The Value of Hidden Scientific Resources: Preserved Animal Specimens from Private Collections and Small Museums

MIREIA CASAS-MARCE, ELOY REVILLA, MARGARIDA FERNANDES, ALEJANDRO RODRÍGUEZ, MIGUEL DELIBES, AND JOSÉ A. GODOY

Natural history collections have existed for considerable time, and their contribution to research has been discussed and praised in recent decades. In scientific literature, however, there is a general lack of records from private and other small collections. Here, we show that these collections represent a highly valuable resource for research, because they may include an important number of specimens with a broad range of origins. We used the Iberian lynx to demonstrate that the wider and less-biased representation of specimens often found in these collections allows for additional and better inferences than those that are drawn exclusively from large institutions. Locating small zoological collections, however, is very time consuming, and, unfortunately, such collections often disappear quickly, putting their long-term persistence at risk. We propose that authorities, researchers, and curators work together to locate and legalize these specimens and facilitate their inclusion in public databases and, eventually, in larger natural history museums that will ensure their existence in perpetuity.

Keywords: museum specimens, biological collections, ancient DNA, species history, private collections

Natural history collections in large museums, universities, or research institutions have existed for a long time, and specimens from a vast number of diverse species from across the globe have been collected and curated. The contribution of these collections and their roles in research have been widely discussed (Brooke 2000, Suarez and Tsutsui 2004, Winker 2004, Pyke and Ehrlich 2010) and have even become the focus of recent praise (Greve and Svenning 2011, MacDonald and Ashby 2011, Nature 2011, Schnalke 2011). Further increasing these collections' potential importance, advances in molecular techniques have enabled their use for genetic and other molecular studies, and many efforts have been made to improve extraction methods from ancient and historical samples (Horváth et al. 2005, Rohland and Hofreiter 2007, Wandeler et al. 2007, Casas-Marce et al. 2010, Rohland et al. 2010).

Despite this recognized interest in historical zoological samples, little or no attention has been paid to some sources of specimens, such as private collections or specimens found at schools, local museums, government offices, and the visitor centers of national parks. These small and private collections tend to include specimens of species with social interest, such as hunting trophies or those with aesthetic value, some of which are now rare or endangered species. In the Iberian Peninsula, a paradigmatic example is the endangered Iberian lynx (*Lynx pardinus*). The Iberian lynx and many other predators were severely persecuted in Spain and Portugal until the late 1980s. In fact, both countries' governments provided economic incentives for their persecution until the early 1970s. The Iberian lynx is currently critically endangered according to the International Union for Conservation of Nature's Red List of Threatened Species (*www.iucnredlist.org*; Nowell and Jackson 1996, von Arx and Breitenmoser-Wursten 2008), with only two remaining populations in southern Spain and a total estimated population of 250 individuals in 2010 (Simón et al. 2012). As part of the overall conservation effort for the species, systematic surveys during the past decades (Rodríguez and Delibes 2002) uncovered a considerable number of specimens in private and other small collections, which highlights the important role played by nonprofessional institutions and individuals in the preservation of this material. This could be the case for many other species and countries; in the Iberian Peninsula alone, for example, these would include the imperial eagle (*Aquila adalberti*), the bearded vulture (*Gypaetus barbatus*), the Cantabrian bear (*Ursus arctos arctos*), and the capercaillie (*Tetrao urogallus*).

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In 2009 and 2010, we attempted to locate as many specimens of Iberian lynx as was possible in large museums and research institutions, smaller local and regional museums and collections, and private collections (including all those specimens found during previous surveys). We did this to evaluate the role of small museums and private collections compared with the more mainstream large museums that are usually the only sources considered in historical studies. In the present study, we discuss the difficulties of searching for and finding specimens and describe the number of specimens and their temporal and geographic origins across the different types of collections. Given the increasing scientific use of historical specimens for molecular studies and our own interest in genetics, we also record whether we were able to obtain permission for invasive sampling across the three types of collections. Finally, we explore the long-term preservation of specimens in small museums and private collections to assess the need for actions to ensure their perpetuity.

