Research Networking Programme – EURAPMON

Research and monitoring *for* and *with* raptors in Europe

FINAL EURAPMON CONFERENCE REPORT

Sierra Espuña Natural Park, The Hotel Monasterio of Santa Eulalia, Aledo (Murcia district), SPAIN

Monday 9th to Wednesday 11th March 2015

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ESF Remit

The European Science Foundation (ESF) was established in 1974 to create a common European platform for cross-border cooperation in all aspects of scientific research. With its emphasis on a multidisciplinary and pan-European approach, the Foundation provides the leadership necessary to open new frontiers in European science.

Its activities include providing science policy advice (Science Strategy); stimulating co-operation between researchers and organisations to explore new directions (Science Synergy); and the administration of externally funded programmes (Science Management). These take place in the following areas: Physical and engineering sciences; Medical sciences; Life, earth and environmental sciences; Humanities; Social sciences; Polar; Marine; Space; Radio astronomy frequencies; Nuclear physics.

Headquartered in Strasbourg with offices in Brussels, the ESF's membership comprises 75 national funding agencies, research performing agencies and academies from 30 European nations. The Foundation's independence allows the ESF to objectively represent the priorities of all these members.

Foreword

With the Final Conference, the Research Networking Programme EURAPMON (Research and monitoring *for* and *with* raptor in Europe) of European Science Foundation is concluding with its activities and will end in May 2015. The aim of the conference was to widen the established international network, which will contribute in the future to the integrated and continental scale research and monitoring of raptors for implementation of transborder benefits to raptor populations, biodiversity and ecosystem conservation, and human health. EURAPMON core team consisted of two Chairs, two External Coordinators, two Co-Chairs, 15 Steering Committee members and 6 Advisory Experts who successfully built a pan-European network, and enabled raptor research and monitoring to be recognized as an important international monitoring scheme in gaining biodiversity and environment conservation and human health. The Final EURAPMON Conference was the last test for that, and with 80 participants from 26 countries the event reached truly pan-European dimensions.

I would like to express my gratitude to all who have taken an active part at the conference as workshop leaders or invited speakers, but most of all to Guy Duke, Dorte Herzke, Richard Shore, Igor Eulaers, Pertti Saurola, Alessandro Andreotti, Paola Movalli, Dan Osborn, Chris Wernham, Mark Wilson, David Noble, András Kovács and Staffan Roos. This was now already the fourth EURAPMON meeting organized by the excellent *with* raptor research and monitoring group at University of Murcia represented by Antonio J. Garcia Fernandez, Emma Martinez Lopez, Pilar Gomez Ramirez and Inés Corominas. At last but not least I would like to thank to EURAPMON Coordinator Irena Bertoncelj for her successful dealing with complicated coordination of different EURAPMON activities running side by side with no hesitation to put also some of her free time into it so that everything was accomplished well and on time.

All this would not be possible without support of national funding bodies and European Science Foundation that supported our efforts during five years of EURAPMON, from May 2010 to May 2015. My special thanks go to Dr. Paola Campus, ESF Science Officer, who has joined us in 2012 and helped us greatly in sailing across different obstacles to our final goal.

We are now at the end of the current ESF RNP EURAPMON. There are numerous people who have contributed to it, but I would like to point that without initial enthusiasm now already 10 years ago there would be no EURAPMON, and this is thanks to Guy Duke and Paola Movalli. We are finishing the program, but Final Conference with enormous enthusiasm and input of the participants gave enough ideas for future life of EURAPMON and project applications that would enable it. Thank you very much to all!

Al Vrezec
EURAPMON Chair

Preface and acknowledgments

The EURAPMON Final Conference, the concluding event of ESF funded Research Networking Programme, brought together raptor researchers, experts and managers, as well as students with interests in raptor research, monitoring and conservation. The conference combined plenary talks given by leading raptor researchers, presentations of EURAPMON results, four workshops, poster presentations and a fieldtrip. The conference aimed to improve transnational cooperation in raptor research and monitoring through sharing of knowledge and experience and consider challenges and opportunities for the future beyond EURAPMON.

This report combines a summary report to ESF and presents an overview of results of each of the five workshop sessions, the main discussion topics and assessment of the results and impact of the event on the future directions of the field.

First of all I would like to thank the conference Scientific Committee for their participation at numerous skype meetings during which conference programme was shaped and harmonized. Of course the conference could not happen without very hard work of representatives of University of Murcia Dr Emma Martínez López, Professor Antonio Garcia-Fernandez, Dr Pilar Gómez-Ramírez and Inés Corominas – thank you for excellent organization of the conference. The conference also could not take place without the financial contribution of ESF. Special thanks also to all the invited speakers for their contribution and to all participants who presented their posters. And last but not least thanks to all the participants for sharing their knowledge and ideas and thus contributing to the aims of EURAPMON.

Irena Bertoncelj
EURAPMON Coordinator

Summary report to ESF

SUMMARY

This Final EURAPMON Conference provided an opportunity to share the outcomes and achievements of EURAPMON, an opportunity to build new connections and ideas for the future, and an opportunity to consider what next for EURAPMON.

The **Opening session** provided a historical review of the development of the programme, its aims, results and achievements. Three invited **plenary speakers** presented overview of issues related to raptor research and monitoring including role of raptors as bioindicators, results of long-term monitoring of White-tailed Eagle in Sweden and past, current and future perspectives of contaminant monitoring using raptors. Participants of the conference presented over 20 posters which gave an opportunity especially to younger researcher and students to present their work.

Five **Working Sessions** were organized as workshops with emphasis on discussion and exchange of knowledge. The first session addressed focused on the needs of EU level users of raptor research and monitoring data and thus addressed EURAPMON work package (WP) 3. The purpose of this session was to build understanding among Conference participants of user needs at EU level, and to provide pointers for any EURAPMON follow-on project in terms of potential future network activities that would be most beneficial to EU level end users. The second workshop examined the potential for development of a pan-European contaminant monitoring using raptors and addressed WP1 and WP6. Sharing of best practice guidelines for raptor population monitoring in Europe (WP5) was addressed in the third workshop. The workshop was organized as a series of invited talks of selected monitoring coordinators around Europe with discussion panels as a step forward in spreading best practice for raptor monitoring in Europe. The fourth workshop on monitoring contaminants, emerging diseases and environmental change with raptors (including the use of scientific collections) and the links to human health addressed WP4 and WP5. The fifth workshop addressed WP4 and was aimed at setting strategic priorities for pan-European monitoring of raptor populations and demography with guidance for decision makers.

The closing session pulled together the conclusions from the working sessions and obtained a degree of consensus on future priorities for a possible follow-on to EURAPMON. The suggested elements for a COST Action were discussed and were broadly supported by the participants. The closing session provided significant material to inform the work of the EURAPMON Steering Committee in designing a possible follow-on to EURAPMON, and significant stimulus for participants to inform their future research and collaborations.

OVERVIEW OF SCIENTIFIC CONTENT AND DISCUSSION

The opening session included presentation of the road EURAPMON has travelled, the network growth, organized science meetings, exchange and short visits and the main achievements of EURAPMON. The purpose of this session was to provide the conference participants with a

shared understanding of the aims and objectives of EURAPMON and of its achievements, and to provide participants with a clear orientation as to the purpose of the Final Conference. Furthermore the results and outcomes of three EURAPMON funded exchange visits were presented. These included: A review of raptor and owl monitoring activity across Europe: its implications for capacity building towards pan-European monitoring; An overview of existing raptor contaminant monitoring activities in Europe and Best practices on raptor contaminant monitoring activities in Europe.

Three invited plenary speakers presented overview of issues related to raptor research and monitoring. Dr. David Noble from the British Trust for Ornithology presented what role can raptors play as bioindicator and what is the general value of birds as bioindicators. Dr. Veerle Jaspers from the Norwegian university of science and technology presented past, current and future perspectives of contaminant monitoring using raptors. Dr. Björn Helander from the Swedish Museum of Natural History showed results of long-term for and with monitoring of the White-tailed Eagle in Sweden.

Participants of the conference were invited to present their raptor related work at the conference in a form of posters. Over 20 posters were presented with topics ranging from raptor health monitoring; their exposure to different environmental contaminants; best practice in predatory birds prior to chemical analysis; ecology of raptors and their prey; general changes in raptor population status in several countries; new techniques and web applications used in raptor migration monitoring and bird of prey monitoring by citizen science programs.

The main part of the conference comprised five sessions organized by EURAPMON Steering Committee members and Advisory Experts. These workshop sessions addressed the main aims of EURAPMON through knowledge exchange, discussion and generation of future ides for continuation of EURAPMON network. Each of the sessions is described below.

User needs at EU level

This session focused on the **needs of EU level users** of raptor research and monitoring data.

This includes users of data arising from (contaminant and other) monitoring with raptors, and users of data arising from (population) monitoring for raptors. The consideration of user needs is one of the main objectives of EURAPMON. Indeed, only by making raptor R&M of relevance to a range of end users can we ensure the relevance of our work to society and attract resources to take forward raptor R&M in the future, and catalyse action for the conservation and restoration of raptor populations themselves.

The purpose of this session was to build understanding among Conference participants of user needs at EU level, and to provide pointers for any EURAPMON follow-on project in terms of potential future network activities that would be most beneficial to EU level end users.

Workshop on the development of a pan-European contaminant monitoring using raptors

The potential for using raptors to monitor large-scale spatial and temporal trends in environmental contaminants has been long-recognised.

The current workshop was designed to build in particular on the earlier inventory of monitoring by Gomez-Ramirez et al. (2014), such as to investigate the potential for developing and initiating pan-European monitoring, using raptors, of trends in priority environmental contaminants.

Initially, the workshop focused on the specific example of mercury (Hg). Subsequently, through breakout groups and plenary sessions, the workshop considered which other priority compounds are widely monitored (enabling pan-European monitoring through collation of currently collected data), whether long-term data across Europe may exist in uncollated forms for legacy compounds, and which emerging compounds may be of priority for monitoring.

Towards good practice guidance for raptor monitoring in Europe

The aim of this workshop was to develop common best-practice guidelines for monitoring of raptors in Europe and to form a group of experts that would prepare such guidelines, which should be applicable to all species in all European countries taking into account ecological and infrastructural regional differences. It brought together different views and experiences with raptor monitoring regarding different regions and species, specifically to multi-species monitoring schemes, migration monitoring schemes, endangered rare species monitoring schemes, and monitoring schemes for common raptors.

The workshop was organized as a series of invited talks of selected monitoring coordinators around Europe with discussion panels as a step forward in spreading best practice for raptor monitoring in Europe. Different experiences were shared in order to approach common or at least comparable monitoring protocols to be used in calculation of reliable trend estimates on one hand and to provide raptor monitoring data suitable for conservation management, environmental evaluations and research needs at European scale.

Monitoring contaminants, emerging diseases and environmental change with raptors (including the use of scientific collections) and the links to human health

There is increasing interest worldwide on a One Health approach which links wildlife, environmental and human health. This workshop examined the relevance of raptor research and monitoring to this emerging One Health agenda. It considered specific case studies where the link between raptor research and monitoring and human health has been made, including work on diclofenac and on lead. It also considered what role scientific collections (of raptor specimens) may play in research and monitoring on contaminants, emerging diseases and environmental change, and how this links through to human health.

The workshop sought to raise awareness in the raptor research and monitoring community of the links between raptor R&M and human health. It sought to outline challenges and opportunities with a view to taking forward this area of work linking raptor research and monitoring to human health in a possible EURAPMON follow-on programme.

Setting strategic priorities for pan-European monitoring of raptor populations and demography – guidance for decision makers

As resources for nature conservation are always limited it is increasingly important to carry out the monitoring of population numbers and demography in resource-efficient ways. This is especially true where there is, as is often the case, a trade-off between resources available for monitoring and those for active conservation programmes. In an ideal world, we might well aspire to monitor and carry out intensive ecological studies of all raptor species but, at both national and pan-European scales, it is generally not possible to monitor everything, and there is unfortunately often a need to establish monitoring priorities. This workshop sought to develop previous EURAPMON work to provide guidance on appropriate assemblages of raptor species to monitor at pan-European scale.

The workshop had two aims:

1. To examine the feasibility of producing a categorisation of European raptor and owl species according to a range of criteria, and associated guidance for use; and
2. To consider how such a categorisation could be used to assist conservation organisations and decision makers in selecting appropriate suites of species to monitor depending on national and, particularly, EU needs and priorities.

The workshop considered criteria previously suggested for ranking European raptor species and identifying priorities, including: global, EU and national conservation responsibility (conservation status and listings); suitability as bioindicators (e.g. of habitat change or wider biodiversity); sensitivity to climate change; contaminant influence; susceptibility to other specific threats (e.g. wind farms). It also considered practical criteria for selection of species to monitor, such as: the distribution of each species across Europe; existing monitoring coverage (based on the EURAPMON inventory work); and ease of monitoring.

