

## Progress on bringing together raptor collections in Europe for contaminant research and monitoring in relation to chemicals regulation

Paola Movalli, Guy Duke, Gloria Ramello, Rene Dekker, Al Vrezec, Richard Shore, Antonio Garcia-Fernandez, Chris Wernham, Oliver Krone, Nikiforos Alygizakis, et al.

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# Environmental Science and Pollution Research

## PROGRESS ON BRINGING TOGETHER RAPTOR COLLECTIONS IN EUROPE FOR CONTAMINANT RESEARCH AND MONITORING IN RELATION TO CHEMICALS REGULATION

--Manuscript Draft--

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<b>Corresponding Author:</b>	Paola Anna Movalli, PhD Naturalis Biodiversity Center Leiden, NETHERLANDS
<b>Corresponding Author Secondary Information:</b>	
<b>Corresponding Author's Institution:</b>	Naturalis Biodiversity Center
<b>Corresponding Author's Secondary Institution:</b>	
<b>First Author:</b>	Paola Movalli, PhD
<b>First Author Secondary Information:</b>	
<b>Order of Authors:</b>	Paola Movalli, PhD
	Guy Duke
	Gloria Ramello
	Rene Dekker
	Al Vrezec
	Richard Shore
	Antonio Garcia-Fernandez
	Chris Wernham
	Oliver Krone
	Nikiforos Alygizakis
	Alexander Badry
	Fausto Barbagli
	Koos Biesmeijer
	Giovanni Boano
	Alexander L. Bond
	Yael Choresh
	Jan Bolding Christensen
	Alessandra Cincinelli
	Sara Danielsson
	Andreia Dias

Rune Dietz
Marcel Eens
Silvia Espin
Igor Eulaers
Sylke Frahnert
Georgios Gkotsis
Natalia Glowacka
Pilar Gomez-Ramirez
Marco Grotti
Michel Guiraud
Peter Hosner
Ulf Johansson
Veerle L.B. Jaspers
Pepijn Kamminga
Jan Koschorreck
Burkhard Knopf
Eero Kubin
Sabrina LoBrutto
Rui Lourenco
Tania Martellini
Emma Martinez-Lopez
Rafael Mateo
Maria-Christina Nika
Varvara Nikolopoulou
Dan Osborn
Olivier Pauwels
Marco Pavia
M. Gloria Pereira
Heinz Ruedel
Pablo Sanchez-Virosta
Jaroslav Slobodnik
Christian Sonne
Nikolaos Thomaidis
Fuiz Tibor
Till Toepfer
Gabriele Treu
Risto Vainola
Jari Valkama
Steven Van der Mije
Didier Vangeluwe
Ben H. Warren

	Friederike Woog	
<b>Order of Authors Secondary Information:</b>		
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<b>Abstract:</b>	<p>Movalli et al (2017) argued for development of a framework bringing together raptor tissue collections in Europe in support of contaminant monitoring for better chemicals management. We outline recent progress in this regard under the COST Action 'European Raptor Biomonitoring Facility' (ERBFacility). A review of 116 collections reveals that many thousands of raptor specimens arrive annually. In most countries, the main recipients are natural history museums, many of which store frozen samples suitable for contaminant monitoring. There is strong interest among collections to collaborate and enhance this tissue resource through development of a 'distributed European Raptor Specimen Bank'. Developing the Bank will involve: prioritising species, tissue matrices and compounds; proof of concept work; addressing legal and other constraints; enhancing standards and protocols for gathering, processing and storing samples; developing policy on access to samples; and developing a samples database. The Bank will be integrated with a complementary Biomonitoring Scheme (specifying priority contaminant analyses) and Sampling Programme (enhancing specimen supply). The resulting European Raptor Biomonitoring Facility will be capable of delivering pan-European contaminant data for chemicals management. Simultaneously, the project LIFE APEX is demonstrating systematic use of contaminant data from raptors (and other apex predators) for chemicals management. Applications include prioritization of substances for PBT assessments, identifying predominant chemical mixtures in biota, and assessing the effectiveness of EU chemicals risk management measures. Together, ERBFacility and LIFE APEX offer considerable promise to reduce contaminant risks to human and wildlife health in Europe.</p>	
<b>Suggested Reviewers:</b>	<p>Jose Tarazona European Food Safety Authority jose.tarazona@efsa.europa.eu Responsible for biomonitoring of PPPs at EFSA</p>	
	<p>Keith Bildstein Hawk Mountain Sanctuary bildstein@hawkmountain.org Was involved in previous EURAPMON network</p>	
	<p>Peter Korytar European Commission peter.korytar@ec.europa.eu Responsible for EC's IPCChem platform for data on environmental contaminants - has attended ERBFacility meeting.</p>	
<b>Opposed Reviewers:</b>		
<b>Additional Information:</b>		
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## PROGRESS ON BRINGING TOGETHER RAPTOR COLLECTIONS IN EUROPE FOR CONTAMINANT RESEARCH AND MONITORING IN RELATION TO CHEMICALS REGULATION

