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ORIGINAL PAPER

Independent contributions of threat and popularity to conservation translocations

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Abstract Species translocations are popular tools in conservation, but may be increasingly motivated by species' popularity, rather than their threat status. We analyzed relative contributions of threat status (a surrogate for extinction risk) and popularity (an estimate of the degree of public knowledge, awareness or notoriety) to the likelihood of developing translocation projects for a representative whole regional fauna (174 conservation translocations during the last two decades for 82 out of the 527 species of Spanish terrestrial vertebrates). Three measures of threat status were obtained from technical (IUCN) and legal sources. Popularity estimates were obtained from body size data and two different Internet search protocols. All combinations of the three factors used to estimate threat status were correlated, as were the three indicators of species popularity (internet popularity indexes and body mass). Selected estimates unbiasedly captured differences in both threat and popularity among species. Threat and popularity were only weakly correlated, as expected

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when considering faunas as a whole rather than the better-studied subsets. Threat status and popularity had significant and equivalent contributions to explain the development of conservation translocations. Popularity, or lack thereof, partly explained the development of projects for non-threatened but popular species, as well as the lack of projects for several highly endangered species unknown by the public. Observed mismatches between technical and social criteria can be prevented by (a) strict separation of conservation translocations from translocations directed to cover other social demands or (b) development of explicit, quantitative decision-making criteria aimed at rigorous *ex-ante* evaluations of translocations.

Keywords Decision criteria · Internet searches · Popularity · Conservation translocations · Threat status

Introduction

Species translocations (IUCN/SSC 2013) are increasingly used to deal with the current human-driven biodiversity crisis (Pérez et al. 2012; Batson et al. 2015). Most recent research has been aimed to increase the establishment success of translocated individuals or populations (reintroduction biology; Amstrong and Seddon 2008; Batson et al. 2015). Less effort has been devoted to address the reasons behind the initial decisions on starting a translocation project (review in Pérez et al. 2012). These decisions are taken by the national or regional administrations legally responsible for the conservation of biological diversity (De Klemm and Shine 1993). Hence, translocation projects may be influenced by both (1) technical issues related to threat status or feasibility of conservation actions (Pérez et al. 2012) and (2) the general awareness of the public and politicians on the necessity of these actions (Verissimo et al. 2011). There are projects whose main goals seem philosophical, aesthetical, or sociopolitical, and are directed to species or populations of local rather than global interest and low rather than high threat status (Sarrazin and Barbault 1996; Pons and Quintana 2003). Popularity, the degree of public knowledge or notoriety of species, influences conservation decisions through its effects on the success of awareness and fund-raising campaigns (Barua 2011; Verissimo et al. 2011).

We analyzed the relative contributions of threat status and popularity to the likelihood of developing conservation translocations. We used the exhaustive database compiled by Pérez et al. (2012) on conservation translocations developed in Spain for all terrestrial vertebrates and freshwater fish during the last two decades. The Spanish case study is representative of global trends in the application of technical and social criteria to the development of translocation projects, according to a worldwide literature review (Pérez et al. 2012). The full database included species threatened and not threatened, with and without translocation projects, thus avoiding both publication bias (Bajomi et al. 2010), false negative effects (Lobo et al. 2010), and bias associated to the analyses of best-known species subsets (Roberge 2014). If conservation of viable wild populations is the main reason for translocations, their likelihood should be mainly related to the species' threat status. Interactive effects of popularity will indicate that public awareness is reinforcing this primary goal, at least for the most popular species. Additive effects of popularity, however, will show conservation efforts directed to popular species not threatened by small wild populations. Relative additive influences of threat and popularity for developing translocation projects may influence the likelihood of success of general translocation policies, as efforts directed to popular species with low threat status may decrease resources available for preserving less popular species that need translocation projects (Pérez et al. 2012).

Materials and methods

Translocation projects and threat status

We compiled the full database of the conservation translocation projects carried out in Spain for terrestrial vertebrates (mammals, birds, reptiles and amphibians) and freshwater fish during the past two decades (see Pérez et al. 2012 for details). The legal responsibility for starting and developing conservation projects lies in the 17 Spanish autonomous regional governments. For this reason, more than one translocation project can be developed for some species. We did not consider restocking projects for game hunting and for sport fishing. Intensive reviews of the scientific and popular literature (including red data books and the World Wide Web) were the basis of the compilation. Enquiries directed to relevant scientists, conservation managers and naturalists ensured that the compilation was complete. The case study compiles 174 conservation translocations for 82 species (Pérez et al. 2012).

