EVALUATING THE EFFECTIVENESS OF CONSERVATION ATTENTION AT A SPECIES LEVEL

Creating a framework for general use

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CONTENTS

LIST OF ACRONYMS

AZE	Alliance for Zero Extinction
BEM	Business Excellence model
CBD	Convention on Biological Diversity
CCF	Cambridge Conservation Forum
CMP	Conservation Measures Partnership
DPSIR	Driving force – Pressure – State – Impact – Response
EDGE	Evolutionarily Distinct and Globally Endangered
ICA	Index of Conservation Attention
IOO	Input, Output and Outcome
IUCN	International Union for the Conservation of Nature
MCQs	Multiple Choice Questions
NBSAP	National Biodiversity Species Action Plan
NGO	Non-governmental organisation
PA	Protected Area
RL	IUCN Red List of Threatened Species
SCS	Species Conservation Strategy
SRC	Species Report Card
SSC	Species Survival Commission
SSG	Species Specialist Group
TNC	The Nature Conservancy
WAZA	World Association of Zoos and Aquariums
ZMG	Zoo Measures Group
ZSL	Zoological Society of London

Abstract

Conservation effectiveness is difficult to measure due to the varying and subjective goals of individual programmes. Evaluating the effectiveness of species conservation as a whole has received little interest, despite the prevalent use of species as a unit of biodiversity. The goal of population recovery will only be achieved over long timescales so does not provide a useful benchmark against which to measure. Much of the information regarding species-specific interventions remains unrecorded.

I propose a framework for measuring the achievement of the intermediate goal of effective conservation attention, at a species level. Expert knowledge is elicited through questionnaires to assess some of the Zoological Society of London's Evolutionarily Distinct and Globally Endangered (EDGE) species against the framework. Higher ranking EDGE species tend to achieve a higher conservation attention effectiveness score. The questionnaire is quick and simple to complete, and provides the first attempt to assess the status of all conservation activities and processes in place for multiple species. Following improvements recommended here, this framework will be a useful addition to the toolkit for assessing conservation effectiveness, providing a 'recipe' against which to compare species conservation, and will promote collection of information detailing successful efforts to save species.

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INTRODUCTION

1.1 CONSERVATION EFFECTIVENESS

The state of biodiversity continues to decline, despite increased investment (Butchart et al. 2010). Identifying common components of success allows prediction of future successes (Kapos et al. 2009; Nicholson et al. 2012), and prioritisation of limited funds (James et al. 1999).

The expected links between actions and their impacts are often assumed, but rather than relying on received wisdom, it is necessary to critically evaluate whether commonly accepted practices result in effective conservation (Pullin & Knight 2001). Many methods have been developed to assess this (e.g. Christensen 2003; The Nature Conservancy 2007; Kapos et al. 2008; Black & Groombridge 2010).

Reporting effectiveness promotes celebration of conservation; positivism is needed to reinvigorate the discipline (Garnett & Lindenmayer 2011; Sodhi et al. 2011).

1.2 EVALUATION

Evaluation is the method by which conservation effectiveness can be assessed. Evaluating the results of interventions can improve accountability (Christensen 2003), though this can have a detrimental effect; practitioners are under pressure to report successes rather than failures in order to meet donor expectations (Redford & Taber 2000).

Evaluation expertise exists, including in several cross-disciplinary societies, e.g. the European Evaluation Society (www.europeanevaluation.org). A clearly defined goal against which progress can be evaluated is necessary (Kleiman et al. 2000). However, many conservation interventions remain undocumented (Brooks et al. 2009), or are recorded in 'grey literature', making evaluation difficult. Documenting and evaluation of conservation interventions and communication of findings with other practitioners must be encouraged (Sutherland et al. 2004).

Detailed evaluations are time-consuming, and associated monitoring requirements demanding on limited budgets (Ferraro & Pattanayak 2006). Short funding cycles available to most practitioners create strong motivation to spend the majority of resources on conservation action, rather than on monitoring that, although useful for broader conservation, is perceived to be less important within a project than action (Ferraro & Pattanayak 2006). As projects attempt to cover more cross-disciplinary objectives, practitioners must spend more time on elaborate planning stages, leaving less time for implementation and evaluation (Bottrill et al. 2011b).

1.2.1 Conceptual models

Conceptual models are tools used to provide a simple visualisation of a complicated system (Salafsky et al. 2002). They can make explicit the assumptions in the relationship between an action and an outcome (Kapos et al. 2008). Key transitions, that if monitored will indicate change within the system, can be identified (Kapos et al. 2010).

1.2.2 Indicators

An indicator is a simple, intuitive metric describing the transition between two states of interest (Jones et al. 2011). Indicators should be relevant to biodiversity and policy, measurable, representative of overall trends, scientifically defendable, sensitive to change, broadly acceptable, affordable to produce and possible to aggregate (UNEP 2003). Hierarchical and nested indicators can be disaggregated or combined, representing trends at different scales (Leverington et al. 2008).

Robust indicators that measure outcomes can be developed, but need thorough testing before widespread application (Howe & Milner-Gulland 2011). There is a clear need for development of reliable indicators (Kapos et al. 2009) that can be easily updated and tracked through time (Balmford et al. 2009).

1.3 Conservation attention

Due to the long timescales over which the ultimate goals of conservation will occur, intermediate goals are needed; providing an achievable situation towards which practitioners can work (Kleiman et al. 2000). An appropriate timeframe for reporting progress allows findings to influence management decisions (Jones et al. 2011). Conservation attention, defined by Sitas et al. (2009), refers to action that has been planned or implemented for a species. Extending conservation attention to include the outcomes of action (without which the action itself is meaningless), creates a suitable candidate for an intermediate goal for species conservation i.e. aiming to have all necessary interventions completed and showing results, rather than waiting several decades for population recovery.

1.4 PROJECT OR SPECIES LEVEL?

Most methods for evaluating conservation effectiveness are designed for use at a programme or project level (e.g. O'Neill 2007; Kapos et al. 2008) or an organisational level (e.g. Christensen 2003). There is reluctance to express shortcomings at a project or organisation level to protect reputations (Redford & Taber 2000), which biases inferences that can be made from resulting evaluations (Kapos et al. 2008).

Assessing conservation at these levels is undoubtedly important, but for a species the cumulative effect of all efforts is key (Kondolf et al. 2008). Status of a species is assessed across its whole range, but action usually occurs at a regional or national level (Mace et al. 2008). Stronger links are needed between site-specific initiatives and global monitoring (Saterson et al. 2004). Combining project and organisational evaluation results will give a more holistic view of species conservation – but projects' and organisations' impacts will interact, so summing individual evaluations will not be sufficient (Rodrigues 2006).