Paola Movalli<sup>1,a</sup>, Guy Duke<sup>2</sup>, Gloria Ramello<sup>3</sup>, René Dekker<sup>1</sup>, Al Vrezec<sup>4</sup>, Richard F. Shore<sup>5</sup>, Antonio García-Fernández<sup>6</sup>, Chris Wernham<sup>7</sup>, Oliver Krone<sup>8</sup>, Nikiforos Alygizakis<sup>9</sup>, Alexander Badry<sup>10</sup>, Fausto Barbagli<sup>11</sup>, Koos Biesmeijer<sup>1</sup>, Giovanni Boano<sup>4</sup>, Alexander L. Bond<sup>12</sup>, Yael Choresh<sup>13</sup>, Jan Bolding Christensen<sup>14</sup>, Alessandra Cincinelli<sup>15</sup>, Sara Danielsson<sup>16</sup>, Andreia Dias<sup>17</sup>, Rune Dietz<sup>18</sup>, Marcel Eens<sup>19</sup>, Silvia Espín<sup>6</sup>, Igor Eulaers<sup>18</sup>, Sylke Frahnert<sup>20</sup>, Tibor I. Füzis<sup>21</sup>, Georgios Gkotsis<sup>22</sup>, Natalia Glowacka<sup>23</sup>, Pilar Gómez-Ramírez<sup>6</sup>, Marco Grotti<sup>24</sup>, Michel Guiraud<sup>25</sup>, Peter Hosner<sup>26</sup>, Ulf Johansson<sup>16</sup>, Veerle L.B. Jaspers<sup>27</sup>, Pepijn

---

<sup>1</sup> Naturalis Biodiversity Center, Vondelaan 55, 2332, AA Leiden, Netherlands

<sup>2</sup> Environmental Change Institute, University of Oxford, 3 South Parks Road, Oxford OX1 3QY, UK

<sup>3</sup> National Institute for Biology, Večna pot 111, 1000 Ljubljana, Slovenia

<sup>4</sup> Museo Civico di Storia Naturale di Carmagnola, Via S Francesco di Sales, 188, 10022, Carmagnola, Torino, Italy

<sup>5</sup> Centre for Ecology & Hydrology, Lancaster Environmental Centre, Lancaster LA1 4AP, UK

<sup>6</sup> Area of Toxicology, Dept of Health Sciences, University of Murcia, Campus de Espinardo, 30100 Murcia, Spain

<sup>7</sup> BTO Scotland, Beta Centre (Unit 15), Stirling University Innovation Park, Stirling, FK9 4NF, UK

<sup>8</sup> Department of Wildlife Diseases, Leibniz Institute for Zoo and Wildlife Research, Alfred-Kowalke-Strasse 17, D-10315 Berlin, Germany

<sup>9</sup> Environmental Institute, Okružná 784/42, 97241 Koš, Slovak Republic

<sup>10</sup> German Environment Agency, 06844 Dessau, Germany

<sup>11</sup> Museo di Storia Naturale dell'Università di Firenze, Sezione di Zoologia "La Specola", Via Romana 17, 50125 Firenze, Italy