We obtained the threat status in Spain of all species of terrestrial vertebrates and freshwater fish from three sources: (1) the Red List maintained by the International Union for the Conservation of Nature (IUCN; http://www.iucnredlist.org, accessed March 2016); (2) the most recent updates of Spanish red data books (Doadrio 2001; Madroño et al. 2004; Pleguezuelos et al. 2004; Palomo et al. 2008); and (3) the last country-level official list of endangered species (BOE 2011). We followed the species checklist maintained by Salvador and Elvira (2014), updated with taxonomic reviews when necessary (e.g. Leunda et al. 2009 for freshwater fish). A few taxa described after the publication of the Spanish red data books have no published threat status. We assigned to them the status of the former subspecies or local population before the species was split. Eight species have populations with different legal status in different regions of Spain (e.g. island or isolated populations of more widespread species); in these cases, we chose the more threatened category. IUCN and red data book threat categories, extinct in the wild (EW), critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), data deficient (DD), and least concern (LC), were sequentially coded in ascending increase of threat from 1 (LC) to 7 (EW). Legal Spanish conservation status was coded as 4 (listed as endangered), 3 (listed as vulnerable), 2 (listed with no further evaluation) and 1 (not listed).

Threat status listed in these sources may have differed from status when the decision of developing (or not) the reintroduction projects were taken. However, timing such decisions was generally impossible because most projects lack published records (Pérez et al. 2012). We assumed that changes in status during the last two decades would have been minor for most species (Hoffmann et al. 2010).

Estimating popularity

Popularity is defined as the degree of knowledge by the public of a given species (Zmihorski et al. 2013), that is, the awareness or notoriety given to it by the public. Popularity varies according to country, gender, age, cultural level, or ethnic and social group, among others (Turvey et al. 2014), as well as among species depending on traits such as body size, aesthetics, taxa, and others (Frynta et al. 2010; Zmihorski et al. 2013; Roberge 2014; Tella and Hiraldo 2014). This variability and fuzzy definition implies that no single estimate will capture unbiasedly the true popularity of all species. Combination of several estimators derived from large-scale survey methods will improve the accuracy of results (Frynta et al. 2010). The public generally known better larger species than the smaller ones (e.g., Sitas et al. 2009). We compiled body size estimates for all species from national red data books, complemented with reference handbooks and scientific papers for species described after data book publication. Homogeneous data were available for the maximum body length (cm, tail excluded) of freshwater fish, amphibians and reptiles and for body mass (g) of birds and mammals. Mean value from reported ranges was computed for species with sexual size dimorphism. Relative body sizes were estimated as proportions over the size of the largest species of each group. Relative body sizes account for differences in measurement units among taxa, as well as for differences in the relative perception of size by people among taxa groups.

In addition to body size, we used two internet-based indicators of popularity (Takada 2013; Zmihorski et al. 2013; Roberge 2014). General species-specific worldwide knowledge was estimated as Google scores, i.e. number of pages where the searched phrase appears when introduced in the Google browser (accessed March 2016). Searched phrases were the currently accepted scientific name of each species (Zmihorski et al. 2013). National-scale knowledge was estimated by assessing the global monthly search volume using the Keyword Tool in Google AdWords (Takada 2013). The global monthly search volume shows the approximate average monthly number of search queries matching each keyword over the past 12-month period (accessed March 2016). Keywords for AdWords searches were the most common Spanish names, without accents, rather than the scientific names, as proposed by Takada (2013). Use of species' names in the Internet might change after launching translocation projects, which are usually announced here and in the media. Internet searches to estimate popularity should have been performed just before project launching to avoid this bias. However, internet searches for past time windows are not straightforward, and there is uncertainty in timing the start of reintroduction projects (Pérez et al. 2012). We assumed that changes in the use of species' names in the Internet would have been minor as compared to among-species differences in use.