1.5 EXPERT KNOWLEDGE

Documentation of single-species actions is often limited to case studies (Brooks et al. 2009). In data-poor situations, or where speed is required, expert knowledge can be elicited (Scholes & Biggs 2005; Donlan et al. 2010). Although not a substitute for scientific research (O'Neill et al. 2008), expert elicitation can capture complexities of a situation (Hockings 2003) and provide more current information than is available from the literature (Leverington et al. 2008). Many studies have used expert elicitation, particularly to investigate threats (e.g. Whitfield et al. 2008; Donlan et al. 2010). The wealth of knowledge held by experts can be extracted using appropriately designed questionnaires (Kleiman et al. 2000).

1.6 EVOLUTIONARILY DISTINCT AND GLOBALLY ENDANGERED SPECIES

In 2007, the Zoological Society of London (ZSL) proposed the Evolutionarily Distinct and Globally Endangered (EDGE) index to prioritise species for conservation (Isaac et al. 2007). Subsequently ZSL introduced an EDGE of Existence programme (hereafter EDGE programme) to improve conservation efforts for high priority EDGE species, focusing on the top 100 ranked mammals and top 100 ranked amphibians (C. Waterman, pers. comm.).

ZSL are now instigating the preliminary evaluation of the EDGE programme and the state of conservation for some of the highest ranking EDGE species, the results of which will be presented as species report cards (SRCs; Sinfield 2011).

ZSL is looking for an index for use by conservation practitioners who are experts in the species they are assessing, to help with this evaluation. Index results must be suitable for use by research organisations, e.g. ZSL, and other parties wishing to evaluate effectiveness of conservation attention at the species level. The index must be simple to use, intuitive and non-technical; practitioners find primary literature overly technical and difficult to apply to their practical situations (Pullin et al. 2004).

1.7 AIM AND OBJECTIVES

This project aimed to develop improved methods for evaluating, and monitoring over time, the effectiveness of conservation attention using EDGE species as a case study, to be achieved through the following objectives:

- Producing a calibrated, robust index for evaluating effectiveness of conservation attention at the species level using expert knowledge, which can be tracked over time.
- Contributing to development of EDGE SRCs by providing preliminary assessments of the effectiveness of conservation attention directed at some of ZSL's top 100 EDGE mammals and amphibians.
- Initiating information exchange with potential EDGE species experts to facilitate development of a network of EDGE species professionals (hereafter EDGE network).

I present a framework for assessing the effectiveness of conservation attention at the species level, based on a results chain conceptual model. The framework is translated into a questionnaire and completed by experts for some of ZSL's EDGE species. Scoring methods are discussed and preliminary scores using the favoured approach presented for the species assessed. An exploration of the scores follows, leading to recommendations for improvements to develop the framework further.

BACKGROUND

2.1 MEASURING CONSERVATION EFFECTIVENESS

To engage the wider public and counter past pessimism, conservation must prove it can succeed, and show how these achievements can be made (Garnett & Lindenmayer 2011; Redford et al. 2011).

Measurement of success requires definition of an ultimate goal that must be achieved to render an outcome effective (Kleiman et al. 2000), so progress towards the goal can be tracked. Building on expertise in other disciplines (Stem et al. 2005), several methods to measure conservation effectiveness have been developed (Table 2.1).

2.1.1 CONCEPTUAL MODELS

Conceptual models are important tools for developing evaluative processes (Margoluis et al. 2009). Results chains identify assumptions made in drawing links between conservation actions and their effects (Kapos et al. 2008). Models are useful ways of visualising a system, allowing others to understand basic premises underlying an evaluation.

There are five widely recognised temporal divisions of conservation action: strategies, inputs, actions, outputs and outcomes (Woodhill 2000; Ferraro & Pattanayak 2006) which form a basic logic model (Figure 2.1).

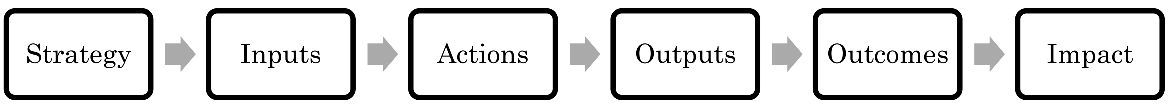


FIGURE 2.1 A conceptual model of the five widely recognised stages of conservation action. Evaluation of effectiveness can be aimed at any one of these stages; the ease in assessing effectiveness of each stage decreases in moving from left to right. Diagram adapted from Margoluis et al. (2009).

Firstly a plan, the 'strategy', outlines activities proposed to combat a problem (Margoluis et al. 2009). This plan may not exist as a formal document. 'Inputs' describe the resources required in order to carry out the 'actions' specified in the strategy (Woodhill 2000). Measures of effectiveness have

TABLE 2.1 Current approaches used to measure effectiveness in conservation, their methods, applications and the level at which the evaluation is intended to be performed. For more information see text. CBD = Convention on Biological Diversity; CCF = Cambridge Conservation Forum; TNC = The Nature Conservancy; ZMG = Zoo Measures Group.

Approach	**Method used**	**Data used**	**Applications**	**Level of evaluation**	**Main source**
Driving force – Pressure – State – Impact – Response	Conceptual model and framework	Combinations of indicators	Measuring achievement of CBD goals	Any	Mace & Baillie (2007)
CCF Evaluation Tool	Conceptual model translated into questionnaires	Project manager responses	Project planning and evaluation	Project or programme	Kapos et al. (2008)
Project Conservation Impact Summary Form	Questionnaire based on ZMG indicators for zoo conservation work	Project manager and independent reviewer responses	For funders to assess the impact of their projects	Project	Mace et al. (2007)
Miradi	Low cost computer software	User input	Complete planning and evaluation tool for practitioners	Project	http://miradi.org
TNC scorecard	Three component scorecard, defined by variation in ecological attributes	Site monitoring data, expert knowledge	Status assessment of sites	Site	Parrish et al. (2003)
Site Consolidation Scorecard	Scorecard with 16 pre-determined site-specific benchmarks	Monitoring data, expert knowledge	Measuring a protected area's capacity to enact conservation	Site	TNC (2007)
Business Excellence model	Model based on criteria for business quality management	Organisational records, expert knowledge	Improving common conservation processes across an organisation	Programme or organisation	Black & Groombridge (2010)
Index of Conservation Attention	Four point framework	Literature review, action plans	Measure action planned and implemented for a species	Species	Sitas et al. (2009)

previously focused on inputs, e.g. money spent, as a proxy for conservation success, assuming presence of inputs guarantees success (Kapos et al. 2008).

Actions produce tangible 'outputs', e.g. educational leaflets, which are another candidate for measurement (Mace et al. 2007). 'Outcomes', direct effects brought about by outputs (e.g. changed behaviour resulting from education programmes), occur over a long timescale and are difficult to measure in usual project cycles (Kapos et al. 2008).

