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András Kovács, Ubbo C. C. Mammen and Chris V. Wernham

European Monitoring for Raptors and Owls: State of the Art and Future Needs

Sixty-four percent of the 56 raptor and owl species that occur in Europe have an unfavorable conservation status. As well as requiring conservation measures in their own right, raptors and owls function as useful sentinels of wider environmental "health," because they are widespread top predators, relatively easy to monitor, and sensitive to environmental changes at a range of geographical scales. At a time of global acknowledgment of an increasing speed of biodiversity loss, and new, forward-looking and related European Union biodiversity policy, there is an urgent need to improve coordination at a pan-European scale of national initiatives that seek to monitor raptor populations. Here we describe current initiatives that make a contribution to this aim, particularly the current "MEROS" program, the results of a questionnaire survey on the current state of national raptor monitoring across 22 BirdLife Partners in Europe, the challenges faced by any enhanced pan-European monitoring scheme for raptors, and some suggested pathways for efficiently tapping expertise to contribute to such an initiative.

Eastern Imperial Eagle *Aquila heliaca* (Photo: A. Kovács).

INTRODUCTION

Background, Aims, and Approaches

At present, 64% of the 56 raptor and owl species that occur in Europe have an unfavorable conservation status (1). As well as pan-European concern for these birds in their own right, many of the species represent sentinels of ecosystem change at a time of global acknowledgment that biodiversity loss is intensifying, at least partly as a result of climate change. Raptors and owls are valuable in this respect, because they are top predators (integrating a range of specialist and generalist food chains), many are widespread across large geographical areas, they are relatively easy to study compared with other taxa, and some are particularly sensitive to environmental changes at a range of spatial scales (2, 3). Because of their position high in the food chain, raptors and owls are among the first organisms to show measurable responses to changing environmental conditions and pressures. Changes in their population size or demographic rates indicate changes (which may be adverse) in the environment and/or that differing competition for resources is arising, changes that may be natural or anthropogenic but that may well need to be understood and acted upon. Thus, information that the monitoring of raptor populations provides is of environmental, social, and economic importance.

In 1988, the Martin-Luther University, Halle, Germany, founded MEROS (the "monitoring of European raptors and owls" scheme), with the aim of bringing together and making available the results of the many local and regional raptor and owl monitoring activities that were known to be taking place across Europe. Still extant, this scheme has achieved a great deal (see below). However, it has also identified some of the challenges of encouraging and maintaining such cooperation at a pan-European scale. A workshop on "The Development of a European Raptor Monitoring Network" (Sicily, October 2006) brought together approximately 30 participants from a broad range of raptor-monitoring backgrounds across Europe; they agreed on the increasing applied need for greater European cooperation, data gathering, and reporting of raptor population and demographic data to assist raptor conservation. For the presentation at that meeting, BirdLife Hungary had coordinated a questionnaire survey of BirdLife Partners across Europe, with the aim of reviewing relevant projects in progress.

The European Union (EU) recently updated its biodiversity policy and set key objectives to 2010 and beyond (4). One of these is to conserve "most important species and habitats," including a large proportion of Europe's raptor species and the habitats in which they live. A pan-European monitoring scheme for raptors would make a large contribution toward EU policy needs in this context by

- building a strategic monitoring program based on standardized methods;
- promoting effective and efficient information exchange and skills and/or technology transfers between European countries (with associated savings in time, energy, and funding); and
- providing timely and accessible trend information and policy advice toward effective raptor conservation.

Here we aim to summarize, as best we can, the state of raptor monitoring for raptors across Europe. By "monitoring for raptors," we mean the recording of information on population numbers, territory occupancy, demographic parameters, and other related biological variables that contribute to our

