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'Building a Future for Wildlife'? Evaluating the contribution of the world zoo and aquarium community to *in situ* conservation

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In light of the United Nations declaring 2010 as the 'International Year of Biodiversity', we carried out an audit of *in situ* conservation projects supported by the world zoo and aquarium community. The results of our questionnaire survey show that the 113 evaluated projects are helping to improve the conservation status of high-profile threatened species and habitats in biodiversity-rich regions of the world. Our results show that thanks to the investment made by zoos and aquariums, particularly financial, these projects reached overall impact scores of a magnitude suggestive of an appreciable contribution to global biodiversity conservation. The present first global appraisal of the contribution of the world zoo and aquarium community to *in situ* conservation from a supported project's perspective thus suggests that zoos and aquariums are on track for 'Building a Future for Wildlife', as stipulated in the revised *World Zoo and Aquarium Conservation Strategy* of 2005. However, zoos and aquariums could make an even stronger contribution by allocating more resources to *in situ* conservation, which – as our results show – would significantly increase the projects' conservation impact. Increased pooling of resources among zoological institutions thus appears to be advisable.

Key-words: aquarium; biodiversity; evaluation; *in situ* conservation; WAZA; zoo.

INTRODUCTION

Evaluating the success of conservation efforts and identifying the most effective approaches are important challenges facing conservationists, policy makers and donors alike (Kleiman *et al*., 2000; Salafsky *et al*., 2002; Sutherland *et al*., 2004; Ferraro & Pattanayak, 2006). Accordingly, approaches to evaluating conservation performance have been reviewed by Stem *et al*. (2005) and additional evaluation tools have been proposed recently (e.g. Pullin & Stewart, 2006; Mace *et al*., 2007; Kapos *et al*., 2008; McDonald-Madden *et al*., 2009). While single conservation efforts have been assessed (e.g. Gusset *et al*., 2008), large-scale evaluations of multiple conservation initiatives and their outcome are lacking. Such broad evaluations may be particularly important in the case of conservation projects supported by zoos and aquariums. In part as a response to critiques about the relevance and/or the efficacy of their *ex situ* activities, many zoos and aquariums claim to have conservation of wild species and habitats as the overarching principle of all their activities (Tribe & Booth, 2003; Miller *et al*., 2004; Leader-Williams *et al*., 2007; Zimmermann & Wilkinson, 2007), as stipulated in the revised *World Zoo and Aquarium Conservation Strategy* (WAZA, 2005). The Strategy bears the title '*Building a Future for Wildlife*'. However, these wildlife conservation efforts are often criticized for being public-relations stunts, superficial and ineffective. In fact, to date, there has been no compilation and assessment of the world zoo and aquarium community's contribution to *in situ* conservation from the perspective of supported projects.

The World Association of Zoos and Aquariums (WAZA) is the umbrella organization for the world zoo and aquarium community. Its nearly 300 members include leading zoos and aquariums, regional and national associations of zoos and aquariums, as well as some affiliate organizations from around the world. WAZA membership requires a binding commitment to conservation. In the years 2000/

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2001, WAZA organized three *in situ* conservation workshops searching for a strategy on how WAZA should become involved in *in situ* conservation (WAZA, 2004). One recommendation was that WAZA (with the goal of becoming a globally recognized conservation organization) should brand suitable conservation projects. The idea behind the WAZA branding is to create a win–win situation; the brand promotes the project (e.g. http://www.waza.org) and the brand allows WAZA to use the project to convey what zoos and aquariums do for conservation. Projects (or programmes) are branded on application, with three sets of endorsement criteria, focusing on biological, operational, and institutional and partnership issues. Applications may be submitted by either the project organization or a WAZA member supporting the project. Since the inception of the scheme in 2003, the number of WAZA-branded projects has steadily increased to 163 (September 2009).

In light of the United Nations declaring 2010 as the 'International Year of Biodiversity', and with WAZA being a partner of the 'Countdown 2010' initiative, we considered it timely to compile and assess these conservation projects supported by the world zoo and aquarium community to address two questions: (1) What is the conservation impact of these projects? (2) What is the contribution made by zoos and aquariums to these projects?