The 'impact' is the end goal: "improved conservation response and/or reduced pressures" (Kapos et al. 2008). Impacts are often only detectable over several decades, so do not provide useful benchmarks for most projects (Mace et al. 2007).

Quantification of the stages becomes more difficult in progression from left to right (Figure 2.1). Many evaluations focus on inputs and outputs as measures of success (Woodhill 2000). More recent efforts measure outcomes and impacts, and test assumptions made in construction of a conceptual model, often at a project or programme level (e.g. Mace et al. 2007; Kapos et al. 2008). Whilst this provides invaluable information for organisations and individuals to ensure efficiency and effectiveness, it makes it difficult to assess effectiveness of conservation aimed at a species as a whole (Sitas et al. 2009).

2.1.2 APPROACHES CURRENTLY USED

Driving force – Pressure – State – Impact – Response

Various formulations of the Driving force – Pressure – State – Impact – Response (DPSIR) framework are used to understand threats, actions and consequences (e.g. Zalidis et al. 2004; Roura-Pascual et al. 2009), particularly to measure achievement of the Convention on Biological Diversity (CBD) goals for 2020 (Mace & Baillie 2007). The DPSIR framework is a useful conceptual model from which to work, but will not alone provide enough guidance for developing conservation effectiveness evaluations (Stem et al. 2005).

Cambridge Conservation Forum Evaluation Tool

The Cambridge Conservation Forum (CCF), a group of conservation non-governmental organisations (NGOs) and researchers, used conceptual models to investigate assumed links between conservation action and outcomes for seven categories of conservation activity (Kapos et al. 2008). Models were translated into questionnaires asking multiple choice questions (MCQs) to assess project effectiveness. Analysis showed outcomes are a better predictor of success than implementation (Kapos et al. 2009).

The CCF tool is demand driven, and practitioners find it helpful as a planning tool (Kapos et al. 2010) and a record of information. However, as it is assessed by project managers, responses are likely to be subjective (Hockings 2003) – managers may wish their projects to appear successful. Using the tool is time-consuming, and the interface is not user-friendly (though ease of use is being improved [V. Kapos, pers. comm.]).

Zoo Measures Group

The Zoo Measures Group (ZMG) developed a set of indicators to measure effectiveness of zoos' conservation projects (Mace et al. 2007). This has been adapted by Chester Zoo and the World Association of Zoos and Aquariums (WAZA) to produce the Project Conservation Impact Summary Form (http://www.waza.org/en/site/conservation/conservation-impact).

Conservation activities are divided into five groups, following Mace et al. (2007). MCQs quantify resource input and output for each activity. A conservation impact score is automatically generated based on answers given by the project leader. The form can be reviewed by an independent party, with original scores omitted to provide an independent comparison.

Although rapid, the assessment has limited universality due to its exact quantitative measures (e.g. number of people receiving education: 0–10, 11–100, 101–1000, 1001+; Mace et al. 2007), which may not accurately represent necessary levels of conservation for species with a very restricted range. One study found that an earlier qualitative version of the ZMG method was the least consistent measure of success when compared to counts of Darwin

Initiative outputs and a qualitative ranking system (Howe & Milner-Gulland 2011).

The current version is not finalised, and feedback has been invited. This will help improve usability. The measure is likely to have wider applicability than to zoo conservation work, though it is restricted to assessments at a project or organisation (rather than species) level. Greater transparency in scoring would be beneficial.

Conservation Measures Partnership

The Conservation Measures Partnership (CMP) is a collaboration between conservation NGOs, coordinated by Foundations of Success. In response to demand from donors, CMP seeks ways to evaluate project success to ensure efficient use of funds and recognition of effective interventions.

CMP products include a Rosetta Stone of conservation effectiveness terminology, Open Standards (standard operating procedures for conservation; www.conservationmeasures.org), and software to aid project planning and evaluation by taking project managers through steps to outline goals and efficient ways of achieving them (https://miradi.org/). By promoting clarity regarding goals and assumptions before commencing a project, the software helps identify indicators to use in measuring success against achieving stated goals (V. Kapos, pers. comm.).

Scorecards

Scorecards for measuring conservation effectiveness are often based on qualitative information from practitioners rather than quantitative monitoring data (Hockings 2003). Although not necessarily a representation of absolute truth, qualitatively obtained results may have greater practical application (Patton 2002).

The Nature Conservancy (TNC) scorecard has three components: a set of key biodiversity targets (as representative of the whole), an accompanying set of ecological attributes key to the targets' persistence and acceptable levels of variation within which these attributes can vary without affecting species persistence. Targets are assessed to see whether they fall within the acceptable ranges (Parrish et al. 2003). Levels assigned to each attribute range from 'poor' to 'very good'. This vague language may lead to inconsistent interpretation (Regan et al. 2006).

Traditional scorecards such as TNC's focus on status assessment, failing to recognise contributing factors such as management and communication. Composite scores risk oversimplifying information (Stem et al. 2005).

In partnership with Parks in Peril, TNC also developed a Site Consolidation Scorecard, addressing some of these limitations by measuring processes leading to consolidation of protected areas (PAs), i.e. a site's ability to undertake conservation (Leverington et al. 2008). Rather than measure the long-term impact of recovered biodiversity, the scorecard measures progress in sixteen pre-defined indicators believed to describe, at their highest score, the ideal state for a PA to become successful (TNC 2007).

Different types of conservation actions can have different bearings on overall success; the most important should receive greater weighting to obtain a representative score (Stem et al. 2005). However, weighting is subjective; even if weights are based on criteria ranked by an expert group, there is likely to be subjectivity resulting from individuals' experiences – another group could order the criteria differently (Regan et al. 2006). If inappropriate weights are applied, resulting scores are meaningless. There is a trade-off between complexity and suitability – overly comprehensive methods, theoretically ideal, can be difficult to apply (Stem et al. 2005).

Business Excellence Model

The Business Excellence model (BEM) proposed by Black and Groombridge (2010) measures effectiveness of processes necessary for achieving conservation, rather than seeking best practice for individual situations (Black et al. 2011b). Based on criteria outlined by an European Foundation for Quality Management award, the BEM looks at a project or programme level and scores effectiveness and breadth of management approaches (Black

& Groombridge 2010). Factors considered include leadership skills of conservation professionals (Black et al. 2011a); people and local community management; and policy (Black & Groombridge 2010). By focusing on processes rather than species-specific interventions, the approach provides a universal method of project evaluation based on a model from the business sector, maximising learning across projects.

2.2 STANDARDISED FRAMEWORKS

Frameworks are widely used to express common processes in a standard way applicable across different situations. Frameworks to guide assessments and development of conservation initiatives include the threat reduction assessment (Salafsky & Margoluis 1999), adaptive management and its application (e.g. Plummer & Armitage 2007; Cundill & Fabricius 2009), and developing situation-relevant management effectiveness assessment tools (Hockings 2003).