Data analyses

Deviance-partitioning analyses were used to estimate the relative influence of threat status, internet popularity, body size and their potential interactions on the number of reintroduction projects carried out per species. Deviance partitioning allows for estimating relative contributions of explanatory variables on the likelihood of the response variable, even when explanatory variables are correlated (e.g. Anadón et al. 2006; Carrete et al. 2007). Analyses were carried out for all species and for each taxonomic group separately by means of Generalized Linear Models with a quasipoisson approximation, given the overdispersion of the response variable (Zuur et al. 2010), using the hier.part package (Mac Nally and Walsh 2004) from the R 3.0.3 program (R Development Core Team 2014). We first carried out a full set of univariate analyses with all these independent variables (three threat categories, raw and log-transformed data for internet popularity scores, and absolute and relative, raw and log-transformed data, for body size) and selected the most explanatory variable from each group of independent variables measuring threat, internet popularity, or body size. Because quasi-likelihood estimation does not yield a likelihood value, we employed the explained deviance as the selection criterion. We then compared models in which the joint effects of each group of variables, each one represented by its most explanatory variable, were simultaneously considered. We also checked for possible interactions between variables. Then we built a general model summarizing the total deviance explained by the three variable groups. Finally, we calculated the pure and joint effects (deviance explained) of threat status, internet popularity and body size using basic algebra (Anderson and Gribble 1998). From these values we also calculated the pure and joint effects of threat status and total popularity (i.e., internet popularity + body size).

Results

Translocation projects, threat status, and popularity

The database of terrestrial vertebrates and freshwater fish living in Spain included 598 species: 50 freshwater fish, 29 amphibians, 69 reptiles, 360 birds and 90 mammals. We excluded a bird that is globally extinct, the Canary Islands oystercatcher *Haematopus meadewaldoi* (not included in Appendix S1), and 71 bird species that are exclusively winter visitors or that only migrate over Spain (Appendix S1).

Much more species were non-threatened (LC, DD and NT categories) than threatened (VU, EN, CR and EW categories) except for freshwater fishes, where 80% of species (40 out of 50) were threatened (Fig. 1). Most species (442, 84%) had no conservation translocations during the last two decades. 34% (57 out of 169) of threatened species had conservation translocations, whereas 7% of non-threatened species (25 out 358; Fig. 1) had been translocated.

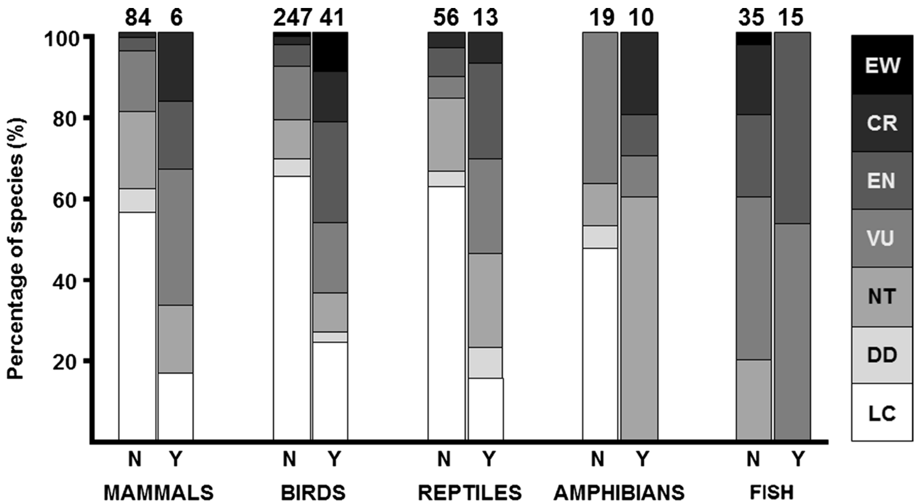

Fig. 1 Percentages of species with (Y) and without (N) translocation projects in Spain during the last two decades according to taxonomic group and threat status (IUCN categories for Spain). *EW* extinct in the wild, *CR* critically endangered, *EN* endangered, *VU* vulnerable, *NT* near threatened, *DD* data deficient, *LC* least concern. Figures over the bars indicate the absolute number of species in each project x group category

Table 1 ANOVA testing for differences in threat status among species with and without ongoing translocation project

Effect	*df*	F	P
Taxonomic group	4	7.02	< 0.001
With/without translocation project	1	37.45	< 0.001
Project × group	4	1.14	0.336
Error	517		