The **closing session** involved feedback from the workshop sessions held on the previous two days, and brief wrap up by the past and present EURAPMON Chairs. During this session we obtained a degree of consensus on future priorities for a possible follow-on to EURAPMON.
The suggested elements for a COST Action were discussed and were broadly supported by the participants. The closing session provided significant material to inform the work of the EURAPMON Steering Committee in designing a possible follow-on to EURAPMON, and significant stimulus for participants to inform their future research and collaborations. In particular, the session is expected to enhance the future EU-scale impact of raptor research and monitoring, notably in relation to EU nature policy and EU pesticides regulation. The Conference as a whole will have further strengthened integration between ornithologists and ecologists and conservationists working 'for' raptors, and ecotoxicologists working 'with' raptors.

ASSESSMENT OF RESULTS AND IMPACT ON FUTURE DIRECTION OF THE FIELD

The conference was very successful both in terms of expanding the EURAPMON network, share the outcomes and achievements of EURAPMON, exchange of experience and knowledge of raptor monitoring in different countries and in developing new ideas for the future of the EURAPMON network.

The closing session involved feedback from the workshop sessions held on the previous two days, and brief wrap up by the past and present EURAPMON Chairs. The purpose of the closing session was to provide feedback to all participants on the proceedings of the parallel workshop sessions, to provide comment on the Conference proceedings from the EURAPMON Chairs, and to obtain a degree of consensus on future priorities for a possible follow-on to EURAPMON.

The closing session provided significant material to inform the work of the EURAPMON Steering Committee in designing a possible follow-on to EURAPMON, and significant stimulus for participants to inform their future research and collaborations. In particular, the session is expected to enhance the future EU-scale impact of raptor research and monitoring, notably in relation to EU nature policy and EU pesticides regulation. The Conference as a whole will have further strengthened integration between ornithologists and ecologists and conservationists working 'for' raptors, and ecotoxicologists working 'with' raptors.

User needs at EU level
The workshop session will have heightened awareness in the European raptor research and monitoring community of EU needs in relation to Art. 12 reporting on the Birds Directive, and of EU needs in relation to EU pesticides regulation. This will result in an improved contribution of the raptor research and monitoring community towards meeting these needs in future.

Workshop on the development of a pan-European contaminant monitoring using raptors
Overall, the geographical extent of monitoring using similar species or species guilds and similar matrices clearly show the feasibility for a future pan-European contaminant monitoring using raptors, although certain regions require more effort.
The literature-based assessment that has been conducted has also provided insights into the conceptual framework for any future pan-European monitoring. Such monitoring is potentially likely to be biased by spatial and temporal factors, as well as matrix- and species-specific considerations. With regard to matrices, future efforts should aim at employing matrices that maximise toxicological relevance while minimising ethical, logistic and analytical requirements, and should aim at integrating toxicological endpoints with ecological tracers and effect endpoints. Finally, the choice of species to target offers a challenging exercise due to species-specific habitat use, biogeography and dietary habits.
The workshop also composed an inventory of laboratories present that would be interested in further exploring the potential for collaborating in pan-European monitoring (Table 2). This compilation of a core group provides a platform from which future discussion and collaborative effort can be focused.

Towards good practice guidance for raptor monitoring in Europe
The results of the workshop gave sufficient future perspectives for EURAPMON network in terms of collaborative work and as feed-in for future international project applications. The main novelty is to enhance international research cooperation in order to conduct continental scale studies with integrated population and ecological data about raptor species over the whole distribution range in Europe. Currently, studies are mainly focused on local or national scale, but the need for large-scale approach is needed to obtain advanced and comprehensive raptor research in Europe on one hand and establishment of pan-European raptor monitoring scheme of the other.

Monitoring contaminants, emerging diseases and environmental change with raptors (including the use of scientific collections) and the links to human health
The workshop will have raised awareness in the raptor research and monitoring community of the links between raptor R&M and human health. The session highlighted a number of challenges and opportunities with a view to taking forward this area of work linking raptor research and monitoring to human health in a possible EURAPMON follow-on programme. By linking raptor research and monitoring to human health, the impact and relevance of the work can be enhanced and this can help secure more resources for raptor research and monitoring in the future.
Workshop presenters will prepare a joint account of the workshop for publication and this will be disseminated to practitioners and researchers working on One Health and on Beyond GDP.

Setting strategic priorities for pan-European monitoring of raptor populations and demography – guidance for decision makers

It was suggested that the approach required for the environmental and human health contamination work is rather different, in that the needs of major information users (such as the European Chemicals Agency – ECHA) are already clear and there is no need to provide further guidance on monitoring priorities. Rather, the approach should be to advise such users on what is possible to support their statutory duties. Further thought and liaison with the EURAPMON "with raptors" community is therefore required as to whether and how information on contaminant monitoring is included in our proposed outputs.

We agreed the next step will be to circulate a summary to the EURAPMON network asking for offers of help from people (experts on species/groups and also experts on wider criteria/threats) to work on the categorisation of species, and to manage this work. We would hope that the output could be made publically available – ideally as a peer-reviewed, open access publication in an appropriate journal, and also a concise and carefully tailored summary product, with appropriate guidance notes, targeted directly at the EU "for raptors" conservation policy audience.

PART A – OPENING SESSION

Introductory session

Al Vrezec[1] and Guy Duke[2]

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INTRODUCTION

The Final Conference was the concluding networking event of the European Science Foundation (ESF) Research Networking Programme EURAPMON (Research and monitoring *for* and *with* raptors in Europe) which started in May 2010 and will finish in May 2015. Therefore, this was the largest EURAPMON with 80 participants from 26 European countries (see List of participants in Appendix), comprehending raptor researchers, experts and managers, as well as students with interests in raptor research, monitoring and conservation. This provided an opportunity to share the outcomes and achievements of EURAPMON, an opportunity to build new connections and ideas for the future, and an opportunity to consider at transnational level what next for established EURAPMON network. The conference was aimed as a wrap up of all discussions and achievements of the EURAPMON network during its five years (Duke & Movalli 2010, Duke et al. 2012, van Hattum 2012, Espin et al. 2013, Vrezec et al. 2013, Movalli & Dekker 2014). The Final Conference combined plenary talks given by leading raptor researchers, presentations of EURAPMON results, four workshops, poster presentations and a fieldtrip.

PURPOSE

The purpose of opening session was to provide the conference participants with a shared understanding of the aims and objectives of EURAPMON, give advanced overviews of *for* and *with* raptor monitoring, and to provide participants with a clear orientation as to the purpose of the Final Conference.

OVERVIEW OF CONTENT

The Introductory session was composed by the welcome to participants given by the EURAPMON Chair Dr. Al Vrezec, EURAPMON former Chair Mr. Guy Duke and in the name of the host organization University of Murcia Prof. Antonio J. Garcia Fernandez, Vice-Rector of Research at University of Murcia, and Dr. Emma Martinez Lopez, General Coordinator of Research at University of Murcia. The Chair welcomed all participants and specially thanked to Organizing Committee of University of Murcia for an excellent organization of already the fourth EURAPMON Science Meeting. He also thanked to all speakers and workshop organizers, to

European Science Fundation and its EURAPMON Science Officer Dr. Paola Campus, who participated the conference, and furthermore to all that were engaged into EURAPMON activities, especially to the Steering Committee, funding Chair Mr. Guy Duke, funding Coordinator Dr. Paola Movalli and to the Coordinator Dr. Irena Bertoncelj.

Al Vrezec introduced participants with the program of the Final Conference, and Guy Duke provided a brief introduction to EURAPMON, its aims and objectives, and the purpose of this Final Conference.

Guy welcomed participants to this Final EURAPMON Conference. He noted that he had had the privilege of being the Chair of EURAPMON for the first half of the programme period (May 2010-December 2012). He said it was a pleasure to see a lot of familiar faces at the Conference who were present at the very start of EURAPMON and also many people that have joined along the way. He thanked Antonio Garcia Fernandez, Emma Martinez Lopez and their colleagues for hosting this Final Conference in such a wonderful venue.

The aim of EURAPMON, as stated in the original proposal in 2008, is 'To strengthen the contribution of raptor research and monitoring in Europe to biodiversity, environmental and human health benefits, including maintenance of raptors populations and habitats, and reduced chemicals threats to ecosystem and human health.' This aim was very much geared towards enhancing the impact of raptor research and monitoring in Europe. And indeed, EURAPMON has made, and will continue to make (well beyond the end of the programme period in May 2015) an important contribution in this respect.

EURAPMON is, of course, a Research Networking Programme. ESF RNPs focus very much on networking, as opposed to the funding of research per se. Undoubtedly the most important thing that EURAPMON has done has been to bring people together, and in particular, to bring together those who are more focused on monitoring for raptors, and those more focused on monitoring with raptors. This has generated lots of new ideas and thinking and collaborations that would not have happened without EURAPMON. Above all, EURAPMON has been a catalyst to advance R&M for raptors in Europe.

The original EURAPMON objectives, as given in the EURAPMON proposal in 2008, were:

1. To develop a Europe-wide network for monitoring for and with raptors;
2. To build consensus on Europe-wide priorities and needs for raptor research and monitoring
3. To spread best practices and build capacities; and
4. To develop a web-based database, inter-operable data and analytical outputs for user needs.

EURAPMON has been very active in addressing each of these four objectives over the last 5 years. The work done and achievements attained are covered by Al Vrezec, Paola Movalli and Irena Bertoncelj in their presentations.

Of particular concern is the issue of how we can sustain the EURAPMON network once the ESF programme has come to an end this May. EURAPMON has undoubtedly been very resource-efficient, but to be sustained we will need to secure ongoing funding.

This matter is being discussed in the EURAPMON Steering Committee, which has identified a few possible sources of funding. These include the possibility of taking EURAPMON forward as a COST Action, which is very similar to a Research Networking Programme.

Another possibility would be to develop a Marie Curie Initial Training Network. They enable a group of partner institutions to recruit a number of doctoral researchers to take forward training and capacity building.

The expected benefits of EURAPMON, as stated in the 2008 proposal, were:

- Competitive edge for Europe.
- Centres of excellence.
- More integrated analysis at European scale.
- Better understanding of large-scale, long-term patterns.
- Possible new indicators – biodiversity, REACH.
- Better identification of European-level R&M priorities.
- Enhanced science-policy interface.

EURAPMON has done well in delivering these benefits:

- By bringing researchers and practitioners together, sharing and advancing knowledge and building capacities, we have certainly enhanced Europe's competitive edge in this field.
- While we have not had the resources to build individual centres of excellence, EURAPMON has brought leading researchers and practitioners in raptor R&M together and helped the sharing of best practice to enhance excellence in research and monitoring.
- As regards better understanding of large-scale and long-term patterns, EURAPMON has helped us to better understand in particular the pattern of raptor monitoring itself across EUROPE and helped us to identify what can be done to fill gaps and address priorities.
- As regards indicators, EURAPMON has enhanced collaborations across EUROPE and better understanding of user needs could help generate raptor-based indicators in future. Raptors have many qualities that make them useful as sentinels of environmental change.
- As regards identifying research priorities, this Conference is expected to provide some strong pointers for the future.
- As for science-policy interface, this Final Conference includes a user needs session, which focuses on the needs of EU policy makers, both in relation to nature policy and in relation to chemicals policy.

For introduction to raptor monitoring and to enhance further brainstorming at the conference Al Vrezec introduced to plenary lectures:

- Dr. David Noble (British Trust for Ornithology, UK) gave the plenary **"**The value of bioindicators - what role can raptors play?" in which he presented why we need biodiversity indicators and how we use them and then discussed of what value in the sense of bioindication of biodiversity the raptors are. The plenary was aimed to give participants aspects of *for* raptor monitoring within biodiversity monitoring.
- Dr. Veerle Jaspers (Norwegian university of science and technology, Norway) gave the second plenary entitled "Contaminant monitoring using raptors - past, current and future perspectives" and concentrated at different kinds of *with* raptor monitoring in terms of contaminants and their effects on raptors. In the lecture also some future perspectives of *with* raptor monitoring were presented to serve for further discussions during the conference.

The Road EURAPMON has travelled and achievements

Paola Movalli[1], Irena Bertoncelj[2], Al Vrezec[2]

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INTRODUCTION

The session was aimed to present an overview of EURAPMON network development since its conception in 2005, activities during running of ESF RNP from 2010 to 2015, and to give an overview of main achievements in five years of running the RNP. Paola Movalli covered the period 2005-2012, Irena Bertoncelj the period from end 2012-2015, and Al Vrezec the achievements.