Other frameworks provide standardised classification to aid comparisons. The most well-known of these is the IUCN (International Union for the Conservation of Nature) Red List of Threatened Species (RL), used to assess risk of extinction for the world's flora and fauna (Mace et al. 2008). Salafsky et al. (2008) merged several approaches to create 'Unified classifications of threats and actions'. Salafsky et. al intend that use of the framework will allow comparison of different situations; the specifics of each being defined in a common language.

Frameworks are useful if applicable to a wide range of situations. Assumptions on which classification systems are developed must be specified when using the framework. However, as systems become more familiar, some users apply their own interpretation, and do not investigate their assumptions (Mace et al. 2008). This can lead to inconsistent use of classifications and limits comparisons.

2.3 INDICATORS

A single indicator, or set of several, can summarise the product of a framework. The biological and socioeconomic worlds are inherently complex – one cannot accurately measure every component of the system of study, so indicators provide a useful simplified representation of a system's state (Asah 2008).

Indicators should be measurable, precise, consistent, and sensitive to the phenomenon being tracked (Salafsky & Margoluis 1998). Indicators of success should directly link to goals or objectives (Stem et al. 2005). Global scale indicators include coverage of PAs (Chape et al. 2005), extent of forest cover (Pereira & Cooper 2006), the Red List Index (Butchart et al. 2004) and the Living Planet Index (Loh et al. 2005).

Who are they useful for?

Indicators range from knowledge-focused, where the sole purpose is to facilitate learning about a system, to action-focused, with the aim to inform policy (Jones et al. 2011). The specifics of an indicator depend on the purpose for which it is designed – attention should be paid to indicator objectives and design to ensure they are robust (Jones et al. 2011). Indicators are invaluable for decision-making and useful in communicating with non-specialists, if presented in a non-technical way (Schiller et al. 2001).

Interest in indicators has increased in response to the call for evaluating progress towards the CBD 2020 targets (Nicholson et al. 2012). However, if an indicator becomes a target for improvement it loses its objectivity (Howe & Milner-Gulland 2011). To combat this there have been suggestions to build linked indicator sets based on DPSIR (Sparks et al. 2011).

Indicators are a valuable tool in evaluating conservation effectiveness as they allow tracking of outcomes over time. Broad indicators developed by one organisation or individual can be useful in myriad situations (Butchart et al. 2010). The coarser an indicator is, the less sensitive it will be to change (Jones et al. 2011).

2.4 Conservation attention

Effectiveness of conservation action is measured over long timescales, invariably meaning monitoring must take place outside of project duration (Bottrill et al. 2011b). There is a move to recognition of intermediate goals and measures of success (Salafsky & Margoluis 1999; Kleiman et al. 2000), allowing monitoring of meaningful targets with funding sourced for the original project. Project staff can chart progress against goals which could realistically be achieved in the lifetime of their work (Mace et al. 2007). Conservation attention can be measured on a shorter timescale than the ultimate goal of conservation and so may be a suitable proxy for progression towards effective conservation.

2.4.1 The Index of Conservation Attention

Sitas et al. (2009) developed the Index of Conservation Attention (ICA), a framework measuring conservation resource allocation. Attention is defined as the level of actions proposed, developed and undertaken for a species. The four point index is assessed using species action plans and peer-reviewed literature (Sitas et al. 2009). It is likely to miss local projects or those not widely reported. A species scores 3 if it has a clear action plan in the process of being implemented, or 0 if there is no plan (Sitas et al. 2009).

The ICA is the first to attempt to assess conservation effectiveness at the species level, but does not consider wider processes involved in conservation action (e.g. information sharing, communication; Kleiman et al. 2000) or record effectiveness resulting from implementation. It would gain from development into a measure of achievement of a set of goals; presence of a plan does not guarantee action, and implementation does not assure achievement of desired effects (Kapos et al. 2009).

2.5 Species conservation

Most considerations of conservation (e.g. in policy or the literature) include biodiversity at the species unit (Garnett & Christidis 2007). Many programmes are species-specific, and despite a move towards a more holistic ecosystem-based approach (e.g. Hassan et al. 2005), many conservation metrics focus on species (e.g. the RL, Alliance for Zero Extinction [AZE] sites). Conservation of a species can be the common denominator linking seemingly unrelated projects.

2.5.1 THE ULTIMATE GOAL

The ultimate goal of species conservation is often population recovery and persistence (but see Redford et al. [2011]), a biological goal. Social goals and the processes bringing about goal achievement should also be considered (Kleiman et al. 2000).

2.5.2 FACTORS AFFECTING SUCCESS

Table 2.2 lists factors widely regarded as vital for effective species conservation. Some are types of activity undertaken by conservation organisations, and others are broader processes.

TABLE 2.2 Factors generally considered to be important for effective species conservation, showing a sample of the literature where each is discussed.

Factor	**Selected references**
Engaging with stakeholders	Kleiman et al. (2000); Saterson et al. (2004); Stem et al. (2005); IUCN/Species Survival Commission (2008); Salcido et al. (2008); Kapos et al. (2010); Prip et al. (2010)
Management programme	Moore & Wooller (2004); IUCN/Species Survival Commission (2008); Sitas et al. (2009); Kapos et al. (2010); Prip et al. (2010); Bottrill et al. (2011a)
Education and awareness	Balmford & Cowling (2006); Bride (2006); Butchart et al. (2006); Prip et al. (2010); Howe & Milner-Gulland (2011)
Funding and resource mobilisation	Kleiman et al. (2000); Kapos et al. (2008); Salcido et al. (2008); Black & Groombridge (2010); Prip et al. (2010); Bottrill et al. (2011b); Howe & Milner-Gulland (2011)
Addressing threats	Salafsky & Margoluis (1999); Salafsky et al. (2002); Butchart et al. (2006); IUCN/Species Survival Commission (2008); Pressey & Bottrill (2008); Salafsky et al. (2008); Sitas et al. (2009); Kapos et al. (2010); Redford et al. (2011)
Status knowledge	Dunn et al. (1999); Salzer & Salafsky (2006); IUCN/Species Survival Commission (2008)
Communication	Kleiman et al. (2000); Stem et al. (2005); Balmford & Cowling (2006); Kapos et al. (2008); Leverington et al. (2008); Brooks et al. (2009); Black & Groombridge (2010); Kapos et al. (2010); Bottrill et al. (2011b)
Capacity building	Balmford et al. (2005); Salcido et al. (2008); Brooks et al. (2009); Kapos

Factor	Selected references
	et al. (2009); Black & Groombridge (2010); Bottrill et al. (2011b)
Scope of species range	Mace et al. (2008); Sitas et al. (2009); Redford et al. (2011)
Law and policy	Butchart et al. (2006); TNC (2007); Salafsky et al. (2008); Brooks et al. (2009); Black & Groombridge (2010)
Project management and leadership	Black & Groombridge (2010); Black et al. (2011a)

Engaging with stakeholders

Stakeholder partnerships are essential (Saterson et al. 2004). Collaboration increases efficiency by reducing duplication of effort (Stem et al. 2005) and utilising the diverse knowledge of stakeholders (Kleiman et al. 2000). The private sector is becoming involved, due to demand for comprehensive corporate social responsibility programmes (Overbeek & Harms 2011). Governments are contributing more to funding and undertaking conservation (Salcido et al. 2008).