Threat status: IUCN categories for Spain, log-transformed

Taxonomic groups: Mammals, Birds, Reptiles, Amphibians and Freshwater fish

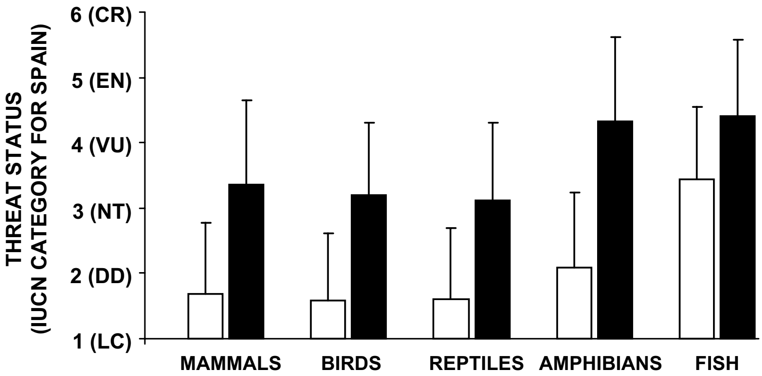

Fig. 2 Threat status (Mean + SE; IUCN categories for Spain, backtransformed) among species with (closed bars) and without (open bars) translocation project and for each taxonomic group

The number of translocation projects per species varied between 1 and 11 (Appendix S1). Threat status was less favorable for species with than for species without conservation translocations for all taxonomic groups (Table 1, Fig. 2).

Body sizes of Spanish terrestrial vertebrates vary from 2 g (pigmy shrew *Suncus etruscus*) to 160 kg (brown bear *Ursus arctos*) in birds and mammals, and from 3.6 cm (Iberian stippled toad *Pelodytes ibericus*) to 3.5 m (Atlantic sturgeon *Acipenser sturio*) in reptiles, amphibians and fishes. Birds, mammals and, to a lesser extent, fishes were the most popular animal groups according to Internet-based indicators, with estimates spanning five orders of magnitude (Table 2). The most popular species were the house sparrow (*Passer domesticus*) (Google scores; 156×10^5) and the bearded vulture (*Gypaetus barbatus*; *quebrantahuesos* in Spanish; Google AdWords; 22200; Appendix S1).

Contributions of threat and popularity to ex situ conservation action

All combinations of the three factors used to estimate threat status were correlated, as were the three indicators of species popularity (internet popularity indexes and body mass; Table S1 in Appendix S2). Correlations were always positive. Popularity indexes and threat status were positively associated, though weakly (Appendix S2).

Table 2 Means and ranges for the two internet-based estimates of popularity

	Google score	Google AdWords
Mammals	263,251 (6580–3,460,000)	1691 (0–18,100)
Birds	345,002 (16,000–15,600,000)	747 (0–22,200)
Reptiles	106,026 (2420–1,390,000)	496 (0–9900)
Amphibians	70,711 (4520–406,000)	211 (0–1300)
Fish	111,915 (742–2,130,000)	935 (0–8100)

Google scores are the number of pages retrieved when introducing the scientific name of the species in the Google browser, and Google AdWords are the approximate average monthly number of search queries matching common species names over the past 12-month period

Species whose specific and generic names are the same (i.e. *Anguilla anguilla*, *Oenanthe oenanthe* or *Bufo bufo*) were excluded for Google score results, as they were retrieved 2-3 orders of magnitude more frequently than other names, thus suggesting a bias in the method (11 mammals, 29 birds, 1 reptile, 2 amphibians and 2 fishes). Pine marten *Martes martes* was excluded from AdWords results since its Spanish common name, *Marta*, matches a popular female name and gave results two orders of magnitude larger than the rest

The best univariate models showed moderate explanatory power (from 14% to up to 31% deviance explained) for each driver (threat status, internet popularity and body size). Best models generally included conservation status according to the Spanish official list, log-transformed AdWord scores, or log-transformed relative body size (Table 3). Interaction terms were not significant. Deviance partitioning analyses revealed that threat status and total popularity had significant and equivalent additive contributions to explain the

Table 3 Deviance (%) explained by univariate g models for the relationships between number of translocation projects and explanatory variables (variables)

Factor	Variable	ALL	MAM	BIRD	REP	AMP	FISH
Threat status	IUCN-world	5.02	**31.29**	7.65	–	–	–
	IUCN-Spain	7.57	–	**13.28**	17.69	–	–
	Official list	**14.19**	27.64	11.62	**26.53**	**28.03**	–
Internet popularity	Google	–	–	–	12.18	–	9.05
	AdWord	4.21	15.46	5.52	–	–	**16.11**
	logGoogle	–	–	–	**27.84**	–	11.95
	logAdWord	**12.26**	**21.19**	**15.52**	15.40	–	–
Body size	Absolute	–	–	15.37	–	–	–
	Relative	5.14	–	–	–	–	–
	logAbsolute	7.12	**14.16**	**33.45**	–	–	–
	logRelative	**17.60**	–	–	–	–	–
	N	526	90	288	69	29	50

