EWDA Network Meeting:
How to start up a wildlife health surveillance programme

Amphitheater 1, 2nd Floor, Faculty of Medicine, University of Thessaly

Background:

Out of 49 European countries, we know of only 14 countries that have a wildlife health surveillance programme at a level 2 or 3. Level 2 means partial general surveillance, i.e. wide range of programmes but restriction in various ways, e.g. geographical regions or covered species. Level 3 means comprehensive general surveillance, involving the entire country, and a wide range of species and diseases covered. Therefore, we have no or only poor knowledge of the state of wildlife health in the majority of European countries. In wildlife health surveillance, as in many other areas, "The first step is the hardest". How did those European countries who do have partial or comprehensive general surveillance of wildlife health get started? Knowledge of their histories may be useful for people who are keen to start wildlife health surveillance in their own country. However, this information is not generally available. The goal of this EWDA Network meeting is to use the knowledge from OIE training programmes, plus from the start-up periods of countries with established wildlife health surveillance systems to help other countries to set up their own systems.

Programme:

13:00-14:00.	Welcome coffee
14:00-14:05.	Welcome and introduction (Thijs Kuiken)
14:05-14:15.	Overview of wildlife health surveillance in Europe as of 2009 (Thijs Kuiken)
14:15-14:30.	Review of requirements of a wildlife health surveillance programme (Marie-Pierre Ryser)
14:30-15:30.	Start-up and growth spurts of established wildlife health surveillance systems in a selected number of countries, part 1 (4 x 15 min; Paul Tavernier, Belgium; Antonio Lavazza, Italy; Jorge Lopez, Spain; Marie-Pierre Ryser, Switzerland)
15:30-16:15.	Break and Poster Viewing
16:15-16:45.	Start-up and growth spurts of established wildlife health surveillance programmes in a selected number of countries, part 2 (2 x 15 min; Jolianne Rijks, The Netherlands; Becki Lawson and Paul Duff, UK)
16:45-17:30.	Panel discussion: what worked, what didn't? (Panel: all speakers on start-up and growth spurts of established programmes. Chair: Thijs Kuiken)
17:30-18.00.	Break and Poster Viewing
18.00-19:00.	Situation reports of a selected number of countries who wish to start a wildlife health surveillance programme (4 x 15 min; Daniel Mladenov, Bulgaria; Gudrun Wibbelt, Germany; Charalambos Billinis, Greece; Sara Savic, Serbia)
19:00-19.45.	Panel discussion: how to get started? (Panel: all speakers on countries wishing to start a programme. Chair: Thijs Kuiken)
19.45-20:00.	Concluding remarks (Thijs Kuiken)

Overview of wildlife health surveillance in Europe as of 2009

Author(s): Kuiken, Thijs[1]; Ryser-Degiorgis, Marie-Pierre[2]; Gavier-Widén, Dolores[3]; Gortázar, Christian[4]

Affiliation(s):
[1] Department of Viroscience, Erasmus University Medical Centre, 3000 CA Rotterdam, The Netherlands
[2] Centre for Fish and Wildlife Health, Vetsuisse Faculty, University of Bern, Länggass-Strasse 122, Postfach, 3001 Bern, Switzerland
[3] National Veterinary Institute, Travvägen 20, SE-751 89 Uppsala, Sweden
[4] National Wildlife Research Institute IREC (CSIC-UCLM-JCCM), Ronda de Toledo s/n, Ciudad Real 13071, Spain

Presenter: Thijs Kuiken (t.kuiken@erasmusmc.nl)

Wildlife health surveillance is important for the health of the public, domestic animals, and wildlife itself. It can be divided into general (otherwise known as scanning or passive surveillance) surveillance and targeted surveillance (otherwise known as active surveillance). General surveillance is the pathological or clinical examination of animals found dead or moribund, typically involving investigation for the presence of a range of infectious and/or non-infectious diseases. Targeted surveillance is the testing of animals for the presence of specific pathogens. Effective wildlife health surveillance requires an effective international network.
In 2009, the European Wildlife Disease Association (EWDA) organised a meeting to update the knowledge on the status of wildlife disease surveillance among European countries. Based on a questionnaire survey, speakers from 25 European countries presented summaries of the status of wildlife health surveillance in their countries. No information was obtained from the remaining 24 countries in Europe. An overview of the status of wildlife health surveillance in Europe at that time was published[1].
The survey participants were asked to categorise their country's surveillance level based on the following classification: **level 1**: no general surveillance, that is, absence of a programme of general wildlife health surveillance, but limited targeted surveys of selected wild animal species for a few specified diseases; **level 2**: partial general surveillance, that is, a wide range of programmes including detection, diagnosis and management of disease-related information, but restricted in various ways (e.g., only selected species or only part of the country); **level 3**: comprehensive general surveillance, that is, one or several programmes covering the entire country and being comprehensive with respect to species of animals examined and types of diseases assessed.
Out of the 25 participating countries, 11 countries had level 1 surveillance, 8 countries had level 2 surveillance, and 6 countries had level 3 surveillance. Instead of, or in addition to, general wildlife health surveillance, several countries performed targeted surveillance for rabies, avian influenza, tuberculosis, classical swine fever, trichinellosis, paratuberculosis, transmissible spongiform encephalopathy, echinococcosis, bluetongue, ecto- and endoparasites without further specification, Aujeszky's disease, porcine circovirus infection, encephalomyocarditis in wild boar and rodents, European brown hare syndrome, tularemia, and/or Crimean-Congo haemorrhagic fever.
The number of people employed full-time in wildlife health surveillance per country was usually below ten, but ranged widely. The number of wildlife surveillance programmes per country ranged from none to over ten, with just over half of respondents saying that they had one or two wildlife surveillance programmes. By far the most important funding for wildlife health surveillance was provided by the national government, with additional funding from hunter organisations, universities, research projects, non-governmental organisations, the agricultural industry, and environmental organisations.
The intensity of surveillance, both general and targeted, also varied greatly per country. In general surveillance programmes the number of animals examined ranged among countries

from 30 to 5,000 per year. In targeted surveillance programmes the number of animals examined ranged among countries from tens to tens of thousands per year. The survey results showed that, in total, over 18,000 wild animals were examined by general surveillance and over 50,000 wild animals were examined by targeted surveillance in Europe on an annual basis.

1. Kuiken T, Ryser-Degiorgis MP, Gavier-Widen D, Gortazar C. Establishing a European network for wildlife health surveillance. Rev Sci Tech Oie 2011; 30:755-61.

Review of requirements of a wildlife health surveillance programme

Author(s): Ryser-Degiorgis, Marie-Pierre[1]; Sleeman, Jonathan[2]; Nguyen, Natalie[2]; Zimmer, Patrick[3]; Duff J., Paul[4]; Gavier-Widén, Dolores[5]; Grillo, Tiggy[6]; Lee, Hang[7], Rijks, Jolianne[8]; Tana, Toni[9]; Uhart, Marcela[10]; Ratanakorn, Parntep[11]; Ågren, Erik[5]; Stephen, Craig[3]

Affiliation(s):
[1] Centre for Fish and Wildlife Health, Vetsuisse Faculty, University of Bern, Länggass-Str. 122, Postfach, 3001 Bern, Switzerland
[2] USGS National Wildlife Health Center, 6006 Schroeder Road, Madison, Wisconsin 53711-6223, United States of America
[3] Canadian Wildlife Health Cooperative, 52 Campus Drive, Saskatoon, Saskatchewan S7N 5B4, Canada
[4] Animal and Plant Health Agency Diseases of Wildlife Scheme, Penrith Veterinary Investigation Centre, Penrith, Cumbria CA11 9RR, United Kingdom
[5] Department of Pathology and Wildlife Disease, National Veterinary Institute, SE-751 89 Uppsala, Sweden
[6] Wildlife Health Australia, Suite E, 34 Suakin Drive, Mosman, New South Wales 2088, Australia
[7] Conservation Genome Resource Bank for Korean Wildlife, Seoul National University College of Veterinary Medicine, Seoul 08826, Republic of Korea
[8] Dutch Wildlife Health Centre, Utrecht University, Yalelaan 1, 3584 CL Utrecht, the Netherlands
[9] Ministry for Primary Industries, 25 The Terrace, Wellington 6011, New Zealand
[10] Latin America Program, One Health Institute, School of Veterinary Medicine, University of [1] California, 1089 Veterinary Medicine Drive, Davis, CA 95616, United States of America
[11] Monitoring and Surveillance Center for Zoonotic Diseases in Wildlife and Exotic Animals, Thailand National Wildlife Health Center, Faculty of Veterinary Science, Mahidol University, 999 Putthamonthon 4 Road, Salaya, Nakhon Pathom 73170, Thailand

Presenter: Marie-Pierre Ryser (marie-pierre.ryser@suisse.unibe.ch)

The World Organisation for Animal Health (OIE) recommends that every country has a set of government policies, regulations and programmes to be able to effectively manage issues related to pathogens in wildlife because countries which are not prepared are at increased risk of experiencing significant impacts from wildlife-related diseases. National wildlife disease programmes generally have two primary objectives: (1) to reduce the social, human health, economic and ecological costs to society of pathogens in wild animals; and (2) to meet international obligations to detect and report important pathogens that are present in wild animals. Components of a national wildlife disease/health programme include: prevention; early detection (surveillance); timely decisions and responses; and effective pathogen management (including advanced planning, scientific research, expertise and education) [1]. During a workshop on evidence-based design of national wildlife health programmes [2], five key attributes of such programmes were proposed: (1) being knowledge and science based; (2) fostering cross-nation equivalence and harmonisation; (3) developing partnerships and

national coordination; (4) providing leadership and administration of national efforts and (5) capacity development. Proposed core purposes of national programmes include: establishing and communicating the national wildlife health status; leading national planning; centralising information and expertise; developing national networks leading to harmonisation and collaborations; developing wildlife health workforces; and centralising administration and management of national programmes [3].