Management programme

An action plan is an important component of a management programme (Sitas et al. 2009). The presence of a plan may not affect whether a species receives conservation attention, but can provide leverage to obtain funding (Bottrill et al. 2011a). For species close to extinction, recovery plans are beneficial (Moore & Wooller 2004).

The IUCN Species Survival Commission (SSC) advocates Species Conservation Strategies (SCSs) (IUCN/SSC 2008). There is a clear link between SCSs and conservation action. An SCS is not necessarily written for a single species, but includes species-specific actions. It is a “range-wide blueprint” for species conservation (IUCN/SSC 2008). The IUCN stipulate developing each of the components of an SCS (status review, vision, goals, objectives and actions) should be a participatory process (IUCN/SSC 2008).

A National Biodiversity Species Action Plan (NBSAP) is a government endorsed action plan operating at a national or regional level (Prip et al. 2010). The “cornerstone of national biodiversity planning”, NBSAPs include developing plans, implementation, monitoring and reporting (Prip et al. 2010). However, they often assume external funding will allow activities to take place, rather than including planning for finance (Prip et al. 2010).

Education and awareness

Education and raising awareness is listed by Salafsky et al. (2008) in their unified classification of conservation actions. There is a need to reconnect people with nature (Balmford & Cowling 2006), and tailored education and public awareness is vital (Butchart et al. 2006). Despite their importance (Howe & Milner-Gulland 2011), education outcomes are often not reported (Bride 2006). The CBD describes understanding biodiversity loss as a prerequisite for widespread effective conservation and sustainable use. Education must be actively provided, not just a passive dissemination of scientific research (Bride 2006).

Funding and resource mobilisation

Not only is funding necessary to undertake activities to ensure persistence of a species (Kleiman et al. 2000), higher levels of funding are correlated with higher levels of success (Howe & Milner-Gulland 2011).

Diversification of funding sources is increasing (Salcido et al. 2008). Sources of funding influence project success; multinational donor agencies demand more multi-disciplinary objectives from projects, stretching resources to a maximum and potentially giving results that are not in the best interest of a country or species (Bottrill et al. 2011b). Projects funded for less than three years have inadequate time to complete activities and can only report on processes and occasionally outputs (Bottrill et al. 2011b).

Addressing threats

Salafsky et al. (2008) provide a classification of threats to allow consistent communication between projects. Timing, scope and severity of threats should be acknowledged (Butchart et al. 2006).

Status knowledge

There are several gaps in our knowledge of threatened species (Dunn et al. 1999), especially those receiving less conservation attention (e.g. EDGE species). Researchers can contribute to reducing the research-implementation gap (Knight et al. 2008) by undertaking applied ecological research on endangered species in partnership with practitioners.

Communication

There are calls to improve communication among species experts (Bottrill et al. 2011a). Information management in conservation is problematic (Kapos et al. 2008). Practitioners often struggle to access information generated through research (Sunderland et al. 2009). Kleiman et al. (2000) suggest improving the frequency, quality and method of information sharing among stakeholders. Evaluation processes can improve communication (Balmford & Cowling 2006; Leverington et al. 2008).

Capacity building

There is an immediate need for capacity building in order to meet the CBD targets (Balmford et al. 2005). Donor support allows building of capacity (Salcido et al. 2008), which can itself be a limiting factor for evaluations of conservation effectiveness (Bottrill et al. 2011b). Capacity building is on the list of unified actions provided by Salafsky et al. (2008), and is a key category of work undertaken by members of the CCF (Kapos et al. 2008).

Scope of species' range

The breadth across which an approach is applied is as important as its effectiveness (Black & Groombridge 2010). A distinction can be made between activities depending on the proportion of a species' range that they cover (Sitas et al. 2009).

Law and policy

Law and policy are key considerations (Butchart et al. 2006; TNC 2007; Black & Groombridge 2010), and affect available funding (Brooks et al. 2009) and raising awareness (Carpenter 2006). Policy/legislation features on the unified list of actions (Salafsky et al. 2008) and CCF's list of activities (Kapos et al. 2008). The contribution of multinational agreements is very different from that of national laws (Carpenter 2006).

Project management and leadership

Measuring core processes of leadership (Black & Groombridge 2010) may improve the efficiency with which objectives can be achieved (Kleiman et al. 2000). The BEM uses this approach.

Project management varies between organisations, who may be reluctant to make public their evaluations if results are not resoundingly successful (Redford & Taber 2000).

2.6 Expert elicitation as an information source

Expert elicitation is often under-valued; important information may be left unrecorded (Brooks et al. 2009). Expert elicitation enables use of existing data (Leverington et al. 2008), collection of additional data (O'Neill et al. 2008), and can be resource- and time-efficient (Scholes & Biggs 2005). Information supplied by experts is a synthesised combination of published data and their own observations, providing a more holistic view than an empirical approach (Johnson & Gillingham 2004). When sampling expert knowledge, there is a trade-off between the number of judgements that can be accurately elicited, and holding the interest of the respondent until the end of the survey process (Shephard & Kirkwood 1994).

2.6.1 Uncertainty

Uncertainty associated with expert elicitation must be accepted and quantified. There is a tendency towards over-confidence in estimates (O'Neill et al. 2008). When eliciting from multiple experts, responses will vary; discrepancies may be disagreements over values or more fundamental problems with vague concepts or inappropriate terminology (Johnson & Gillingham 2004).

Lack of accuracy caused by uncertainty results from two main pathways: the expert may not possess the correct knowledge to answer the question, or the expert may possess the correct knowledge but be unable to express it, implying an inappropriate method of elicitation (Martin et al. 2012). The latter is suggested by presence of consistent bias across multiple experts and/or fields of knowledge (Martin et al. 2012).

Where uncertainty is associated with a variable, it is better to express the variable as a range of possible values (Mace et al. 2008).

2.6.2 Other potential sources of bias

Other sources of bias in expert elicitation include accessibility bias, where a certain piece of information is more readily called to mind and so has a disproportionate bearing on opinion, and anchoring and adjustment bias, where an expert struggles to alter quantitative estimates after specification of an initial value (Martin et al. 2012). When eliciting expert knowledge to assess project or programme effectiveness, there may be a vested interest of the project leader in making their project appear successful (Brooks et al. 2009).