Models were generalized linear models with quasipoisson approximation. Variables were related to threat status, internet popularity and body size (Appendix S1), either raw or log-transformed. Boldface indicates models with the largest value of explained deviance for each group, as well as the variables included in the deviance partitioning analyses shown in Table 4

N number of species. –: non-significant ($p > 0.05$)

development of conservation translocations (Table 4). Joint effects were also significant, but with very low explanatory power. Threat effects were larger than total popularity effects for mammals and amphibians, whereas the opposite was found for birds and fishes (Table 4). Detailed partition analyses for threat status, internet popularity and body size are shown in Appendix S3.

Discussion

Both threat status and popularity were independently associated to the likelihood of developing conservation translocations, with similar contributions. 66% of threatened species (threat status Vulnerable or higher) had no conservation translocations while 7–9% of non-threatened species had translocation projects. Examples of the former were Atlantic sturgeons *Acipenser sturio*, lizards of the *Iberolacerta* species complex, Balearic shearwaters *Puffinus mauretanicus* and several bat species in the genus *Myotis*, *Plecotus* and *Rhinolophus*. Examples of the latter were the smooth snake *Coronella austriaca*, the white stork *Ciconia ciconia* and the Spanish ibex *Capra pyrenaica* (Appendix S1). Results cannot be attributed to bias in the databases, as they include exhaustive assessments for all species (Bajomi et al. 2010; Lobo et al. 2010). We are not aware of any other study that analyses conservation translocations and popularity status for whole regional faunas (see Fischer and Lindenmayer (2000) for a classical large-scale review of conservation translocations worldwide). Collinearity between threat status and popularity estimates did not cause these results either. Both factors were only weakly correlated, and deviance partitioning analyses did not detect interactive effects among threat and popularity.

All projects declare a main conservation goal in terms of maintaining viable wild populations, as happens for mors projects worldwide (Brichieri-Colombi and Moehrenschlager 2016), although most do not include further details on reasons behind their development (Pérez et al. 2012). Threat status had a positive effect on the likelihood of developing conservation translocations, with a low to moderate explanatory power (5–28% deviance explained), and mean threat status for species with translocations were on average higher than for species without. Nevertheless, there were species with projects with relatively low threat status (Vulnerable), or even not endangered. In situ management actions rather than translocations would have been better conservation alternatives for low-threatened species

Table 4 Pure and joint effects of threat status and total popularity (internet popularity + body size) on the number of translocation projects developed for each species of terrestrial vertebrates

Factor	ALL	MAM	BIRD	REPT	AMPH	FISH
Threat	16.38	27.71	5.28	19.10	28.03	–
Popularity	16.50	17.71	28.88	20.41	–	18.62
Threat + popularity	0.49	3.58	8.00	7.43	–	–
Total	32.72	49.00	42.16	46.94	28.03	18.62
N	526	90	288	69	29	50

Figures show the proportions of deviance explained by each factor and its interaction when significantly different from zero (see Appendix S3 for more detailed results). The specific variables included in models to estimate the effects of each factor for each group are indicated in Table 3

N number of species

(Caughley 1994; Pérez et al. 2012). Hence, the relative influence of technical criteria on the development of translocations may be even lower than suggested by our deviance partitioning analyses.

Body size, a well-known popularity estimate, and two Internet-based popularity indicators showed consistent associations, suggesting that the selected estimates captured unbiasedly differences in popularity among species. Internet-based indicators can be computed for all species of any given community of regional or national list, allowing for complete analyses of popularity associations (Zmihorski et al. 2013). Nevertheless, the utility of wide-scale searches for long lists of species may be biased as popularity estimates by a number of factors. First, search results are expected to vary in time depending on factors such as the media dissemination of the development of reintroduction projects. Tracking such changes in time will be difficult and time-consuming (e.g. Roberge 2014) thus precluding estimates for full lists of species. Search engines that look at specific time windows of Internet traffic will solve this problem. Automatic disambiguation techniques to analyze the semantic context of cited words (Navigli 2009; Zhong and Ng 2012) will also improve the precision of searches as popularity estimates. These methods will allow eliminating references to pages that use species' names with a different meaning. Disambiguation techniques will also differentiate between references involving positive conservation interests for charismatic species, that may encourage conservation actions (Clucas et al. 2008; Frynta et al. 2010; Zmihorski et al. 2013), from those implying negative attitudes towards e.g. dangerous species, that may discourage conservation action (Knight 2008).

