

Determinants of bird conservation action implementation and associated population trends of threatened species

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1 **Title**

2 Determinants of bird conservation action implementation and associated
3 population trends of threatened species

4 **Short Running Title** - avian conservation actions

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14 **Statement of authorship**

15 DL, TB, SB, MH, JL, AU designed the study. SB provided the data. MK performed
16 modeling work and analyzed output data. DL wrote the first draft of the manuscript
17 and all authors contributed substantially to revisions.

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22

23 **Abstract**

1 Conservation actions, such as habitat protection, attempt to halt the loss of
2 threatened species and help their populations to recover. Thus far, research has
3 examined the efficiency and the effectiveness of actions individually, yet,
4 conservation actions generally occur simultaneously so the full suite of
5 implemented conservation actions should be ~~considered~~assessed. We used the
6 conservation actions associated with the threatened birds of the world (IUCN Red
7 List) to assess which biological ~~factors~~ (related to taxonomy and ecology) and
8 anthropogenic factors (related to geo-economics and population trends) are
9 associated with the implementation of different classes of conservation actions. We
10 also assessed which conservation actions are associated with increasing population
11 trends. Threat category, taxonomic order, and geo-economic variables were the
12 strongest predictors of implemented ~~which~~ conservation actions ~~were~~
13 implemented. Species with invasive alien species control/eradication, *ex-situ*
14 conservation, international legislation, reintroduction, or education and awareness-
15 raising were more likely to have increasing populations. I'd add a sentence in listing
16 the less effective actions. These results illustrate the importance of developing a
17 predictive science of conservation actions and the relative efficiencies of each class
18 of implemented conservation action for threatened and near-threatened birds
19 around the world.

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2 **Introduction**

3 Due to human activities, the rate of species extinction is higher now than at any
4 other time in the past 65 million years (Barnosky et al 2011, Pimm et al 2014).

5 Conservation efforts aim to slow-down, stop, and reverse threats to species and thus
6 the current loss of biodiversity. However, the extinction risk to species continues to
7 rise (CBD 2014). This does not mean conservation efforts have failed. Indeed,
8 conservation efforts have circumvented at least 20% of projected increases in
9 aggregate extinction risk to birds and mammals over the last four decades, as
10 measured by changes in the IUCN Red List of Threatened Species (hereafter, “Red
11 List”) (Hoffmann et al 2010). For ungulates, increases in aggregate extinction risk
12 since 1996 would have been eight times greater in the absence of conservation
13 action (Hoffmann et al 2015).

14 Targeted actions to recover birds have been particularly successful. For
15 example, between 1994 and 2004, conservation efforts likely prevented at least 16
16 bird species from going extinct (Butchart et al 2006, Rodrigues 2006). The
17 implementation of conservation actions for threatened species is critical if we are to
18 support the recovery of currently threatened species, as agreed in Aichi Target 12 of
19 the 2010–2020 Strategic Plan for Biodiversity (<https://www.cbd.int/sp/targets/>)
20 and prevent more species from declining and going extinct.

21 Research on the suite of parameters that affect extinction risk for threatened
22 species, including biological and geo-economic factors and threats, has made great
23 progress toward predicting extinction risk (Bland et al 2014, Cardillo et al 2006,

1 2008, Davidson et al 2009, Davies et al 2006, Fisher and Owens 2004, Mace 2004,
2 Owens and Bennett 2000, Purvis et al 2000). While these studies have been
3 remarkably informative about the extinction risk and threats facing species, it is
4 only through the implementation of conservation actions that we have a chance to
5 improve the status of threatened species. Thus, just as there currently is a predictive
6 science of extinction risk, there is a need for a predictive science of conservation
7 actions, which would illuminate how, why, and where conservation actions are best
8 implemented for threatened species and assess their efficiency.

9 Such a predictive science of conservation actions has not been completely
10 overlooked. Hayward (2011) used a subsample of 144 threatened mammals from
11 the Red List that improved or declined in status between 2004 and 2008
12 assessments to assess the link between threats, conservation actions, and
13 population trends. Brooks et al (2009) focused on the suite of conservation actions
14 implemented in tropical rainforests to examine their effectiveness. Chapman (2014)
15 surveyed experts about conservation actions as to whether they thought the actions
16 were successful. Finally and most comprehensively, Williams et al (2012) conducted
17 a literature review that assessed the efficiencies of each of the IUCN conservation
18 action categories for birds. Building off of these attempts to assess the efficiency and
19 effectiveness of implemented conservation actions, we assess the biological and geo-
20 economic parameters that influence conservation action implementation and are
21 associated with increasing population trends, using data for birds from the Red List.