METHODS

Following Mace *et al*. (2007), we sought to calibrate all projects against a common standard of how influential the project was (regardless of what kind of activity it involved) for conservation (cf. Salafsky & Margoluis, 1999; Kapos *et al*., 2009). We asked how much the project improved the conservation status of a target species or habitat. To achieve this objective for different types of project, each project was categorized by its main activity (i.e. education/training, habitat protection, research or species protection). We divided our assessment of impact into three subcomponents, which can vary according to the main type of activity that the project involved. Thus, the overall impact score for a project is a function of the importance, the volume and the effect of a project (for details, see Mace *et al*., 2007). In short, importance, volume and effect are measures of the conservation significance of the target, the scale of the intervention and its outcome, respectively (Table 1). We scored A = 1, B = 2, C = 3 and D = 4 for all measures, and the total project score was calculated as the product of importance × volume × effect. One was the lowest and 64 was the highest possible score. This system shows fairly consistent scores for all measures and the total project score across independent assessors, as well as between the project expert and independent assessors (Mace *et al*., 2007).

We therefore designed an Internet-based questionnaire survey in which experts were asked questions about the activities of their project and the contribution made by zoos and aquariums in relation to their project. Notably, we did not reveal what the scoring matrix consisted of to the project experts. In order to increase the willingness to respond, questions were short and closed, response options were pre-grouped into bands and reminders were sent before expiry of the reply deadline. We sent the questionnaire to experts from 149 WAZA-branded projects, of whom 113 responded. This constitutes a response rate of 76%, thus reducing potential response bias towards more successful projects (White *et al*., 2005). As recommended by Mace *et al*. (2007), we subsequently verified the project scoring based on our own information. Compiled questionnaire data were analysed using GRAPHPAD INSTAT 3 (2003), with the significance level set at $P = 0 \cdot 05$.

RESULTS

Projects mainly focused on mammals (50%), among them mostly on charismatic primates (13%) and carnivores (12%) (Fig. 1). Most projects (73%) worked on taxa classified as globally threatened with extinction (classification after IUCN, 2008). Amphibians (Fisher's exact test: $P < 0 \cdot 001$) and fishes ($P = 0 \cdot 03$) were significantly under-represented in the

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	PROJECT ASSESSMENT MEASURES		
	IMPORTANCE	VOLUME	EFFECT
	How influential/significant was the target (people, species, habitat, policy) of the project for conservation?	How many/much of the target (people, species, habitat, policy) were/was addressed by the project?	How did the project affect relevant conservation outcomes?
Education	Influence of the target people: A: low (untargeted) B: moderate (children) C: high (school teacher, media people) D: very high (leaders) Target: people (local communities, tourists, visitors). Influence: extent to which these people influence relevant policy or practice, now or in the future.	Number of people who received the education: A: <10 B: 10–100 C: 101–1000 D: >1000	Effect of the project: A: no discernible effect B: marginal improvements C: improvement D: substantial improvements Effect: a documented change in awareness or behaviour that is likely to have beneficial outcomes for conservation, compared with no project.
Training	Influence of the target people: A: low (front line staff) B: moderate (supervisors) C: high (middle-ranked personnel) D: very high (decision makers) Target: people (involved directly or indirectly in conservation outcomes). Influence: extent to which these people influence relevant policy or practice, now or in the future.	Number of people who received the training: A: <10 B: 10–100 C: 101–1000 D: >1000	Effect of the project: A: no discernible effect B: marginal improvements C: improvement D: substantial improvements Effect: a documented change in attitude or behaviour affecting the relevant conservation policy or practice, compared with no project.
Habitat protection	Significance of the target area: A: no global loss/negligible B: some evidence of decline/local C: many areas are in decline/national or regional D: under global threat/international Target: an area. Significance: importance of the target area; e.g. globally, regionally, nationally.	Area targeted by the project (km^2): A: <10 B: 10–1000 C: 1001–10 000 D: $>10\,000$	Effect of the project: A: no discernible effect B: marginal improvements C: improvement D: substantial improvements Effect: a documented change in the overall conservation status of the habitat within the area of the project, compared with no project.
Research	Significance of the research target: A: low/negligible B: moderate/local C: high/national or regional D: very high/international Target: the subject under investigation (species, habitat, policy). Significance: relative importance of the research target in relation to global priorities.	Cost of the project (US$): A: <1000 B: 1000–10 000 C: 10 001–100 000 D: $>100\,000$	Effect of the project: A: no relevance B: marginal relevance C: considerable relevance D: clear relevance Effect: the potential relevance of the research project for conservation outcomes, compared with no project.
Species protection	Significance of the target species: A: not threatened B: nationally or regionally threatened C: globally at lower risk (NT, LC) D: globally threatened (CR, EN, VU)	Proportion of the species' global population targeted by the project (%): A: <1	Effect of the project: A: no discernible effect B: marginal improvements C: improvement D: substantial improvements