PURPOSE

The purpose of this session was to provide conference participants with a perspective of the development of EURAPMON over time. While many conference participants have been engaged in EURAPMON since the start, others have joined more recently, so this presentation helped to build a shared understanding for the programme. Furthermore the session was aimed to give main achievements of the EURAPMON network as a potential of added value, which such international network can provide in raptor research and monitoring.

OVERVIEW OF CONTENT

1. The genesis of EURAPMON (2005-06)

The idea of EURAPMON emerged from Paola Movalli's EU Marie Curie Fellowship 2005-07, which was hosted by the UK Centre for Ecology and Hydrology under the supervision of Dan Osborn. The fellowship had a research element, involving work on contaminants in the lanner falcon, and a networking element, inspired by an idea from Dan Osborn. The aim of this networking element was to develop networking in Europe among those working on research and monitoring *for* raptors (mostly ornithologists and conservationists) together with those working on research and monitoring *with* raptors (mostly ecotoxicologists).

In order to deliver this element of the fellowship, Paola Movalli organised, in October 2006, a first Workshop, in Sicily where she was studying Europe's most important population of the Lanner Falcon. This workshop brought together about 50 leading researchers, among whom were many of the EURAPMON Final Conference participants. The workshop shared the work going on around Europe and was the first to bring together the 'for' and 'with' groups. In a key session on the final day, we put down on paper a project concept to develop a pan-European network.

2. Securing funding for EURAPMON (2007-10)

Following Scopello, work continued to build on the project concept and identified funding opportunities. The Scopello proceedings were published in a Special Issue of *Ambio* in 2008. This was made possible by a generous grant from the Secretariat of the UN Convention on Migratory Species and by financial contributions from the institutions of the various authors.
In 2007-8, with input from many of the Scopello participants, Guy Duke and Paola Movalli lead the preparation of a proposal to the European Science Foundation for a Research Networking Programme. In mid-2009 we learned that the project was approved, subject to ESF Member Organisations agreeing to commit the necessary funds. In the autumn of 2009, encouraged by the ESF Project Officer Lars Kristiansen, who was very helpful in this phase, Guy and Paola worked to persuade ESF Member Organisations and others, notably the Spanish Ministry for Research and the Italian Environment Ministry, to fund EURAPMON. By early 2010, EURAPMON had secured the five hundred thousand Euros required for the programme to be viable. EURAPMON was launched in May 2010.

3. The first part of ESF RNP EURAPMON (2010-12)

The first **EURAPMON Steering Committee** meeting was held in Brussels in May 2010, with Guy Duke elected as Chair and Paola Movalli appointed as Coordinator. The Steering Committee has done a great job over the last 5 years in guiding EURAPMON forwards to deliver its various objectives.
The first major EURAPMON event was the **Inaugural Workshop**, held again in the Riserva Naturale dello Zingaro, Scopello, Sicily, in October 2010. Over 50 people from 25 countries attended this first EURAPMON workshop, many of whom had been at the 2006 workshop. The workshop held sessions on each of the EURAPMON objectives and was very important in consolidating the network and mapping out the work that EURAPMON would carry out over the 5-year project period. A detailed report is available on the website.
A lot of work was carried out during the first two and a half years of EURAPMON to get the network up and running.
The EURAPMON **website**, was designed and filled with content, with the support of the contractor AtBt. This website has stood the test of time as an ambassador and communication channel for EURAPMON. A EURAPMON **brochure** was also published and distributed.
In 2011 a very successful **call for National Coordinators** was launched and Coordinators were appointed for 29 countries covering over 90% of Europe, substantially extending the reach and impact of the EURAPMON network.
A **second major workshop** was held in Murcia in 2012, which brought together over 50 participants from 27 countries, including most of the National Coordinators, to obtain a first overview of monitoring for raptors in Europe, and plan an online survey. The proceedings of this workshop were subsequently published as a special issue of the journal *Acrocephalus* (actual publication took place in 2013).
A very successful **online survey** of monitoring for raptors was launched in 2011, led by Andras Kovacs with support from Guy Duke, Pertti Saurola, Al Vrezec, Chris Wernham, Ian Burfield in particular, creating an important database on existing monitoring for raptors.
A **first call for short and exchange visits** was prepared and issued, resulting in EURAPMON funding 5 short visits and 1 longer exchange visit, enabling young researchers to move between institutions to gain and share knowledge.
A **third workshop** was held in Amsterdam in late 2012, which carried out an overview of monitoring with raptors in Europe. This workshop was led by Richard Shore, Nico van den Brink

and Bert van Hattum. It was supported by a EURAPMON **exchange visit**, awarded to Pilar Gomez-Ramirez, who coordinated a questionnaire on the topic leading up to the workshop.
Thus, the first half of EURAPMON (May 2010-December 2012) went a long way to grow and consolidate the network and to deliver on the programme's objectives. It laid solid foundations for the second half of the programme period.

4. The second part of ESF RNP EURAPMON (2012-15)

In December 2012 Al Vrezec took over as the EURAPMON Chair and Irena Bertoncelj as EURAPMON external coordinator, both employed at the National Institute of Biology in Ljubljana, Slovenia. Following a Steering Committee meeting in Brussels in January 2013 a second call for Short and Exchange visits was launched. Within this call **two longer exchange visits and four short visits** were awarded.
Both exchange visits provided input for **two parallel workshops organised in May 2013** in Murcia, Spain. One workshop focused on analysis of questionnaires for the inventory of raptor population monitoring. The second workshop was dedicated to preparing a Best practice protocols for contaminant monitoring.
An inventory of the current raptor population and contaminant monitoring schemes in Europe was compiled based on an extensive questionnaire advertised by EURAPMON Steering Committee and National Coordinators. The results of raptor contaminant monitoring schemes are already available on EURAPMON website in a form of an excel sheet. The results of raptor population monitoring will soon be available on the EURAPMON website as an online searchable database with possible search by purpose of the scheme, types of samples collected and a list of monitored contaminants.
To continue with capacity building especially for students a **summer school was organised at Naturalis in August 2014** to link contaminant monitoring with raptors, and raptor population monitoring, took advantage of NATURALIS large collection of raptor skins. EURAPMON provided funding for 14 participants from 8 countries.
In autumn 2014 the **fourth exchange visit grant** was awarded to Igor Eulaers to carry out a Pan-European assessment of exposure to major contaminants in raptors and associated heath impacts.

5. Overview of main EURAPMON achievements

The EURAPMON network increased greatly during EFS RNP running and presents today real pan-European network (Fig. 1). Main step was the appointment of National Coordinators in 2012.

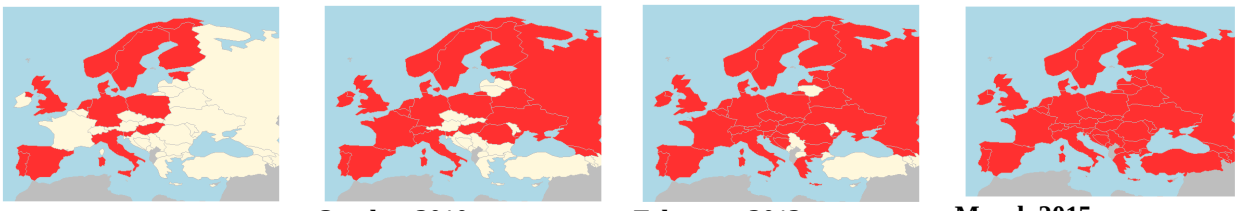

Fig. 1: Increase of EURAPMON network according to four milestone events: (1) the first Steering Committee meeting in Brussels (17 May 2010), (2) the Inaugural Workshop in Scopello (7 October 2010), (3) the Workshop on Inventory of Monitoring for Raptors in Europe in Murcia (9 February 2012), and (4) the Final EURAPMON Conference in Murcia (9 March 2015).

Till the Final EURAPMON Conference seven major events took place: (1) **Inaugural Workshop, Scopello, Oct 2010** (Duke & Movalli 2011), (2) **Workshop-Inventory of existing raptor monitoring in Europe, Murcia, Feb 2012** (Duke, Kovacs, van Hattum), (3) **Workshop-Inventory of existing raptor contaminant monitoring activities in Europe, Amsterdam, Nov 2012** (van Hattum, Gómez-Ramírez), (4) **Workshop: Setting best practices on raptor contaminant monitoring activities in Europe, Murcia, May 2013** (Espín , García Fernández, Martínez López), (5) **Workshop-Review of inventory of monitoring *for* raptors, Murcia, May 2013** (Vrezec, Wernham, Derlink), (6) **Technical Workshop on Migratory Birds Poisoning, Tunis, May 2013 (co-funded by EURAPMON)** (Shore), and (7) **Summer School-Monitoring *for* and *with* raptors in Europe, Leiden, August 2014** (Movalli, Dekker). All activites were regulary reported to the network through two EURAPMON websites (http://www.eurapmon.net/, http://www.esf.org/) or other e-announcements.

The dissemination of the EURAPMON network has taken place also at three international conferences: (1) **19th Conference of the European Bird Census Council, Cluj, Romania, Sep 2013** (Burfield et al.: *EURAPMON inventory of raptor monitoring schemes in Europe)*, (2) **Eagles of Palearctic: Study and Conservation, Elabuga, Tatarstan, Russia, Sep 2013** (Vrezec et al.: *Project EURAPMON and inventory of raptor monitoring schemes in Europe)*, and (3) **I. Worldwide Raptor Conference, Bariloche, Rio Negro, Argentina, Oct 2013** (Saurola et al.: *Pan-European inventory of raptor monitoring schemes in Europe with the Finnish raptor monitoring scheme as an example)*. ESF RNP EURAPMON initiated also several publications, and most notable are three publications that were direct results of EURAPMON activities: (1) the Introductory brochure, (2) the scientific paper "***An overview of existing raptor contaminant monitoring activities in Europe***" published in *Environmental International* in 2014 by Gomez-Ramirez et al. (15 authors from 9 countries), and (3) **special issue of the journal *Acrocephalus*** on the overview of *for* raptor monitoring in Europe published in 2012 (46 authors from 26 countries).

In terms of monitoring best-practice and capacity building EURAPMON was active at providing different products. The book *Raptors: a field guide for surveys and monitoring* (Hardey et al. 2009) has been made on-line available to the network through the EURAPMON website as guidelines for *for* raptor monitoring. At one workshop a guidelines for *with* raptor monitoring "*Sampling and contaminant monitoring protocol for raptors*" were prepared by Espin et al. and given available on-line at EURAPMON website in 2014 (Espin et al. 2014). To achieve integration between *for* and *with* raptor monitoring the summer school "*Monitoring for and with raptors in Europe*" was organized in 2014 giving special emphasis to museum collections (Movalli & Dekker 2014).

During this session some major achievements coming out of EURAPMON Exchange visits were presented:

- Dr. Irena Bertoncelj (National Institute of Biology, Slovenia), Dr. Maja Derlink (University of Ljubljana, Slovenia) presented "A review of raptor and owl monitoring activity across Europe: its implications for capacity building towards pan-European monitoring"
- Dr. Pilar Gómez-Ramírez (University of Murcia, Spain) presented "An overview of existing raptor contaminant monitoring activities in Europe"
- Dr. Silvia Espín (University of Turku, Finland) presented "Best practices on raptor contaminant monitoring activities in Europe"

PART B – WORKING SESSIONS

User needs at EU level

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INTRODUCTION

This session focused on the **needs of EU level users** of raptor research and monitoring data.
This includes users of data arising from (contaminant and other) monitoring with raptors, and users of data arising from (population) monitoring for raptors.
Consideration was given to:

- needs (notably of the European Food Safety Agency EFSA) relating to EU chemicals regulations for environmental risk assessment of chemicals;
- needs (notably of Member States for reporting to the European Commission) relating to the EU nature regulations (notably the Habitats and Birds Directive) for the assessment of favourable conservation status of species and habitats.

The consideration of user needs is one of the main objectives of EURAPMON. Indeed, only by making raptor R&M of relevance to a range of end users can we ensure the relevance of our work to society and attract resources to take forward raptor R&M in the future, and catalyse action for the conservation and restoration of raptor populations themselves.
The session included two presentations:

- A presentation by Dr Jose Tarazona, Head of Pesticides Unit, European Food Safety Agency (EFSA) on the '***Role of monitoring data with raptors in the EU environmental risk assessment of chemicals: Needs from regulatory scientific assessors***.'
- A presentation by Guy Duke on '***EU needs in relation to Article 12 of the Birds Directive***.'

The presentations were followed by discussion.

PURPOSE

The purpose of this session was to build understanding among Conference participants of user needs at EU level, and to provide pointers for any EURAPMON follow-on project in terms of potential future network activities that would be most beneficial to EU level end users.