Methods to assess the role of collections

To assess the role of different kinds of collections in the preservation of the specimens and their use in scientific studies, we classified each specimen as belonging to one of the following three categories: large museums, small museums, and private collections (see supplemental table S1, available online at *http://dx.doi.org/10.1525/bio.2012.62.12.9*). Large museums include national and international museums, research center collections, and university museums. Small museums include city halls, local and regional museums, schools, visitor centers of natural and national parks, and other governmental offices. Private collections include all those collections not linked to any public or scientific institution.

Several of the specimens from private collections and small museums were located in the course of surveys carried out in Spain (1987–1988) and Portugal (1995–1997). We also performed an extensive search to locate new specimens in 2009 and 2010. We searched for specimens deposited in large museums through the European Nature Information System (EUNIS; *http://eunis.eea.europa.eu*) and the Global Biodiversity Information Facility databases (GBIF; *http://data.gbif.org*; Edwards 2004), and we directly contacted national and international museums. We also contacted the Spanish environmental enforcement agency (the Servicio de Protección de la Naturaleza [SEPRONA]) to get information about confiscated remains of Iberian lynx, as well as regional authorities that could have information on the location of legal private collections. Finally, we interviewed landowners and rangers as opportunities arose to ask about any private collections that they might know of, albeit with only a few positive results.

For all specimens, we recorded when and where they were captured, hunted, or found and the type of collection in which they had been stored. Because we were interested in taking tissue samples for genetic studies during the 2009 survey, we also recorded whether we were granted permission for invasive sampling. We were particularly interested in sampling tissues that yielded good-quality DNA (Casas-Marce et al. 2010). For the specimens in private collections and small museums that were initially located in our earlier surveys, in 1987–1988 and 1995–1997, we also recorded whether we were able to locate them again to quantify the loss of specimens over time. A few specimens that we did not repursue because of their remote location were excluded from the analysis.

In 2009, we discovered some previously unknown specimens, usually through third parties. In a few cases, however, we were unable to find the owners, or we located them after our original study had finished. In both cases, we considered the specimens as *not found*. This explains why the probability of finding specimens in 2009 that were also first "discovered" in 2009 is slightly less than one (see the "Long-term preservation of specimens" section). In all cases, in order to take into account the deadline constraints of funded projects, which generally last between 1 and 3 years, we considered a specimen as *not found* or *unavailable for sampling* if we could not find it or could not get permission for sampling, respectively, within 1 year from the start of our search.

To evaluate the geographical and temporal coverage the three types of collections encompass, we described the distribution of Iberian lynx specimens across space and time. We tested the effects of the type of collection (fixed effects) on getting permission for invasive sampling (as the dependent variable) with a generalized linear model, using the mean probability of sampling within a given collection to account for the variation among collections considered in the same group (i.e., large museums, private collections, or small museums) and using a quasi-Poisson error distribution.

We evaluated the loss of specimens over time in private collections and small museums. Whether we could relocate a specimen was considered the dependent variable, and the number of years since the specimen was located for the first time was the fixed factor in a generalized linear model with binomial error distribution. We obtained similar results and reached the same qualitative conclusions when we excluded the specimens discovered in 2009 from the data set and when we included the type of collection as an additional factor.

The statistical analyses were performed with R (version 2.10.1; R Development Core Team 2009). Plots were prepared with R and SigmaPlot (version 11.0). Maps were prepared with ArcMap version 10.0.

Searching for and finding specimens

We found 466 specimens between 1987 and 2010: 261 of them in large museums, 48 in small museums, and 157 in private possession. In the case of the large museums, we encountered a general lack of electronic databases. Despite interest in and efforts to improve electronic access to museum databases during the last decade (Winker 1999, Graves 2000, Scoble 2000, Wirtz 2000, Edwards 2004, Graham et al. 2004), the existing global databases are very poorly updated, and many museums do not have their own electronic database. Only 6 of the 261 specimens that we located in scientific institutions were found in the GBIF

database, and 2 of them were included too late to become part of our genetic study, despite their having formed part of the institution's collection for decades (table S1).