Surveillance is an essential component of health programmes. It is defined as the on-going recording of disease/pathogen occurrence in populations with a view to disease management. A wildlife health surveillance programme should comprise four core elements: detection of diseases/pathogens (event detection, specimen submission); identification of diseases/pathogens (diagnostic investigation); analysis and communication (analysis of information, requiring input from epidemiologists and wildlife biologists); and information management (collection of animal/sample metadata, outbreak descriptions, data submission to notification systems) [4]. Depending on the needs, objectives and resources, different types of surveillance may be carried out: general or targeted (Table 1, risk-based (focused on areas with highest probability of occurrence or with most serious expected consequences), adaptive (complementing general using targeted surveillance activities as needed). Surveillance may rely not only on laboratory diagnostics but also on participatory (stakeholder knowledge) and/or syndromic approaches (identifying case clusters with common characteristics before a diagnosis is made). To be effective and comprehensive, a surveillance programme should include various components investigating different aspects of health events which serve to complement one another, including but not limited to both general and targeted surveillance approaches, outbreak investigation and archiving of biological samples [1,4,5,6].

In summary, a wildlife health surveillance programme requires the existence of a network of field partners submitting material to diagnostic laboratories with expertise in wildlife diseases, the storage and analysis of diagnostic data, and the communication of results to stakeholders. Depending on the country, a national wildlife health programme may rely on a network of local surveillance programmes or on a single country-wide programme [2]. The OIE may offer support in capacity building of national wildlife disease laboratories [7].

1. OIE 2010. Training manual on wildlife diseases and surveillance. 56 pp. http://www.oie.int/fileadmin/Home/eng/Internationa_Standard_Setting/docs/pdf/WGWildlife/A_Training_Manual_Wildlife.pdf
2. Nguyen N. T., Duff J. P., Gavier-Widén D., Grillo T., He H., Lee H., Ratanakorn P., Rijks J. M., Ryser-Degiorgis M.-P., Sleeman J. M., Stephen C., Tana T., Uhart M., Zimmer P. Report of the workshop on evidence-based design of national wildlife health programmes. USGS Open file report 2017-1038. 28 pp. http://www.wildlifedisease.org/wda/Portals/0/Forums/Report%20of%20the%20Workshop.pdf
3. Stephen C., Sleeman J., Nguyen N., Zimmer P., Duff J. P., Gavier-Widén D., Grillo T., Lee H., Rijks J., Ryser-Degiorgis M.-P., Tana T., Uhart M. 2018. Proposed attributes of national wildlife health programmes. OIE Review 37: in press.
4. OIE 2015a. Guidelines for wildlife disease surveillance: an overview. 8 pp. http://www.oie.int/fileadmin/Home/eng/Internationa_Standard_Setting/docs/pdf/WGWildlife/OIE_Guidance_Wildlife_Surveillance_Feb2015.pdf
5. OIE 2015b. Training manual on surveillance and international reporting of diseases in wild animals. 99 pp. http://www.oie.int/fileadmin/Home/eng/Internationa_Standard_Setting/docs/pdf/WGWildlife/A_Training_Manual_Wildlife_2.pdf
6. Ryser-Degiorgis M.-P. 2013. Wildlife health investigations: needs, challenges and recommendations. BMC Veterinary research 9:223, https://doi.org/10.1186/1746-6148-9-223
7. OIE (no date). Twinning laboratories - A guide to OIE laboratories twinning projects. 16 pp. http://www.rr-middleeast.oie.int/download/pdf/Twinning%20labs.pdf

Table 1. Tentative compilation of the definitions of general and targeted surveillance. The following sources of information were taken into consideration: The Training Manuals for OIE national focal points for wildlife, the OIE Animal Health Code, and the review article by Hoinville et al. 2013 (Prev. Med. Vet. 112:1-12, DOI:10.1016/j.prevetmed.2013.06.006)

	General / Scanning	**Targeted / Hazard-specific**
Alternative terminology	**Passive** (=observer-initiated)	**Active** (=investigator-initiated)
Objective	Searching for **any disease** within a population → detection of cases/signals (early warning)	Detect a **specific health hazard**: most often a pathogen, also e.g. a toxic compound or anomaly (early warning, demonstration of disease freedom, monitoring of success of control measures, …)
Health status of investigated animals	**Disease focus** (≈ clinical surveillance: detecting dead or live but visibly sick animals)	Apparently healthy or diseased = **independent of health status**, whether alive or dead «Weighted surveillance»: when focused on a high-risk subset of the population (e.g. looking for a specific pathogen in all animals found dead or showing signs of illness)
Geographical area and animal species	Usually **all** that covered by the health programme	Pre-defined, often **risk-based**
Material collection	**Cases as they occur**, are found and submitted = opportunistic (whole carcasses or samples)	**Proactive sampling** or search of disease cases or information (samples, whole carcasses, others) usually according to a **pre-defined** sampling plan: - Population size? - Prevalence estimation vs. freedom of disease? - Stratification: sex & age ratio, geographical distribution, season, …
Population-level inference	Poor / **tip of iceberg**	**Improved - good** (depends on data collection strategy & usual limitations such as the access to wildlife samples)
Investigation method	**Pathology**, clinical exam, … Further tests as needed («routine»)	Standardized, systematic procedure: Mostly **antigen detection** Others: histology, toxicology, serology, …

Wildlife Disease Surveillance in Belgium

Author(s): Tavernier, Paul[1]

Affiliation(s):
[1] Belgian Wildlife Disease Society (BWDS) / WILDPAD

Presenter: Paul Tavernier (paul_tavernier@skynet.be)

Current surveillance level (based on criteria presented in Kuiken et al., 2011): Level 2

Apart from the pioneering work by Prof. Paul Pastoret in the 1980s for the eradication of rabies, health surveillance in Belgian wildlife was non-existent before 2000. After the turn of the millennium, simultaneous initiatives grew from the Flemish and the Walloon sides, although from different perspectives.
In Wallonia, the initial programme was targeted and aimed to determine the prevalence of paratuberculosis in free-living cervids (Veterinary Faculty of Liège, supported by the Walloon Government and the hunting world). It evolved to the "Réseau de Surveillance Sanitaire en Faune Sauvage" (RSSFS) by extension of surveillance to other pathogens in game.
The Belgian Wildlife Disease Society (BWDS) started in 2003 as a voluntary initiative considerate of biodiversity. In addition to creating a forum for those interested in wildlife health, a main objective (in line with the aims of the OIE) was to start up the Belgian notification of wildlife diseases. Biennial symposia organized since 2005 created the dynamics leading to the fulfilment of this objective. In the meantime, a federal government project WILDSURV, in which BWDS members designed a prototypic prioritisation system to determine the needs for wildlife disease surveillance, taking into account country-specific parameters, was successfully concluded in 2010, despite differences at the regional level. Wildlife matters being a regional competency, a wildlife working group was set up in 2011 within the Federal Food Agency in order to prepare the semestral notifications to the OIE in consultation with the regions. The regions are also included in the epidemiological communication platform PLASUR.
The surveillance is mainly targeted and focuses on a restricted number of pathogens, selected because of their importance for public health, livestock health or public interest. Flemish data are collected by the regional agency "Agentschap voor Natuur en Bos" (ANB, wildlife department) while Walloon data are collected by the RSSFS, in cooperation with the regional agency "Agence des Eaux et Forets". The surveillance of zoonotic notifiable diseases (e.g. rabies, avian influenza) is steered by the federal government. General surveillance is now included in the RSSFS activities, whereas in Flanders the ANB announced the start-up of a "passive surveillance" network from February 2018 on. Funding comes from the regional governments.
The Belgian story shows how wildlife disease surveillance in both regions was initiated by a few individuals with divergent backgrounds. Instigated by the BWDS, the government started organising the data collection to implement the notification of wildlife diseases to the OIE. Although BWDS members are no longer involved, key responsibilities having been claimed firmly by particular stakeholders based on their regional mandates, we can state the original BWDS objective to make things progress has been met successfully. The complex Belgian administrative structures in combination with human and political factors, made wildlife health surveillance in Belgium a closed scenery with minimal citizen participation.