22 Here, we assess which factors predict implementation of conservation
23 actions, and examine which actions are associated with different directions of

Commented [MH1]: But I didn't think 'Near Threatened' was included in the categories you subsequently list? Is it worth adding this as a category in the brackets at the end of the sentence?

1 population trends for threatened and Near Threatened bird species (i.e. in the
2 categories of Critically Endangered, Endangered or Vulnerable).

4 **Material and methods**

5 We examined the conservation actions underway for species assessed by BirdLife
6 International as threatened (i.e., Critically Endangered, Endangered or Vulnerable)
7 or Near Threatened on the Red List (BirdLife International IUCN red List for birds
8 2014 <http://www.birdlife.org> on May 27 2014). We excluded those Critically
9 Endangered species tagged as Possibly Extinct (PE) because most such species
10 require targeted searches to rediscover any surviving individuals before the most
11 appropriate conservation actions can be determined.

12 Birds are an excellent study group to investigate such questions, because all
13 birds have been comprehensively assessed against the Red List Categories and
14 Criteria (IUCN 2012), revealing 1,373 species to be threatened and 959 to be Near
15 Threatened; i.e., 22% of the world's 10,425 bird species are considered of elevated
16 conservation concern (BirdLife International 2014). Further, 145 species are
17 assessed as recently Extinct, Extinct in the Wild, or Critically Endangered (Possibly
18 Extinct) (1% of all bird species) and only 62 are Data Deficient (0.5% of all bird
19 species). Moreover, bird populations occur in most habitats and all countries
20 worldwide, they are easily identifiable, practical to monitor and research, and there
21 are large networks of people studying birds, compiling information about them and
22 implementing conservation actions for them (Brooks et al 2008).

1 We used data on conservation actions underway as documented in the
2 Species Information Service, the database co-managed by IUCN and BirdLife
3 International, which underpins the Red List. The fields for conservation actions
4 underway largely represent a subset of the actions in the classification scheme
5 developed by Salafsky et al (2008), and relate to a subset of those actions for which
6 meaningful data can be compiled for the majority of species on the Red List (see
7 Table 1). Conservation actions included in the database represent those that are
8 ongoing or took place within the last decade. One conservation action we excluded
9 was the identification of 'important sites' for species. Because nearly all (>95%) of
10 threatened and Near Threatened bird species have Important Bird and Biodiversity
11 Areas (IBAs) identified for them (BirdLife International 2014b), this parameter
12 would have little explanatory power in our analysis. We examined both biological
13 and anthropogenic factors as independent predictor variables of conservation
14 action implementation (see Table 1). We also included monitoring which is not
15 technically a conservation action according to Salafsky et al (2008) but is instead a
16 research need, yet tends to be a critical component in terms of assessing population
17 trends as related to conservation actions. All biological data were extracted from the
18 Species Information Service in July 2012
19 (<http://www.birdlife.org/datazone/species>).

20 For the habitat type used by each species, we considered only the broad
21 'level 1' classes ([http://www.iucnredlist.org/technical-documents/classification-](http://www.iucnredlist.org/technical-documents/classification-schemes/habitats-classification-scheme-ver3)
22 [schemes/habitats-classification-scheme-ver3](http://www.iucnredlist.org/technical-documents/classification-schemes/habitats-classification-scheme-ver3)) coded as being of major importance
23 during the breeding season. To simplify the analyses, we summed the four marine

1 habitat subcategories, neritic, intertidal, marine coastal and oceanic, to create a
2 more general “marine” category (which included 107 species), and pooled the
3 categories for caves and rocky areas, introduced vegetation and artificial
4 terrestrial/aquatic habitats, other habitats, and unknown habitats into a class we
5 termed “other” (which included 142 species). Species that inhabit multiple
6 geographic realms were scored in a “multiple” category, we scored species in
7 multiple landmass types in a “multiple” category as well.