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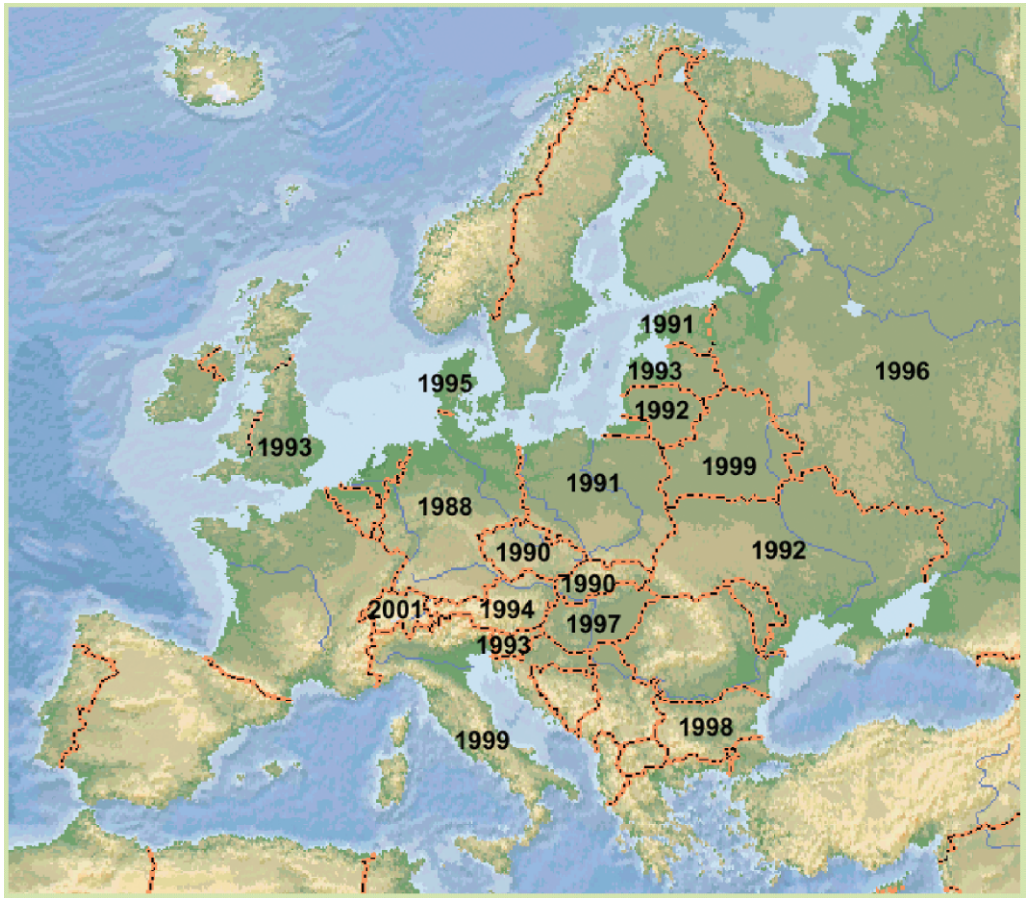

Figure 1. EU member states that participate currently in the MEROS program (since year shown).

understanding of raptor population status and "health." Here, we specifically do not include monitoring environmental contaminant levels and related variables in raptors. Although such variables also potentially contribute to knowledge of raptor population health, they are dealt with in a separate article in this volume (5). We include the monitoring that already feeds into the MEROS scheme, and the results of the BirdLife questionnaire survey. We then examine some of the key challenges that face the maintenance and enhancement of a pan-European reporting scheme and suggest ways that some of these challenges might be met in the future. With limited time and resources available for our review, we do not profess to present a comprehensive inventory of every project that monitors for raptors in Europe, but it is our hope that we include some of the key projects that set blueprints for the way forward. Most of all, we very much hope that this review will encourage those individuals and organizations that carry out relevant raptor monitoring work in Europe, but with which we failed to make contact so far, to make themselves known to us, and that they will also be keen to participate in any future initiatives to develop a pan-European scheme.

MEROS: MONITORING OF EUROPEAN RAPTORS AND OWLS

At its establishment in 1988, the MEROS program (6) comprised 85 study plots and 100 volunteers. Since 1990, it has been continuously extended, and today draws in information from 18 European countries: Austria, Belarus, Bulgaria, Czech Republic, Denmark, Estonia, Germany, Hungary, Italy, Latvia, Lithuania, Poland, Russia, Slovakia, Slovenia, Switzerland, Ukraine, and the United Kingdom (Fig. 1). These data originate from almost 600 study areas and around 196 000 raptor and owl territories (although only around 270 of the 600 areas supply data each year; some information also dates back to the 1950s, because historical data sets have been collated in some cases). Information is received for 26 raptor species (of which 19 species are listed in Appendix 1 of the EU Bird Directive) and 11 owl species (6 listed in Appendix 1 of the EU Bird Directive) (7).