<sup>12</sup> Department of Life Sciences, Natural History Museum, Akeman Street, Tring, Hertfordshire, HP23 6AP, UK

<sup>13</sup> Shamir Research Institute, University of Haifa, 199 Aba Chushi Ave., Haifa, Israel

<sup>14</sup> Natural History Museum of Denmark, Universitetsparken 15, 2100 Copenhagen Ø, Denmark

<sup>15</sup> University of Florence, 50019 Sesto Fiorentino, Italy

<sup>16</sup> Naturhistoriska riksmuseet, Box 50007, 104 05 Stockholm, Sweden

<sup>17</sup> CIBIO-InBIO, Universidade de Évora, Casa Cordovil 2<sup>a</sup> Andar, Rua Dr. Joaquim Henrique da Fonseca, 7000-890 Évora, Portugal

<sup>18</sup> Aarhus University, Frederiksborgvej 399, 4000 Roskilde, Denmark

<sup>19</sup> University of Antwerp, Department Biology, Universiteitsplein 1, Wilrijk (Antwerp), Belgium

<sup>20</sup> Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Invalidenstraße 43, 10115 Berlin, Germany

<sup>21</sup> Hungarian Natural History Museum, Baross u 13, Budapest, Hungary

<sup>22</sup> National and Kapodistrian University of Athens, 15771, Greece

<sup>23</sup> Environmental Institute, Okružná 784/42, 97241 Koš, Slovak Republic

<sup>24</sup> Department of Chemistry and Industrial Chemistry, Via Dodecaneso 31, Genova, Italy

<sup>25</sup> Institut de Systématique, Evolution, Biodiversité (ISYEB), Muséum National d'Histoire Naturelle, CNRS, Sorbonne Université, EPHE, UA, CP 51, 57 Rue Cuvier, 75005 Paris, France

<sup>26</sup> Danish Museum of Natural History, University of Copenhagen, Øster Voldgade 5-7, 1350 København K, Denmark

<sup>27</sup> Norwegian University of Science and Technology, Høgskoleringen 5, Trondheim, Norway

1 Kamminga<sup>1</sup>, Jan Koschorreck<sup>10</sup>, Burkhard Knopf<sup>28</sup>, Eero Kubin<sup>29</sup>, Sabrina  
2 LoBrutto<sup>30</sup>, Rui Lourenco<sup>31</sup>, Tania Martellini<sup>32</sup>, Emma Martínez-López<sup>6</sup>, Rafael  
3 Mateo<sup>33</sup>, Maria-Christina Nika<sup>22</sup>, Varvara Nikolopoulou<sup>22</sup>, Dan Osborn<sup>34</sup>, Olivier  
4 Pauwels<sup>35</sup>, Marco Pavia, M. Glória Pereira<sup>5</sup>, Heinz Rüdell<sup>36</sup>, Pablo Sanchez-  
5 Virosta<sup>6</sup>, Jaroslav Slobodnik<sup>9</sup>, Christian Sonne<sup>18</sup>, Nikolaos Thomaidis<sup>22</sup>, Till  
6 Töpfer<sup>37</sup>, Gabriele Treu<sup>10</sup>, Risto Väinölä<sup>38</sup>, Jari Valkama<sup>38</sup>, Steven Van der Mije<sup>1</sup>,  
7 Didier Vangeluwe<sup>35</sup>, Ben H. Warren<sup>39</sup> and Friederike Woog<sup>40</sup>  
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10 <sup>a</sup> Corresponding author: paola.movalli@naturalis.nl  
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15 Environmental contaminants impose multi-billion Euro costs on human and  
16 wildlife health in Europe (Trasande *et al* 2015). Although there are more than  
17 60,000 chemicals marketed in Europe, so far only 600 chemicals have been  
18 screened and identified as PBT (persistent, bioaccumulative, toxic), ED  
19 (endocrine disrupting) and/or CMR (carcinogenic, mutagenic, toxic for  
20 reproduction) (Gkotsis *et al* 2019). A suite of EU chemicals legislation (EC 2001,  
21 EC 2004a, EC 2004b, EC 2004c, EC 2006, EC 2008, EC 2009a, EC 2009b, EC 2012)  
22 aims to reduce chemical risks to humans and wildlife, and the EU's Seventh  
23 Environment Action Programme (EC 2014) calls for better scientific knowledge  
24 towards achieving a non-toxic environment.  
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27 Movalli *et al* (2017) noted the value of raptors as sentinels of environmental  
28 health in general, and highlighted in particular the potential value of raptor  
29 tissue collections, which can be analysed for contaminant exposure to inform  
30 risk assessment of chemicals, assess the effectiveness of chemicals risk  
31 management measures, and provide early warning of emerging contaminant  
32 problems. They argued for development of a framework bringing together raptor  
33 tissue collections in Europe – including those of natural history museums  
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38 <sup>28</sup> Fraunhofer Institute for Molecular Biology and Applied Ecology, 57392 Schmallenberg,  
39 Germany