8 Geo-economic factors, which describe the economic development of the
9 places where species live, can be an important determinant of conservation
10 implementation. To calculate the per capita area-weighted Gross Domestic Product
11 (GDP) for a species, we averaged the GDP for all countries in which each species
12 occurs relative to the portion of its range within each country (Rodrigues et al
13 2014). The GDP is calculated as per capita in 1990 international Geary-Khamis
14 dollars. GDP data are from the World Economic Outlook by the International
15 Monetary Fund (2014 dataset): <http://www.imf.org/external/data.htm>. One
16 hundred and eighty-eight countries belong to the IMF. For the few that do not
17 belong to it, we used estimates of GDP from the CIA Factbook (accessed 21 Feb
18 2015; see SOM for a list of countries):

19 <https://www.cia.gov/library/publications/the-world-factbook/fields/2004.html>.

20 Binomial regression models were fit to explain the presence of conservation
21 actions for 2,177 bird species. Missing data, among 4 variables with between 0.05%

1 and 5.9% missing (see SOM for details of missing data), were singly imputed (Figure
2 1).

3 Best models were selected using a combination of the Akaike Information
4 Criterion (AIC) and an assessment of the generalized variance inflation factor to
5 ensure low collinearity among predictors. Collinearity among predictors was judged
6 acceptable when the generalized variance inflation factor was below $\sqrt{3}$ (Zuur et al
7 2010). If the generalized inflation factor was $> \sqrt{3}$, that model was not considered
8 valid. After a final model was selected, Pearson residuals were binned and examined
9 to ensure no patterns emerged that would suggest an important predictor was left
10 out of the model. Residuals were plotted against all predictor variables, both those
11 included and excluded from the model, to ensure important predictors had not been
12 removed. Model averaging was conducted on the best models so that the cumulative
13 Akaike weight ≥ 0.95 (Johnson and Omland 2004) for each of the nine conservation
14 actions, resulting in one average final model for each conservation action. The best
15 models used for averaging are reported (Supplemental Online Material Table 1)
16 along with the averaged parameter estimate, unconditional standard error, and
17 confidence intervals (Supplemental Online Material Table 2). To determine the
18 importance of variables we calculated the 90% (estimate $\pm 1.64SE$) and 95%
19 (estimate $\pm 1.96SE$) confidence intervals around the model averaged parameter
20 estimates (Kittle et al., 2008; Mazerolle 2004). If the confidence interval does not
21 contain 0 we can conclude that the parameter has an effect on the dependent
22 variable (i.e. the estimate is different from 0).

1 Using linear regression, the relationship between predictor variables and the
2 number of conservation actions was analyzed.

3 Finally, a binomial regression model was fitted (using AIC and the
4 generalized variance inflation factor as detailed above) to explore which
5 conservation actions were associated with an increasing versus decreasing
6 population trend for threatened and Near Threatened bird species. Population
7 trends are based on ongoing trend data over the last several years. Coefficients for
8 binomial regression were interpreted as the odds ratio using the antilog of the raw
9 coefficients. Numerical results are reported as mean \pm SEM. All tests were
10 conducted using R statistical software, ver. 3.0.2, R Core Team 2014.

11

12 **Results**

13 ***Number and Class of Implemented Conservation Actions***

14 In total, 5,424 conservation actions are documented as being implemented
15 for the 2,177 threatened and Near Threatened bird species on the Red List, with a
16 mean of 2.55 ± 0.028 conservation actions per species. The most frequent
17 conservation action implemented was for a protected area to cover a population of
18 the species (74% of species). International trade regulations and action plans exist
19 for 23% and 18% of species, respectively. Other conservation actions were
20 implemented for < 10% of species. Predictive models for the conservation actions,
21 international trade regulations, international legislation, invasive species control,
22 and action plans, all had relatively high weighted-explained deviance, 0.68, 0.59,
23 0.55 and 0.54, respectively. Predictive models for other conservation actions, Ex Situ

1 conservation, monitoring, reintroduction, education and population protection
2 didn't explain the deviance as well, 0.38, 0.35, 0.29, 0.21, 0.2, respectively.

3 Red List category was the most important predictor for conservation action
4 implementation. More severely threatened species were more likely to be targeted
5 by more conservation actions, with Critically Endangered and Endangered species
6 having significantly more conservation actions than Vulnerable and Near
7 Threatened species ($F_{3,2173} = 45.56$, $P < 0.001$).

8 Species that live in Europe or multiple regions had the most conservation
9 actions implemented, while species in West and Central Asia, North Africa, and
10 Antarctica had the fewest ($F_{13,2163} = 21.69$, $P < 0.001$). In addition, species that breed
11 in more countries have more conservation actions implemented ($F_{1,2175} = 240.4$, $P <$
12 0.001). For every 1% increase in the ~~amount~~ area of a species range with in G20 or
13 OECD countries, the number of conservation actions increased by 0.00196 and
14 0.0093, respectively ($F_{1,2175} = 9.54$, $P = 0.002$; $F_{1,2175} = 148.8$, $P < 0.001$). As the area-
15 weighted GDP of species increased, so did the likelihood that the species would have
16 conservation actions in place ($F_{1,2175} = 81.51$, $P < 0.001$).