Somewhat surprisingly, effects of popularity were independent to the effect of threat status on the likelihood of developing conservation translocations. Social attitudes may play a prominent role in conservation decisions, but its comparable strength and independence from scientific criteria may involve conflicts leading to unnecessary and/or unsuccessful projects focused on species of low or even no conservation concern (Pérez et al. 2012). Directing funds and effort to these projects would be of little value for other threatened species because translocation projects are usually directed tightly to the specific needs of focal species to improve success (Batson et al. 2015). The 'flagship' or 'umbrella' species concept, useful for in situ conservation action (Barua 2011), will not apply for ex situ conservation. Funds used to translocate low-threat but popular species would reduce direct effort on more threatened species less known by the public. Translocation tactics aimed at improving establishment success must be balanced by equivalent developments of translocation strategies aimed at improving the proper use of the translocation tool (Pérez et al. 2012).

Potential conflicts between conservation and social goals may be tackled following two alternative methods: (1) tease apart translocations aimed at maintaining viable wild populations of highly endangered species from projects based on social demands for restoring locally popular species, considering the later as recreational or private initiatives, not as projects of general public interest (IUCN/SSC 2013) and (2) develop explicit, quantitative decision-making criteria aimed at rigorous *ex-ante* evaluations of the necessity, risks, and technical suitability of projects (Pérez et al. 2012). Both approaches can contribute to direct the scarce resources available for conservation to the most viable and necessary translocation projects, precluding unnecessary projects for popular but only weakly threatened species.

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References

Amstrong DP, Seddon PJ (2008) Directions in reintroduction biology. Trends Ecol Evol 23:20–25
Anadón JD, Giménez A, Martínez M, Martínez J, Pérez I, Esteve MA (2006) Factors determining the distribution of the spur-thighed tortoise *Testudo graeca* in south-east Spain: a hierarchical approach. Ecography 29:339–346
Anderson MJ, Gribble NA (1998) Partitioning the variation among spatial, temporal and environmental components in a multivariate data set. Aust J Ecol 23:158–167
Bajomi B, Pullin AS, Stewart GB, Takács-Sánta A (2010) Bias and dispersal in the animal reintroduction literature. Oryx 44:358–365
Barua M (2011) Mobilizing metaphors: the popular use of keystone, flagship and umbrella species concepts. Biodivers Conserv 20:1427–1440
Batson WG, Gordon IJ, Fletcher DB, Manning AD (2015) Translocation tactics: a framework to support the IUCN Guidelines for wildlife translocations and improve the quality of applied methods. J Appl Ecol 52:120–129
Boletín Oficial del Estado (BOE) (2011) Real Decreto 139/2011 de 4 de febrero para el desarrollo del Listado de Especies Silvestres en Régimen de Protección Especial y del Catálogo Español de Especies Amenazadas. BOE 46:20912–20951
Brichieri-Colombi TA, Moehrenschlager A (2016) Alignment of threat, effort, and perceived success in North American conservation translocations. Conserv Biol 30:1159–1172
Carrete M, Grande JM, Tella JL, Sánchez-Zapata JA, Donázar JA, Díaz-Delgado R, Romo A (2007) Habitat, human pressure, and social behavior: partialling out factors affecting large-scale territory extinction in an endangered vulture. Biol Conserv 136:143–154
Caughley G (1994) Directions in conservation biology. J Anim Ecol 63:215–244
Clucas B, McHugh K, Caro T (2008) Flagship species on covers of US conservation and nature magazines. Biodiv Conserv 17:1517–1528
De Klemm C, Shine C (1993) Biological diversity conservation and the law: legal mechanisms for conserving species and ecosystems. IUCN, Gland
Doadrio I (ed) (2001) Atlas y Libro Rojo de los peces continentales españoles. Ministerio de Medio Ambiente, Madrid
Fischer J, Lindenmayer DB (2000) An assessment of the published results of animal relocations. Biol Conserv 96:1–11
Frynta D, Lišková S, Bültmann S, Burda H (2010) Being attractive brings advantages: the case of parrot species in captivity. PLoS ONE 5:e12568
Harris JBC, Reid JL, Scheffers BR, Wanger TC, Sodhi NS, Fordham DA, Brook BW (2012) Conserving imperiled species: a comparison of the IUCN red list and US endangered species act. Conserv Lett 5:64–72
Hoffmann M et al (2010) The impact of conservation on the status of the world's vertebrates. Science 330:1503–1509
IUCN/SSC (2013) Guidelines for reintroductions and other conservation translocations. Version 1.0. IUCN/SSC, Gland
Knight AJ (2008) "Bats, snakes and spiders, Oh my!" How aesthetic and negativistic attitudes, and other concepts predict support for species protection. J Environ Psychol 28:94–103
Leunda PM, Elvira B, Ribeiro F, Ferreiro RM, Oscoz J, Alves MJ, Collares-Pereira MJ (2009) International standardization of common names for Iberian endemic freshwater fishes. Limnetica 28:189–202
Lobo JM, Jiménez-Valverde A, Hortal J (2010) The uncertain nature of absences and their importance in species distribution modelling. Ecography 33:103–114
Mac Nally R, Walsh CJ (2004) Hierarchical partitioning public domain software. Biodivers Conserv 13:659–660
Madroño A, González GG, Atienza JC (eds) (2004) Libro rojo de las aves de España. Organismo Autónomo Parques Nacionales, Madrid
Navigli R (2009) Word sense disambiguation: a survey. ACM Comp Surv 41:Article 10. https://doi.org/10.1145/1459352.1459355