40 <sup>29</sup> Oulu University, Paavo Havaksen tie 3, Oulu, Finland

41 <sup>30</sup> Dept. STEBICEF, Section Animal Biology, University of Palermo, via Archirafi 18, 90123  
42 Palermo, Italy

43 <sup>31</sup> Laboratório de Ornitologia, Instituto de Ciências Agrárias e Ambientais Mediterrânicas ICAAM,  
44 Universidade de Évora, Pólo da Mitra, Valverde, Évora, Portugal

45 <sup>32</sup> University of Florence, 50019 Sesto Fiorentino, Italy

46 <sup>33</sup> Institute for Game and Wildlife Research, Ronda de Toledo 12, Ciudad Real, Spain

47 <sup>34</sup> Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT,  
48 UK

49 <sup>35</sup> Institut Royal des Sciences Naturelles de Belgique, Rue Vautier 29, B-1000 Brussels, Belgium

50 <sup>36</sup> Fraunhofer Institute for Molecular Biology and Applied Ecology, 57392 Schmallenberg,  
51 Germany

52 <sup>37</sup> Zoological Research Museum Alexander Koenig, Adenauerallee 160, D-53113 Bonn, Germany

53 <sup>38</sup> Finnish Museum of Natural History, Post Box 17, FI-00014 University of Helsinki, Finland

54 <sup>39</sup> Institut de Systématique, Evolution, Biodiversité (ISYEB), Muséum National d'Histoire  
55 Naturelle, CNRS, Sorbonne Université, EPHE, UA, CP 51, 57 Rue Cuvier, 75005 Paris, France

56 <sup>40</sup> Staatliches Museum für Naturkunde Stuttgart, Rosenstein 1, Stuttgart, Germany  
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1 (NHMs), environmental specimen banks (ESBs) and others (e.g. in research  
2 institutions) – in support of contaminant research and monitoring for better  
3 chemicals management. They suggested this framework would involve among  
4 other things identifying and digitising relevant collections and developing a  
5 searchable database of these collections to make them more visible and  
6 accessible to ecotoxicologists and competent authorities.

7  
8 Here, we outline progress that has been made in this regard through the launch  
9 of two mutually reinforcing initiatives, the COST Action *European Raptor*  
10 *Biomonitoring Facility*’ (ERBFacility<sup>41</sup>), which launched in October 2017 and in  
11 which 27 COST member countries are participating, and the EU LIFE project  
12 *Systematic use of contaminant data from apex predators and their prey in*  
13 *chemicals management* (LIFE APEX<sup>42</sup>), which launched in September 2018.