Regional wildlife health surveillance in Lombardy, Italy

Author(s): Lavazza, Antonio[1]; Chiari, Mario[2]; Farioli, Marco[2]

Affiliations:
[1] Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna (IZSLER), via Antonio Bianchi 7/9, 25124 Brescia, Italy
[2] DG Welfare Lombardy Region, Piazza Città di Lombardia 1, 20124 Milan, Italy

Presenter: Antonio Lavazza (antonio.lavazza@izsler.it)

Current surveillance level (based on criteria presented in Kuiken et al., 2011): Level 2

In Italy the owner of wildlife is the State and the Veterinary Services are under the governance of the Ministry of Health, which establishes national control plans, gives instruction on remit and activities and transfers funding to administrative Regions. Therefore, wildlife health surveillance plans are set up at a regional level (level 2 of surveillance according to Kuiken et al. 2011). Similar to a few other Italian regions, Lombardy (North Italy, 23,861 km^2, 10 million inhabitants) has established its own wildlife health surveillance programme (Regional decree 5/12/2012). This is based on general surveillance, i.e. found dead animals (635 in 2015, 612 in 2016, 1086 in 2016 and 538 till 31/5/2018) are examined in order to identify the causes of death. Moreover, targeted surveillance is performed in some species for defined agents/diseases: wild boar (Aujeszky's Disease Virus; Swine Vesicular Disease; African Swine Fever, Classical Swine Fever, trichinellosis, tuberculosis), red deer, roe deer, chamois, mouflon, fallow deer (paratuberculosis, bluetongue, tuberculosis, Chronic Wasting Disease); red fox (rabies, trichinellosis, tuberculosis), hare (European Brown Hare Syndrome, tularemia, brucellosis), avian species (avian influenza, West Nile Virus, Usutu). Other specific agents could be also included in targeted surveillance due to increase of incidence revealed by general surveillance (i.e. Infectious Keratoconjunctivitis in chamois; distemper in red fox, Schmallenberg virus in ungulates).
The activities are coordinated by the Veterinary Services of the Regional Government. Locally veterinary authorities support hunters and rangers in field monitoring/sampling and help them in delivering samples to the IZSLER laboratories. Regional parks and rehabilitation centres actively contribute to the surveillance. Other activities include specific research projects funded by national and international bodies or by national/local stakeholders and courses/workshops for veterinarians and stakeholders.
The financial support comes from Regional government funding within the Health and Welfare Division. It is not a fixed annual amount, but it depends on needs and defined targets for each year. Being of public interest, the diagnostic analyses performed by IZSLER are covered with its budget funded by the Region itself.
The surveillance scheme established in Lombardy in 2012 is the outcome of the path aimed to coordinate the previously isolated monitoring activities already in force, to create a stable operative network and to generate useful information on the epidemiological situation in wildlife. Continuous gradual improvement is achieved every year, mainly in terms of organization and a specific attention is given to quickly set up targeted surveillance in response to field events and outbreaks. This in the light of the risk of the introduction of «exotic» diseases for which strict measures must be applied hampering the network operativity (e.g. African Swine Fever).
The achievements and lessons learned from the Lombardy experience include: 1) the flexibility of the plan in terms of content and activities and its relatively low cost; 2) the existence of a Technical Committee which evaluates the outcome of the plan each year and decides on changes and implementations; 3) the presence of a fixed and tested network based on local resources.
Recommendations to those who start a wildlife health surveillance programme to: 1) optimize the already established experiences at a local level to develop better organized national

surveillance systems; 2) have at least one specific contact (i.e. Official Veterinarian) as reference point for stakeholders in each local district; 3) to continuously make available the outcomes and recommendations coming from the activity.

National wildlife health surveillance in Spain

Author(s): López-Olvera, Jorge Ramón[1]; Cáceres, Germán[2]; Velarde, Roser[1]; Gortázar, Christian[3]

Affiliations:
[1] Wildlife Ecology & Health research group and Servei d'Ecopatologia de Fauna Salvatge, Departament de Medicina i Cirurgia Animals, Universitat Autònoma de Barcelona. Facultat de Veterinària (edifici V), Travessera dels turons s/n, Universitat Autònoma de Barcelona, Bellaterra, 08193, Barcelona, Spain.
[2] Subdirección General de Sanidad e Higiene Animal y Trazabilidad, Área de Epidemiología, Ministerio de Agricultura, Pesca y Alimentación. C/ Almagro 33, 3ª planta, 28071, Madrid, Spain.
[3] SaBio IREC, National Wildlife Research Institute (CSIC-UCLM-JCCM). Ronda de Toledo, 12, Ciudad Real, 13071, Spain.

Presenter: Jorge Ramón López Olvera (Jordi.Lopez.Olvera@uab.cat)

Current surveillance level (based on criteria presented in Kuiken et al., 2011): Level 2

Spain has a **level 2** (Kuiken et al. 2011) national wildlife disease surveillance (WDS) programme called "Plan Nacional de Vigilancia Sanitaria en Fauna Silvestre (PVSFS - https://www.mapama.gob.es/es/ganaderia/temas/sanidad-animal-higiene-ganadera/pvfs2018_tcm30-437517.pdf) that includes targeted and general wildlife disease surveillance in all relevant taxa. Specific targeted programmes exist for avian diseases (West Nile, avian influenza), wild boar and pig diseases (Aujeszky's disease, classical and African swine fever), diseases under coordinated surveillance with the Ministry of Health (rabies, trichinellosis, hydatid disease) and recently tuberculosis.
The PVSFS is coordinated by the Ministry of Agriculture and carried out on the ground by 17 regional competent authorities. Activities within the PVSFS are carried out either by national and regional government staff and laboratories including regional official laboratories and national reference laboratories represented by the laboratory of Santa Fé (Granada) and Algete (Madrid). In some regions, part of the programme takes place with the collaboration of universities, research institutes, hunter associations and wildlife rehabilitation centers (WRCs). The organizations involved vary among regions.
Most wildlife disease surveillance is funded by national and regional government budgets. Additional activity carried out by universities, research institutes and WRCs may be both national/regional government funded or funded through specific projects and other sources.
Several Spanish regions started their wildlife disease surveillance activities in the 1990s. At the national level, targeted surveillance programmes for selected diseases (as listed above) were already in place in those years. In 2003 the national PVSFS was set up and progressively coordinated with the already running regional programmes and with the targeted national programmes for selected diseases. In 2017 the PVSFS was adapted to meet the requirements of the action plan on wildlife tuberculosis PATUBES (https://www.mapama.gob.es/es/ganaderia/temas/sanidad-animal-higiene-ganadera/patubes2017_3_tcm30-378321.pdf).
The current scheme has effectively managed to coordinate wildlife disease sampling and data collection in Spain, mostly regarding targeted surveillance, integrating pre-existing national and regional programmes. However, protocols need further harmonization, and the PSVFS would benefit from a broader scope and larger input from general surveillance, mostly through

networking with universities, research institutes, WRCs and other groups linked to wildlife such as hunters, environmental agencies and others.
Wildlife diseases have no borders; therefore, regional and national schemes need to be fully coordinated and harmonized at a national level. Current data collection on wildlife diseases needs also to become better integrated with wildlife population monitoring in order to move from basic and specific WDS to modern integrated monitoring schemes. NGOs including both hunters and conservationists should be involved in these schemes to maximize the chances of early disease detection increasing the opportunities for efficient and timely intervention. Finally, intervention strategies for relevant wildlife diseases should be drafted (e.g. PATUBES).
The Spanish experience suggests the possibility of progressively moving from small, regional and specific programmes (regional schemes; targeted surveillance for a few key diseases) to broader programmes (national, general, integrated WDS). It also shows that early methodological harmonization and coordination with the main stakeholders through meetings and networking help in generating efficient WDS schemes.