OVERVIEW OF CONTENT

EU needs in relation to Article 12 of the Birds Directive (Guy Duke)
The EU Birds Directive Article 12 governs Member State reporting on the Directive, and requires a trennial report from MS. Nine triennial reports were submitted by MS from 1979 to 2007. These reports focused on policy, with nothing about outcomes or species status. The Commission and MS recognised that this was not very useful.

During 2009-12, there was intensive work to develop a new reporting format, building on consultation with MS and BirdLife International. New Art. 12 reports for the period 208-12 were delivered by 27 of the 28 MS at end 2013. The principles of the new reporting format include: reporting on population numbers, trends and distributions for all native breeding birds and all non-breeding birds for which Special Protection Areas are selected under the Directive; and reporting on threats, pressures, conservation measures and numbers within national SPA networks for all native breeding birds and all non-breeding birds for which SPAs have been selected. The Commission also encourages non-obligatory reporting on non-native species. Population trend data includes short-term (most recent 12 years) and long-term (since c. 1980).

Reporting is done by MS in collaboration with BirdLife International. Within the EU, MS and BirdLife work together to collect data for an agreed EU database, from which EU products are derived. The database, together with national assessments from non-EU European countries, inform BirdLife's periodic Birds in Europe assessments.

In the UK, the work of gathering and organising the data is overseen by the UK Avian Population Estimates Panel (APEP). This brings together a number of statutory organisations (UK Joint Nature Conservation Committee and the four country conservation bodies, Scottish Natural Heritage, Natural England, Natural Resources Wales and The Northern Ireland Environment Agency) and non-governmental organisations (RSPB, Wildfowl and Wetlands Trust, BTO, Game & Wildlife Conservation Trust). JNCC coordinates APEP, WWT covers water birds, BTO terrestrial birds, RSPB birds of prey and single species surveys, and GWCT gamebirds.

The process involves: an initiation meeting to discuss issues and timeframe; collation of estimates for different species groups by the respective lead organisations; collation of draft overall UK estimates; meetings to resolve problems; drafting of the assessment; submission of the assessment report to the Commission and publication (in British Birds).

As the data is used for statutory purposes, including conservation case-work, peer review and audit are very important in the process. Only published estimates are used (wherever possible) and there are no 'black boxes' (i.e. where it is not clear how the estimates have been derived).

Various lessons have been learned from the APEP process. It provides periodically updated sources of estimates for statutory uses. It provides a 'on-stop shop' for data end users. It has a cost, but not excessive. It builds on and strengthens partnerships between UK statutory bodies and NGOs. It identifies data deficiencies and helps target further surveys. Overall, the process is found to be useful and valuable.

The raptor research and monitoring community has an opportunity to engage in the next Art. 12 reporting round. Between now and 2016, work will be ongoing to reconfigure surveillance schemes to better deliver information on pressures and threats. In 2017, new UK estimates of water bird and raptor numbers will be produced, and these will be delivered to APEP 4 in 2017, with a view to completion of the next UK Art. 12 report in 2018. This will feed in to other reviews and priority setting and a UK national Red List update by 2020.

Lessons from the current (2008-12) Art. 12 reporting exercise will be used to fine-tune the guidelines for the next cycle (report for 2013-18 due December 2019). Outputs in 2015 from the 2008-12 reporting include: European status assessments; updated IUCN Red List; and the provision of all the data online at http://bd.eionet.europa.eu/article12/summary. This includes maps for all species. The database includes data consolidated and available by MS submission.

In conclusion, the next round of Art.12 reporting provides a major opportunity to align processes that collate policy-relevant species monitoring data, including raptor data. The key dates to keep in mind are: 2017-18, the optimal timing for publication of relevant raptor data; 2018-mid 2019 national collation of data by each MS; December 2012 next submission of Art. 12 reports by MS.

Role of monitoring data with raptors in the EU environmental risk assessment of chemicals: Needs from regulatory scientific assessors (José V. Tarazona; Head Pesticides Unit. European Food Safety Authority, Parma, Italy)

Disclaimer: Jose V. Tarazona is a staff member of the European Food Safety Authority. The content of this presentation is responsibility of the author and does not necessarily represent the official view of the Authority.

The presentation focused on the use monitoring activities with raptors as biological indicators to monitor the hazard and risks of regulated chemicals and environmental contaminants. It presented a general overview on the needs from scientist involved in the regulatory risk assessment, using the EU regulations on pesticides (Plant Protection Products Regulation) and the REACH Regulation as examples. Both include hazard evaluations (PBT assessments) and environmental risk assessments as essential elements for supporting decisions on marketing authorisations.

The EU regulatory frame for pesticides includes a specific assessment for birds. EFSA developed a guidance document (EFSA, 2009) which includes the assessment of the bioaccumulation potential of pesticides and its risk for raptors. EFSA is planning to review this guidance in the future, and monitoring data on raptors could be of high value for refining the current guidelines. The risk assessments under REACH are much more general, focus on mammals as representative of all terrestrial vertebrates and specific risk assessments on birds are expected to be an exception. Both regulations include a PBT assessment, and the pesticides regulation also includes a POP assessment. Monitoring data on raptors may contribute to the assessment of the biomagnification potential. Both regulations consider the use of scientific publications in the risk assessment, and EFSA has developed a specific guideline (EFSA, 2011).

The requirements for the use of monitoring data with raptors in the regulatory context are not fundamentally different from basic scientific peer-review principles, but usually require a much higher level of reporting than that required for a scientific publication. Obviously, scientific quality (good study design, analytical method, sample id., statistics, …) is the first step; it is essential to report all these elements with a sufficient level of detail (e.g. in an additional information document) to allow risk assessors to verify the reliability of the methodology and results. Access to raw data may be needed in some cases. The EFSA (2011) guidance can be used by the study authors when designing and reporting a study to check which elements should be incorporated to ensure that the results could be used in the regulatory context. A second element is the relevance, in addition to monitoring measured concentrations, it is very useful to report additional information on the biology and ecology of the monitored individuals and populations, in order to allow risk assessors to link the information with the hazard and risk assessment needs. The needs are different for the PBT/POP and for the risk assessments. Examples and details were included in the presentation.

References

EFSA, 2009. Guidance Document on Risk Assessment for Birds and Mammals. EFSA Journal 7(12): 1438.

EFSA, 2011. Guidance on submission of scientific peer-reviewed open literature for the approval of pesticide active substances under Regulation (EC) No 1107/2009. EFSA Journal 9(2):2092.

KEY DISCUSSION POINTS

The outcomes of the discussion are summarized under Closing session.

ASSESSMENT OF THE RESULTS AND IMPACT OF THE EVENT ON THE FUTURE DIRECTIONS OF THE FIELD

The workshop session will have heightened awareness in the European raptor research and monitoring community of EU needs in relation to Art. 12 reporting on the Birds Directive, and of EU needs in relation to EU pesticides regulation. This will result in an improved contribution of the raptor research and monitoring community towards meeting these needs in future.

Workshop: Developing pan-European contaminant monitoring using raptors

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INTRODUCTION

Contaminants, alone and in combination with other major anthropogenic stressors such as habitat and climate change, are major stressors of wildlife, ecosystems and, ultimately, Man. Chemicals that are highly persistent in the environment, bioaccumulate, and are toxic (PBT chemicals) are of particular concern because of their potential to be transported globally, to magnify through food chains, and to cause toxicity in higher vertebrates. In Europe, plant-protection products, biocides and industrial chemicals are regulated through various instruments of the European Union and regulation has largely been harmonised at a pan-European level. However, there is no current monitoring at the same spatial scale to demonstrate the effectiveness, or otherwise, of these instruments, particularly in mitigating against exposure to potentially harmful contaminants.

The potential for using raptors to monitor large-scale spatial and temporal trends in environmental contaminants has been long-recognised. More recently, EURAPMON funded exchange visits have been instrumental in cataloguing the scale of such activity in European countries (Gomez-Ramirez et al. 2014) and in developing and disseminating information on best practice for such monitoring (Espin et al. in preparation; www.eurapmon.net). The current workshop, held as part of the final EURAPMON conference in March 2015, was designed to build in particular on the earlier inventory of monitoring by Gomez-Ramirez et al. (2014), such as to investigate the potential for developing and initiating pan-European monitoring, using raptors, of trends in priority environmental contaminants.

PURPOSE AND KEY DISCUSSION POINTS

Initially, the workshop focussed on the specific example of mercury (Hg). Consideration was given to current information on trends, as gathered from existing raptor monitoring activities, and whether this provided proof of concept of the potential for pan European monitoring using raptors (section 1). The workshop, through breakout groups and plenary sessions, subsequently considered which other priority compounds are widely monitored (enabling pan-European monitoring through collation of currently collected data), whether long-term data across Europe may exist in uncollated forms for legacy compounds, and which emerging compounds may be of priority for monitoring (section 2). Finally, concepts that may be important or novel for successful development of pan-European monitoring were also discussed (section 3).

1. A literature-based assessment of the exposure and associated health effects of Hg in European raptor species: a case-study for pan-European monitoring *with* and *for* raptors

A recent EURAPMON funded exchange visit (awarded to Igor Eulaers) has been undertaken with the aim of conducting a literature-based assessment of the exposure and associated health effects of major contaminants in European raptor species. This first ever pan-European assessment aimed at providing empirical exposure and effects data for particular compounds and assessing some of the practical and methodological challenges that might arise during a programme of contaminant monitoring n raptors at a pan-European scale. Based upon the inventory by Gomez-Ramirez et al. (2014), the assessment focussed on a commonly targeted contaminant, mercury (Hg). Polychlorinated biphenyls, organochlorine pesticides and flame retardants were also reported by Gomez-Ramirez et al. (2014) as commonly targeted contaminants across Europe, and will be addressed in similar assessments over the course of the coming year.

From a total of 33 species for which Hg exposure has been studied in Europe, most data were available for twelve species, which Gomez-Ramirez et al. (2014) had previously also identified as those monitored most commonly across Europe. The assessment was therefore focussed on these species, while introducing additional focus on the different trophic guilds they constituted, i.e. piscivorous, avivorous and (diurnal and nocturnal) mammivorous. The frequency with which different species were analysed for Hg in the published literature was similar to the frequency they were monitored in different European studies, as reported by Gomez-Ramirez et al. 2014. The geographic extent over which analysis extended differed markedly between species. Published data were mostly available for piscivorous species but were largely restricted to northern regions, while studies on avivorous and mammivorous species, though less numerous, covered a wider geographical range that extended to southern Europe. As a general trend across species, most monitoring effort was in northern regions while little to no current data are available for Eastern Europe. In terms of types of sample analysed, data were markedly more abundant (in decreasing order) for feather, hepatic and renal residues than for eggs and muscle, the latter two though were still more commonly analysed than brain, heart, bone, blood, lung and ovaries. Overall, the geographical extent of monitoring using similar species or species guilds and similar matrices clearly show the feasibility for a future pan-European contaminant monitoring using raptors, although certain regions require more effort.

The severity of the reported exposure, here solely assessed for hepatic, egg and feather residues, was higher in diurnal than in nocturnal mammivorous species, and even higher in avivorous and piscivorous species. Although egg exposure in nocturnal mammivorous species did not surpass threshold levels at which reproduction was impaired or sterility was reached, hepatic and feather concentrations showed that numerous subpopulations of all species are likely to be reproductively impaired and that thresholds associated with individual mortality have been frequently surpassed as well in avivorous and piscivorous species. Subpopulations majorly impacted were typically those reported with intensive agricultural use of organic Hg compounds, i.e. northern Europe, Germany and UK. Although feather concentrations indicate that exposures have locally decreased as a result of local mitigation, overall levels are still elevated relative to concentrations that are assumed to reflect natural (geogenic) exposure, and concentrations above those potentially associated with impaired reproduction are often still reported. Our ability to assess Hg levels and impacts at a pan-European scale from literature data confirm the potential for pan-European monitoring for certain compounds using raptors as sentinels. These results also indicate the ongoing need to monitor *for* raptors as well, as current environmental Hg concentrations may well be impacting some raptor populations and future trends in Hg release are uncertain.

The literature-based assessment that has been conducted has also provided insights into the conceptual framework for any future pan-European monitoring. Such monitoring is potentially likely to be biased by spatial and temporal factors, as well as matrix- and species-specific considerations. With regard to matrices, future efforts should aim at employing matrices that maximise toxicological relevance while minimising ethical, logistic and analytical requirements, and should aim at integrating toxicological endpoints with ecological tracers and effect endpoints. Finally, the choice of species to target offers a challenging exercise due to species-specific habitat use, biogeography and dietary habits (see section 3).