17 Species' biology was also associated with the implementation of conservation
18 actions. Species with longer generation times were more likely to have more
19 conservation actions. For every year increase in generation length, the number of
20 conservation actions implemented increased by 0.13 ($F_{1,2175} = 482.6$, $P < 0.001$).
21 Species that inhabit marine and inland wetland had more conservation actions in
22 place than species in other habitats ($F_{7,2169} = 20.28$, $P < 0.001$). More specifically,
23 species in these habitats tended to have more monitoring, protected areas, invasive

1 alien species control/eradication, *ex-situ* conservation, and international legislation.
2 The type of landmass where a species occurred was an important predictor variable
3 for all implemented conservation actions except education and awareness-raising,
4 reintroduction, and *ex situ* conservation, with more actions implemented for species
5 inhabiting oceanic islands ($F_{3,48} = 9.22, P < 0.001$).

6 Taxonomic order was an important factor in all ten best models for
7 education and awareness-raising, action plans, *ex situ* conservation, international
8 legislation, and trade control. The taxonomic orders Anseriformes (ducks, geese,
9 and swans), Falconiformes (raptors), Gaviiformes (divers/loons),
10 Phoenicopteriformes (flamingoes), and Psittaciformes (parrots) had the highest
11 numbers of conservation actions while Caprimulgiformes (nightjars),
12 Columbiformes (pigeons), Cuculiformes (cuckoos), Passeriformes (perching birds),
13 and Piciformes (woodpeckers) had the fewest ($F_{23,2153} = 21.68, P < 0.001$).

14

15 ***Conservation Actions and Population Trends***

16 Among threatened and Near Threatened bird species, 83% have decreasing
17 population trends, 3% increasing, 11% stable, and 2% have unknown population
18 trends (BirdLife International 2014). Population trend was a predictor variable in
19 58% of the models. Specifically, it was a predictor in all ten best models for *ex situ*
20 conservation, invasive alien species control/eradication, reintroduction, and
21 international trade controls. Species with increasing populations had more
22 conservation actions in place ($4.01 \pm .185$) than those with decreasing (2.51 ± 0.03),
23 stable (2.47 ± 0.09) or unknown population trends (0.98 ± 0.14) ($F_{3,2173} = 34.31, P <$

1 0.001). The best generalized binomial regression model that explained an increasing
2 or decreasing population trend based on the conservation actions in place included
3 education and awareness-raising, international legislation, reintroduction, *ex-situ*
4 conservation, and invasive alien species control/eradication (Table 2). Species with
5 these conservation actions showed increased odds of having a positive population
6 trend of 2.16, 2.62, 2.82, 3.09, and 10.63 respectively (Figure 2).

7

8 **Discussion**

9 These results depict both the biological and anthropogenic environment in
10 which conservation actions are most likely to be implemented and are most likely to
11 be effective. More severely threatened species received more types of conservation
12 actions, presumably because the conservation of more severely threatened species
13 is seen as more urgent, and/or because more threatened species face a wider range
14 of threats. Species with increasing population trends had 1.6 times more
15 conservation actions in place than those with stable or decreasing populations,
16 suggesting that implementation of multiple conservation actions may be more
17 effective in reducing extinction risk. In particular, the implementation of invasive
18 alien species control/eradication, *ex-situ* conservation, international legislation,
19 reintroduction, and education and awareness-raising were most frequently
20 associated with positive population trends. Knowledge of the circumstances in
21 which conservation actions are implemented as well as which ones are most
22 successful, such as we describe here, could tremendously benefit the future of
23 species conservation with implications for future resource allocation for

1 conservation actions as well as assessments of the potential success of different
2 types of actions.

3 Biological factors important in predictive models of biodiversity threats, such
4 as generation length, clutch size, taxonomic group, and habitat type, were also
5 important in all of the best predictive models of conservation action
6 implementation. In particular, generation length was an important predictor for five
7 of the nine conservation action types assessed and is an important predictor in
8 threat models (Owens and Bennett 2000, Fisher and Owens 2004). Many of the
9 biological factors in the models are correlated with taxonomy, and closely related
10 species within taxonomic groups are generally susceptible to similar threats (Gaston
11 and Blackburn 1995, Mace 2004, Owens and Bennett 2000); consequently, they tend
12 to receive similar conservation actions.