Nevertheless, searching for specimens in large museums is much easier than locating private collections or small museums. We often performed our search with little more than the names of the village and the bar where the hunting trophy had previously been seen. Moreover, private collections tend to have very few specimens, which means that the effort required in order to find a reasonable number of samples is tremendous, particularly considering that one must often meet each owner in person and that the specimens may be spread across a vast territory.

Geographic and temporal origin of specimens

For several historical populations, we found specimens exclusively or almost exclusively in private collections, whereas specimens from large museums tended to be from very few populations that are consequently overrepresented (figure 1a). Similarly, across some decades (i.e., 1900–1939), we could find specimens only in private possession, and for others (i.e., 1940–1979), private collections contributed a remarkable number of specimens (i.e., from the 25 specimens from the 1950s that we found, 10 were in private collections, as were 43 out of 144 from the 1970s). The specimens sampled in large museums were collected mostly during particular time intervals, which are also overrepresented (i.e., 1970–2009; figure 1b). Many specimens in the Doñana Biological Station collection were collected over the past 10–20 years—a period in which ongoing research facilitated the discovery of many dead animals from a single population. These quantities (50 specimens since 1990, 30 since 1995, and 21 since 2000) inflate the total number of specimens in large museums and introduce bias toward more recent dates and a specific site. Interestingly, museums outside Iberia tend to have older specimens—more than 100 years old—probably because collection efforts of such institutions were abundant during the nineteenth century.

This tendency of some large museums' collections to be concentrated in certain time periods and areas—when and where collecting or research effort has been larger—implies that historical distribution estimates built solely with data from scientific collections may be biased (Rodríguez et al. 2012). For example, Gil-Sánchez and McCain (2011) reconstructed the range dynamics of the Iberian lynx using a data set that contained only 17 records (5%) from private collections and 212 records (66%) from scientific collections (most of the remaining records came from inventories of hunting trophies). A comparison of the resulting distribution (figure 2 in Gil-Sánchez and McCain 2011) and our distribution of specimens from private and other small collections (figure 1a) shows that these authors probably underestimated the former range of the Iberian lynx. Conversely, Rodríguez and Delibes (1992) performed systematic field sampling of sightings and death reports over the entire potential range of the Iberian lynx, which yielded