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Table 1. Continued

PROJECT ASSESSMENT MEASURES		
IMPORTANCE	VOLUME	EFFECT
Target: a species in the wild. Significance: level of endangerment of the target species; e.g. globally, regionally, nationally.	B: 1–10 C: 11–50 D: >50	Effect: a documented change in the conservation status of the species within the focus of the project, compared with no project.

Table 1. Criteria, scores and explanations for evaluating the impact of *in situ* conservation projects supported by the world zoo and aquarium community, according to the type of project (modified from Mace *et al*., 2007). The overall impact score for a project is a function of importance, volume and effect: CR, Critically Endangered; EN, Endangered; LC, Least Concern; NT, Near Threatened; VU, Vulnerable (IUCN, 2008).

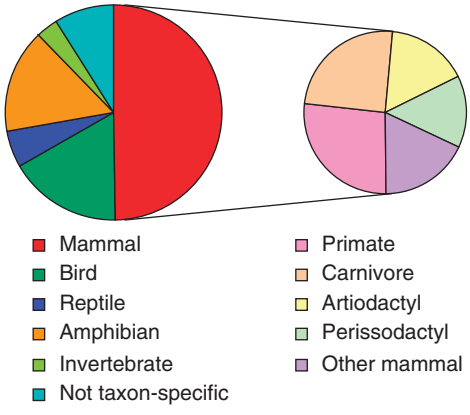

Fig. 1. Taxonomic distribution of *in situ* conservation projects supported by the world zoo and aquarium community.

number of projects relative to the percentage of threatened species described in these taxa. Projects were primarily active in the Palearctic (28%), Afrotropic (27%) or Indo-Malay (25%) biogeographic realms (Fig. 2) (classification after Olson *et al*., 2001). Projects strongly focused on terrestrial biomes (86%), among them chiefly on tropical and subtropical forests (39%). Terrestrial biomes at a high conservation risk, especially Mediterranean woodlands ($P < 0 \cdot 001$) and temperate grasslands ($P = 0 \cdot 001$), were significantly under-represented in the number of projects (classification after Hoekstra *et al*., 2005).

Projects typically applied for WAZA branding to increase publicity (31%) or credibility (28%) for the project, or to attract support from zoos and aquariums (25%). However, projects were generally undecided whether the WAZA branding resulted in the desired outcome (47%). Projects mainly received support from one (40%) or two to five (36%) zoos and aquariums. Zoos and aquariums primarily became involved in a project because they initiated it (41%) or because projects requested support from them (37%). The main source of project support provided by zoos and aquariums was monetary funding (48%). The contribution made by zoos and aquariums (including non-monetary support) often covered more than half of the total financial expenditures of a project per year (49%). Most projects (59%) would not be viable without the support from zoos and aquariums. The financial expenditures of projects were typically in the range of US$10 000–100 000 year^{-1} (41%), with the duration of projects often being longer than 10 years (46%).

