

NOCTURNAL RAPTORS AS SENTINEL SPECIES OF ENVIRONMENTAL CONTAMINATION BY ARSENIC AND HEAVY METALS

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INTRODUCTION

Wild birds have been recognized as good bioindicators of environmental contamination for the following reasons:

- They are on the top of the food chain.
- They have a wide distribution.
- They have a long life span.

They have been used for predicting future environmental changes and can provide early warning of the potentially harmful effects of environmental contaminants on humans and animals.

NOCTURNAL RAPTORS AS SENTINEL SPECIES

- Birds have been extensively used as environmental contamination biomonitors since the mid-1960s.
- Raptors are the most used animal.
- A lot of nocturnal raptors are sensitive to pollutants and territorial
 - information about spatial and temporal exhibition.
- There are a large number of monitoring programs with raptors in Europe
 - with 52 pollutants monitored in the last 50 years.
- The most commonly used nocturnal raptor used is the Eagle Owl (*Bubo bubo*).

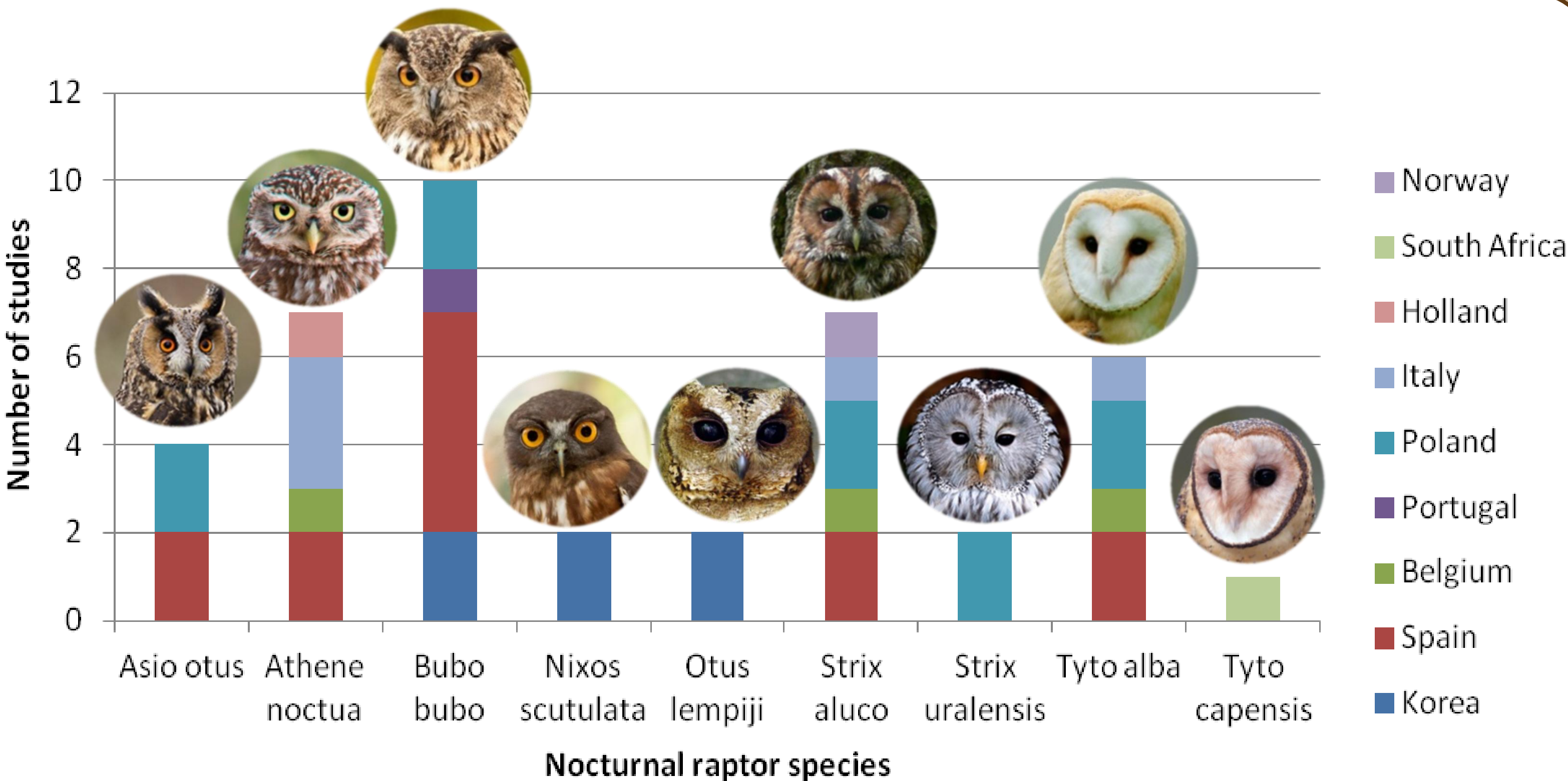


Figure 1. Nocturnal raptors used in 18 studies of metal and metalloids monitoring between 2003 and 2014.