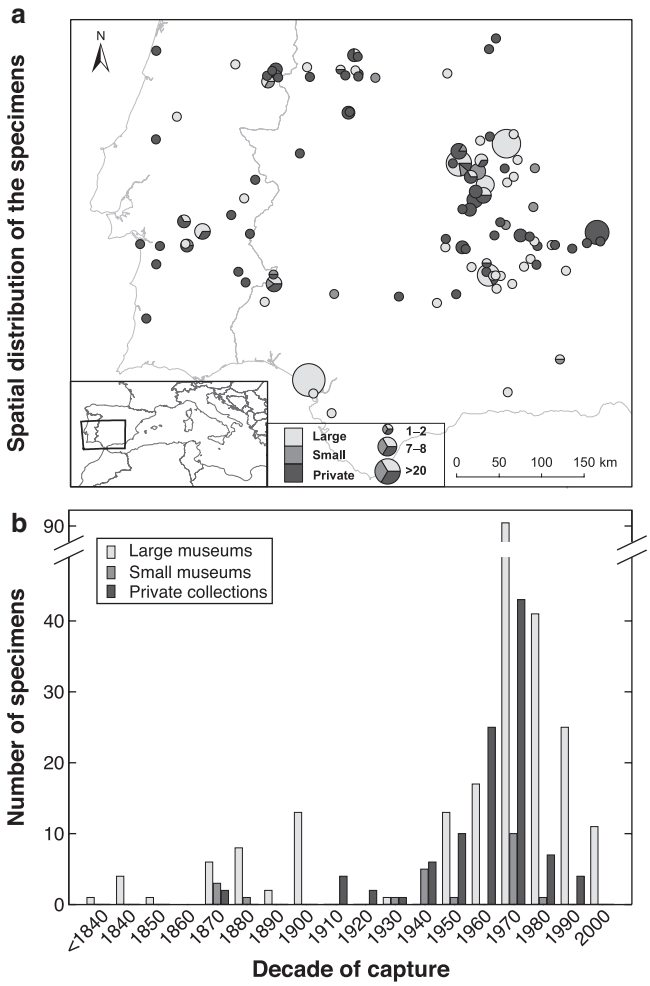

Figure 1. (a) Capture locations and (b) decade for all the Iberian lynx specimens identified to date. In panel (a), we observe that many areas would be poorly represented—or not represented at all—if specimens from private collections and small museums were not considered. Specimens from large museums clump in certain areas where lynx populations have received greater scientific attention. In panel (b), we observe that certain periods tend to be overrepresented because of the number of specimens from large museums, whereas specimens from large museums are scarce or absent from other periods. The specimens from private collections and small museums helped to fill these time gaps. Abbreviation: km, kilometers.

less biased estimates of the former distribution and its dynamics (Rodríguez and Delibes 2002, 2004) and allowed them to find many of the records from private collections we report here.

Tissue sampling of specimens

We were permitted to sample 75% of the specimens that we located. The probability of getting permission for invasive sampling in large museums was lower than that in smaller collections, but this difference was not significant ($N = 402$

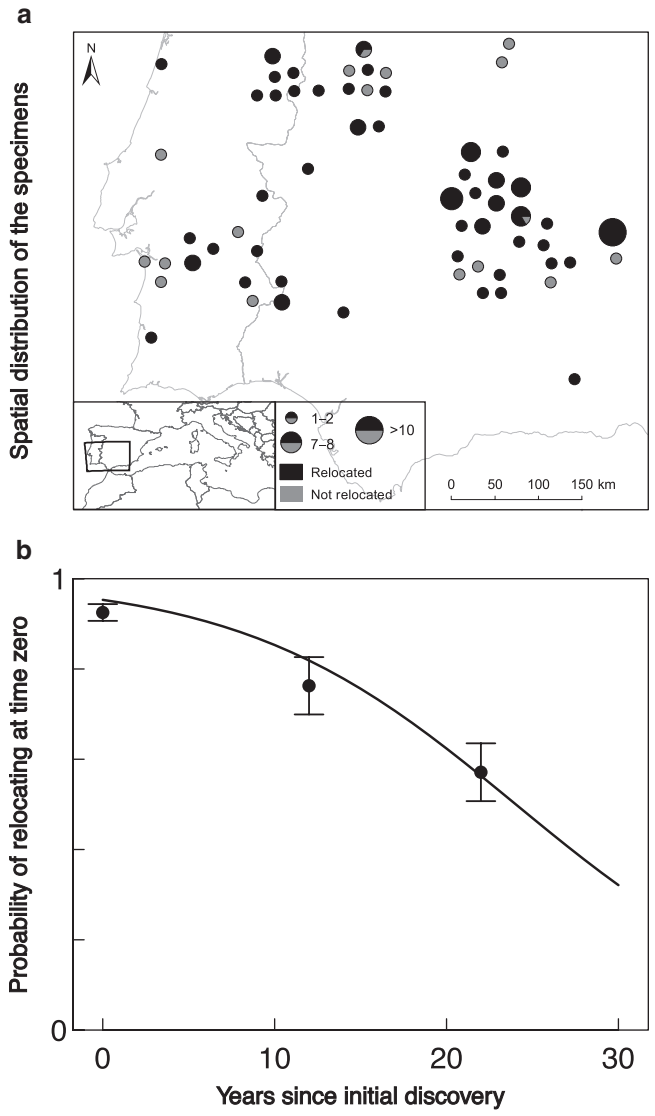

Figure 2. Loss of Iberian lynx specimens in private and small museums over time. (a) The distribution of the relocated and not relocated specimens from private collections and small museums. The loss of specimens reduces the quality of any future study in which such specimens would potentially be used. Forty-eight specimens are not shown, since we have no information about their geographical origin; 39 of them were relocated. (b) The probability of relocating known specimens as a function of the number of years since their initial discovery. The trend line represents the generalized linear model that we used to test the loss over time (z = –5.106, p < .001). Abbreviation: km, kilometers.