MEROS encourages a survey-plot–based recording approach, designed explicitly to be suitable for raptors and owls. The basic elements of the program comprise a stable network of study plots (average of 120 km^2 in size) and a dedicated database that is routinely updated to hold the data securely in the long term. Fieldworkers participate voluntarily in the program, on condition that they: *i)* define a freely selected study area that they monitor for several years (at least 3 years), *ii)* carry out fieldwork to define minimum scientific standards to record and report breeding population numbers and/or breeding success (the number of young per breeding pair), and *iii)* use the same field methods and survey effort each year. Any given study plot must be at least 25 km^2 in extent, but observers are free to select the size and shape of their area, dependent on their selected study species and the structure of the local terrain. The survey methods applied are species specific, and observers are encouraged to carry out rigorous work on one or a small number of species within their study area, rather than only semiquantitative work on a wider range of species.

The Society for Ecology and Monitoring of Raptors and Owls has been responsible for managing MEROS since 2002, and the program is currently funded by private sponsors. MEROS cooperates closely with many ornithological stations. Most of its volunteer surveyors are ornithologists, but some hunters and falconers also take part. All contributors receive the "Annual Report of Raptors and Owls" (8, 9), which contains details of the numbers of records submitted in the relevant year, a list of contributors to the scheme, and summarized population

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Table 1. Results of BirdLife questionnaire about raptor monitoring activities in Europe.

	No. BirdLife Partners (of 22)	%
What do you monitor?		
Rare and threatened raptor species	19	86
Common raptor species	19	86
Distribution (presence/absence)	13	59
Population size (breeding)/trend	18	82
Breeding success	14	64
Threats	15	68
Habitat quality	6	27
Habitat use	7	32
Other	4	18
Where?		
Throughout the country	15	68
Focusing on important bird areas	11	50
Focusing on special protection areas	11	50
Ramsar sites	5	23
Focusing on areas protected at national level	9	41
Outside protected areas	10	45
Other	5	23
How often?		
Constantly (throughout the year)	9	41
Seasonally—breeding season	17	77
Seasonally—winter counts	14	64
Seasonally—counts of migrants	10	45
Occasionally	7	32
By what means?		
Total counts	17	77
Transects	8	36
Point counts	10	45
Territory mapping	10	45
Synchronous counts	8	36
Individual marking	8	36
Occasional observations	13	59
Other	1	5
Individual marking		
Regular (aluminium) rings	13	59
Color rings	7	32
VHF (radio) tracking	7	32
Satellite tracking	5	23
Wing tags	6	27
Bleaching	0	0
Other	1	5
Data management		
Common monitoring database	14	64
Species specific database	11	50
Species specific geographic information system	9	41
Species specific research	13	59
Data provision to other institutions (e.g., state nature conservation organization)	14	64
Regular cooperation		
With other national raptor conservation organizations	14	64
With BirdLife Partners	12	55
With other international organizations	11	50
Funding		
Mainly national funding	11	50
Mainly foreign funding sources	6	27
Mainly state funding	8	36
Mainly private sponsorship	9	41

trend and breeding success information. In addition, MEROS has published 4 supplement publications on the scheme (10–13), and more than 30 research articles have been based on scheme data, e.g., on Tengmalm's owl *Aegolius funereus* (14), eagle owl *Bubo bubo* (15), goshawk *Accipiter gentilis* (16), and red kite *Milvus milvus* (17). Some analyses of trend information from the scheme have been undertaken (18) and comparisons made between reproduction of raptors in Germany and the Czech Republic (19). MEROS hosts a scientific conference for scientific exchange every 4 years and publishes associated papers in proceedings (20, Mammen, in prep.). "Furthermore, there are irregular smaller meetings to present recent results and/or to enlist new members.

BIRDLIFE INTERNATIONAL: STATE OF MONITORING FOR RAPTORS IN EUROPE

The BirdLife International Partnership is one of the leading organizations in the monitoring and conservation of European birds of prey and owls (21). For the raptor monitoring workshop (Sicily 2006), MME/BirdLife Hungary initiated a questionnaire survey among BirdLife Partners about the current state of monitoring raptors in Europe. The purpose of the survey was to get an overall picture of the capacity and extent of ongoing raptor monitoring activities of the European BirdLife Partners and, by providing feedback to respondents, to promote future cooperation among the respondents. The simple questionnaire was designed to answer the most important questions about any monitoring efforts (what, where, when, and by what means) by listing options on the target species, area coverage, frequency of surveys, and methods used. Additional questions were developed to gather information about individual marking of raptors, management of monitoring data, cooperation with other organizations, and sources of funding.