National wildlife health surveillance in Switzerland

Author(s): Ryser-Degiorgis, Marie-Pierre; Segner, Helmut

Affiliations:
Centre for Fish and Wildlife Health, Vetsuisse Faculty, University of Bern, Switzerland

Presenter: Marie-Pierre Ryser (marie-pierre.ryser@vetsuisse.unibe.ch)

Current surveillance level (based on criteria presented in Kuiken et al., 2011): Level 3

National issues related to animal health are under the responsibility of the Federal Food Safety and Veterinary Office (FSVO) but as concerns free-ranging wildlife (understood as wild animals other than fish and invertebrate aquatic organisms), the Federal Office of Environment (FOEN) plays a major role because the Swiss Ordinance on Hunting and Protection of Free-Living Mammals and Birds stipulates that the FOEN shall support investigations into diseases of wildlife.
General wildlife disease surveillance activities have been conducted at least since the 1940s, and targeted surveillance has also existed for a long time (rabies). A national general surveillance programme was initiated in 1962, when a mandate of the FOEN was attributed to the former Division for Poultry, Game and Fish Diseases of the University of Bern. This Division was founded in 1956 within the Institute of Veterinary Bacteriology and later moved to the Institute of Animal Pathology. It was renamed the Centre for Fish and Wildlife Health (FIWI) in January 1998. Starting from 2005, the tasks of the FIWI were redefined in a cooperation contract with the FOEN (health issues relevant to wildlife management and conservation) and FSVO (role of wildlife as a reservoir of pathogens relevant to domestic animals and humans) and the FIWI was declared the national competence centre for wildlife and fish diseases. In January 2014, the FIWI became an independent institute [1]. Since then, it has been officially recognized as a component of the national early warning strategy of the FSVO and has also received additional support by the FOEN towards increased competencies in wildlife immobilisation and health supervision of translocations.
General wildlife health surveillance at the FIWI concerns primarily mid-sized to large mammals and birds but it has progressively extended to more taxa (e.g. garden birds, bats, amphibians) and the entire country.
Targeted surveillance programmes for notifiable diseases (e.g. bovine tuberculosis, African Swine Fever) are coordinated by the FSVO and cantonal veterinary authorities, with reference

laboratories performing the analyses and the FIWI acting as a consultant. The FIWI performs cross-sectional studies and monitors selected non-notifiable diseases (e.g. sarcoptic mange). Funding for the FIWI is provided by the University of Bern, the FSVO, the FOEN and other funding sources (research).
Strengths and key achievements of the FIWI include its development from a small pathology diagnostic unit to a more comprehensive national programme (disease ecology). Diseases and pathogens not previously known to occur in Switzerland or elsewhere have been described. There has been increasing recognition by the government, the University and wildlife biologists of the value of a unit dedicated to wildlife health. A wildlife biobank has been established.
The main weaknesses of the programme at the FIWI consist in the impossibility to increase capacities due to infrastructural and financial limitations.
The main barriers and challenges include the high personnel turnover associated with the type of allocated funds, the maintenance of sufficient funding, the development/maintenance of relevant expertise, and the fulfilment of the requirements of both the University and the governmental organisations.
The next steps include the selection of a new FIWI director (the current one retiring in 2020) and the negotiation of new contracts with the federal authorities. A stabilisation of the core positions occupied by experienced personnel is desirable.

1. Ryser-Degiorgis M.-P., Segner H. 2015. National competence centre for wildlife diseases in Switzerland: Mandate, development and current strategies. Schweiz. Arch. Tierheilk. 157: 255-266.

The Dutch Wildlife Health Centre

Author(s): Rijks, Jolianne M[1]; Gröne, Andrea[1,2]

Affiliation(s):
[1] Dutch Wildlife Health Centre, Utrecht University, Utrecht, 3584 CL, The Netherlands.
[2] Department of Pathobiology, Utrecht University, Utrecht, 3584 CL, The Netherlands.

Presenter: Marja Kik, for Jolianne Rijks (j.m.rijks@uu.nl)

Current surveillance level (based on criteria presented in Kuiken et al., 2011): Level 3

In 2002, the Dutch Wildlife Health Centre (DWHC) was set up to fill the void of general wildlife disease surveillance in the Netherlands. Located at the Erasmus MC in Rotterdam during start-up (2002-2007), it is now embedded in the Faculty of Veterinary Medicine in Utrecht (2008-to date). Its baseline activities are currently financed by government (Ministry of Agriculture, Nature, and Food Quality; Ministry of Health, Welfare, and Sport) and university (Faculty of Veterinary Medicine, Utrecht University). The Centre has a coordinating role and functions thorough collaboration with other institutes. On its baseline budget, it performs general wildlife disease surveillance through post-mortem investigation of cases of unusual morbidity/mortality in wildlife. Case history, gross necropsy and histology determine the further diagnostic tests to be performed, for which collaborating diagnostic institutes are approached. Reportable diseases are directly notified to the relevant authorities and wildlife signals relevant to public health are shared each month in the Signalling Forum Zoonoses (SoZ), a platform of key animal and public health institutes. Findings may instigate further investigations for proper understanding of on-going events. The form in which this is done is generally a research project, executed in collaboration with other institutes and often led by them, and for which extra funding must be raised.
Targeted wildlife disease surveillance is performed by multiple organisations in the Netherlands. On its baseline budget, DWHC is only involved in AIV surveillance in wild birds. All organisations performing targeted surveillance inform DWHC of the results on request, so

that DWHC can compile the data for the bi-annual OIE listed and non-listed wildlife disease reports.
Networking and material and information sharing are essential components for a national wildlife health centre to function. In 2008, the focus shifted from large outbreaks to unusual mortality, and substantial effort was put into engaging the field to report and submit such cases, and into proper sample- and data-banking, for which cooperation with a larger and a more experienced wildlife health organisation (the Canadian Wildlife Health Cooperative) has been beneficial. Results are reported back to submitters via individual case reports, website (https://www.dwhc.nl), a digital newsletter, an annual report, and training sessions. The obtained scientific knowledge is shared via peer-reviewed publications and used in teaching at the Faculty of Veterinary Medicine.
Throughout the years, the functioning of the centre was improved by applying the recommendations of an external audit (2012), the weekly discussion of cases by the team, the assignment of theme leaders for research, and the participation in international wildlife health networks (EWDA, ASF-STOP). DWHC has had notable successes, such as the detection of four important diseases previously not known to occur in the Netherlands. These were mostly zoonoses and led to public health actions. However, documenting disease occurrence in wildlife is just part of the role of a national wildlife health centre, and DWHC still has a way to go to mature. Funding remains insecure and is not at the required level. A second external audit is planned in late 2018.

National wildlife disease surveillance in Great Britain

Author(s): Duff, J. Paul[1]; Irvine, Richard M.; Lawson, Becki[2]

Affiliations:
[1]Animal and Plant Health Agency, Diseases of Wildlife Scheme (APHA DoWS)
[2]Institute of Zoology, Zoological Society of London

Presenters: Paul Duff (Paul.Duff@apha.gsi.gov.uk) and Becki Lawson (becki.lawson@ioz.ac.uk)

Current surveillance level (based on criteria presented in Kuiken et al., 2011): Level 3

A general (i.e. scanning) surveillance scheme for wildlife diseases was set up in England and Wales in 1998. This ran in parallel and conformed with new livestock species general surveillance projects introduced at the same time. These schemes incorporated coverage of Scotland, conducted by the Scottish Agricultural College, utilising the same Veterinary Investigation Disease Analysis (VIDA) diagnostic framework for diseases of both livestock and wildlife. From 1998 to 2005, the Diseases of Wildlife Scheme (DoWS) considerably increased in size and budget, partly in response to the government's need for surveillance for West Nile and Avian Influenza (AI) viruses in wild bird species. After several years of consultation, the England Wildlife Health Strategy was published in 2009. One of the provisions of this strategy was that national wildlife disease surveillance would subsequently be undertaken in Great Britain (GB) by a partnership of organisations under the leadership of the APHA DoWS. This GB Wildlife Disease Surveillance Partnership (GBWDSP) was formed in 2009 and comprises six other partner organisations of government agencies, non-government organisations and academia, comprising the Scottish Agricultural College Consulting Veterinary Services; Garden Wildlife Health, Institute of Zoology; Centre for Environment, Fisheries and Aquaculture; Wildfowl and Wetlands Trust; Natural England; and Forestry Commission England. General surveillance activities are conducted across all countries of Great Britain (i.e. England, Scotland and Wales) and include screening for both infectious and non-infectious disease. All vertebrate species of wildlife are covered: mammals, birds, reptiles, amphibians, fish. Cetaceans, marine turtles and large-bodied sharks are covered by a

separate project organised by one of the Partner organisations, funded by Department for Environment, Farming and Rural Affairs (Defra) Biodiversity. In addition, targeted surveillance programmes for notifiable diseases also exist, led by APHA, working with GBWDSP Partner organisations, for example, bovine tuberculosis in wild mammals, AI in wild birds. The APHA DoWS is government funded by Defra and the Welsh and Scottish Governments. GBWDSP partners have other government and non-government sources of funding, but all receive some financial support from Defra.
A major strength of Partnership working is how it has enabled provision of enhanced wildlife disease surveillance. The GBWDSP (Ref 1.) has a broad interest in identification of wildlife diseases relevant to wildlife health and biodiversity, livestock and public health. Production of open access quarterly reports (Ref 2.) since 2010 has facilitated information sharing amongst communities with an interest in wildlife health. Adoption of citizen science schemes for certain taxa has enhanced the efficiency and scale of surveillance. Integration of surveillance with population monitoring for some species has allowed quantification of disease impact on biodiversity. The weaknesses of the current scheme include variation in carcase collection and delivery capability for different wildlife species, variable surveillance effort across taxa and by region, and limitations relating to toxicological testing. Challenges include ensuring sufficient funding coupled with prioritising surveillance effort based on finite resource availability and developing and maintaining relevant veterinary and other scientific expertise. Also, to ensure the work is relevant to government needs and requirements and to communicate the importance of disease threats to biodiversity and 'One Health'. Future goals are to improve co-ordination of information both within Great Britain and with similar schemes elsewhere in Europe and globally and to further develop horizon scanning procedures.