specimens, $p = .89$). The lower probability of getting permission for invasive sampling from large museums was caused by a refusal from particular museums rather than by a general trend. In general, a lack of response or a long delay during the application process was the main reason for the specimens' being unavailable for sampling. In one case, we were not informed—ever—as to the reason for which we could not sample the specimens in which we were interested. In addition, we were often not able to get the kind of tissues that ensured a high success rate of DNA retrieval (Casas-Marce et al. 2010) and had the option of receiving only small cuts of skin or tiny pieces of dried tissue from the skull, which significantly lowered the probability of obtaining usable DNA.

We also experienced long delays in obtaining export permits from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) for sampling specimens kept in the United States, which also led us to consider the specimens *unavailable for sampling*. In this regard, when an institution is not registered as a CITES institution, which is often the case when the institution itself does not hold a natural history collection, specific CITES permits must be requested for each specimen, a process that can last from a few days to several months depending on the country (see *www.cites.org* for further details). The same procedures would apply to specimens from small and private collections.

In contrast, the lack of specific protocols for sampling permission facilitated the process in most of the private collections and small museums. After a specimen was located, the owners of private collections were often very willing to collaborate. We could invasively sample any kind of tissue we needed for a positive DNA extraction (Casas-Marce et al. 2010), the only requirement being that we left the specimens in "good condition." This was also the case for small collections held in schools, local museums, and even some universities (considered here as large museums), where additional details about our project or the verbal permission of the person responsible for the collection was usually enough to sample the specimens.

Long-term preservation of specimens

We were able to find 61% of the specimens that we attempted to relocate. The lapse between the year in which a specimen was found for the first time and the year in which we tried to relocate it had a significant negative effect on the probability of relocating the specimen ($N = 187$ specimens, $p < .001$). The longer the time lapse was, the lower the probability of relocating the specimen was, which meant that there was a significant loss of specimens through time. For instance, 26 out of 53 specimens located in 1987 could not be found in 2009, whereas we could not find 8 out of 40 specimens located in 1997 and 4 out of 98 new specimens that we discovered in 2009 (figure 2b). We considered a specimen to be *not relocated* when we could not find the owner (82%), when the specimen was thrown away (12%), or, to account for the time constraints that scientists face when searching, when we found the specimen after our study was already finished (6%). This loss of specimens reduced the number of potentially available samples from some areas (figure 2a) and some periods.

An important issue with private collections is that of the legality and liability concerns of many people for

possessing specimens of endangered species. The procedure to legalize specimens that were captured prior to CITES signature (1980) is not well known by owners, and animals killed illegally cannot be owned privately. Therefore, many people either hide their specimens or throw them away. For instance, we heard of specimens that were thrown away after the law criminalizing their possession in Spain was passed in 1980, and some people later denied having a previously recorded specimen on our return. Furthermore, specimens from private collections that have not yet been legalized cannot have a CITES permit to circulate, which makes a strictly legal sampling procedure practically impossible. In addition, the value of the specimens to the initial collector is generally not the same as to subsequent generations in the family, which increases the chances that specimens disappear with time. Poor preservation of the specimens, caused by a lack of dedicated infrastructure, is another reason why people decided to discard their collections.

At the same time as this study, a pilot program to legalize Iberian lynx specimens in private collections was initiated in Portugal by the Institute for Nature Conservation and Biodiversity. During the course of this initiative, a few CITES applications were received, and some specimens were even donated to the institution. In Spain, a few voluntary donations also occurred, even though that was not the aim of the survey; this indicates that a program similar to that started in Portugal could produce positive results in Spain. None of these issues are concerns in most large museums, which provide better environments for the long-term preservation of specimens, assume keeping the collection for the future as their main goal, and systematically legalize their collections.