Altogether, 22 BirdLife Partners completed and returned the questionnaire (see Table 1). Based on the information gathered, the majority of responding BirdLife Partners conduct country-wide monitoring of rare and threatened raptor species, as well as more common species, and focus on their population size and trend, threats, breeding success, and distribution. The main periods of the year for data collection are the breeding season and the winter months. Half of the BirdLife Partners monitor raptor populations in important bird areas and in special protection areas. Most of the Partners carry out total counts, complemented by occasional observations. Besides the most often used regular (metal) rings, approximately 30% of the Partners apply markers and tools (color rings, tags, and transmitters) make remote individual identification possible. The majority of Partners have developed their own common monitoring databases but, in addition, conduct some species-specific research. Most of them cooperate regularly and share information with other leading national and international raptor conservation organizations or expert groups within and outside the BirdLife Partnership.

We must stress that this assessment is based only on direct correspondence with BirdLife Partners across Europe. We have not had the time to carry out a more comprehensive assessment of other raptor monitoring initiatives. Some important examples of these are described in other articles in this volume (22, 23). A number of partners that responded to the questionnaire indicated that the majority of raptor monitoring in their country was carried out by organization(s) other than the BirdLife Partner (e.g., in Finland, Romania, Slovakia, and Switzerland).

CHALLENGES AND FUTURE DEVELOPMENTS

Key Challenges for a Pan-European Monitoring Scheme for Raptors

The existing MEROS program provides an established and sound basis from which to build an enhanced truly pan-European monitoring scheme for raptors. However, experience and knowledge gained from MEROS and the many national raptor monitoring programs (e.g., the Scottish Raptor Monitoring Scheme [23], and the Finnish Raptor Grid [22, 24]) must be tapped effectively to make timely and efficient progress. Because a number of raptor species are of immediate conservation concern and/or are subjected to deliberate and illegal persecution by humans, many raptor fieldworkers regard their data (particularly georeferenced location data) as highly sensitive. This means that they need to be assured that the

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information they provide to any European scheme will be stored securely. They also need to have clear explanation of the reasons for collation of the data and its value as an evidence base for applied conservation science purposes, and to receive regular feedback on the scheme and uses of their data. Language differences make building this understanding more difficult at a pan-European scale (as MEROS has identified); solutions need to be found by building effective relationships between any pan-European scheme and national coordination points in each participating country or area, so that the national coordination organization can act as an effective "bridge" and can interact with local fieldworkers in the local language. In this context, it is also likely to be preferable for the national coordination organization to collate and hold the raw data, with appropriate summary data only passing to the pan-European scheme, to reduce the concerns of individual contributors about their sensitive data being passed on to third parties.

A pan-European monitoring program for raptors will be most effective if potential exists to compare trends in the same species between different countries or regions, because such comparisons can give clues to reasons for adverse population changes in some cases. In addition, national boundaries are artificial from a biological perspective, and, to show representative population trends for many species, cross-border data sets are imperative. The selection of species to monitor as a high priority will be a major challenge for any enhanced pan-European scheme. National programs will all have their own priorities (see questionnaire section), generally a mixture of species of high current conservation interest and widespread, usually more common species that often form useful indicators of adverse changes in the wider countryside. There was consensus at the Sicily workshop in 2006 that any pan-European scheme should, as a priority, concentrate on promoting high and comparable standards of data collection among national schemes already in operation across a range of species and on transferring skills and knowledge to help establish schemes for key species of conservation concern in countries that do not currently have them. Expanding species coverage in a more proactive manner should become a strategic priority only once an enhanced pan-European scheme is firmly established.