Key steps in the development include 1) recognition that national wildlife disease surveillance is required (2) drawing up of a national wildlife disease strategy to cover these requirements (3) forming a network of organisations to deliver the needs of the strategy in terms of all species, all diseases and all regions of the country.

Refs

1. Wildlife disease surveillance Gateway http://apha.defra.gov.uk/vet-gateway/surveillance/seg/wildlife.htm
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National wildlife health surveillance in Bulgaria

Author(s): Mladenov, Daniel[1,2]

Affiliation(s):
[1] Fungi Plants Ltd.
[2] Faculty of Veterinary Medicine, Trakia University, Stara Zagora, Bulgaria

Presenter: Daniel Mladenov (dr.danmladenov@gmail.com)

Bulgaria is an outside border of Europe with large biological diversity of wild animals. In recent years due to climate change and village depopulation there is an increasing number of wildlife populations, disease reservoirs, zoonosis and zooanthroponosis. A detailed local wildlife health surveillance network database is not fully developed and available.

Partial terrain studies on infectious and parasitic diseases have been performed in order to protect the domestic and wild animals from various pathogenic agents. Several local and

international organizations are working for protection of wildlife without official networking or connection between each other. A well-developed local and international systematic database will be very useful to all those willing to participate in wildlife conservation activities.

National wildlife health surveillance in Germany

Author(s): Wibbelt, Gudrun[1]; Staubach, Christoph[2]

Affiliation(s):
[1] Leibniz Institute for Zoo and Wildlife Research, Berlin, Germany.
[2] Friedrich-Loeffler-Institut, Greifswald - Insel Riems, Germany.

Presenter: Gudrun Wibbelt (wibbelt@izw-berlin.de)

Current surveillance level (based on criteria presented in Kuiken et al., 2011): Level 1

The country is subdivided into 16 federal states, each being responsible for regional disease surveillance programmes concerning notifiable and non-notifiable diseases. These may slightly differ in terms of targeted pathogens and/or wildlife species depending on the local situation. However, these programmes are run in accordance with legislative requirements, partly co-financed by EU and supervised by the Friedrich-Loeffler-Institut, the federal research institute for animal health, under the administration of the federal ministry of food, agriculture and consumer protection. At the level of each federal state, depending on geographical size and wildlife numbers estimated by the regional hunting bag, different wildlife species are examined annually for specific pathogens in all federal states, for example with African Swine Fever advancing westerly, Germany holds a particular critical position in the surveillance of wild boar. These animals are also investigated for Classical Swine Fever and *Trichinella spiralis*. Foxes, raccoons, martens, raccoon dogs are examined for rabies in all federal states, while specific wild bird populations are targeted for avian influenza investigations depending on their regional occurrence. Specific regional investigations concern tuberculosis in deer, for example. Some federal states also include investigations on *Echinococcus* sp. or Aujeszky's disease based on their own decision.
Beside these governmental organized programmes there are a number of research projects targeting varying wildlife species and pathogens which are organized by university groups or extramural research institutes. Some of these projects cover many areas of the country, most are limited to a specific region.
While notifiable disease surveillance is covered – in regard to sampling and financially –there is no system which allows an overview at a national level of the results of different additional investigations, neither pathologic investigation of wildlife found dead and submitted to regional veterinary investigation centres nor the outcome of the different research projects except for data published in (inter-)national journals.
A first important move towards an improved knowledge about investigations already happening would be an open database, where lab entries of pathogen investigations on wildlife species could easily be shared. Besides the fact, that the technical difficulties will be rather challenging, the political framework of federal states might pose the biggest obstacle to share existing data and moreover, to develop a national strategy for wildlife surveillance. However, if all parties involved in wildlife research and/or pathogen detection would be willing to participate in such discussions aiming to reach a mutual agreement on strategic plans even just based on each federal state, this would be the first step needed to proceed towards national wildlife health surveillance.

National wildlife health surveillance programmes in Greece

Author(s): Valiakos, George[1]; Giannakopoulos Alexios[1]; Birtsas, Periklis[2]; Drougas, Aimilia[3]; Tsokana, Constantina[1]; Chatzopoulos, Dimitrios[1]; Sokos, Christos[1]; Spyrou, Vassiliki[2]; Sofia, Marina[1]; Papadopoulos, Elias[4]; Papaspyropoulos, Konstantinos[1]; Korou, Laskarina-Maria[5]; Komnenou, Anastasia[4]; Billinis, Charalambos[1]

Affiliation(s):
[1] Faculty of Veterinary Medicine, University of Thessaly, Karditsa, Greece
[2] University of Applied Sciences of Thessaly, Greece
[3] ARION- Cetacean Rescue and Rehabilitation Research Center, Nea Moudania, Greece
[4] Faculty of Veterinary Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece
[5] Veterinary Services, Ministry of Rural Development and Food, Athens, Greece

Presenters: Charalambos Billinis (billinis@vet.uth.gr) and Anastasia Komnenou (natakomn@vet.auth.gr)

Current surveillance level (based on criteria presented in Kuiken et al., 2011): Level 1

National targeted surveillance programmes are conducted by the Veterinary Services of the Ministry of Rural Development and Food and implemented by the regional Veterinary Authorities with the assistance of forestry authorities and hunters for detection of West Nile virus (WNV) and Avian influenza Virus (AIV) in wild birds; Rabies in wild animals (mainly red foxes) found dead or suspected of having rabies; and African swine fever (ASFV) in wild boars. General and targeted surveillance programmes are conducted in UTH and AUTH for bacterial, viral and parasitic pathogens in wildlife (European brown hares, wild boars, wild deer, grey wolves, brown bears, wild birds, marine mammals, reptiles) for detection of pathogens including *Leishmania* spp, *Toxoplasma. gondii*, *Neospora caninum*, *Brucella suis*, *Coxiella burnettii*, *Bartonella* spp, European Brown Hare Syndrome Virus, Porcine Circovirus-2, Porcine Reproductive and Respiratory Syndrome Virus, ADV, Avian Influenza Virus, West Nile Virus (WNV), Hepatitis E Virus, *Actinobacillus pleuropneumoniae*, *Mycoplasma hyopneumoniae*, *Mycobacterium bovis*, *Salmonella* spp., *Trichinella* spp., Morbillivirus, *Dirofilaria*, *Thelazia* spp, *Uncinaria* spp etc.
Various types of organisations co-ordinate these schemes and are involved; Ministry of Rural Development and Food, Veterinary Faculties of UTH and AUTH, Forest authorities, Hunting organizations, Non- governmental organizations.
The national ASFV and WNV surveillance programmes are funded by the state budget while in the Peloponnese region the WNV surveillance activities are also funded by the Prefecture of Peloponnese. The national programmes for AIV and Rabies virus are co-funded by the European Union (EU). The surveillance studies conducted by UTH and AUTH are funded by national and EU funds through the implementation of research programmes.
The development of national surveillance schemes usually follows outbreaks in humans, domestic or wild animals as well as the epidemiological condition in neighbouring countries, while in the case of general surveillance programmes implemented in the context of research programmes, their development is based on the earlier literature in other countries.
The strengths and key achievements of the current schemes are the detection of new pathogen strains prior to detection in humans and livestock (e.g. AIV), prior to dispersion in new areas (e.g. rabies, morbillivirus), the early pathogen detection before being established in the country (e.g. ASFV, *Thelazia* spp), the pathogen isolation from wild animals for further study (e.g. WNV in wild birds), identification of high risk areas for pathogen dispersion, notification of public authorities to implement prevention measures (e.g. WNV, Rabies) and adding knowledge on the health status and the role of wildlife in the epidemiology of important pathogens (e.g. *Leishmania* in hares and bovine tuberculosis in wild boars).
Most of these surveillance schemes are focused on diseases causing major impact on humans and domestic animals rather than wildlife. Most of these schemes are limited in

duration and in geographical coverage because of lack of continuous funding, permanent staff and legal restrictions. The next step is the establishment of a structure with permanent staff with expertise on wildlife health and ecology, regular funding and the appropriate licenses to implement all the necessary actions for general and targeted surveillance programmes.