2. Identifying priority compounds for which monitoring is already common across Europe

A pragmatic reality in identifying which compounds could be monitored at pan-European scale is that resources for most current monitoring schemes are limited and already focussed on contaminants that are of national priority. National schemes are unlikely to be able to refocus rapidly onto new activities in order to harmonise with other schemes. The potential for pan-European monitoring therefore would most easily be achieved by focussing on priority compounds that are of common interest across several European member states. For this reason, the workshop was held in three breakout groups, approximating geographical clusters. Each assessed which contaminants are of priority interest and are being monitored by at least some countries in the region (Table 1). Monitoring of some legacy compounds (organochlorine pesticides, PCBs), Hg and lead is relatively common, and there are socio-economic and ecological drivers associated with the need for their monitoring. Providing information on pan-European trends may well be possible for such compounds with data that has already been gathered. The workshop also successfully identified a number of emerging contaminant groups for which information is patchy across Europe, thus providing a focus for new monitoring efforts at a pan-European scale.

Table 1. Priority compounds for monitoring as identified by breakout groups and potential drivers of why these compounds should be monitored.

compound	breakout groups			potential drivers for monitoring
	northern Europe	**central Europe**	**southern Europe**	
Mercury	✓	✓	✓	UNEP Minamata Convention
Lead	✓	✓	✓	UNEP poisoning guidelines
Cadmium	✓	possibly		potential toxicant[1]
Arsenic		possibly		potential toxicant[1]
Polychlorinated biphenyls	✓	✓	✓	OSPAR Convention
Organochlorine pesticides	✓	✓		OSPAR Convention
Flame retardants	✓	✓		OSPAR Convention
Perfluorinated compounds	✓	emerging		potential toxicant[1]
Short-chain paraffins	possibly			potential toxicant[1]
Second generation anticoagulant rodenticides	possibly	✓	✓	failure of risk assessment and mitigation at member state level
Non-steroidal anti-inflammatory drugs		✓	✓	large-scale mortality in vultures
Pharmaceuticals	unknown	emerging		potential toxicant[1]
Nanoparticles		emerging		potential toxicant[1]
Endocrine disruptors		emerging		potential toxicant[1]
Neonicotinoid pesticides		emerging		potential toxicant[1]

[1] Compound(s) known to be present in the environment and to be potentially toxic to wildlife, but for which wildlife exposure is relatively poorly characterised.

3. Concepts to build a successful development of pan-European monitoring

Amongst the conceptual issues raised during the workshops plenary session, a first aspect considered how chemical analyses could be done involving multiple countries and analytical facilities. Various models are possible which could include a focus in particular laboratories for a specific set of compounds, possibly further enhance analytical quality assurance and control (QA/QC). However, it raises legal and practical issues for transport of samples across international boundaries. It also raised issues over resourcing analysis of samples from large numbers of samples from multiple countries, although these difficulties might be ameliorated through sample exchange and reciprocal analyses between partnered laboratories. An alternative model suggests to pool data produced by different laboratories and initiate QA/QC between participating laboratories.

A second aspect that was discussed was the difficulty in monitoring for contaminants in a single species across Europe where geographical range may be limited. The choice for a single species would also depend, amongst other factors, on the trophic pathways of interest, but candidate generic species that were suggested included Common Buzzard *Buteo buteo*, White tailed Eagle *Haliaeetus albicilla*, Common Kestrel *Falco tinnunculus*, Barn Owl *Tyto alba*, Tawny Owl *Strix aluco*, and Peregrine Falcon *Falco peregrinus*. An alternative to using a single species is that of trophic guilds (essentially clusters of species), although this concept would need to be explored to ensure that the variability between species within clusters is well characterised. Such trophic guild approach may be particularly suitable for lead monitoring, where a key trophic guild would be scavengers such as buzzards, eagles, kites and vultures. A sub-group of this guild, scavengers that might eat livestock carcasses, might be the focus for monitoring nonsteroidal anti-inflammatory drugs (NSAIDs), other veterinary pharmaceuticals and antibiotics. Where multiple trophic pathways were of interest, such as with Hg, multiple guilds might need to be covered. Some of the concepts around using trophic guilds will be investigated using Hg as an exemplar, in the work by Igor Eulaers resulting from his EURAPMON funded exchange visit.

A third aspect that was discussed was the establishment of pan-European networks that could be relatively fast to implement as they capitalise on currently generated data. Two possibilities in particular were highlighted:

- A pan-European monitoring for poisoning: to collate and report collectively on poisoning investigations that are currently conducted in countries such as Spain, France and the UK.
- A pan-European monitoring for visceral gout: to conduct post-mortem analyses and record the presence signs for visceral gout, a key clinical sign of intoxication from NSAIDs (Table 1), and the collated data reported via the EURAPMON or other agreed website. This effectively would provide a rapid assessment of screening for visceral gout at pan-European level and may be particularly important given the licensing of diclofenac for veterinary use in Italy and Spain, and concerns that *Aquila* species may be as susceptible as *Gyps* vultures to NSAID intoxication.

A final aspect that was discussed considered the different future directions of future pan-European monitoring, which may include:

- characterising of cranial concentrations, as the brain is often a key target organ for contaminants such as Hg and many organic chemicals than can pass through the blood-brain barrier. Such analysis may be able to link to exposure and effects in humans.

- linking contaminant monitoring to the "One Health" agenda.
- undertaking source apportionment for contaminants to identify major contamination sources and to distinguish between anthropogenic and geogenic sources of contaminants.
- including stable isotope analysis as a routine tool to investigate contaminant exposure.
- expanding contaminant monitoring activities to eastern-European states.

As final point on the agenda of the workshop composed an inventory of laboratories present that would be interested in further exploring the potential for collaborating in pan-European monitoring (Table 2). This compilation of a core group provides a platform from which future discussion and collaborative effort can be focussed. This list is not exclusive and it is hoped that other organisations will be added to this list in the near future.

Table 2. Laboratories present at the workshop which showed interest in further establishing a pan-European monitoring *with* and *for* raptors.

country	**organisation**	**contact person**	
Belgium	University of Antwerp	Marcel Eens	marcel.eens@uantwerpen.be
Denmark	Aarhus University	Igor Eulaers	ie@bios.au.dk
Estonia	Estonian University of Life Sciences	Madis Leivits	madis.leivits@emu.ee
France	CNRS-University Franche-Comté	Clémentine Fritsch	clementine.fritsch@univ-fcomte.fr
Germany	German Environmental Agency	Gabriele Treu	gabriele.treu@uba.de
Germany	Leibniz Institute for Zoo and Wildlife Research	Oliver Krone	krone@izw-berlin.de
Netherlands	Naturalis	Paola Movalli	paola.movalli@skynet.be
Norway	Norwegian Institute of Air Research	Dorte Herzke	dorte.herzke@nilu.no
Norway	Norwegian University of Science and Technology	Veerle Jaspers	veerle.jaspers@ntnu.no
Spain	Catalonia Institute for Energy Research	Rafael Mateo	rafael.mateo@uclm.es
Spain	University of Murcia	Emma Martinez	emmaml@um.es
Spain	University of Extremadura	Paco Soler	soleretox@unex.es
UK	Fera Science	Sheonaid Charman	sheonaidh.charman@fera.gsi.gov.uk
UK	Centre for Ecology & Hydrology	Richard Shore	rfs@ceh.ac.uk

Workshop: Towards good practice guidance for raptor monitoring in Europe

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INTRODUCTION

The inventory of raptor monitoring in Europe conducted within EURAPMON revealed that there are only few countries where monitoring of the whole raptor assemblage is conducted. In most countries only few raptor species are monitored and one of the reasons of that given by the national coordinators was the lack of common and standardized best practice protocols (Vrezec et al. 2012). Therefore sharing knowledge and experience in raptor monitoring is crucial in promoting a pan-European raptor monitoring network. An excellent basis is the publication "Raptors: a field guide for surveys and monitoring" (Hardey et al. 2009) which covers some of the European raptor species. The workshop tried to bring together different views and experiences with raptor monitoring regarding different regions and species, specifically to multi-species monitoring schemes, migration monitoring schemes, endangered rare species monitoring schemes, and monitoring schemes for common raptors.

PURPOSE

Our suggested aim was to brainstorm over possibilities and needs to reach integrated pan-European raptor monitoring schemes following standardized monitoring protocols. The idea was to develop commonbest-practice guidelines for monitoring of raptors in Europe and to form a group of experts that would prepare such guidelines, which should be applicable to all species in all European countries taking into account ecological and infrastructural regional differences. In the opening part the following questions and workshop aims were presented to the participants in order to initiate the brainstorming:

- What we can do in terms of common monitoring approach and data analysis?
- To seek for possibilities of case studies for selected raptor species or monitoring schemes (e.g. migration monitoring)
- To seek for possibilities to form a group of experts that would prepare comprehensive raptor monitoring guidelines, which should be applicable to all species in all European countries taking into account ecological and infrastructural regional differences.

OVERVIEW OF CONTENT

The workshop was organized as a series of invited talks of selected monitoring coordinators around Europe with discussion panels as a step forward in spreading best practice for raptor monitoring in Europe. Different experiences were shared in order to approach common or at least

comparable monitoring protocols to be used in calculation of reliable trend estimates on one hand and to provide raptor monitoring data suitable for conservation management, environmental evaluations and research needs at European scale. In the talks the main views for different approaches in raptor monitoring across Europe were given to stimulate discussions at one and to share experiences at the other hand.
The workshop was divided in four thematic slots focused on 1) multi-species monitoring schemes, 2) migrating raptors monitoring schemes, 3) monitoring schemes for endangered rare raptor species and 4) monitoring schemes for common raptors. In each slot two talks were presented, followed by a short discussion.

Workshop schedule and speakers

9.10-9.15 Introduction to the workshop (Al Vrezec)
9.15-9.35 The Scottish Raptor Monitoring Scheme - recent developments in good practice multi-species monitoring (Amy Challis; SCOTLAND, UK)
9.35-9.50 Raptor monitoring in Estonia, 1994-2014: Raptor Grid vs. common bird surveys (Ülo Väli, Jaanus Elts, Asko Lõhmus, Rein Nellis, Renno Nellis, Hannes Pehlak; ESTONIA)
9.50-9.55 Short discussion on multi-species monitoring schemes
9.55-10.10 Transpyr: a transboundary program for monitoring raptor populations through migration counts in the Pyrenees, focus on Organbidexka Pass (Jean-Paul Urcun; FRANCE)
10.10-10.25 The migration of Honey Buzzards in southern Italy: results of different monitoring projects (Michele Panuccio; ITALY)
10.25-10.30 Short discussion on migrating raptors monitoring schemes
10.30-10.45 Monitoring of Golden Eagle in Norway (Jan Ove Gjershaug; NORWAY)
10.45-11.00 Monitoring of the Golden Eagle in Hungary (Gabor Papp; HUNGARY)
11.00-11.05 Short discussion on monitoring schemes for endangered rare raptor species
11.05-11.20 Population monitoring of the Tawny Owl in Slovenia: playback and nestbox approach (Al Vrezec; SLOVENIA)
11.20-11.35 Towards integrated population monitoring: productivity, survival and population change of the Finnish Tawny and Ural Owls (Pertti Saurola; FINLAND)
11.35-11.40 Short discussion on specific monitoring schemes for common raptors
11.40-12.10 Discussion (Alessandro Andreotti)

MAIN DISCUSSION TOPICS

There is a general idea to incorporate raptor monitoring into multispecies surveys and with the two talks of the **first slot,** from Scotland (UK) and Estonia, we tried to reveal to what extend this is possible. These talks have shown that such surveys can provide robust population trends estimations for some common mainly diurnal raptors, and comparable results to specialized monitoring schemes can be achieved. Multispecies surveys are useful especially when considering non-breeding or wintering raptors monitoring schemes. However, the need of volunteers training is essential. The **second slot** of talks dealt with migration monitoring with focus given to the Honey Buzzard *(Pernis apivorus)* as an example in case monitoring schemes in France and Italy. Using raptor population indices it is possible to produce reliable trend estimations that are useful for overall European population trend estimation. However, high heterogeneity of protocols and lack of long-term researches were set as problems and a big need

to establish a network of raptor migration monitoring sites over Europe was remarked. For the purpose of a complete estimation of raptor populations at an European scale, it was also noted the importance of the identification and monitoring of all the relevant bottlenecks where soaring migratory birds congregate to cross ecological barriers. For trends estimation is however essential to take into account meteorological data as well as climate change effects. At this regard it will be important to take into account the results of studies carried out with different methodologies (radar, satellite-tracking, etc.). Again, training courses for volunteers appeared to be essential. The **third slot** on endangered rare raptor species monitoring was given with the Golden Eagle *(Aquila chrysaetos)* as a case species, which is distributed over much of Europe, with case monitoring schemes from Norway and Hungary. Both protocols include nest inspections, reproduction monitoring and ringing. Monitoring includes material collecting for different analyses (e.g. genotyping, diet) and more detailed analysis of survival or causes of death that can be used in conservation management plans. In the **fourth slot,** concerning specific monitoring schemes for common raptors, the case of the Tawny Owl *(Strix aluco)* was presented with monitoring schemes from Finland and Slovenia. Tawny Owl as raptor species breeding in the nest boxes is an ideal species to start with integrated pan-European monitoring schemes. For locating territories and population estimates, the playback method was proposed, but for understanding meaning of trends ringing of nestlings and adults in the nests is essential for getting crucial information about survival, recruitment and dispersal. Ideal comprehensive monitoring scheme should include approaches, playback survey of selected study plots and nest inspections, especially in the areas in which larger availability of natural nest sites could strongly influence occupancy rate of nest boxes. Nest cards can be useful approach for data collecting with volunteers.

