European Raptor Biomonitoring Facility
Advice Hub

Minimal recommended raptor monitoring scheme

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MINIMAL RECOMMENDED RAPTOR MONITORING SCHEME (MRRMS)

FOR ASSESSMENT OF POPULATION CONTEXTUAL DATA FOR SUPPORTING CONTAMINANT BIOMONITORING WITH RAPTORS

Unlike conservation raptor monitoring schemes, which tend to be mainly focusing on rare, threatened or range-restricted raptor species, contaminant biomonitoring focused on raptors at pan-European scale requires related population information on common, widespread and abundant species. Common species can act as sentinels for contaminant impacts as well as environmental changes over large areas, contributing internationally comparable data and samples for ecotoxicological analysis. A recent review of established raptor monitoring schemes across Europe revealed a deficiency of monitoring of common raptors (Derlink et al. 2018). The current large spatial monitoring gaps need to be addressed in order to reach fully operable pan-European raptor population monitoring. Ideally this would mean that all raptor species should be representatively covered by monitoring schemes in every country in which they occur, but such schemes are rare in Europe and demand large numbers of qualified volunteers and a high degree of coordination (e.g. Saurola 2012, Challis et al. 2018). Most European countries report major gaps and constraints arounf raptor monitoring, including lack of volunteers, skills, funding and coordination (see Vrezec et al. 2012, Dulsat-Masvidal et al. 2021). These gaps and constraints limit the stablishment of a pan-European raptor biomonitoring scheme for a number of raptor species and for a number of population contextual data parameters. Therefore, in the hope of making a future truly pan-European raptor monitoring scheme feasible and cost-effective, we propose here a **Minimal Recommended Raptor Monitoring Scheme (MRRMS),** which we hope may presents a suitable starting level for establishing raptor monitoring in each European country where schemes are currently lacking. The aim is to encourage measurement of internationally comparable parameters (using harmonized by not standradised recommended methods) within an established raptor monitoring network. There is then also the potential for schemes, once started, to collect more advanced parameters when monitoring capacity is developed and increased. For the MRRMS, focal raptor species and population contextual parameters are proposed to be measured in order to obtain fesible and low-cost field data collection.

FOCAL RAPTOR SPECIES

Identifying the most appropriate European raptor species is essential to ensure a cost and labour effective way for biomonitoring of pollutants. The grouping of birds of prey, falcons and owls into clusters of similar lifestyles regarding food choice, habitat type and migration behaviour not only helps to understand similar patterns of accumulated contaminants but also provides a base to select one representative of a specific habitat or food web to study (Gomez-Ramirez et al. 2014). To further identify the most suitable single species as sentinel for monitoring pan-European patterns and trends in environmental contaminants that pose risks to both wildlife and human health, we not only considered ecological characteristics of the species, but also included aspects of target tissues, exposure pathways and identified the most relevant pollutant groups. To do so, we restricted our selection to terrestrial exposure pathways and considered four priority pollutant groups: toxic metals (lead and mercury); anticoagulant rodenticides; pesticides; and medicinal products. Considering information on the distribution and key ecological traits (food-web, foraging trait, diet, preferred habitat, and migratory behavior) of European raptors, we identified the most appropriate sentinel species. Common Buzzard (Buteo buteo) and Tawny Owl (Strix aluco) proved the most suitable candidates for many of the pollutants considered (Table 1). The Common Buzzard and Tawny Owl were amongst, if not the most, suitable species compared to the other raptor species based on key traits such as widespread distribution across the monitoring area, feeding ecology and habitat selection. These two species are abundant in Europe, enhancing the likelihood that samples and population contextual data can be collected (Badry et al. 2020). The Common Buzzard and Tawny Owl appear to be the two most suitable species for a range of contaminant groups.

TABLE 1 – A Overview of the most appropriate sentinel raptor species as biomonitors for different pollutant groups in Europe evaluated based on their distribution and key ecological traits (foodweb, foraging trait, diet, preferred habitat, and migratory behaviour).

The most suitable sentinel value of each selected species is marked with selected pollutant groups (see details in Badry et al. 2020).

RAPTOR SPECIES	PB	HG	ANTICOAGULANT RODENTICIDES	PESTICIDES	MEDICINAL PRODUCTS
Tawny Owl (Strix aluco)		●	●	●	●
Common Buzzard *(Buteo buteo)*	●		●		●
Eurasian Eagle Owl *(Bubo bubo)*		●	●		
Barn Owl (Tyto alba)		●	●		
Little Owl (Athene noctua)		●	●		
Common Kestrel (Falco tinnunculus)			●		●
Golden Eagle (Aquila chrysaetos)	●				
Northern Goshawk (Accipiter gentilis)		●			
Long-eared Owl *(Asio otus)*			●		

FIGURE 1 – The Tawny Owl (Strix aluco; left) and the Common Buzzard (Buteo buteo; right) were selected as the focal species in establishing European raptor biomonitoring scheme for contaminants and should be included as key species in minmal recommended raptor monitoring scheme in Europe.