2.7 ZSL's EDGE programme

Initiated in 2007, the EDGE index prioritises species for conservation according to their phylogenetic history and the current level of threat of extinction that they face. The index provides a value combining phylogenetic branch length and RL classification. An EDGE species has an EDGE score greater than the median for the taxon within which it resides (Isaac et al. 2007).

When the EDGE index was introduced, there were no species-specific actions proposed for 42 out of the top 100 EDGE mammals (Isaac et al. 2007). On average, EDGE scores for species found outside PAs were higher than those within PAs (Isaac et al. 2007).

2.7.1 Goals

The EDGE programme aims to:

- Raise awareness of EDGE species.
- Identify the current status of poorly known and possibly extinct EDGE species.
- Develop and implement conservation strategies for all EDGE species not currently protected.

- Increase conservation capacity in countries where EDGE species occur, through supporting local scientists and conservation specialists to undertake research into focal EDGE species.
- Support all ongoing conservation activities for EDGE species.

Adapted from http://www.edgeofexistence.org/about/edge_goals.php

2.7.2 SPECIES REPORT CARDS

ZSL intend to summarise information on EDGE species in the format of an SRC, structured around the DPSIR model (Sinfield 2011). A pressure section will summarise threats; state will show current extinction risk, and where possible time series data; and the response section will summarise what is currently being done for the species and whether or not it is working (Sinfield 2011).

A conference held at ZSL in 2011 discussed the development of SRCs (Sinfield 2011). Each section of the SRC will combine a series of indicators, following the recommendations of Salafsky & Margoluis (1998). SRCs will include results of various analytical methods; each SRC measure ultimately being expressed categorically e.g. high, medium, low (Sinfield 2011).

Issues raised at the workshop included how to assess what conservation actions have been undertaken and to what extent, how to track progress of the EDGE programme towards its goals and understand its impact on EDGE species, and how to develop a framework that can be used by others (Sinfield 2011).

METHODS

3.1 IDENTIFYING THE GOAL

Accurately measuring population recovery was beyond the remit of this framework. The goal against which effectiveness is measured here is: *to have everything in place necessary for effective species conservation to occur*, i.e. that will lead, over time, to population recovery.

3.2 A CONCEPTUAL MODEL

Before developing a framework to assess effectiveness of conservation attention, links between actions and expected effects were identified and made explicit (Margoluis et al. 2009). A literature review and visualisation of results chains (Salafsky et al. 2002) produced nine factors vital for effective species conservation for inclusion in the framework: engaging with stakeholders, management programme, education and awareness, funding and resource mobilisation, addressing threats, status knowledge, communication, capacity building and scope of species' range (Table 3.1).

TABLE 3.1 Factors essential for effective species conservation, with important components for consideration. Designation of framework factor levels are based on the important components extracted from the literature.

Factor	Important components	References
Engaging with stakeholders	Partnerships improve long-term stability of initiatives	Mackechnie et al. (2011)
	Local people are the most important stakeholders	Kainer et al. (2009)
Management programme	Existence of an action plan does not guarantee its use	TNC (2007)
	Plans can, and do, catalyse actions	Fuller et al. (2003)
	Framework of IUCN SCS provides a 'blueprint' for comprehensive action plan	IUCN/SSC (2008)
Education and awareness	Education efforts must be active, rather than passive dissemination	Bride (2006)
	Host country inhabitants may be more aware of appropriate cultural nuances	Kevan de Haan (2007)
	Educators should be trained specialists	Bride (2006)
Funding and resource	Consider source of funding	Bottrill et al. (2011b)
	Need at least 3 years' funding to be able to	

Factor	Important components	References
mobilisation	report outcomes	
	Diversity of funding sources is only option for long-term security	TNC (2007)
Addressing threats	Contributing factors (indirect threats) and direct threats	Salafsky et al. (2008)
	Proactive conservation considers future threats	Lindenmayer et al. (2011)
Status knowledge	Need monitoring to ensure objectives achieved	Bottrill et al. (2011b)
	Improved knowledge can reveal a species is not as threatened as first believed	Bottrill et al. (2011a)
	Helpful to be predictive in impact actions will have	Nicholson et al. (2012)
Communication	Information should be available in appropriate languages	Duchelle et al. (2009)
Capacity building	Lack of appropriate training in developing countries	Kevan de Haan (2007)
	Local people should be employed at higher than support staff level	

3.2.1 Factors for inclusion in the framework

Criteria for thresholds of each factor were based on considerations highlighted in the literature (Table 3.1). Stakeholder engagement should culminate in partnerships involving local stakeholders (Kainer et al. 2009; Mackechnie et al. 2011). Management programmes based on formal action plans may be more comprehensive than informal efforts, and promote coordinated conservation efforts (IUCN/SSC 2008). Education and awareness-raising is more successful if dedicated programmes are developed with specially trained educators (Bride 2006), and may benefit from the cultural sensitivity of an in-country educator (Kevan de Haan 2007). Stability and sourcing of funds is integral (TNC 2007); a minimum of three years' funding is needed to allow measurement of intervention outcomes (Bottrill et al. 2011b). Direct, indirect (Salafsky et al. 2008) and future (Lindenmayer et al. 2011) threats should be considered. To predict the impact that interventions will have, monitoring and evaluation programmes are essential (Nicholson et al. 2012). These can identify when a species has been considered threatened due to lack of information rather than actual endangerment (Bottrill et al.

2011a). Information generated should be available in the language(s) of the countries where the species is found (Duchelle et al. 2009). To foster greater local contribution to conservation, in-country staff members should be employed in specialist roles (Kevan de Haan 2007), with training provided where necessary (Duchelle et al. 2009).

Project management and leadership

Despite focus on leadership skills of conservation practitioners (Black et al. 2011a), and project management processes (Black & Groombridge 2010; Black et al. 2011b) these factors are omitted from this framework due to measurement limitations. Management and business appraisal processes are likely to be kept confidential within each organisation. A species expert can report on leadership and project management for their own organisation, but is unlikely to be able to provide information for other organisations.

Law and policy

Local scale policies take myriad forms of variable benefit (Carpenter 2006). International policies, e.g. the CBD, promote coordination but do not have jurisdictional power (Brooks et al. 2009). Law and policy are not included in the framework as they are not always essential for effective species conservation, and creation of categories to adequately describe efforts across the whole of a species range would not have been possible.

3.2.2 USE OF WORKSHOP OUTPUT

A breakout group from the SRC workshop discussed development of a means to assess effectiveness of conservation attention (Sinfield 2011). Ideas centred on a framework split into input, output and outcome components in an attempt to build on Sitas et al.'s (2009) ICA. Disaggregation into three stages ensures consideration of the intention, occurrence and impact of an action (Margoluis et al. 2009).