KEY DISCUSSION POINTS

The discussion has taken place between talks and as general discussion at the end of the workshop. Three main key points were set as steps towards setting best practice of raptor monitoring in order to approach integrated pan-European monitoring scheme:

A. Establishment of working groups for setting best practice protocols:

To achieve efficient preparation of common monitoring protocols at pan-European scale it was suggested establishing working groups dealing with specific groups of raptor monitoring schemes dealing with (1) breeding populations, (2) migratory populations, and (3) wintering populations. The tasks of these groups would be to (1) prepare best-practice monitoring protocols as guidelines, (2) to stimulate integrated monitoring across Europe (pan-European network), and (3) to prepare guidelines for training of monitoring fieldworkers or to conduct expert exchanges across Europe (capacity building).

B. Interest in migration working group:

Through the discussion, a need and interest of establishing a migration working group and a network of migrating raptor monitoring sites were already set out. An overview and evaluation of current migration monitoring network should be one of the main topics with bringing together existing data (multi or single species) and to establish integrated network with good practice guidance (multi or single species).

C. Single species focal projects (case study):

Within the established EURAPMON network it would be possible to start with case studies on selected species, starting with common species, but ideally non-PECM species (EURAPMON *for* inventory is a good baseline for selecting the species). With multi-authorship work it is a goal to bring together existing data (trends), to include *with* priority material collection, to produce species-specific guidelines (monitoring protocols, manuals, priorities), to give guidance for recruiting new volunteers (best-practice on this), to improve existing scheme, and to publish. The same continental scale project (same approach) was proposed as an international research project to set scientific baseline for integrated pan-European raptor monitoring scheme.

ASSESSMENT OF THE RESULTS AND IMPACT OF THE EVENT ON THE FUTURE DIRECTIONS OF THE FIELD

The results of the workshop gave sufficient future perspectives for EURAPMON network in terms of collaborative work and as feed-in for future international project applications. The main novelty is to enhance international research cooperation in order to conduct continental scale studies with integrated population and ecological data about raptor species over the whole distribution range in Europe. Currently, studies are mainly focused on local or national scale, but the need for large-scale approach is needed to obtain advanced and comprehensive raptor research in Europe on one hand and establishment of pan-European raptor monitoring scheme of the other.

Workshop: Monitoring contaminants, emerging diseases and environmental change with raptors (including the use of scientific collections) and the links to human health

Paola Movalli

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INTRODUCTION

There is increasing interest worldwide on a One Health approach which links wildlife, environmental and human health. This workshop examined the relevance of raptor research and monitoring to this emerging One Health agenda. It considered specific case studies where the link between raptor research and monitoring and human health has been made, including work on diclofenac and on lead. It also considered what role scientific collections (of raptor specimens) may play in research and monitoring on contaminants, emerging diseases and environmental change, and how this links through to human health.
The workshop session included four presentations, from Paola Movalli, Oliver Krone, Debbie Pain and Dan Osborn, followed by discussion.

PURPOSE

The workshop sought to raise awareness in the raptor research and monitoring community of the links between raptor R&M and human health. It sought to outline challenges and opportunities with a view to taking forward this area of work linking raptor research and monitoring to human health in a possible EURAPMON follow-on programme. By linking raptor research and monitoring to human health, the impact and relevance of the work can be enhanced and this can help secure more resources for raptor research and monitoring.

OVERVIEW OF CONTENT

1. Monitoring contaminants, emerging diseases and environmental change with raptors (including the use of scientific collections) and the links to human health (Paola Movalli)

This presentation covered: a brief overview of the EU policy context for linking monitoring of environmental components such as raptors to human health; the 'One Health' approach; the variety of ways in which raptor monitoring may be of relevance to human health; the role that scientific collections of raptor specimens, such as those of the Naturalis Biodiversity Centre in The Netherlands, can play in taking forward work linking raptors and human health; pilot work being carried out at the Naturalis; challenges and opportunities in relating raptor research and monitoring to human health.

EU policy context

There are several areas of EU policy or programme activity of relevance to research and monitoring on raptors in relation to human health. These include: policy on chemicals; the programme on emerging and vector-borne diseases; and policy on environmental change.

As regards chemicals, there is growing concern in the EU and worldwide about negative human health and environmental impacts caused by chemicals, in particular endocrine disruptors. The EU has introduced regulations aimed at phasing out endocrine disruptors in water, industrial chemicals, plant protection products and biocides. The European Commission is currently working on a proposal for science-based criteria for endocrine disruptors. The European Community is also a party to the Stockholm Convention on Persistent Organic Pollutants (POPs). The European Commission is developing a strategic approach to the effects of medicinal drugs on the environment. However, there is still a lot of scientific concern that not enough is being done to safeguard environmental and human health from the impacts of toxic chemicals.
As regards emerging and vector-borne diseases, the European Centre for Disease Control runs a major programme aimed at monitoring the spread and limiting the health impact of such diseases.
As regards environmental change and human health, there is increasing recognition of the potential health impacts of environmental change including change resulting from climate change and biodiversity loss. An EU Environment and Health Strategy is in place (though needs updating).

The 'One Health' approach

One Health is defined as "the collaborative effort of multiple health science professions, together with their related disciplines and institutions – working locally, nationally, and globally – to attain optimal health for people, domestic animals, wildlife, plants, and our environment."
The One Health approach is based on several considerations:

- the recognition that nearly 75 percent of all emerging human infectious diseases worldwide in the past three decades originated in animals;
- the recognition that environmental health may affect human and animal health through contamination, pollution and poor conditions that may lead to new infectious agents;
- the conviction that, to provide adequate healthcare, food and water for the growing global population, the health professions, and related disciplines and institutions, must work together.

The Scope of 'One Health' includes the convergence of environmental health with human, animal and plant health, and issues such as the detection and response to contaminants, surveillance and prevention of emerging diseases, and the relationship between environmental change and human health.
Potential outcomes of the 'One Health' approach include: more interdisciplinary programmes; more information sharing; and more prevention of harmful impacts.

Links between raptor R&M and human health

Raptor research and monitoring is of great relevance in this One Health approach and can usefully inform human health issues.
As regards environmental contaminants, there is a long history of ecotoxicological research and monitoring with raptors. Raptors are good indicators to reveal the environmental incidence of contaminants and more can be done to relate contaminants in raptors to the risks posed by these contaminants to human health. A good example is the impact of the veterinary drug diclofenac on vultures and the resulting spread of rabies in humans (see presentation by Debbie Pain).
As regards emerging and vector-borne diseases, raptors in Europe and the US are, for example, increasingly affected by west nile virus, which in humans is a potentially fatal infection. Work on the spread of west nile virus in raptors, for example in Austria, is already providing information

on the risks to humans. Raptors have also been found to show infection with candida strains resistant to antifungal therapies. Monitoring of candida in the gastrointestinal tract of raptors may therefore help elucidate risks to human health from the environmental presence of contaminants, which lead to resistant strains of candida.
And as regards environmental change, stable isotope analysis of raptor tissues can reveal changes over time in feeding ecology and in habitats, which can have related impacts on human health and wellbeing.
Environmental change, contamination and emerging diseases are frequently linked. For example, the emergence of infectious diseases is frequently a consequence of anthropogenic environmental change. Raptor research and monitoring offers potential to explore these linkages.

Role of scientific collections
Museum collections have huge potential value in taking forward the One Health agenda and specifically in providing large collections of raptor specimens for research linked to environmental and human health.
As regards environmental contaminants, the link between the chlorinated hydrocarbons in DDT and the decline of the peregrines was revealed by studies on museum collections of raptor eggs. This raised awareness of the posed by such chemicals to humans. Raptor tissues from museum collections and specimen banks (feathers, eggs, blood, muscle, kidney, adipose tissue, bone) offer the potential to research contaminant levels in raptors over space and time, allowing better-informed interpretation of modern-day contaminant levels. This can better inform understanding on risks to human health from such environmental contaminants.
As regards emerging and vector-borne diseases, collections of raptor tissues in museums such as Naturalis (which continues to acquire specimens), and in environmental specimen banks, could become increasingly important in tracking the spread of pathogens such as the west nile virus.
As regards environmental change, museum collections can be used for work to elucidate historical change in habitats, and this can inform thinking on the likely impacts on such change on human health and wellbeing.

Pilot work at Naturalis
At Naturalis, we are currently carrying out a pilot project to demonstrate the potential to exploit the world-class collection of raptor specimens to derive data on historical levels of persistent, bi-accumulative and toxic chemicals. Such data can provide baselines against which to evaluate modern-day chemicals. This work involves the analysis of feathers from kestrel collections, using neutron activation at the INAA facility at TU Delft. Feathers are amenable to the study of a range of contaminants including mercury and certain persistent organic pollutants. As part of this work, we are also preparing a protocol on the sampling of museum feathers for work on environmental contaminants. We are also exploring the possibility of linking temporal and spatial data on endocrine disrupting chemicals in raptors to the incidence of endocrine-related health impacts in humans.

Scientific Collections International
SciColl is a collaboration between many of the world's leading natural history collections, which aims to increase the use and impact of scientific collections for interdisciplinary research and societal benefits, and expand the access, awareness and appreciation of scientific collections. SciColl promotes a new generation of interdisciplinary research that relies on collections, through conferences, workshops and networking activities devoted to four global research challenges –

emerging diseases, environmental change, food security and human migration. Work on raptor collections can be of particular relevance to the first two of these:

- Emerging diseases. Infectious human diseases emerge when changes in climate and the distribution of wild habitats, agricultural lands and human-dominated areas bring pathogens, disease vectors and disease reservoir populations into new contact. Scientific collections provide unique opportunities to study these changing distribution patterns as well as the evolution of the pathogens and their hosts.
- Environmental change. Earth's environment has changed throughout its history and scientific collections provide the lenses through which these changes can be observed. New instruments allow data mining from new and old collections, offering new historical records of phenomena such as biodiversity (using DNA, for example) or climate (using isotopes).

Scientific collections and capacity-building

Scientific collections provide a valuable resource for capacity building and can be valuable partners for summer schools, workshops and exchange visits in any EURAPMON follow-on. The EURAPMON Summer School, which was held at Naturalis, illustrates this nicely. The summer school provided an opportunity for 14 early stage researchers to expand their knowledge of raptor monitoring, including hands on use of museum specimens. This proved an inspirational setting for the participants. A report of the Summer School is available on the EURAPMON website.

Challenges and opportunities

Challenges relating raptor R&M to human health include the need to better elucidate and demonstrate:

- the links between contaminants in raptors and human health;
- the utility of raptors for the monitoring of emerging and vector-borne diseases in relation to human health;
- the utility of raptors for the monitoring of environmental change in relation to human.

Opportunities include:

- incorporating work on these challenges within a EURAPMON follow-on networking project (e.g. COST Action)
- making greater use of raptor collections in museums and specimen banks in addressing these challenges by bringing these collections in to the network.

2. Contaminants in raptors as apex predators affecting human health. Lead intoxication in white-tailed sea eagles in Europe. (Oliver Krone)

The oral ingestion of lead containing bullet fragments and lead shots embedded in live prey or carrion poses the most important mortality factor for the white-tailed sea eagle accounting for 25% of the mortality in Germany. To investigate the causes of the lead intoxications in the white-tailed sea eagle (WTSE) as an umbrella species for other scavenging birds and to develop potential solutions to the problem a joint research project was initiated by the IZW. In the project which was funded by the Federal Ministry of Education and Research (BMBF) social scientists, biologists and veterinarians worked together. From the beginning all relevant stakeholders such as representatives from hunting organisations, ammunition industry, nature conservation organisations and scientists were involved in the process. Topics covered within the joined-

project focused on home range size, food choice and feeding behaviour and on the impact of lead intoxication for the population of the white-tailed sea eagle. In addition lead free rifle bullets were tested regarding their performance and effect on game animals. Geese and ducks, potential prey of the sea eagle were analysed for the number carrying lead shot bullets in their bodies. A discourse and a conflict analysis were conducted to better understand the arguments and concerns of the different stakeholder parties. A national questionnaire revealed the state of information among the hunters and their understanding to the problem. All results were immediately communicated to the stakeholders by a project homepage (www.seeadlerforschung.de) and at workshops. A leaflet and three brochures have been produced to inform a broader audience interested (Krone et al. 2009b). The striking results on the white-tailed sea eagles initiated follow-up studies on safety aspects of rifle bullets, on the performance of lead-free bullets under real hunting conditions and on the contamination of game meat and consumers' health.