National wildlife health surveillance in Serbia

Author(s): Savic, Sara[1]; Lupulovic, Diana[1]; Bugarski, Dejan[1]; Lazic, Sava[1]; Cirkovic, Miroslav[1]; Plavsic, Budimir [2]; Petrovic, Tamas[1]

Affiliation(s):
[1] Scientific Veterinary Institute "Novi Sad", Novi Sad, Serbia
[2] Veterinary Directorate, Ministry of Agriculture, Forestry and water Management

Presenter: Sara Savic (sara@niv.ns.ac.rs)

Current surveillance level (based on criteria presented in Kuiken et al., 2011): Level 2

Current official surveillance activities are all instructed and led by the government's Veterinary Directorate. There are targeted surveillance programmes for detection of specific pathogens, applied across the whole country, which include rabies in jackals and foxes, African and Classical swine fever in wild boar, West Nile virus in wild birds and mosquitoes, avian influenza in wild birds, and pseudorabies and trichinellosis in wild boar. These programmes are financed by the Serbian government (Veterinary Directorate, Ministry of Agriculture, Forestry and Water Management).
There is one national project coordinated by Scientific Veterinary Institute of "Novi Sad" with a main topic to study the presence of different pathogens in wildlife population. This project is applied only for the northern part of the country. These activities are financed by the government but by the Serbian Ministry of Education, Science and Technological Development) as a research activity. Within this project the following diseases have been monitored:

- For deer species – various endo parasites, Q fever, toxoplasmosis, brucellosis, leptospirosis, herpesvirus, pestivirus, hepatitis E virus, Bluetongue and Mycoplasma infections.
- For wild boar – trichinellosis, intestinal and respiratory parasites, brucellosis, leptospirosis, Aujeszky disease, swine influenza, parvovirus, circovirus, PRRS, hepatitis E virus and *Mycoplasma hyopneumoniae*
- For wild birds – various parasites, avian influenza, paramyxoviruses and West Nile
- And for bats – corona virus and orthoreoviruses

In all the afore mentioned species research on antimicrobial resistance on bacterial isolates from the intestinal tract is ongoing
There are some regional projects which deal with a certain disease which can involve wildlife, especially if a disease is zoonotic. These initiatives are usually coordinated by academic or research institutions and frequently involve wildlife just from a certain region. These projects are financed by the regional research funds as a scientific activity and include examples focused on Surveillance of *Eustrongylus* in fish and leishmaniasis and dirofilariasis in foxes and jackals.
The key strategy in development of several governmental wildlife health surveillance programmes was the need to control most dangerous zoonoses such as rabies, or to control emerging diseases such as Classical swine fever and African swine fever.
The programme on rabies was very well done, thorough, with the commitment of all parties involved (since 2011, there are two actions of oral vaccinations and monitoring of vaccination per year in spring and fall in foxes and jackals). Serbia is still not free from rabies (with just a few sylvatic cases per year) but has good control and information of the situation. The

weakness and the limiting factor is always the budget. Our Serbian Veterinary Directorate every year proposes programmes for different diseases, but there is never enough of the budget to cover all of them. Programmes that would be needed in Serbia are surveillance programmes for all flavivirus infections, live bird surveillance for Avian influenza, antimicrobial resistance in wildlife on a national level and programme for surveillance of parasitoses and antihelmintic resistance of parasites in wildlife. For the future, the Scientific Veterinary Institute "Novi Sad" plans to propose programmes for surveillance with a highlighted purpose of those programmes – not only for scientific purposes, but to become aware which pathogens are circulating among our wildlife in Serbia. The lessons learned and recommendations from the experience in Serbia would be the necessity of a One Health approach and principles on national and international level. The wildlife surveillance should be the joint strategy of many governmental, professional and research institutions and infrastructures. There should be strong institutional collaboration of medical doctors, epidemiologists, clinicians, veterinarians, entomologists, ornithologists, microbiologists, laboratory diagnosticians, hunters and hunting associations etc.

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Poster presentations:

Surveillance for the emerging parasite *Sarcocystis rileyi* in UK wildfowl using hunter harvest

Author(s): Cromie, Ruth[1]; Ellis, M.[2]; Muir, A.[3,4]; Chantry, Julian[5]; Strong, E.[1]; Blake, Damer[3]

Affiliation(s):
[1] Wildfowl & Wetlands Trust, Slimbridge, Gloucester, GL2 7BT, UK.
[2] British Association for Shooting and Conservation, Marford Mill, Rossett, Wrexham, LL12 0HL, UK.
[3] The Royal Veterinary College, Hawkshead Lane, Hertfordshire, AL9 7TA, UK.
[4] (current address) European Association of Zoos and Aquaria, Louis Schmidtlaan 64, Brussels 1040, Belgium.
[5] Veterinary Pathology Diagnostic Services, Leahurst, University of Liverpool, Neston, CH64 7TE, UK.

Presenter: Ruth Cromie (ruth.cromie@wwt.org.uk/ ruth.cromie@outlook.com)

Occasional reports from hunters of unusual findings of 'rice-like grains' in the muscles of wildfowl they had shot coincided temporally with the finding of sarcocystosis in a small number of ducks found as part of the Wildfowl & Wetlands Trust's (WWT) long term UK general surveillance programme of waterbirds found dead in or around WWT's network of wetland reserves. The striking lesions which could be readily seen by those interfacing with wildlife during hunting activities and subsequent meat preparation offered an opportunity for targeted surveillance. Existing relationships between the WWT and the British Association for Shooting and Conservation (BASC) were used to quickly establish a mechanism for reporting cases and submitting samples via an on-line reporting website 'The UK Wildfowl Sarcocystis Survey' (www.sarcocystissurvey.org.uk). This was accompanied by awareness raising via the BASC wildfowling membership and articles in relevant printed and electronic publications. The partnership was then expanded to incorporate additional expertise and resources in primarily pathology and parasitology ultimately representing a non-governmental organisation and academic partnership project. In addition to the Sarcocystis Survey website, a bespoke questionnaire survey was undertaken of BASC wildfowling members to help understand historical and contemporary experience of the infection and the wildfowl species involved.
This collaborative project has already identified the species of parasite involved, the wildfowl intermediate hosts involved, confirmed the emerging nature of the infection in UK wildfowl,

and determined some aspects of the impact of the parasite on host fitness. However, further research is needed to identify the definitive carnivore host involved and better understand the epidemiology of the disease plus its wider impacts from a conservation perspective. The latter aspect is important in terms of determining WWT's organisational health priorities and thus resourcing for the future. As is typical for wildlife disease surveillance, the project has succeeded by bringing together partners with some overlapping interests yet different and complimentary skills and using a body of people on the ground who also have an interest in the health of their quarry species. Moreover, the partnership was easy to establish due to existing relationships and networks, and individually enthusiastic partners. In terms of resources, although the molecular parasitology and pathology have involved expenditure, to date most of the resources needed have been staff time – and the input of a post graduate veterinary student facilitated the research aspects.
Using hunters for surveillance programmes of quarry species has limitations and potential biases, however the benefits of utilising a network of eyes on the ground arguably outweigh this. Given the migratory nature of the hosts involved and reports of the disease higher up the North West European flyway, there remains the possibility of using this UK model more extensively working with national and/or European hunting organisations. Despite future resource needs for such expansion, the lack of absolute need for expensive diagnostics, instead relying on visual diagnosis in the field (accepting potential problems), is a definite strength of this surveillance programme.

Post-release health surveillance in reintroduced species of British birds

Author(s): Jaffe, Jenny[1]; Januszczak, Inez[1]; Molenaar, Fieke[1]; Vaughan-Higgins, Rebecca J.[1]; Hopkins, Tim[1]; Beckmann, Katie[1]; Fountain, Kay[1]; Carter, Ian[2]; Saunders, Richard[2]; Sainsbury, Anthony W.[1]

Affiliation(s):
[1] Institute of Zoology, Zoological Society of London, Regent's Park, London, NW1 4RY, UK.
[2] Natural England, Unex House, Bourges Boulevard, Peterborough, PE1 1NG, UK

Presenter: Jenny Jaffe (jennyjaffe@yahoo.com/ DRAHS@zsl.org)

The Disease Risk Analysis and Health Surveillance for Interventions scheme (DRAHS) works in partnership with Natural England (a government body) to undertake disease risk analysis and post-release health surveillance for the Species Recovery Programme, which conserves native endangered species in England. Although the work covers invertebrate, reptile, amphibian, avian and mammal species, and includes pre-release disease risk management, this poster focuses on post-release health surveillance in bird species. The project commenced in 1989 with disease risk management for conservation translocations of the red kite (*Milvus milvus*), a species which was extinct in England and now has a population of more than three thousand breeding pairs. Although DRAHS has worked on some level of disease risk management or health surveillance in 19 species of birds, the focus of health surveillance post-release has been on red kites, cirl buntings (*Emberiza cirlus*) and corncrakes (*Crex crex*), and post-conservation intervention in hen harriers (*Circus cyaneus*).
In other taxa clinical examinations are sometimes part of health surveillance by DRAHS and have been used during the pre-release phase in birds. However, the post-release health surveillance work DRAHS carries out in bird species mainly consists of post-mortem examinations, with submissions of dead birds by non-governmental organisations (NGOs) such as the Royal Society for the Protection of Birds (RSPB) and the general public (i.e. general surveillance). If disease is detected during post-mortem examinations, then a targeted disease surveillance study is considered amongst other investigations, as was the case for lead poisoning in red kites.