Most projects (63%) had their main focus on species protection (Table 2). The mean overall impact score for a project was $27 \cdot 9 \pm 1 \cdot 8$ (mean ± SE; range 2–64; importance: $3 \cdot 3 \pm 0 \cdot 1$; volume: $2 \cdot 8 \pm 0 \cdot 1$; effect: $2 \cdot 9 \pm 0 \cdot 1$), indicating an average score of $3 \cdot 0$ per subcomponent (Table 2). This translates into a 'C' score in Table 1, which is the second best score possible for each of the three project assessment measures. The overall impact score across different types of project did not differ significantly

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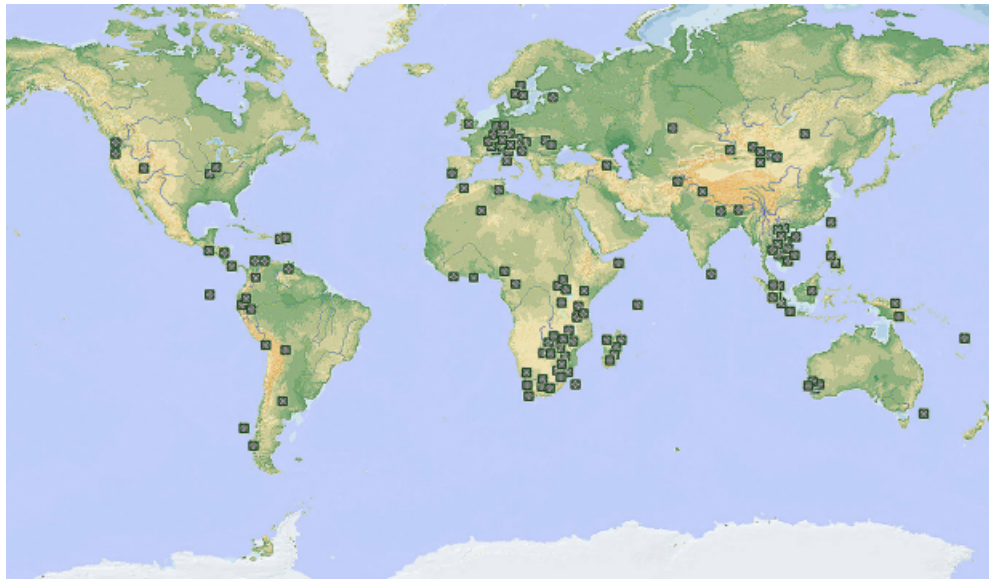

Fig. 2. Geographic distribution of *in situ* conservation projects supported by the world zoo and aquarium community.

(Kruskal–Wallis test: $KW = 5 \cdot 39$, $P = 0 \cdot 15$; Fig. 3). An exploratory analysis of the concurrent influence of the 14 project attributes, for which data were presented above, on the overall impact score for a project (multiple regression analysis: $F = 6 \cdot 25$, $P < 0 \cdot 001$, $R^2 = 0 \cdot 52$) revealed that increasing financial expenditures ($t = 2 \cdot 77$, $P = 0 \cdot 007$; excluding research projects to avoid circularity) and an increasing contribution made by zoos and aquariums to the total financial expenditures ($t = 3 \cdot 63$, $P < 0 \cdot 001$) were the only significant correlates of the total project score (Fig. 4).

DISCUSSION

Do zoos and aquariums contribute to achieving the international '2010 Biodiversity Target' of significantly reducing the current rate of biodiversity loss by 2010? The present first global appraisal of the contribution of the world zoo and aquarium community to *in situ* conservation from a supported project's perspective shows that an increasing number of WAZA-branded projects are helping to improve the conservation status of high-profile threatened species and habitats in biodiversity-rich regions of the world (Figs 1 and 2). In particular, tropical and subtropical forests represent global biodiversity conservation priorities (Brooks *et al*., 2006).