13 Taxonomic order was an important factor associated with education and
14 awareness-raising, action plans, *ex situ* conservation, international legislation, and
15 trade control, suggesting that these five classes of conservation action tend to be
16 applied in a taxonomically selective way. Species in taxonomic groups that are
17 particularly threatened by over-exploitation, such as Anseriformes, which are
18 threatened by hunting (Green 1996), Psittaciformes, which are threatened by
19 trapping for the pet industry (Collar and Juniper 1992, Wright et al 2001) and
20 Falconiformes, some of which are threatened by trapping for falconry (Butchart et al
21 2005), receive a disproportionate number of conservation actions compared with
22 species in other orders. Species in these orders tend to be particularly palatable,

1 colorful, carnivorous, or otherwise charismatic, explaining both their attractiveness
2 for harvest as well as conservation attention (Leader-Williams & Dublin 2000).

3 Whether a species lives on an oceanic island, continental island, or continent
4 was an important predictor for six of the nine conservation actions. Being on an
5 oceanic island was a strong predictor of the existence of action plans, international
6 legislation, international trade regulations, and invasive species control/eradication
7 implementation, while species on continents had more monitoring and protected
8 areas. Invasive species have been a leading cause of extinction for native species on
9 islands (Clavero and Garcia-Berthou 2004). However, eradicating invasive species is
10 an increasingly applied and successful conservation tool (Veitch, Clout, and Towns
11 2011). Our finding that populations of threatened and Near Threatened species are
12 ten times more likely to be increasing when invasive species control/eradication is
13 implemented is a strong signal that this conservation action has a positive impact on
14 such species. With ongoing declines in oceanic seabird populations, international
15 legislation has been strengthened to reduce threats to these species, as they
16 typically cross national borders and often use areas beyond national jurisdiction
17 while foraging or migrating (Croxall et al 2012, Wolf et al 2006). Given the high
18 rates of endemism and endangerment of species on oceanic islands, more protected
19 areas (and their effective management) could help conserve their populations (Kier
20 et al 2009).

21 The implementation of conservation actions requires adequate resources
22 (McCarthy et al. 2012), which explains the importance of geo-economic factors as
23 predictors of the implementation of many conservation actions. Geo-economic

1 factors were present in all of the ten best models, except for education and
2 awareness-raising, and species in more economically developed countries are more
3 likely to receive conservation actions. This appears to be consistent with the
4 Kuznets curve, which predicts that there is an hump-shaped relationship between
5 wealth and environmental quality (Mills and Waite 2009), whereby improving
6 population trends for threatened and Near Threatened species coincided with
7 wealthy countries. However, among poor countries, increases in wealth can lead to
8 increased threats, which can create a complex relationship between a country's
9 financial resources and the conservation of biodiversity (Mills and Waite 2009).
10 Another complication with economic predictive variables is that finances often flow
11 across international borders, which can lead to the transfer of funds for
12 conservation efforts as well as the transfer of threats, such as logging and the
13 harvesting of species (Lenzen et al. 2012, Weinzettel et al 2013). However, some of
14 the richest countries have shown poor results with regard to species recovery, while
15 many of the best successes have come from countries with small per capita GDPs
16 (Rodrigues et al 2014), illustrating that finances alone cannot explain the
17 implementation or efficiency of conservation actions.-

18 Reintroduction, *ex-situ*, invasive alien species control/eradication, education
19 and awareness-raising efforts, and international legislation are all significantly
20 associated with increasing population trends among species of conservation
21 concern. Action plans, monitoring, protected areas, and international trade controls
22 are associated as well, but not significantly. The reasons for these differences are
23 not clear. Certainly, reintroduction and invasive alien species control/eradication

1 are highly targeted actions, which can often yield dramatic positive results.
2 Conversely, action plans and monitoring are preconditions to other conservation
3 actions and alone are insufficient to ensure population increases (furthermore, the
4 existence of an action plan does not necessarily imply that it is being implemented
5 adequately, or at all). Unfortunately, trade controls can often be ineffective, with
6 illegal trade being a widespread issue for utilized species (Magnin 1991). In
7 addition, some conservation actions might have interactive effects that increase
8 opportunities for population recovery. For example, invasive species eradications
9 coupled with reintroductions might increase the likelihood of population recovery
10 more than one of these conservation actions alone.