Challenges include the low numbers of carcases detected and submitted during the post-release phase for corncrakes (n=0 for 2007-2018) and cirl buntings (n=15 for 2007-2012 and n=0 for 2012-2018). For red kites these numbers are higher (n=349 for 1994-2018) and for the rarer hen harrier n=19 for 2011-2018. Radio or satellite tracking devices are sometimes fitted in red kites (n=26, 7% of carcases received) and hen harriers (n=13, 68%), which can aid in detection of these birds. They are spotted by members of the public or representatives of both local NGOs (e.g. Friends of Red Kites) and national NGOs such as RSPB or Predatory Bird Monitoring Scheme. These organisations will often inform the public about and co-ordinate submissions to DRAHS. Lack of refrigeration post-mortem as well as delay in detection, submission and delivery can contribute to advanced levels of decomposition by the time DRAHS receives the carcases, which can hinder diagnosis.
Key achievements of the project include the long-term health monitoring of red kites with 320 birds examined post-mortem since 1994. This has led to a better understanding of both infectious and non-infectious disease threats to the red kite, such as lesions associated with harness-mounted radio transmitters and poisoning by exposure to lead, rodenticides and pesticides. In hen harriers, a publication showed how novel techniques were used to confirm shooting after detection of suspected ballistic fragments by radiography. Two other cases of shooting were confirmed by radiography and post-mortem examination alone.

Post-release Health Surveillance of the Hazel Dormouse (*Muscardinus avellanarius*) in England

Author(s): Januszczak, Inez[1]; Sayers, Ghislaine[2]; Bemment, Neil[2], Morris, Kate[3]; Walsh, Kat[3]; White, Ian[4]; Donald, Helen[1]; Jaffe, Jenny[1]; Sainsbury, Anthony W[1]

Affiliation(s):
[1] Disease Risk Analysis and Health Surveillance programme (DRAHS), Institute of Zoology, Zoological Society of London, Regent's Park, London, NW1 4RY, UK
[2] Paignton Zoo, Totnes Rd, Paignton, TQ4 7EU, UK
[3] Natural England, Victoria House, London Square, Guildford, GU1 1UJ, UK
[4] People's Trust for Endangered Species, 8 Battersea Park Rd, London, SW8 4BG, UK

Presenter: Inez Januszczak (inez.januszczak@hotmail.com/ DRAHS@zsl.org)

Britain's only native species of dormouse, the Hazel Dormouse (*Muscardinus avellanarius*), was once widespread in the UK and is now more restricted in range and vulnerable to local extinction. As a component of Natural England's Species Recovery Programme, hazel dormouse conservation translocations were initiated in 1992 to restore dormice to areas of England from which they had been lost and where natural re-colonisation was unlikely. 28 reintroductions have taken place to 22 different sites across 12 English counties, and more than 800 dormice have been released. Disease risk analysis was not a recommended practice when dormouse reintroduction commenced; dormice released in the 1990s had contact with exotic rodent species, and, consequently, post-release health surveillance is crucial to assessing disease threats to dormice and other native rodent species stemming from dormice conservation translocations. There is a risk that conservation translocations have been counterproductive if non-native infectious agents have been concomitantly introduced, thus it is important to assess and reduce this risk through monitoring the health of the dormice before and after release, and to monitor reintroduced populations, and to implement mitigation measures. Dormice identified for translocation are held in barrier quarantine at the Zoological Society of London and Paignton Zoo and Environmental Park for approximately three months, where they receive a health examination, are monitored for suspected alien infectious agents (such as the cestode *Rodentolepis* spp) and identified by microchip. Following release in mid-June, dormice health is monitored through checking wooden nest-boxes, previously positioned throughout the woodland release site. Sick dormice, which are rarely detected

during the post-release health surveillance, receive appropriate veterinary care and dormice found dead receive detailed pathological examination, the results of which, evaluated in the context of population monitoring, inform future disease risk management and post-release health surveillance. For example, following detection of an adenovirus in a dormouse which died in the mid-2000s in captivity, archive samples of intestinal tissue from dormice with signs of haemorrhagic enteritis on post-mortem examination were examined by PCR and four (one free-living, three captive) of 15 hazel dormice were positive for adenovirus. Although confirmation of the adenovirus strain is pending, management measures, such as efforts to reduce stress in captivity, in transit and at reintroduction sites, have been suggested in order to minimize potential effects of this adenovirus, known in other rodent species to be more likely to cause disease in stressed animals. This type of pathological investigation can provide information on the spatial and temporal distribution, and presence /absence, of virus (and other infectious agents), and gain some information on the association between disease and infectious agent, in captive and free-living populations.

Health Surveillance Programme for Cervids and Musk ox in Norway, 1998-2018

Author(s): Madslien, Knut[1]; Våge, Jørn[1]; das Neves, Carlos[1]; Handeland, Kjell[1]; Vikøren, Turid[1]

Affiliation(s):
Norwegian Veterinary Institute (NVI), Oslo, Norway

Presenter: Knut Madslien (knut.madslien@vetinst.no)

Norwegian Cervids have traditionally been considered to be healthy, especially compared to Cervids in southern Europe, partly due harsh winters in the northern hemisphere which are believed to impede the survival and development of infectious diseases. This fortunate situation was changed drastically by the recent detection of Chronic Wasting Disease (CWD) in Norway, and may be further exacerbated by global warming.
Around 1995, after decades of increase in Cervid population densities, the Norwegian veterinary- and wildlife management authorities realized the need for access to systematic health data from Cervids. Hence, the Health Surveillance Programme for Cervids (HOP) was initiated in 1998, including musk ox (*Ovibos moschatus*) in 2004, and continues indefinitely.
HOP monitors the occurrence of diseases in moose (*Alces alces*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), wild reindeer (*Rangifer tarandus*) and musk ox by systematic surveys of diagnostic samples collected by hunters, post-mortem examinations and by analysing population data from the national Cervid Register. The areas of focus are non-infectious diseases (e.g. ergotism, yew (*Taxus*) intoxication), the transfer of infectious diseases between Cervids and livestock, as well as the significance of Cervids as reservoirs for infections that can be transmitted to humans (zoonosis). Collection and storage of serum samples from captured Cervids is also an important part of the HOP. In the future there will be increased focus on targeted surveillance, based on risk assessments.
The HOP covers the whole of mainland Norway and Svalbard and is operated by the Norwegian Veterinary Institute in Oslo. HOP is funded by the Norwegian Environment Agency and these funds, about 350 000 EUR/year, derive from compulsory fees for hunting permits.
HOP has contributed to the publication of about 80 scientific papers about Cervid health during the last two decades and CWD was actually detected in a wild reindeer in Norway in 2016 through the activity of HOP. Twenty years of operation have proven the HOPs important role as knowledge provider for Cervid health and there are specific plans to extend the programme to include more wildlife species in Norway in the future.

Regional marine mammal's *w*ildlife health surveillance in Canary Islands, Spain

Author(s): Sierra, Eva[1]; Arbelo, Manuel[1]; Felipe-Jiménez, Idaira[1]; De la Fuente, Jesús[1]; Puig-Lozano[1], Raquel; Câmara, Nakita[1]; Arregui, Marina[1]; Ramírez, Tania[1]; Bernaldo de Quirós, Yara[1]; Suárez-Santana, Cristian[1]; García-Álvarez, Natalia[1]; Caballero, María José[1]; Quesada-Canales, Óscar[1]; Andrada, Marisa[1]; Espinosa de los Monteros, Antonio[1]; Herráez, Pedro[1]; Fernández, Antonio[1].

Affiliation(s):

[1] Centro Atlántico de Investigación de Cetáceos. Instituto Universitario de Sanidad Animal y Seguridad Alimentaria. Universidad de Las Palmas de Gran Canaria. Trasmontaña S/N, 35416, Arucas, Las Palmas, Spain.