We are aware that our sample is biased towards projects already supported by zoos and aquariums, with the sample being restricted to WAZA-branded projects. Our results nonetheless show that thanks to the investment made by zoos and aquariums, particularly financial, these projects reached overall impact scores of a magnitude (Fig. 3) suggestive of an appreciable contribution to global biodiversity conservation (Mace *et al*., 2007). Nevertheless, for individual zoos and aquariums to fulfil their claim to have conservation of wild species and habitats as the overarching principle of all their activities, and for WAZA to become a globally recognized conservation organization, current efforts need to be intensified (Tribe & Booth, 2003; Miller *et al*., 2004; Leader-Williams *et al*., 2007; Zimmermann & Wilkinson, 2007; this study). The amount of resources

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	NUMBER OF PROJECTS	PROJECT ASSESSMENT MEASURES (MEAN ± SE)		
		IMPORTANCE	VOLUME	EFFECT
Education/training	3	2·7 ± 0·3	2·3 ± 0·3	2·3 ± 0·3
Habitat protection	21	3·3 ± 0·2	2·3 ± 0·2	2·8 ± 0·2
Research	17	2·9 ± 0·2	2·8 ± 0·2	3·2 ± 0·2
Species protection	71	3·4 ± 0·1	3·0 ± 0·1	2·8 ± 0·1

Table 2. Subcomponent scores of *in situ* conservation projects supported by the world zoo and aquarium community according to the type of project: although 113 projects were analysed, one did not specify to which category it belonged and so only 112 projects are given here.

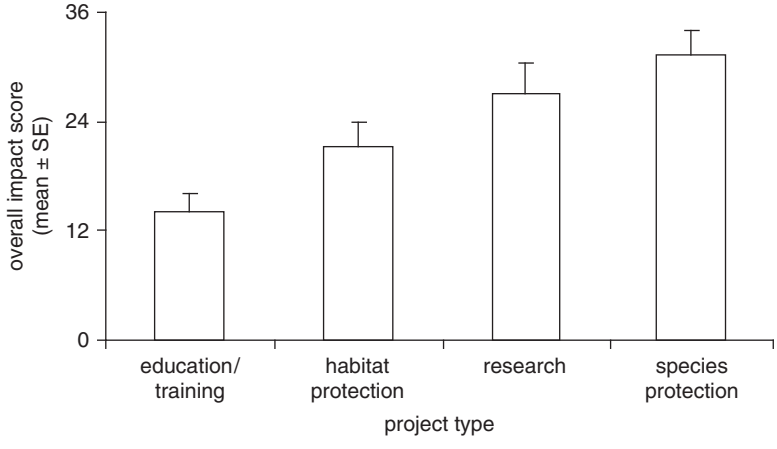

Fig. 3. Overall impact of *in situ* conservation projects supported by the world zoo and aquarium community according to the type of project.

(including non-monetary support) allocated by most zoos and aquariums to *in situ* conservation is still relatively small (Leader-Williams *et al*., 2007; Zimmermann & Wilkinson, 2007), which may significantly limit a project's conservation impact (Fig. 4; also see Mace *et al*., 2007). This may also fuel criticism of the stated conservation mission of zoos and aquariums, to which they should be held accountable. To maximize the global contribution of the world zoo and aquarium community to *in situ* conservation, increased pooling of resources among zoological institutions appears advisable, as our results (Fig. 4) suggest that differences in the overall impact score among projects result primarily from variation in financial investment.

The specific evaluation tool we used (Mace *et al*., 2007), quantifying the importance, volume and effect of a project (Tables 1 and 2), generally proved useful for our purpose to make explicit the assumed linkages between project activities and conservation outcomes. Possible limitations of this tool may include inconsistencies in project scoring and differences in impact scores among project types (Walter, 2005), but the latter turned out not to differ significantly in our analysis. We are aware that many projects involve multiple types of activity, which may be difficult to evaluate separately. Nevertheless, as local conservation success is rarely measured and communicated in an international context (Kleiman *et al*., 2000; Salafsky *et al*., 2002;