Palomo LJ, Gisbert J, Blanco JC (eds) (2008) Atlas y Libro Rojo de los mamíferos terrestres de España. Ministerio de Medio Ambiente, Madrid

Pérez I, Anadón JD, Díaz M, Nicola GG, Tella JL, Giménez A (2012) What is wrong with current translocations? A review and a decision-making proposal. Front Ecol Environ 10:494–501

Pleguezuelos JM, Márquez R, Lizana M (eds) (2004) Atlas y libro rojo de los anfibios y reptiles de España. Ministerio de Medio Ambiente, Madrid

Pons P, Quintana XD (2003) Unsuitable reintroductions and conservation priorities. Oryx 37:285

Roberge JM (2014) Using data from online social networks in conservation science: which species engage the most on Twitter? Biodivers Conserv 23:715–726

R Development Core Team (2014) R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria http://www.R-project.org

Salvador A, Elvira B (eds) (2014) Enciclopedia Virtual de los Vertebrados Españoles. Museo Nacional de Ciencias Naturales, Madrid, Spain http://www.vertebradosibericos.org/

Sarrazin F, Barbault R (1996) Reintroduction: challenges and lessons for basic ecology. Trends Ecol Evol 11:474–478

Sitas N, Baillie JCM, Isaac NJB (2009) What are we saving? Developing a standardized approach for conservation action. Anim Conserv 12:231–237

Takada K (2013) Exploitation of flagship species of Scarabaeid beetles with application of analyzed results on cultural entomology. Appl Ecol Environ Sci 1:1–6

Tella JL, Hiraldo F (2014) Illegal and legal parrot trade shows a long-term, cross-cultural preference for the most attractive species increasing their risk of extinction. PLoS ONE 9:e107546

Turvey ST, Fernández-Secades C, Nuñez-Miño JM, Hart T, Martínez P, Brocca JL, Young RP (2014) Is local ecological knowledge a useful conservation tool for small mammals in a Caribbean multicultural landscape? Biol Conserv 169:189–197

Verissimo D, MacMillan DC, Smith RJ (2011) Toward a systematic approach for identifying conservation flagships. Conserv Lett 4:1–8

Zhong Z, Ng HT (2012) Word sense disambiguation improves information retrieval. In: Proceedings of the 50th Annual Meeting Association for Computational Linguistics: Long Papers vol. 1, pp 273–282

Zmihorski M, Dziarska-Palac J, Sparks TH, Tryjanowski P (2013) Ecological correlates of the popularity of birds and butterflies in Internet information resources. Oikos 122:183–190

Zuur AF, Ieno EN, Elphick CS (2010) A protocol for data exploration to avoid common statistical problems. Met Ecol Evol 1:3–14