STUDIES

- Sample choice → objective of the study, kinetics of the compound and animal species.
- Better work with non-invasive sample
 - many of these animals are protected.

SAMPLE TYPE	
INVASIVE	NON-INVASIVE
Liver	Feathers
Kidney	Non-viable eggs
Muscle	Regurgitated pellets
Bones	Preys
Blood	Feces

Table 1. Sample type depending on whether the death (or injury) of the animal is necessary or not.

FEATHER STUDIES

- Most commonly used sample.
- Concentration of substances in the feather indicate the concentration of substances in blood at feathers growth moment (Hg).
- Concentration is also affected by environmental pollution (Pb, Cd).
- There are different concentration between different parts of the feather (Cu).
- It is necessary to know the type of molt to understand the results.
 - first molted feathers have higher concentrations.

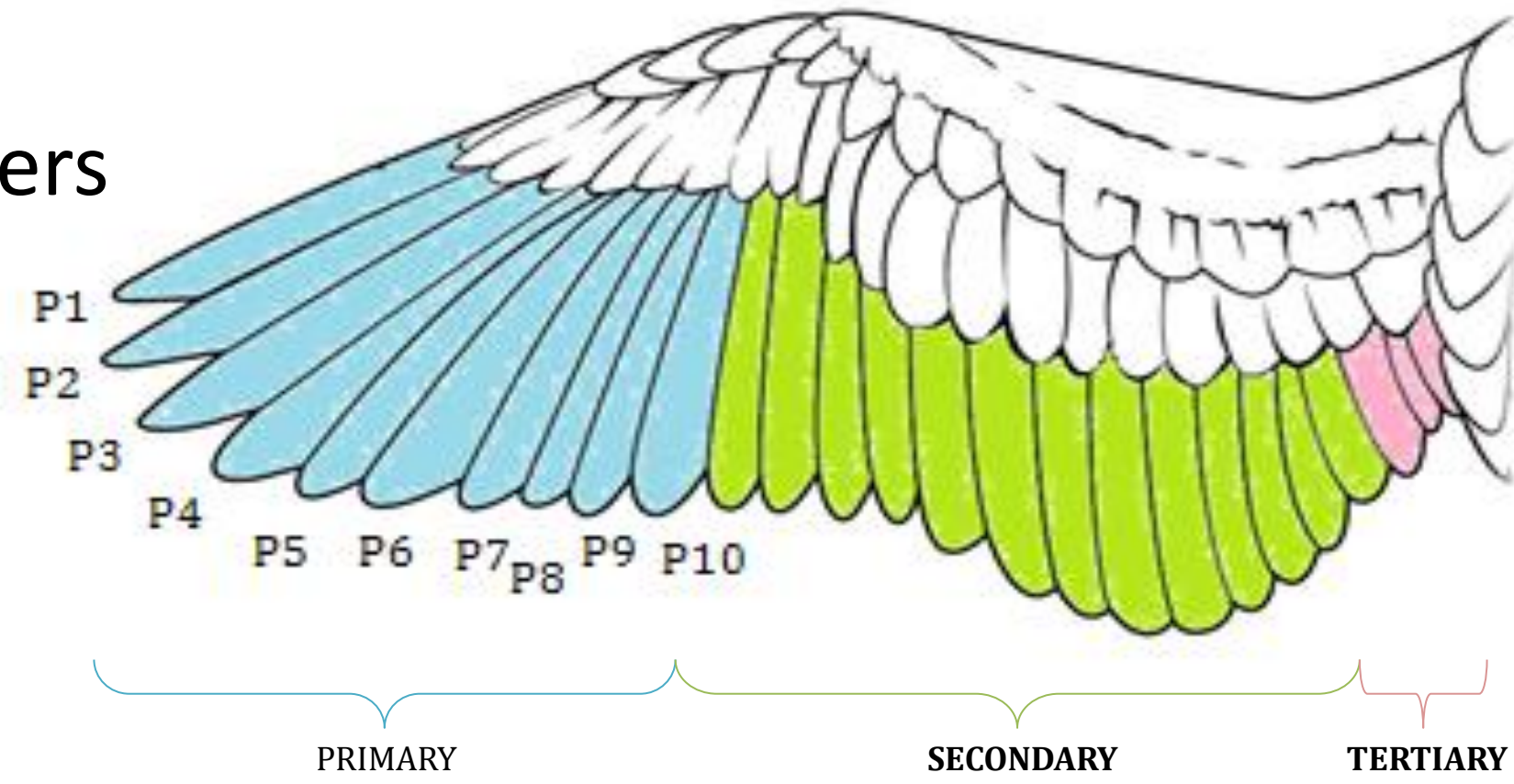
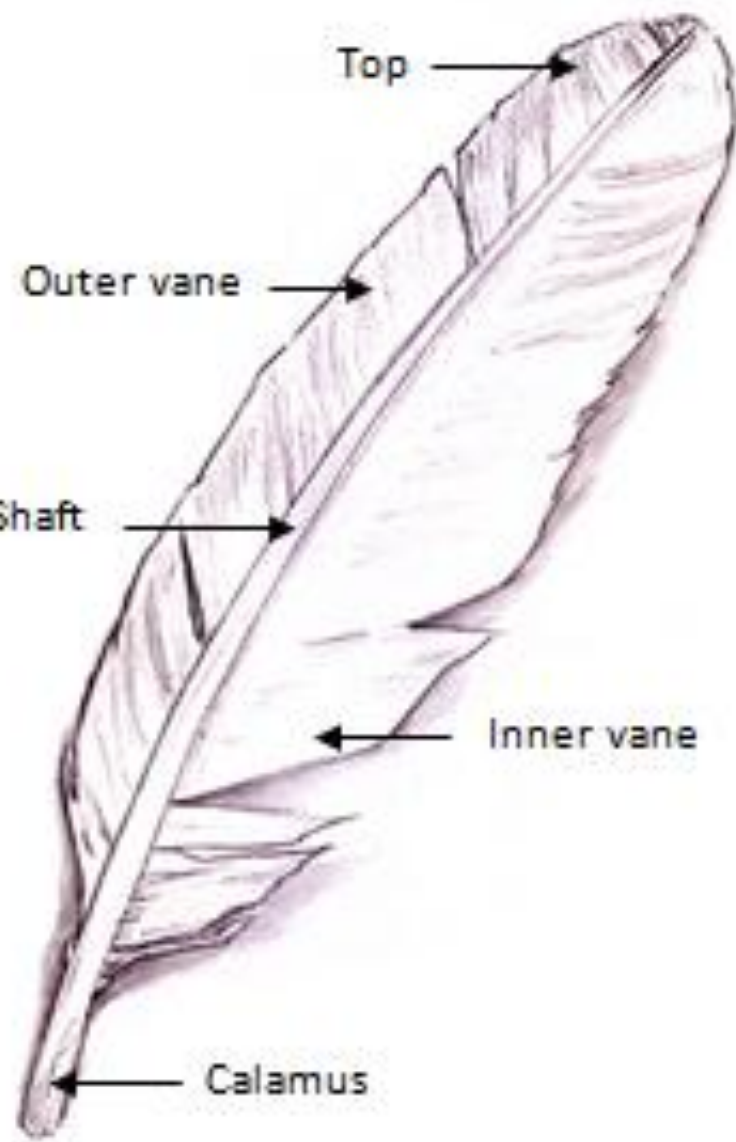