14  
15 Using raptors as particularly appropriate sentinels for PBT compounds (Movalli  
16 *et al* 2018), ERBFacility will help answer what the environmental risks are for  
17 specific chemicals, whether there are emerging contaminant problems needing  
18 remedial action and whether legislation is at all effective in reducing  
19 environmental exposure to contaminants in Europe. ERBFacility builds on ten  
20 years of work involving ecotoxicologists and ornithologists leading up to and  
21 under the European Science Foundation’s research networking programme  
22 EURAPMON (Research and Monitoring for and with Raptors in Europe) (see, for  
23 example, Movalli *et al* 2008, Gómez-Ramírez *et al* 2015, Espín *et al* 2016, Derlink  
24 *et al* 2018, Duke *et al* 2018).<sup>43</sup>

25  
26 At its first General Meeting in Ciudad Real, Spain in February 2018, ERBFacility  
27 set in motion work to bring together NHMs, ESBs and other research collections  
28 towards development of a European Raptor Specimen Bank (ERSpeB).  
29 ERBFacility has since concluded a review of raptor collections in Europe  
30 (Ramello *et al* in prep). The review, which collated data from over a hundred  
31 collections across Europe, revealed that many thousands of raptor specimens  
32 arrive annually at these collections, offering a very substantial resource of raptor  
33 tissue samples for contaminant monitoring. In the UK, specimens are processed  
34 and tissues stored by the Predatory Bird Monitoring Scheme maintained by the  
35 Centre for Ecology and Hydrology (Walker *et al* 2008). In Sweden the lead is  
36 taken by the national ESB at the Naturhistoriska Riksmuseet. A number of  
37 research collections also exist around Europe, such as that of the Leibniz-  
38 Institute for Zoo and Wildlife Research, Germany. However, such specimen banks  
39 and research collections, set up specifically for the purposes of contaminant  
40 monitoring, are the exception rather than the rule. In most countries, the main  
41 recipients of raptor specimens are NHMs. Indeed, the review found that around  
42 75% of responding NHMs across Europe receive fresh raptor/owl specimens.  
43 Most NHMs freeze raptor carcasses on arrival and then process and freeze wet  
44 tissues; indeed, around a third of responding NHMs are already active in storing  
45 frozen raptor tissue samples suitable for contaminant monitoring.

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<sup>41</sup> [www.erbfacility.eu](http://www.erbfacility.eu)

59 <sup>42</sup> [www.lifeapex.eu](http://www.lifeapex.eu)

60 <sup>43</sup> [www.eurapmon.eu](http://www.eurapmon.eu)