11 A predictive science of conservation action implementation and effectiveness
12 should increase the future success of conservation efforts. While our models
13 accounted for many of the biological and anthropogenic factors thought to be
14 associated with threats to species and hence potentially with conservation action
15 implementation, additional factors are likely to play a role. Climate change is an
16 important variable that we did not account for; however, all of the conservation
17 actions that we assessed can be implemented in a “climate smart” manner and
18 remain relevant in the presence of climate change (McClanahan et al 2008, Stein et
19 al 2014). Future efforts should also look at the relationship between particular
20 threats and the implementation of conservation actions, specifically to measure the
21 alignment between them and to use that as a predictor for positive population
22 trends. Future research should investigate similar questions in other taxa and refine
23 our results to pinpoint the correlates of successful conservation actions and help

1 improve the overall effectiveness of conservation action for species of conservation
2 concern.

3

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7 datasets used here are derived. We thank Mike Hoffmann for aiding in the initial
8 coordination of this project.

9

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1 **Tables**

2 **Table 1.** Types of conservation actions underway that were used in the analysis, plus the variables used to
 3 predict conservation action implementation with citations from papers that found these variables to be
 4 important in predicting extinction risk.

Conservation Actions	Definition	IUCN classification scheme
Action Plan	An action/recovery plan exists for the species	Research Needed 2 Conservation Planning
Monitoring	The species is subject to a systematic monitoring scheme	Research Needed 3 Monitoring
Protected Area	The species occurs in at least one protected area	
Invasive Species Control/Eradication	Invasive alien species which impact the species are being (or have been) eradicated, controlled or prevented from spreading	2.2 Invasive/problematic species control
Reintroduction	The species is being (or has been successfully) reintroduced or introduced benignly for conservation purposes	3.3 Species re-introduction
<i>Ex Situ</i>	The species is subject to ex-situ conservation	3.4 Ex-situ conservation
Education /awareness-raising	The species is subject to ongoing (or recent) education and awareness programmes	4 Education & awareness
International Legislation	Species is listed in international legislation (e.g. on Appendices of CITES and/or CMS and/or its Agreements and Instruments (ACAP, AEWa etc)	5 Law & policy
International Trade Management	Species is subject to international management/trade controls	6 Livelihood, economic & other incentives

5

Predictor Variables	Citations
Direction of population Trend	
IUCN Red List Category	
Taxonomic Order	Mace 2004
Body Mass	Gaston and Blackburn 1995; Owens and Bennett 2000; Fisher and Owens 2004; Fisher and Owens 2004
Clutch Size	
Generation Length	Owens and Bennett 2000; Fisher and Owens 2004;
Landmass Type	Davies et al 2006
Habitat Type	Owens and Bennett 2000
Biogeographic Region	Purvis et al 2000; Cooper et al 2008
Number of Countries in Species Range	
Size of Breeding Range	Fisher and Owens 2004; Owens and Bennett 2000
Proportion of Range in G20 countries	Chapron et al 2010

Proportion of Range in OECD countries
GDP of Countries Within Species Range

Christie et al 2006
McKinney 2002; Davies et al 2006

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- 2
- 3

1 **Table 2.** AICc models for conservation actions associated with increasing population trends of Threatened
 2 and Near Threatened species.

	logL	k	AICc	$\Delta AICc$	weight
Population Trend			513.8		
Education + Int Legislation + Reintroduction + <i>Ex Situ</i> + Invasive Control	-250.90	5	5	0.00	0.35
Education + Int Legislation + Reintroduction + <i>Ex Situ</i> + Invasive Control + Action Plan	-250.05	6	7	0.32	0.30
Education + Int Legislation + Reintroduction + <i>Ex Situ</i> + Invasive Control + Action Plan + Protected Areas	-249.39	7	5	1.00	0.21
Education + Int Legislation + Reintroduction + <i>Ex Situ</i> + Invasive Control + Action Plan + Protected Areas + Int Trade	-249.09	8	7	2.42	0.10
Education + Int Legislation + Reintroduction + <i>Ex Situ</i> + Invasive Control + Action Plan + Protected Areas + Int Trade + Monitoring	-249.00	9	3	4.27	0.04

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1 **Figures**

2 Figure 1. Schematic of the data flow.

3 Figure 2. Estimate and 95% confidence interval of odds ratio of implemented
4 conservation actions associated with increasing population trends of threatened
5 and Near Threatened bird species.

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