity season, but certain individuals were able to cover several hundreds of meters between the weekly localisations. In the study area, the whipsnakes currently have enough space for foraging (which might limit their occurrence on other sites), but the vicinity of the urban area is always threatening with development pressure. When we realised in late 2016 that the Budapest Olympic Bid for 2024 was planning a cross-country cycling event on the exact site, we acted quickly by sharing our knowledge on the habitat use of this unique species and we managed to persuade the organisers to cancel their habitat destruction plans. As we wanted to avoid such a case in the future, therefore we decided to advertise the natural values of the area better, by building an educational trail, presenting the unique natural values of this area. As we were previously honoured by the visit of the famous primatologist Dr. Jane Goodall, who personally helped in the release of the first two tagged snakes, we asked her again for help, and we managed to open the Jane Goodall Education Trail for the Conservation of Caspian Whipsnake in 2018, thanks to public donations and local help. The trail became popular trekking destination for locals and also targeted by many field trips by educational institutions, serving as perfect example that locally we can still make a difference in protecting natural values.