1 At a recent ERBFacility meeting convened at the Royal Belgian Institute of  
2 Natural Sciences in Brussels, collections came together to validate the review of  
3 raptor collections and consider how to build on this towards development of the  
4 European Raptor Specimen Bank. The meeting found that there is strong interest  
5 among collections to work together in this regard. However, many collections,  
6 particularly in eastern and southern Europe, are stretched for resources, so any  
7 new 'ask' (e.g. in terms of expanding tissue collections and/or strengthening  
8 standard operating procedures to ensure sample quality) must be tightly  
9 specified. Moreover, collections cannot be expected to build a substantial raptor  
10 tissue bank unless there is a clear regulatory demand for contaminant data and  
11 resources for the necessary analyses to be performed.  
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14 There exists here something of a Catch 22, in that regulatory demand is likely to  
15 grow only once the ability of raptor biomonitoring to provide pan-European  
16 assessments pertinent to chemicals management is proven, while proving this  
17 ability requires a substantial sample bank to be available in the first place.  
18 Overcoming this will probably involve carefully targeted proof of concept work  
19 on one or two selected species and tissue matrices for which a substantial pan-  
20 European bank of samples already exists, and for one or two priority substances  
21 of particular interest to regulators.  
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24 There are clear incentives for collections to engage in this work. These include:  
25 the opportunity to engage in a major European initiative with key regulatory  
26 applications, helping to demonstrate the societal relevance of collections; the  
27 opportunity presented by novel collaboration between NHMs, ESBs and research  
28 collections; the opportunity to expand research interests into ecotoxicology, and  
29 to expand publications output; and the opportunity to know of and exchange  
30 samples with other NHMs and thereby broaden individual collections.  
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34 Taking forward the concept of a distributed ERSpeB will involve further work  
35 under the auspices of the COST Action on a number of issues, building on  
36 relevant existing networks such as the Consortium of European Taxonomic  
37 Facilities and the network of European Bird Curators. These include: prioritising  
38 species, tissue matrices and compounds and carrying out proof of concept work;  
39 addressing legal, personnel and freezer constraints to expanding raptor tissue  
40 sample collections and shipping samples for analysis; adapting NHM standards  
41 and protocols (learning from ESBs) for the gathering, processing and storage of  
42 samples, to enhance sample quality for contaminant analysis; developing  
43 appropriate policy on access to samples to ensure valuable samples required for  
44 contaminant monitoring are not consumed for other purposes; circumscribing  
45 the data content of the European samples database and how it will be developed,  
46 populated and updated to provide real-time information on raptor tissue  
47 samples across Europe. These issues will all be addressed by a sequence of  
48 scientific missions and meetings planned by ERBFacility for the next 12-15  
49 months.  
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54 This paper focuses on work being done in the 'collections arena' under the  
55 auspices of ERBFacility, but it is worth noting that ERBFacility also involves  
56 work in the 'analytical arena', involving ecotoxicologists, veterinary scientists  
57 and chemists, to develop a prioritized European Raptor Biomonitoring Scheme  
58 (ERBiomS), and work in the 'field arena' involving field ornithologists and  
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1 ecologists, to develop a European Raptor Sampling Programme (ERSamP).  
2 Advancing work towards a comprehensive European Raptor Biomonitoring  
3 Facility, capable of delivering pan-European contaminant data for chemicals  
4 management, involves collaboration across these three arenas.

5 While this work is progressing under ERBFacility, LIFE APEX is working to  
6 demonstrate the systematic use of contaminant data from raptors and other  
7 apex predators for chemicals management. Like ERBFacility, LIFE APEX is  
8 building collaborations between collections and analytical laboratories. But  
9 while the focus of ERBFacility is on building networks across the collections,  
10 analysis and field arenas and developing the overall Facility, the focus of LIFE  
11 APEX is on demonstrating that contaminant data from apex predators has useful  
12 regulatory applications, notably in relation to the REACH and Biocides  
13 regulations (Alygizakis *et al* 2019, Gkotsis *et al* 2019, Koschorreck *et al* 2019).  
14

15 LIFE APEX will in particular demonstrate the use of wide-scope target screening  
16 (of more than 2,400 contaminants of emerging concern - CECs), wide-scope  
17 suspect screening (of more than 40,000 CECs) and non-target screening of  
18 samples from raptors (in the terrestrial environment) and other apex predators  
19 (in the freshwater and marine environments) to help the European Chemicals  
20 Agency (ECHA) prioritise substances (among the many tens of thousands  
21 currently used) for more strenuous PBT assessments and identify predominant  
22 chemical mixtures in biota. LIFE APEX will also demonstrate the power of  
23 targeted analyses of raptor matrices to assess the effectiveness of EU chemicals  
24 risk management measures. Proof of concept work on this latter demonstrator  
25 is under way by the Naturalis Biodiversity Center with the UK Centre for Ecology  
26 and Hydrology (which hosts the UK Predatory Bird Monitoring Scheme).  
27

28 Taken together, the growing collaborations across the collections, analysis and  
29 field arenas under ERBFacility and LIFE APEX offer considerable promise to  
30 enhance early warning of emerging contaminant problems, for more timely  
31 identification and management of persistent and bio-accumulative substances in  
32 the environment, for putting risk management measures in place more quickly,  
33 for better understanding predominant chemical mixtures in the environment,  
34 and to ascertain whether risk management measures (and by extension  
35 chemicals regulations) are actually delivering on their purpose in reducing  
36 negative impacts on human and wildlife health. This will complement ongoing  
37 work to monitoring impacts of contaminants on human health.<sup>44</sup>  
38

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46 prey in chemicals management”.  
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