3. Lead ammunition and Diclofenac: Case studies linking raptor, environmental and human health. (Debbie Pain)

Many diseases including those caused by contaminants impact the health of humans, livestock, wildlife and the environment, sometimes in simple ways but often in complex ways that are difficult to predict. Recognition of these links led to the One-Health approach to preventing and mitigating disease risks through cross-sectoral collaborative working. This talk focuses on two contaminants with very different types of human-raptor linkages.

Lead is a highly toxic metal that has been removed from most of the major uses that put at risk human health. However, most ammunition (gunshot and bullets) is still made from lead. Lead ammunition fragments on impact, generally leaving many tiny lead fragments scattered throughout game animals. Lead poisoning of scavenging and predatory raptors that feed on game is a long-recognised cause of mortality, and research and monitoring has considerably furthered our understanding of the disease. More recently, awareness has grown of the risks to the health of human consumers of game shot with lead. Raptors have proven good sentinels of this risk.

Diclofenac is a non-steroidal anti-inflammatory drug (NSAID) that has been widely used in human and veterinary medicine. Across the Indian subcontinent, vultures of the *Gyps* genus, that scavenge dead livestock, declined from being the most numerous large birds of prey to near extinction. This was caused by their sensitivity to diclofenac, widely used as a welfare drug to treat sick cattle. The impacts of the vulture declines on human health and welfare are multiple and significant, culturally and economically. For example, fewer vultures to scavenge cattle carcasses have been associated with increases in feral dogs, dog bites, and human rabies cases.

Both case studies show the value of a One-Health approach to the investigation, prevention and management of risks from contaminants.

5. Raptors and human well-being. (Dan Osborn)

Raptors, along with other top-predators, have been seen as having an iconic value for centuries and are valued by many people for many reasons. There is a continuing close association between people and raptors in many parts of the world. One key factor in human well-being is the links that exist between people and their environment, as illustrated by the values that are attached to coasts, woodlands and gardens in the UK National Ecosystem Assessment and emerging findings that interaction with green space boosts both physical and mental health. Do we know the role that raptors play in these aspects of well-being? If we do not

we should find out because well-being sits at the base of both the economy and health and a new model of the economy is emerging that is based less on consumption. This new model contains elements linked to well-being. The contribution raptors make to these elements of the economy and human health need to be better characterised, described in various circumstances and, where appropriate, valued in market and non-market terms that include cultural values and shared social values and not just the values individuals might assign. Doing so might help improve human well-being and the way we make decisions about how best to conserve raptors.

KEY DISCUSSION POINTS

Discussion highlighted the importance of making links to other groups and initiatives, and recognising existing the regulatory and policy context e.g. One Health initiative; UNESCO intangible cultural assets; EU chemical Regulations; Convention on Migratory Species.
Discussion also highlighted the need to assess the value of raptors in relation to human health and wellbeing. This includes monetary values (e.g. in the UK, 1 pair of ospreys can generate revenues of €1 million), the social value of raptors (people like to see raptors in their environment) and their value in demonstrating regulatory compliance (chemicals, nature conservation). There is also a need to recognise the potentially significant cost of not monitoring raptors (e.g. the cost of the vulture decline in South Asia has been put at $34bn, and may have been less had the decline been identified sooner).
A number of tractable issues link raptors and people, including:

- lead in ammunition poses health and well-being problems (nervous system);
- visceral gout in vultures as an indicator of anti-inflammatory veterinary drug impacts (esp. Italy and Spain?), which may be used to avoid social and economic losses as occurred in India;
- mercury as a concern for both raptors and humans.

Areas with potential for development include:

- the utility of raptors to monitor the spread of selected emerging diseases;
- re-telling the POPs narrative to encompass raptor and human health reproductive, neural and disease issues;
- the economic and social value of raptors to human wellbeing as part of OECD and EU initiatives on ‘Beyond GDP’;
- better use of scientific collections to get temporal and spatial change and environmental change information, using a range of stable isotopes (e.g. Pb, Cd, Hg).

ASSESSMENT OF THE RESULTS AND IMPACT OF THE EVENT ON THE FUTURE DIRECTIONS OF THE FIELD

The workshop will have raised awareness in the raptor research and monitoring community of the links between raptor R&M and human health. The session highlighted a number of challenges and opportunities with a view to taking forward this area of work linking raptor research and monitoring to human health in a possible EURAPMON follow-on programme. By linking raptor research and monitoring to human health, the impact and relevance of the work can be enhanced and this can help secure more resources for raptor research and monitoring in the future.
Workshop presenters will prepare a joint account of the workshop for publication and this will be disseminated to practitioners and researchers working on One Health and on Beyond GDP.

Workshop: Setting strategic priorities for pan-European monitoring of raptor populations and demography – guidance for decision makers

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INTRODUCTION

Resources for nature conservation are always limited. Whilst the monitoring of population numbers and demography is an essential tool in conservation planning and outcome evaluation, it is increasingly important to carry it out in resource-efficient ways. This is especially true where there is, as is often the case, a trade-off between resources available for monitoring and those for active conservation programmes. In an ideal world, we might well aspire to monitor and carry out intensive ecological studies of all raptor species but, at both national and pan-European scales, it is generally not possible to monitor everything, and there is unfortunately often a need to establish monitoring priorities. This workshop sought to develop previous EURAPMON work to provide guidance on appropriate assemblages of raptor species to monitor at pan-European scale.

PURPOSE

The workshop had two aims:

1. To examine the feasibility of producing a categorisation of European raptor and owl species according to a range of criteria, and associated guidance for use; and
2. To consider how such a categorisation could be used to assist conservation organisations and decision makers in selecting appropriate suites of species to monitor depending on national and, particularly, EU needs and priorities.

OVERVIEW OF CONTENT

The workshop considered criteria previously suggested for ranking European raptor species and identifying priorities, including: global, EU and national conservation responsibility (conservation status and listings); suitability as bioindicators (e.g. of habitat change or wider biodiversity); sensitivity to climate change; contaminant influence; susceptibility to other specific threats (e.g. wind farms). It also considered practical criteria for selection of species to monitor, such as: the distribution of each species across Europe; existing monitoring coverage (based on the EURAPMON inventory work); and ease of monitoring.

Workshop schedule and speakers

14:00 – 14:15 Introduction to workshop aims and outputs (Dr Chris Wernham)

14:15 – 14:30 Do global and European conservation status and obligations dictate monitoring priorities? If so, how? (Mr András Kovács)

14:30 – 14:45 Which raptor species might be suitable indicators of wider biodiversity or broad habitat/land-use/climate change? What characteristics of species dispose them as good indicators of environmental change? (Dr David Noble)

14:45 – 15:00 Which raptor species might be particularly susceptible to specific human-induced threats? What characteristics of species render them particularly susceptible? (Dr Staffan Roos)

15:00 – 15:15 Practical considerations for setting species monitoring priorities: existing monitoring coverage and ease of monitoring? What characteristics of species influence monitoring practicalities? (Dr Mark Wilson & Dr Chris Wernham)

15:15 – 15:45 1st BREAK-OUT GROUP SESSION – Further consideration of selection criteria

15:45 – 16:00 Reports back from break-out groups (3 x 5 minutes)

16:00 - 16:30 2nd BREAK-OUT GROUP SESSION – Processes for scoring species against criteria How can species be scored objectively under each criterion (at the workshop and subsequently)? What other guidance to needs to accompany the species categorisations?

16:30 – 16:45 Reports back from break-out groups (3 x 5 minutes)

16:45 – 17:00 Sum up and next steps (Chris Wernham)

KEY DISCUSSION POINTS

The break-out groups first discussed the question - **was the suggested prioritisation work useful?** There was agreement that it was useful for a number of reasons, but also that it was not simple to achieve and that clarification of the approaches that would be used was important. It was suggested that recommendations for enhanced monitoring should not always be focused on species of current conservation concern (conservation listings) because these species already receive a high degree of obligatory monitoring coverage by countries, and not all current threats to raptors would be monitored effectively by simply selecting those with high current conservation listing status. The dichotomy between species that are threatened (rarer species) and species that can be good wider indicators (commoner species) was also highlighted. However, given a choice between two species that were equally suitable for monitoring under a particular criterion, it was felt that the more endangered or decreasing species should be selected. It was felt sensible to try to build on existing monitoring coverage (as reflected in the EURAPMON monitoring inventory).

The groups also considered the **appropriate audience for the outputs of the work**, and concluded that any product should be aimed at EU-scale decision makers (as befits the remit of EURAPMON).

The groups then considered the **parameters most useful to monitor**, depending on the criteria used to select species for monitoring. Population numbers (breeding, wintering and on migration) and breeding success were thought to be most practical to monitor routinely for many species but other parameters (e.g. survival rates and population age structure) should also be monitored whenever resources allow (particularly for long-lived species, as this information can give early warning of adverse changes). The value of existing, long-term data sets, that would allow

observed changes in demographic parameters to be more effectively placed in a biological context, was also highlighted. Overall it was concluded that all breeding parameters can be important but each must be considered in relation to the criteria being used to select between different species, and the life history strategy of each species being considered.

Each group then considered in more detail the **criteria and methods (rationale) that could be used to categorise species, and the justification for these choices**.

Group 1 focused on **practical considerations** (current coverage by monitoring schemes and ease of monitoring). Species that were easy to monitor (e.g. by volunteer non-expert observers) and those covered by multi-species common bird monitoring programmes were considered 'easy wins' for selection. For species considered very hard to monitor, it might be possible to monitor appropriate surrogate species (that respond in a similar manner to environmental change or given threats), but always bearing in mind the possibility that small differences in life history, habitat use, diet or other factors can lead to divergent population trends, even among closely related or ecologically similar species.

Group 2 focused on **specific threats to raptors**, bringing their shared knowledge and experience to bear on a broad range of such threats, including hunting, wind turbines, electrocution on powerlines, deforestation, urbanisation, forest fires, unintentional disturbance (e.g. rock climbing and paragliding), poisoning, and so on. Given the decision that EURAPMON should focus on producing a product for EU-scale decision makers, it was agreed that it was important to consider comprehensively the key threats to raptors across Europe (e.g. as outlined in the most recent round of EU Article 12 reporting) rather than selecting a series of more ad hoc threats (e.g. from the EURAPMON inventory, which is not comprehensive with regard to reporting of threats).

Group 3 focused on **raptors as indicators of wider biodiversity and environmental change**. Participants concluded that the most appropriate criteria depend on the needs of users but, in broad terms, they suggested that land-use needed to be split into some appropriate (but not too many) categories (e.g. forest; agricultural land) and that in including climate change it was important to consider mechanisms of response in choosing appropriate species. They also discussed the value of raptors as sentinels of change (e.g. Osprey in aquatic systems), diseases and parasites, and the need to think about emerging issues as well as established types of environmental change.

ASSESSMENT OF THE RESULTS AND IMPACT OF THE EVENT ON THE FUTURE DIRECTIONS OF THE FIELD

Table: The kind of product that we would aim to generate as guidance for EU-scale decision-makers following the discussions at the workshop.

Group of criteria	Suitability as indicator of wider biodiversity or broad-scale environmental change:				Susceptibility to key human-induced threats (e.g. from Article 12 reporting):			Suitability due to practical considerations:		Conservation status
Example sub-groups	Land-sue change (e.g. forestry management)	Climate change	Wider biodiversity or ecosystem health	Environmental contamination	Threat 1 (e.g. hunting)	Threat 2 (e.g. collison with mad-made structures)	Threat 3 . . .	Monitoring coverage across Europe (existing and historical)	Ease of monitoring (depending on parameter chosen)	IUCN EU BirdLife Life +
Rationale for use of each criterion										
Characteristics of suitable species and definitions of categories										
Species categorization (suitability = HIGH, MEDIUM, LOW)										
Species 1	H	L	H	M	H	L	L	M	M	H
Species 2	L	L	L	H	H	L	H	L	H	L
↓										
Species 56	L	H	M	H	L	H	M	M	H	H

For each criterion (column in the table), we would categorise species as HIGH suitability (there should be high agreement on these), MEDIUM suitability (there might be some disagreement on the merits of these species) or LOW suitability (there should be reasonable agreement that these species are not suitable). It was agreed that it would not be helpful to generate overall scores across criteria for individual species but rather combinations of rankings in columns could be used to identify sub-sets or suites of species that might be suitable for monitoring depending on the objectives and context of monitoring, or the resources available. The focus will be the relative suitability of species under each criterion (i.e. comparisons down columns) *not* comparisons of suitability across criteria. During the process of categorizing species under each criterion (column), it will be important to consider both the strength of evidence for suitability/threat and the strength of impact/response.