(photo: Blaž Koderman, Davorin Tome)

FOCAL POPULATION CONTEXTUAL DATA

Currently, monitoring schemes for Common Buzzard are established in 16 countries (38 % of all European countries) and for Tawny Owl in 13 countries (32 % of all European countries) (Derlink et al. 2018), meaning that there are still large gaps to be covered with population monitoring of these two species across Europe. Population monitoring of both species could be conducted in various ways, but here we propose minimal field data requirements that could be collected annually in all European countries. For countries with already established more advanced monitoring schemes, this would mean only a subset of data that are collected would be required (but comparable parameters could easily be derived from their more advanced monitoring activities), and for the countries without established monitoring schemes, we hope the MRRMS would provide a starting level that is feasible and sufficiently low-cost. The suggested MRRMS is currently focused solely on breeding populations, since this is the most essential part of monitoring to be conducted at pan-European scale and the data collected are most easily interpreted and related to contaminant monitoring results.

Population contextual data can be used to measure both exposure to, and the impact of, contaminants on populations of target raptor species. For the MRRMS, we recommend one parameter indicating species exposure to contaminants and two indicating contaminant impact on the species (Table 2). All these proposed population contextual data parameters also indicate population status and development of the target species, and are therefore essential also for overall conservation assessments.

TABLE 2– Overview of focal population contextual data to be provided within a Minimal Recommended Raptor Monitoring Scheme (MRRMS) for breeding populations of Tawny Owl (Strix aluco) and Common Buzzard (Buteo buteo).

FOCAL POPULATION CONTEXTUAL DATA	CONTAMINANT INDICATION	DERIVED DATA	POSSIBLE METHODOLOGICAL APPROACHES
Population trend	Impact	Annual population indices	The key approach does not require an estimate of absolute number of occupied territories. There are many methodological approaches available *(with or without playback)* and/or nest survey *(see details in Raptor Advice Hub section How to monitor raptors and references therein)*
Breeding productivity per territory *(and trend)*	Impact	Annual indices of successful breeding per territory (simplest is per active nest; could also be per occupied breeding territory; important that consistency is maintained across years)	The proportion of territories that produced at least one young in a year. A range of methodological approaches are possible, from more simple, such as survey of vocalizing fledged young, to more detailed assessments of the young in the nests, which required additional skills and tools *(i.e. nestboxes). (see details in Raptor Advice Hub sections How to monitor raptors and Special considerations/guidance for nest-box studies or monitoring and references therein)*
Diet (and trend)	Exposure	Periodical 5-years reports on the diet composition for main prey groups *(as annual assessment of diet likely to be too challenging)*	Tawny Owl and Common Buzzard are predominantly small mammal predators. However, both species are opportunistic predators and can shift their diet, what might effect their contaminant exposure significantly. Their diet can be assessed from different types of prey remains, and should be differentiated at very basic level evaluating the proportion of main prey groups in the diet *(i.e. small mammal, carrion, birds, other vertebrates, invertebrates)*. For different approaches in diet composition assessments see details in

FOCAL POPULATION CONTEXTUAL DATA	CONTAMINANT INDICATION	DERIVED DATA	POSSIBLE METHODOLOGICAL APPROACHES
			Raptor Advice Hub section **Measuring diet during the breeding season & at other times** *(and references therein).*

FOCAL SAMPLES FOR CONTAMINANT BIOMONITORING IN RAPTORS

Of the matrices commonly collected in raptor biomonitoring, blood and liver are used most extensively for quantifying trends in recent and longer-term contaminant exposure, respectively (Espin et al. 2016). Liver can be used for analyzing all the priority compound groups. It is this applicability to a wide range of contaminants and prevalence of use in existing schemes that leads to the recommended priority sample for collection and use in pan-European monitoring being **liver**. In practice this would mean that the most preferred collected material from the field comes from **carcasses** of dead young or adult birds, which should be collected and stored in the freezers and than further processed within collection curation and analysis (for further details see in Raptor Advice Hub section How to collect samples; and references therein).

With any specimen collected (carcass), it is essential to collect also **specimen contextual data** that describe the sample sufficiently (for more details see Raptor Advice Hub section Collecting specimen contextual data; and references therein). The essential specimen contextual data are defined in the section Collecting specimen contextual data, but when collecting carcasses it is also important to take and store photographs of the specimen for later identification needs, predominantly the head and open wing (see example in Figure 2).

FIGURE 2 – An example of taking photo of an open wing in the Tawny Owl (Strix aluco) for further identification of colour morph

(photo of the head above: red and grey morph) or age class (young bird 1Y-2Y left, adult bird 2Y+ right). (photo: Al Vrezec) [See Advice Hub section on Raptor ID, sexing and ageing for more information]

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FIGURES AND CHARTS


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