Conclusions

Our results indicate that large museums provide a good environment for the long-term preservation of specimens and may store large numbers of specimens of a single species, although the origin of the specimens might be biased to certain periods in which and locations where historic research or collecting efforts were concentrated (figure 1). Large museums, however, do not always have updated databases and are also likely to have strict guidelines and lengthy protocols that may, in fact, discourage researchers from submitting an application that does not always result in the permission to sample. Given the typical time scale of a funded research project—1–3 years—delays of several months to more than a year often become prohibitive.

Searching for specimens in large museums is much easier than locating private collections or small museums. After they are found, however, small museums or owners of single specimens are more than willing to collaborate with research. In our particular case, samples from some populations of Iberian lynx or from specific time periods would not have been obtained without specimens in private collections and small museums (figure 1); in fact, they were essential to ensuring that we had unbiased spatial sampling for our genetic study. The same can be said about studies in which the aim is to evaluate past distributions of endangered species, which carries with it clear consequences for conservation. Sadly, our inability to relocate specimens indicates a rate of loss that strongly threatens the future use of these resources (figure 2).

The case of the Iberian lynx serves as an example of the potential interest of collections that do not belong to more mainstream large museums. Although there is a limited number of species in the same situation as the Iberian lynx (i.e., endangered, rare, valuable in terms of conservation and research, and with high numbers of specimens outside the largest museums), many of the trends that we observed in this study may be generalized to other species. For example, the observed geographic and temporal biases in the origin of the specimens are likely to exist for most collections in large museums around the world, because of the uneven concentration of collection efforts. This means that specimens from different areas and different time periods kept in private collections and small museums might be very valuable, even for those species for which many specimens can be found in large museums.

Because endangered species usually receive a large amount of scientific interest, it is paramount that we increase the quality of these investigations to better understand how species change over time and, in the face of global change, how they cope with the decline and fragmentation of their populations and habitats. Consequently, even for a limited group of species, there are great gains to be made in searching for unconventional sources of specimens, such as private collections and small museums unknown to the scientific community.

In our opinion, authorities should initiate actions that facilitate the legalization of private collections and small museums, thereby reducing the chance of losing both the specimens and the information associated with them. In addition, owners of specimens should be encouraged to donate the specimens to large museums or institutions that would ensure their perpetuity and provide a good environment for its preservation. In the case of the Iberian lynx but also that of any other species (particularly those viewed as scientifically relevant, such as extinct or highly endangered species), we encourage scientists, curators, and authorities to maintain and update common databases of all specimens—those from large museums as well as those from any other collection. In the case of confiscated stuffed specimens and legalized hunting trophies, for which listings sometimes exist, this would be remarkably straightforward.

Despite large cuts in their funding (Dalton 2003, Gropp 2003), their restrictions on destructive sampling, and the lack of updated databases, large museums continue to fruitfully contribute to research and to genetic studies in particular (e.g., Miller and Waits 2003, Godoy et al. 2004, Martínez-Cruz et al. 2007, Wandeler et al. 2007). They also offer the most appropriate environment for the long-term preservation of all kinds of material. If we are to make the most of the resources they can provide, it is our view that they need to invest in updating and modernizing their databases and

infrastructure and reinforce their contribution to research. These improvements would, in turn, encourage large museums to consider one of their eventual missions to include specimens from private and small collections in their own natural history collections (Suarez and Tsutsui 2004, Winker 2004), with the goal of assuring their long-term preservation and making these hidden resources accessible to the scientific community and society at large.

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References cited

Brooke MdL. 2000. Why museums matter. Trends in Ecology and Evolution 15: 136–137.

Casas-Marce M, Revilla E, Godoy JA. 2010. Searching for DNA in museum specimens: A comparison of sources in a mammal species. Molecular Ecology Resources 10: 502–507.

Dalton R. 2003. Natural history collections in crisis as funding is slashed. Nature 423: 575.

Edwards JL. 2004. Research and societal benefits of the global biodiversity information facility. BioScience 54: 486–487.

Gil-Sánchez JM, McCain EB. 2011. Former range and decline of the Iberian lynx (*Lynx pardinus*) reconstructed using verified records. Journal of Mammalogy 92: 1081–1090.