Promotion of rigorous field survey techniques and recording protocols should be a core activity within an enhanced pan-European scheme. Indeed, this is a core part of the existing MEROS scheme. A relevant field guide to the survey and monitoring of raptors was recently published by the Scottish Raptor Monitoring Scheme (25), and provides a useful blueprint for translating and tailoring for other national schemes or a pan-European version. A useful Dutch guide to raptor monitoring also exists (26). Because most raptor monitoring is undertaken by volunteer fieldworkers, the survey design must often achieve a balance between statistical rigor and pragmatism, particularly in countries that have limited numbers of volunteers. Any enhanced pan-European monitoring scheme for raptors should valuably act as a "clearing house" for the sharing of expertise between participating countries, organizations, and individuals.

The recruitment and retention of volunteer fieldworkers to carry out survey work is a major concern for MEROS and many national schemes (23): older fieldworkers are retiring, and it is not easy to find younger volunteers with the skills to replace them and to maintain continuity on study plots in many cases. Thus, support for motivating and training volunteer surveyors should form a core activity of any enhanced pan-European scheme. Although these are issues across Europe, the Sicily workshop clearly identified that, in general, the countries of northern Europe have less difficulty in finding both volunteer surveyors and funding for monitoring than southern European countries. Although changing gradually, attitudes to wildlife are still very different in southern Europe, with much wildlife (including birds) still being seen as a resource for utilization and with little ethos of citizen science or volunteering established. Thus, skills and knowledge transfer from north to south in terms of educating the public about raptors and citizen science opportunities should also form a core activity of any enhanced pan-European scheme.

Perhaps the largest challenge for any pan-European scheme will be long-term continuity of funding to allow the activities that we suggest above to be maintained over time. In this respect, it is critical that the results from any such scheme are: *i)* scientifically rigorous; *ii)* well presented in a manner that is timely, freely available, and "digestible" to policy makers, conservation practitioners, and interested laymen, as well as scientists; and *iii)* that priority is given to making data collation and reporting as relevant to EU biodiversity policy and initiatives as possible, in addition to meeting national monitoring requirements.

The Way Forward: Models for Future Development

There are a number of existing schemes and initiatives from which experience and expertise can be derived for a pan-European monitoring scheme for raptors. MEROS (above) is a logical starting point in this respect. The Pan-European Common Bird Monitoring Scheme (PECBMS) (27), a joint initiative between the European Bird Census Council and BirdLife International, has established an efficient system for providing population-trend information for more than 120 widespread terrestrial bird species for the year 1980 onward, drawing data from 20 countries grouped into 4 biogeographical regions (28). Both MEROS and PECBMS have experienced and found solutions to the inherent problems of centralized data collation and the building of relationships with national coordination organizations, and have developed methods for combining data sets collected by using differing methodologies for producing summarized trends (8, 28). The PECBMS work on deriving biogeographical regions and selection of appropriate species for which to produce pan-European trends, therefore, is relevant to any pan-European raptor-monitoring scheme. The PECBMS currently generates European trends in population numbers for 3 widespread raptor species: common kestrel (*Falco tinnunculus*), common buzzard (*Buteo buteo*), and Eurasian sparrowhawk (*Accipiter nisus*).

To make the information from a pan-European raptor scheme as timely and accessible as possible, Web-based approaches, both to data collation and results presentation, must be considered (at least for development in the future). A number of organizations in Europe are well advanced in the development of Web-based software for entering ornithological data and have much experience in tailoring these to the needs of volunteer birdwatchers, who often have a range of computer experience and need appropriate guidance and training. The British Trust for Ornithology (BTO) in the UK now runs at least 5 Web-based recording schemes (29–31).

Similarly, a number of these organizations have developed comprehensive reporting of multispecies population information and demographic trends online, which are a logical reference source when considering the form of outputs from pan-European raptor monitoring (27, 28, 32–35). Similar organizations in other European countries also have well-developed on-line reporting structures (36). The European Union for Bird Ringing (37) has a great deal of experience of pan-European collation of bird-related data sets that should also be considered in this context. Few schemes have fully

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embraced reporting in a wide range of languages, however, which is likely to be important (at least in summary form) to retain volunteer motivation at a pan-European scale.

The first and most essential step in the development of a pan-European monitoring scheme for raptors is identification of existing relevant projects and expertise across Europe. It is our hope that the Sicily workshop and this review have gone some way to identifying a proportion of these existing activities, but we also hope that any organizations or individuals that carry out raptor monitoring but that are not currently known to us will make contact and support us in an inclusive attempt to enhance current pan-European monitoring activities for the future.

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