It was suggested that the approach required for the environmental and human health contamination work is rather different, in that the needs of major information users (such as the European Chemicals Agency – ECHA) are already clear and there is no need to provide further guidance on monitoring priorities. Rather, the approach should be to advise such users on what is possible to support their statutory duties. Further thought and liaison with the EURAPMON "with raptors" community is therefore required as to whether and how information on contaminant monitoring is included in our proposed outputs.

We agreed the next step will be to circulate a summary to the EURAPMON network asking for offers of help from people (experts on species/groups and also experts on wider criteria/threats) to work on the categorisation of species, and to manage this work. We would hope that the output could be made publically available – ideally as a peer-reviewed, open access publication in an appropriate journal, and also a concise and carefully tailored summary product, with appropriate guidance notes, targeted directly at the EU "for raptors" conservation policy audience.

PART C – CLOSING SESSION

Al Vrezec[1] and Guy Duke[2]

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INTRODUCTION

The closing session involved feedback from the workshop sessions held on the previous two days, and brief wrap up by the past and present EURAPMON Chairs.

PURPOSE

The purpose of the closing session was to provide feedback to all participants on the proceedings of the parallel workshop sessions, to provide comment on the Conference proceedings from the EURAPMON Chairs, and to obtain a degree of consensus on future priorities for a possible follow-on to EURAPMON.

OVERVIEW OF CONTENT

Feedback was provided from each of the parallel workshop sessions 1-4. Richard Shore provided feedback on Workshop 1, Al Vrezec on Workshop 2, Dan Osborn on Workshop 3 and Chris Wernham on Workshop 4.

A keynote presentation was given by Björn Helander (Swedish Museum of Natural History, Sweden) on "A case-study of an integrated for and with long-term monitoring of the White-tailed Eagle *(Haliaeetus albicilla)* in Sweden". The long-term study conducted for already 44 years revealed high importance of integrated monitoring between *for* and *with* raptor monitoring. Strong decrease in White-tailed Eagle population and reproduction stimulated more in depth research and monitoring of environmental contamination for which the eagle has been shown to be an excellent case study and indicative species. Dr. Helander posed some future challenges that should be addressed in future integration of *for* and *with* raptor monitoring:

1. Identify targets for reference with parameters to be used in various assessments for and with different species of raptors

- minimum survival rates, productivity (etc) to sustain populations, species specific, for use in assessments of population status
- critical habitat requirements (etc)
- assemble and scrutinize historical data for estimates of background reference data, for use in assessments of e.g. GES; reproductive parameters, physical measurements (e.g. shell thickness)

2. Strive for increased harmonization of methods, criteria, terminology etc.
3. Attract more young volunteers in the field work…

Guy Duke then provided brief comment on the Conference proceedings from his perspective as the founder Chair of EURAPMON. He noted that it had been a fascinating meeting, with a lot of

excellent presentations, plenty of discussion in the workshops and, just as importantly, outside the formal sessions, stimulating lots of new ideas. It had also been a great opportunity to meet old friends and colleagues and make new connections in a lovely setting with perfect organization.

Guy observed that EURAPMON has built a truly pan-European network, and has delivered significant benefits for the raptor R&M community in terms of outputs and collaborations. He sensed a strong motivation among participants to continue to build this network. The EURAPMON Steering Committee is committed to look for ways to take EURAPMON forward once ESF funding ends in May, and is looking at funding options for the future. He argued that, if EURAPMON is to secure further funding, it must focus on activities which enhance the societal relevance of raptor R&M, to human wealth, health and wellbeing.

Guy outlined in particular the opportunity to take the EURAPMON network forward through a Horizon 2020-funded COST Action. COST Actions are very similar to ESF Research Networking Programmes, with the focus being on networking as opposed to research per se, and typical activities including meetings, short-term scientific missions (up to 6 months), training schools, and dissemination. He noted that COST aims to enable breakthrough scientific developments leading to new concepts and products. COST objectives include '*addressing societal questions by promoting trans-disciplinary, new approaches and topics and identifying early warning signals of unforeseen societal problems...*' Raptor R&M can be of particular value in this respect.

A COST Action must include a network of proposers from institutions located in at least 5 COST Member Countries. The budget is approx. €130,000/year for 4 years, total €520,000 (a very similar level of funding to EURAPMON). The next 'collection date' (latest submission deadline) will be in September 2015, for which the funding decision would be notified in April 2016. COST Action proposals are evaluated on three criteria: excellence, impact, implementation. EU-scale impact is very important. Evaluators are also looking for added value in relation to existing/former efforts. Thus, EURAPMON needs to go beyond what it has done over the last 5 years, to address new challenges and opportunities.

Based on the proceedings at this Conference, Guy suggested the following issues of high EU societal relevance might be considered for possible inclusion as elements in a proposal for a COST Action:

1. Pan-European monitoring for priority substances, including non-steroidal anti-inflammatory drugs NSAIDs), Hg and Pb.
2. Post-marketing monitoring of pesticides to support the work of EFSA.
3. Working on contaminant baselines and reference using scientific collections.
4. Valuation of raptors in relation to human health and wellbeing.
5. Enhancing raptor R&M for Birds Directive Art 12 reporting.

Al Vrezec has noted that during the conference a clear indication was given within participants that EURAPMON network is needed and that pan-European monitoring scheme of raptors including *for* and *with* raptor monitoring perspectives is highly needed to achieve nature conservation as well as in human health important environmental targets. Therefore continuation of this network in the way of achieving pan-European monitoring scheme is essential, and the Final Conferences provided good baseline for that. Raptor monitoring is not focusing itself only to some specific topics and aims, but integrates quite large area of different scopes as shown on the conference, from nature conservation and research issues to human health, food safety and other issues of society interest. And all these provide great perspectives for integrated pan-European raptor monitoring and research scheme in the future.

KEY DISCUSSION POINTS

The suggested elements for a COST Action were discussed and were broadly supported by the participants.

ASSESSMENT OF THE RESULTS AND IMPACT OF THE EVENT ON THE FUTURE DIRECTIONS OF THE FIELD

The closing session provided significant material to inform the work of the EURAPMON Steering Committee in designing a possible follow-on to EURAPMON, and significant stimulus for participants to inform their future research and collaborations. In particular, the session is expected to enhance the future EU-scale impact of raptor research and monitoring, notably in relation to EU nature policy and EU pesticides regulation. The Conference as a whole will have further strengthened integration between ornithologists and ecologists and conservationists working 'for' raptors, and ecotoxicologists working 'with' raptors.

ANNEXES

Conference Programme

DAY 1
Monday, 9 March 2015
Morning session – EURAPMON achievements:

9.00–9.30 Introduction talks (**Dr. Al Vrezec, Mr. Guy Duke**, host University of Murcia)
9.30-10.10 Plenary 1: The value of bioindicators - what role can raptors play? (**Dr. David Noble, British Trust for Ornithology**)

10.10-10.50 Plenary 2: Contaminant monitoring using raptors - past, current and future perspectives (**Dr. Veerle Jaspers, Norwegian university of science and technology**)

10.50-11.15 Coffee break (**poster session** of EURAPMON short-visits, EURAPMON summer school held at Naturalis and of different raptor research or monitoring topics)

11.15-11.30 The road EURAPMON community has travelled (**Dr. Paola Movalli, Dr. Irena Bertoncelj**)
11.30-11.45 Overview of EURAPMON achievements (**Dr. Al Vrezec**)
11.45-12.10 A review of raptor and owl monitoring activity across Europe: its implications for capacity building towards pan-European monitoring (**Dr. Irena Bertoncelj, Dr. Maja Derlink**)
12.10-12.35 An overview of existing raptor contaminant monitoring activities in Europe (**Dr. Pilar Gómez-Ramírez**)
12.35-13.00 Best practices on raptor contaminant monitoring activities in Europe (**Dr. Silvia Espín**)

13.00-14.30 Lunch break

14.30 – 17.30 Afternoon session – User Needs at EU and International Levels (Session leaders: **Mr. Guy Duke and Dr. Dorte Herzke**)

- **Mr. Guy Duke**: "EU user needs for monitoring data on raptor populations in relation to the nature directives."
- **Dr. Jose Tarazona**: "Role of monitoring data with raptors in the EU environmental risk assessment of chemicals: Needs from regulatory scientific assessors."

20.00-00.00 Social Dinner

DAY 2
Tuesday, 10 March 2015

Morning session – future challenges for raptor monitoring 1:

9.00-9.10 Introduction to the workshops
9.10-12.10 Workshop 1 (parallel): Development of pan-European contaminant monitoring using raptors (Chair: **Prof. Richard Shore**)

9.10-12.10 Workshop 2 (parallel): Towards good practice guidance for raptor monitoring in Europe (Chair: **Dr. Al Vrezec**)

- **Dr. Amy Challis**: "The Scottish Raptor Monitoring Scheme - recent developments in good practice multi-species monitoring."
- **Dr. Ülo Väli, Jaanus Elts, Asko Lõhmus, Rein Nellis, Renno Nellis, Hannes Pehlak**: "Raptor monitoring in Estonia, 1994-2014: Raptor Grid vs. common bird surveys."
- **Mr. Jean-Paul Urcun**: "Transpyr : a transboundary program for monitoring raptor populations through migration counts in the Pyrenees, focus on Organbidexka Pass."
- **Dr. Michele Panuccio**: "The migration of Honey Buzzards in southern Italy: results of different monitoring projects."
- **Dr. Jan Ove Gjershaug**: "Monitoring of Golden Eagle in Norway."
- **Gabor Papp**: "Monitoring of the Golden Eagle in Hungary."
- **Dr. Al Vrezec**: "Population monitoring of the Tawny Owl in Slovenia: playback and nestbox approach."
- **Prof. Pertti Saurola**: "Towards integrated population monitoring: productivity, survival and population change of the Finnish Tawny and Ural Owls."

12.10-14.00 Lunch Break

Afternoon session – future challenges for raptor monitoring 2:

14.00-17.00 Workshop 3 (parallel): Monitoring contaminants, emerging diseases and environmental change with raptors (including the use of scientific collections) and the links to human health (Chair: **Dr. Paola Movalli**)

- **Dr. Paola Movalli**: "Monitoring contaminants, emerging diseases and environmental change with raptors (including the use of scientific collections) and the links to human health."
- **Dr. Oliver Krone:**"Contaminants in raptors as apex predators affecting human health."
- **Dr. Debbie Pain**: "Lead ammunition and Diclofenac: Case studies linking raptor, environmental and human health."
- **Prof. Dan Osborn**: "Raptors and human well-being"

14.00-17.00 Workshop 4 (parallel): Setting strategic priorities for pan-European monitoring of raptor populations and demography – guidance for decision-makers (Chair: **Dr. Chris Wernham**)
Invited speakers: **Dr. Chris Wernham, Dr. Mark Wilson, Mr. András Kovács, Dr. David Noble, Dr. Staffan Roos**.

DAY 3
Wednesday, 11 March 2015

Morning session – raptors in the wild:

9.00-9.20 Wrap up of Workshop 1 (**Prof. Richard Shore**)
9.20-9.40 Wrap up of Workshop 2 (**Dr. Al Vrezec**)
9.40-10.00 Wrap up of Workshop 3 (**Dr. Paola Movalli**)

10.00-10.20 Wrap up of Workshop 4 (**Dr. Chris Wernham**)

10.20-11.10 Coffee break (**poster session** of EURAPMON short-visits, EURAPMON summer school held at Naturalis and of different raptor research or monitoring topics)

11.10-11.50 Plenary 3: Monitoring for and with the White-tailed Eagle in Sweden (**Dr. Björn Helander, Swedish Museum of Natural History**)

11.50-12.05 European Science Foundation point of view (**Dr. Paola Campus**)

12.05-12.25 Summary of the conference and future challenges (**Mr. Guy Duke, Dr. Al Vrezec**)

12.25-12.35 Conference conclusion (**Dr. Al Vrezec**)

12.35-14.00 Lunch Break

Afternoon session – field excursion:

14.30-18.00 Field excursion for participants

List of participants

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