Figure 2 and 3. On the top right, the different parts of a feather are indicated whereas the distribution of feathers in the wing of a bird are displayed in the bottom right. Adapted from Dauwe et al. (2003)

RESULTS OF THE STUDIES

- When increase the ingestion of secondary consumers → increase the risk of biomagnification in top predators.
- The animal's diet is a very important factor to consider.
- Compounds concentration tend to stabilize over time → some compounds decrease (e.g. Pb).

SAMPLE TYPE AND COMPOUND TO ANALYZE	
SAMPLE TYPE	COMPOUND
Blood	All (recent exposition)
Liver	All (recent and mid-cronic exposition)
Kidney	Cd
Bones	As, Pb *
Feathers	Cu, Hg*
Non-viable eggs	Lipofilics compounds
Regurg. pellets	Pb

Table 2. Suitable sample for each compound to analyze, especially those marked with *.

CONCLUSIONS

- Nocturnal raptors are good as environmental pollution sentinels.
- The most commonly used specie is the Eagle Owl (*Bubo bubo*).
- Before starting pollutant monitoring studies it must be clear which are the most suitable samples to choose.
- Analysis of feathers is a good non-invasive method for the study of a group of metals (e.g. Hg).
- Need for conclusive studies relating the levels of pollutants in feathers with the potential risk for animal health.



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