Godoy JA, Negro JJ, Hiraldo F, Donázar JA. 2004. Phylogeography, genetic structure and diversity in the endangered bearded vulture (*Gypaetus barbatus*, L.) as revealed by mitochondrial DNA. Molecular Ecology 13: 371–390.

Graham CH, Ferrier S, Huettman F, Moritz C, Peterson AT. 2004. New developments in museum-based informatics and applications in biodiversity analysis. Trends in Ecology and Evolution 19: 497–503.

Graves GR. 2000. Costs and benefits of Web access to museum data. Trends in Ecology and Evolution 15: 374.

Greve M, Svenning J-C. 2011. Dealing with data: Preserve old collections. Science 331: 1515.

Gropp RE. 2003. Are university natural science collections going extinct? BioScience 53: 550.

Horváth MB, Martínez-Cruz B, Negro JJ, Kalmár L, Godoy JA. 2005. An overlooked DNA source for non-invasive genetic analysis in birds. Journal of Avian Biology 36: 84–88.

MacDonald S, Ashby J. 2011. Museums: Campus treasures. Nature 471: 164–165.

Martínez-Cruz B, Godoy JA, Negro JJ. 2007. Population fragmentation leads to spatial and temporal genetic structure in the endangered Spanish imperial eagle. Molecular Ecology 16: 477–486.

Miller CR, Waits LP. 2003. The history of effective population size and genetic diversity in the Yellowstone grizzly (*Ursus arctos*): Implications for conservation. Proceedings of the National Academy of Sciences 100: 4334–4339.

Nature. 2011. Preserve the past. Nature 470: 5–6.

Nowell K, Jackson P, eds. 1996. Wild Cats: Status Survey and Conservation Action Plan. International Union for Conservation of Nature.

Pyke GH, Ehrlich PR. 2010. Biological collections and ecological/environmental research: A review, some observations and a look to the future. Biological Reviews 85: 247–266.

R Development Core Team. 2009. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing.

Rodríguez A, Delibes M. 1992. Current range and status of the Iberian lynx *Felis pardina* Temminck, 1824 in Spain. Biological Conservation 61: 189–196.

———. 2002. Internal structure and patterns of contraction in the geographic range of the Iberian lynx. Ecography 25: 314–328.

———. 2004. Patterns and causes of non-natural mortality in the Iberian lynx during a 40-year period of range contraction. Biological Conservation 118: 151–161.

Rodríguez A, Calzada J, Revilla E, López-Bao JV, Palomares F. 2012. Bringing science back to the conservation of the Iberian lynx. Conservation Biology 26: 737–739.

Rohland N, Hofreiter M. 2007. Ancient DNA extraction from bones and teeth. Nature Protocols 2: 1756–1762.

Rohland N, Siedel H, Hofreiter M. 2010. A rapid column-based ancient DNA extraction method for increased sample throughput. Molecular Ecology Resources 10: 677–683.

Schnalke T. 2011. Museums: Out of the cellar. Nature 471: 576–577.

Scoble MJ. 2000. Costs and benefits of Web access to museum data. Trends in Ecology and Evolution 15: 374.

Simón M, et al. 2012. Reverse of the decline of the endangered Iberian lynx. Conservation Biology 26: 731–736.

Suarez AV, Tsutsui ND. 2004. The value of museum collections for research and society. BioScience 54: 66–74.

Von Arx M, Breitenmoser-Wursten C. 2008. *Lynx pardinus.* IUCN Red List of Threatened Species, version 2012.1. International Union for Conservation of Nature. (19 September 2012; *www.iucnredlist.org/details/12520/0*)

Wandeler P, Hoeck PEA, Keller LF. 2007. Back to the future: Museum specimens in population genetics. Trends in Ecology and Evolution 22: 634–642.

Winker K. 1999. How to bring collections data into the net. Nature 401: 524.

———. 2004. Natural history museums in a postbiodiversity era. BioScience 54: 455–459.

Wirtz P. 2000. Costs and benefits of Web access to museum data. Trends in Ecology and Evolution 15: 374–375.

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