The framework proposed here develops the ideas of this workshop group and their suggestion to consider indicators in high, medium and low categories within input, output and outcome sections.

3.2.3 TERMINOLOGY USED IN FRAMEWORK DEVELOPMENT

Table 3.2 lists terminology used throughout this study in reference to framework components, based on common language used to describe conceptual models (Margoluis et al. 2009).

TABLE 3.2 Terminology used in framework development.

Factors	**Stages (temporal)**	**Levels (quality)**
Engaging with stakeholders	Input	Very low
Management programme	Output	Low
Education and awareness	Outcome	Medium
Funding and resource mobilisation		High
Addressing threats		
Status knowledge		
Communication		
Capacity building		
Scope of species' range		

3.3 DEALING WITH UNCERTAINTY

To recognise uncertainty in expert elicitation four intervals of confidence were defined: *very high*, *high*, *medium* and *low* (following Mastrandrea et al. [2010]). Respondents were asked to define their confidence in the accuracy of each answer given, using these categories.

Anchoring and adjustment bias is limited by provision of MCQ thresholds; experts do not choose a value but are presented with options. Wide quantitative categories should improve the likelihood that observed differences in index score represent a true difference (Salafsky & Margoluis 1999). Accessibility bias is in this case difficult to address, but MCQ thresholds should prompt respondents' memories and thereby reduce its effects.

Potential vested interest bias of project managers is avoided through lack of disaggregation of interventions by organisation or project.

3.4 PILOTING THE FRAMEWORK

Early drafts were tested on Hispaniolan solenodon *Solenodon paradoxus* and pygmy hippopotamus *Choeropsis liberiensis* by researching available literature. Later drafts were piloted during informal interviews with species experts, to identify language and applicability issues (Leverington et al. 2008), and to check consistent interpretation (Salafsky & Margoluis 1998).

3.5 QUESTIONNAIRE FORMAT & PRESENTATION

An electronic spreadsheet format allowed those without reliable internet access to download the questionnaire and complete offline (Appendix II). Wording and layout was piloted. Drop-down boxes provide MCQ answers for framework components. Other information requested included: confidence (in answer given; MCQ), source of evidence (unrestricted data entry – e.g. report, personal observation [Leverington et al. 2008]); additional comments (unrestricted data entry); and time taken to complete questionnaire (MCQ; *less than 15 minutes*, *15-30 minutes*, *31-45 minutes*, *46-60 minutes*, *over one hour*). Time for completion was asked to check the questionnaire was short – to maximise participation (Donlan et al. 2010) and encourage willingness to complete again in the future (Leverington et al. 2008).

The spreadsheet, and workbook format, was protected and cells not intended for completion locked. The file was saved in the older version of Excel documents (.xls, 1997-2003 workbook) to maximise compatibility with respondents' computers.

3.6 TESTING ON THE TOP 100 EDGE MAMMALS & AMPHIBIANS

The top 100 EDGE mammals and top 100 EDGE amphibians were the focal species for this study. Other species for which expert contact information was available were assessed to check usability of the framework across species with different attributes.

3.6.1 SPECIES EXPERTS

Experts, contacted by email, were people who identified themselves as part of the EDGE website community (www.edgeofexistence.org; hereafter the EDGE group); chairs, RL focal points and regional representatives of IUCN/SSC Species Specialist Groups (SSGs; hereafter the IUCN group); and any other people suggested by those already contacted. Respondents were asked to pass the questionnaire onto colleagues who were also species experts. The email included introductory text (Appendix I), and the questionnaire as an attachment.

3.6.2 EDGE NETWORK

Contact information for those who returned questionnaires was compiled to help form the EDGE network, facilitating future assessments and collaboration.

3.7 VISUALISATION OF RESULTS

Results are summarised using a traffic light system symbolising the level at which each factor is recorded (*low* = red, *medium* = amber, *high* = green), with the proportion of the species' range across which the factor is present also represented. Presentation of data in a basic, intuitive format aids communication (Stem et al. 2005) without requiring in-depth familiarity with the framework, and may attract public interest (Jones et al. 2011).

3.8 SCORING

Six scoring methods were investigated. An ordinal scale assumes a linear relationship between levels (Wolman 2006) and can imply equivalence between factors. However, it is the simplest way of scoring; if there is no evidence of other relationships between categories it is the most parsimonious, so most appropriate, method. Weighting was not applied.

3.9 ANALYSIS

Analysis was performed using the R statistical software package (R Core Team 2012). Patterns in index scores were analysed within and across species, taxa, and biogeographic realms (following Udvardy [1975]). Correlations with EDGE rank were investigated. Most analysis was performed on mammals and amphibians ranked within their respective EDGE top 100 lists. Similarities between group means were assessed using t-tests for parametric data and Wilcoxon (paired signed) rank tests for non-parametric data (with paired observations). Statistical significance is assumed where $P<0.05$. Appendix V gives details of statistical tests.

3.9.1 EDGE rank & total index score

The higher the EDGE rank of a species, the higher its total index score should be. This correlates with the EDGE programme's intended effect of raising conservation attention, though due to the time since the programme's inception (five years) this relationship may not be apparent. Presence of 'charismatic' mammals within the top 100 may mask observed patterns; they are less likely to rely on recent increased attention than less well-known species.

3.9.2 Previous versions of the EDGE list

The current amphibian list is the first, but the mammal list has existed in three versions, calculated in 2007, 2010 and 2011 (C. Waterman, pers. comm.). Due to the EDGE score of several species changing (because of revised phylogeny or altered endangerment classification), ranks of some species have changed. Some have decreased, e.g. slender loris *Loris tardigradus* from 22 in 2007 to 67; whilst others have increased, e.g. Peruvian yellow-tailed woolly monkey *Oreonax flavicauda* (79 in 2007, now 64). Thus some species may not have been in their current position long enough for conservation actions to be undertaken so may score poorly overall despite their high ranking.

3.9.3 Goals of the EDGE programme

The goals of the EDGE programme relate to four of the factors: education and awareness, capacity building, management programme and status knowledge. To further suggest evidence for effectiveness of the EDGE programme, total scores for these factors should be higher for higher ranking EDGE species.

3.9.4 Differences between stages

Total scores for inputs should be higher than for outcomes due to the structure of the underlying model on which the framework is based. Inputs are the first component of a three stage process of conservation attention that progresses through time.

Confidence in inputs should be greater than in outcomes; inputs are easier to measure and tangible (Mace et al. 2007). Traditional measures of effectiveness focus on inputs, so information on inputs may be more accessible to respondents. Expert (over)confidence increases with availability of information (Tsai et al. 2008).