Presenter: Eva Sierra (eva.sierra@ulpgc.es)

There is a growing concern about the impact that infectious diseases can produce on animal health and conservation in wildlife populations. The Canary Islands have a geographically strategic position, since they are located between three continents: Europe, America, and Africa. Thus, regular monitoring for the presence of pathogens in free-ranging cetaceans in this particular area of the Central Atlantic is essential to detect the occurrence and distribution of infectious diseases and to predict novel worldwide epidemics. The appearance, disappearance, and re-emergence of pathogens in cetaceans, with both epidemic potential and high mortality rates have threatened the global health status of cetaceans for decades. These include viruses (Cetacean morbillivirus, herpesviruses); bacteria (*Brucella* spp., *Erysipelothrix rhusiopathiae*, *Photobacterium damselae*, *Bartonella henselae*, *Listeria monocytogenes*); and protozoan (*Toxoplasma gondii*), among others. Both retrospective and prospective screening for the presence of these pathogens is performed on banked tissue from stranded cetaceans in the Canary Islands (general surveillance), since 1996 to date. All the major organs and lesions are routinely collected during the necropsy, which are kept in two different formats: fixed in a solution of 4% neutral buffered formalin for histological and immunohistochemical analysis; and stored frozen at -80 ºC for molecular microbiology. The first key stage in the development of our marine mammals' wildlife health surveillance scheme is a standardised protocol carried out with the Regional Animal Health and Environmental department. Based on a network which involved all the islands and with a task force team to work in the field and laboratories in the IUSA. This centre is included in an Institute of Animal Health (www.iusa.eu) which receives all dead wild animals for necropsy and further laboratory analysis. As this centre is linked to the Regional Animal Health Department, it also collaborates as a National point for Animal Health Surveillance. Organisations co-ordinating and involved in this scheme are the Regional Government, University Centre (IUSA) and Cetacean Centre. The second key point was the establishment of a molecular diagnostic laboratory in our facility. Financial support is provided by the University, Regional Government, Islands governments, and private and public wildlife organizations. Our main strengths are the effective network, task force group, labs and tissue bank. Every animal found in different islands is recorded, necropsied and or/and sampled. The weakness is that we need to be as active and effective with other wildlife species (e.g. avian species) as we are with cetaceans. We also would need more financial support from the National government as well as a more precise recognition. But this is under way. In addition, the national network must be officially established, especially due to climate change and its effects on vector- and food- and water-borne diseases. In this way, the Canary Islands are the door of Southern Europe, and they can be a potential source of disease introduction to continental Europe. We are collecting new data regarding pathogens, especially linked to changes in the oceanic environment. We need long term projects as we do not have previous reference. However, since climate change is already occurring, we need to focus our science on its effects on animal health.

Large carnivore health and disease surveillance in Sweden

Authors: Stavenow, Jasmine[1]; Ågren, Erik[1]

Affiliations:
[1] Dept. of Pathology and Wildlife Diseases, National Veterinary Institute (SVA), Uppsala, Sweden

Presenter: Jasmine Stavenow (jasmine.stavenow@sva.se)

In Sweden, every found dead or culled individual of the four large carnivores; Brown bear, Lynx, Wolf, and Wolverine are sent to the National Veterinary Institute (SVA) for sampling and necropsy, as detailed in the Environmental Protection Agency (EPA)regulation NFS 2002:18, §42. These protected species have been intensely monitored since their near extinction in the 20th century. It is the EPA that has the national management responsibility and finances the work on health and disease surveillance of large carnivores at SVA. Parts of the management are delegated to the regional county administrations, such as decisions on culling of nuisance animals and licensed hunting regulations. When large carnivores are found dead the cause of death includes disease, accident, poaching, trauma or road- or railroad collision, where the latter are a major cause of large carnivore mortality. Carcasses are collected and transported to SVA by the county administration staff or the police in case of traffic accidents, unknown causes of death or forensic cases. Freeze-room facilities to store carcasses until transport are available in most counties, and large leak-proof containers are used for transportation by truck to SVA. SVA has examined and sampled carcasses of large carnivores since 1977. For each animal, biological and necropsy data is logged, and tissue samples are stored in a minus 20° Celsius biobank. The biobank contains almost 50 000 tissue samples from roughly 11 000 large carnivores. Data from the necropsy at SVA together with field information and inventory results from governmental agencies, genetic data from universities, observations from citizens and more - are stored together in a database for large carnivores, Rovbase. This national collaboration results in well documented large carnivore populations. There is also a close cooperation with the Museum of Natural History, as selected parts of the carcasses and tissue samples are sent to their collections. Their biobank is a resource for studies focused on environmental toxins and pollutants. The SVA biobank samples are regularly in demand for studies by national and international researchers, and we have regular collaborations with Scandinavian research groups dedicated to studies of ecology and biology of these species, such as the Scandinavian brown bear research project and Scandulv. Some sampling has been for genetic studies, such as inbreeding in wolves, and population structures of the two post-glacial brown bear populations. Poaching is a big concern, especially regarding wolves, but only few of the estimated total number of illegally killed carnivores are found and documented by SVA. Documentation of health and diseases at necropsy can be used together with results from genetic studies to determine possible hereditable associations, as well as assist in management decisions in these highly monitored species that are of political, media, and public concern and scrutiny.

Summary of panel discussion; how to get started?

Below table summarizes the key challenges that participants encountered in setting up a WHS programme in their country, paired with recommendations on how one might deal with these challenges. Good luck!

	Challenge	Recommendation
Motivation	It is an uphill struggle to start a WHS programme.	Have faith in your goal and work hard.
	People fail to understand the importance of WHS.	Keep on "ringing the bell" about the importance of wildlife health, also in terms of "One Health"; be patient, negotiate, identify and engage with key decision-making stakeholders, foster good contacts with range of stakeholders. Share case study examples where results from WHS have had beneficial impact to public/livestock/wildlife health.
National collaboration	Existing WHS activities are operating in isolation, are using different methods, do not share data, involve different disciplines, work in different regions with different rules, and have different goals.	Bring people together at the national level, e.g. organize meetings, workshops, conferences, set up a national wildlife health society. Convince people of the value of harmonizing methods, sharing data, and building a central database: wildlife diseases do not respect borders. Convince people that even if their goals and motivations are different (e.g. wildlife rehabilitation and hunting), it is worthwhile to work together and learn from each other in such a small field. Once they are convinced: - form a collaborative network with organisations and individuals in wildlife health; - develop standard examination protocols, case and incident definitions, appropriate sampling protocols, sample archiving and data-sharing agreements among collaborating organisations; - write a blueprint for a national WHS programme, as a goal on the horizon.
	Activities are usually focused on public health and/or domestic	Convince people that the One Health approach, accounting for health of the environment, of wild and domestic animals,

	Challenge	Recommendation
	animal health, and wildlife health and wildlife conservation is neglected.	and of humans, is important to be successful in WHS, since the problems are often interconnected, and the people involved need each other.
Funding and staff	Any government funding is often too little, only short-term, and comes from one department (Agriculture or Public Health).	Convince the government that WHS is an integral part of national disease surveillance, and that departments involved in environment, agriculture, and public health should co-fund WHS, according to the One Health approach. Make your programme indispensable to government as a source of information and expertise on wildlife health.
	Some universities do not recognize the value of WHS.	Convince the university that a WHS programme provides an opportunity to attract and educate students, to do research, and to serve society, and that they should co-fund this activity.
	It is difficult to get research funding.	One strength of a WHS programme is that it often is the source of information on wildlife disease and the source of wildlife samples. Use that strength to try to get funding for wildlife health research that builds on the basis of, and meshes with, your WHS programme, so that research and surveillance can benefit each other. Keep abreast of new funding streams. Recognize that collaborative proposals (often including academic partners) may be attractive to funders.
	It is difficult to build up and maintain expertise in staff	Convince government and university funders that it takes time to build up knowledge of wildlife health in a country, and that long-term, secure funding is essential to train and maintain wildlife health experts.
Feedback and translation	It is difficult to keep field network and stakeholders satisfied in the long term	Establish specific people to act as regional contact points for stakeholders. Manage expectations about what your WHS programme can achieve. Regularly make the outcomes and recommendations from your activity available to the general public (e.g. website, quarterly newsletter, open access publications and social media).
	It is difficult to translate the results of	Encourage (or perform) collection of data on distribution and density of wildlife, so that

	Challenge	Recommendation
	WHS into actual wildlife health management.	WHS data can be placed in the perspective of wildlife population data, which is crucial for wildlife management. Establish links to governmental and non-governmental organisations in relevant areas (e.g. veterinary health, public health, conservation, hunting, non-native/invasive species management) to identify mutual benefits/overlaps and maximize translation to management and policy.