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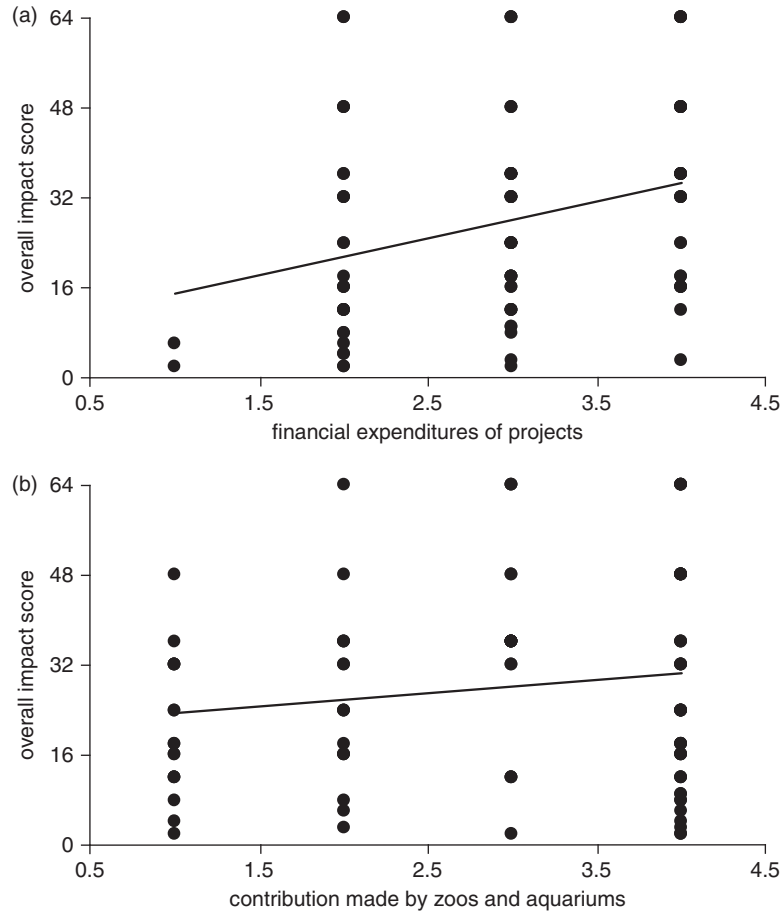

Fig. 4. (a) Increasing financial expenditures of projects [pre-grouped into four bands (US$): <1000, 1000–10 000, 10 001–100 000 and >100 000 year^{-1}] and (b) an increasing contribution made by zoos and aquariums to these total financial expenditures [pre-grouped into four bands (%): <10, 10–25, 26–50 and >50 year^{-1}] lead to a significantly higher overall impact of *in situ* conservation projects supported by the world zoo and aquarium community.

Sutherland *et al*., 2004; Ferraro & Pattanayak, 2006), our study may provide a worthwhile example of a large-scale evaluation of multiple conservation initiatives and their outcome. Other, possibly more elaborate but laborious approaches to evaluating conservation performance (e.g. Pullin & Stewart, 2006; Kapos *et al*., 2008; McDonald-Madden *et al*., 2009) might become expedient once more data have been accumulated (93% of projects that we have evaluated are ongoing). A standardized format for prioritizing conservation projects that request support from zoos and aquariums is currently being developed (R. Spindler *et al*., unpubl. data; cf. Joseph *et al*., 2009), which will effectively complement our practical and efficient approach to formally judge a project's conservation impact.

Zoos and aquariums, at least those supporting the projects evaluated here, seem to be on track for 'Building a Future for Wildlife' (WAZA, 2005), but the community at large could make an even stronger contribution to *in situ* conservation. For example, zoos and aquariums could apply their extensive

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expertise on coordinated management of small and fragmented captive subpopulations to the increasingly important metapopulation management of free-ranging animals (e.g. Gusset *et al*., 2008), possibly including an *ex situ* component (Bowkett, 2009). Based on our analysis, the presently under-represented taxa (amphibians and fishes) and biomes (aquatic systems, Mediterranean woodlands and temperate grasslands) merit special conservation attention (cf. Brooks *et al*., 2006). Within the world zoo and aquarium community, zoo-based conservation organizations and conservation-focused zoo consortiums might be particularly well suited for tackling the task of halting global biodiversity loss.

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PRODUCT MENTIONED IN THE TEXT

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