3.9.5 COMPARING BETWEEN EXPERTS

Where multiple experts completed a questionnaire for a species, quantitative and qualitative comparison between responses was possible. Differences in expert knowledge can make apparent complexities in a situation or may reveal inconsistencies in questionnaire format or respondent interpretation (Martin et al. 2012). Where respondents provide the same answers it suggests these answers are accurate; where several opinions are given there is a tendency for them to converge on the true value (Galton 1907).

3.9.6 RESPONDENT TYPE

Respondents fall into two broad categories: the EDGE group (employees of ZSL, members of the EDGE community and EDGE fellows) and the IUCN group. Response rate of the EDGE group should be higher as they are aware of the programme and may have a vested interest in it. The IUCN group are global contacts for their species and may have conflicting demands on their time.

Length of experience in conservation, and the field in which a respondent works, affect responses in expert elicitation (Donlan et al. 2010). Differences in scores from each group of respondents were compared.

RESULTS

4.1 STRUCTURE OF THE FRAMEWORK

The framework is comprised of two sub-frameworks. One considers temporal stages of conservation attention: *inputs*, *outputs* and *outcomes* (IOOs; Figure 4.1). IOOs are specified for each factor. Progression through stages occurs over time.

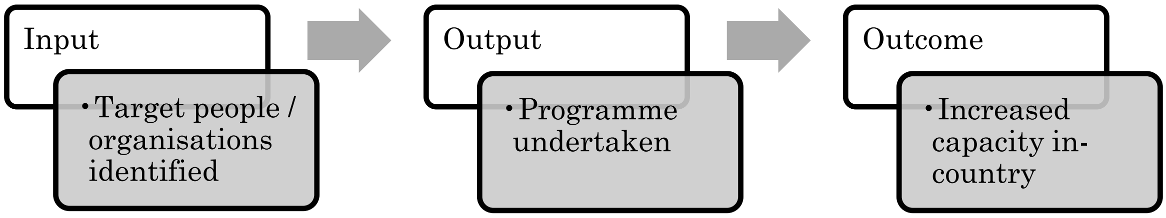


FIGURE 4.1 The three stages of conservation attention; one of the sub-frameworks. The example shown here is for capacity building. Input, output and outcome stages are defined for each factor.

The second gives categorical thresholds of levels at which each factor is measured (*very low* [0], *low* [L], *medium* [M] and *high* [H]; Figure 4.2) at IOO.

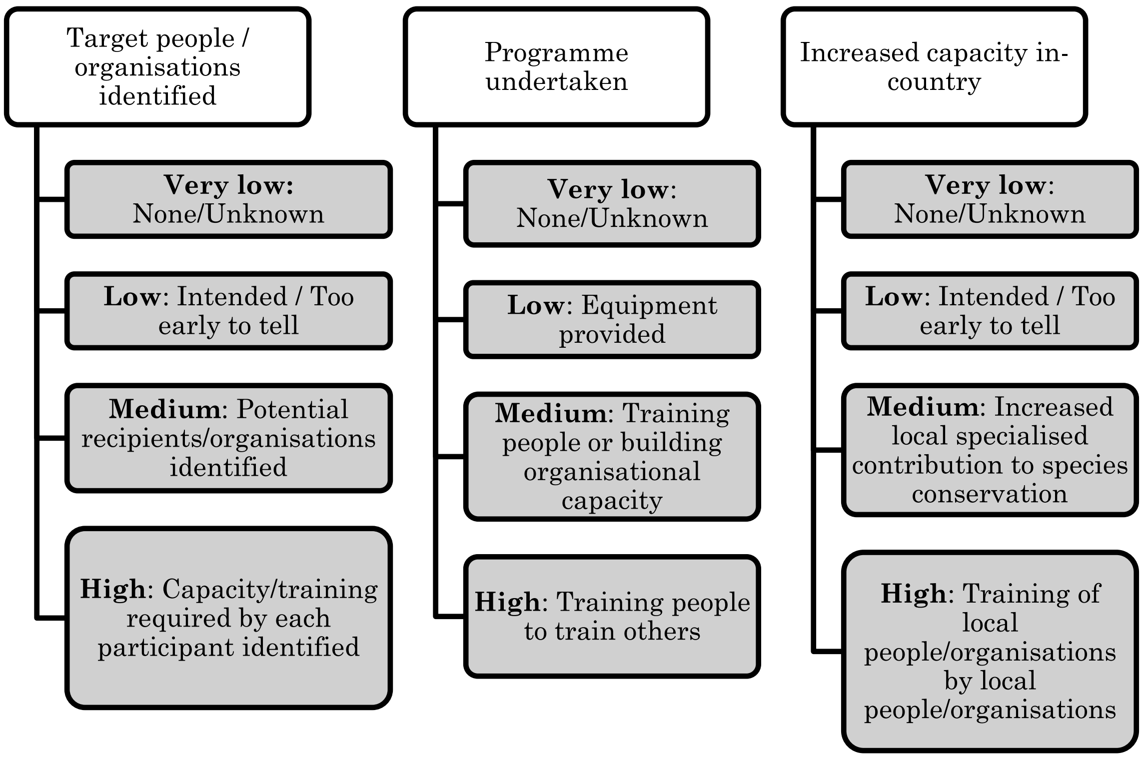


FIGURE 4.2 Levels of conservation attention within each stage. The example shown here is for capacity building. Criteria for very low, low, medium and high levels of each stage of each factor are defined in the framework.

Criteria are defined for each factor at each level. Categories are nested; if a species fulfils the *H* criterion for a factor, it also fulfils the *M* criterion for the same factor. For example, for capacity building at the input stage (Figure 4.2), for the *H* threshold the training required by each participant or organisation must have been identified. This cannot be achieved unless potential participants have been identified (criterion *M*).

Criteria are as detailed as possible, using quantities where appropriate to reduce subjectivity. Where quantitative, efforts have been made to ensure levels are applicable to any species whether widespread or localised.

Scope is independently applied to each factor, at each stage. Scope of a species' range is described as: '*none/unknown*' (level *0*), a '*few, random scattered areas*' (level *L*), '*25% to 75%*' (*M*) and '*over 75%*' (*H*). Wording for level L emphasises disjointed distribution of conservation efforts; whereas the logical (following the other scope categories) description of 'under 25%' implies relative continuity within that area.

Different levels of a factor may be true for different areas of a species' range. For example, in a few PAs staff requiring training may have been identified (capacity building input level *M*; Figure 4.2), but throughout the rest of the range no action for capacity building has taken place (level *0*). The highest level of the factor takes priority, and the scope associated with that level is recorded. In this example, the framework would record that in a few areas of the species' range (level *L*), potential targets for training have been identified (level *M*), giving a composite level of *ML* for capacity building input. This approach, chosen instead of selecting the level seen across the greatest proportion of the range, focuses on achievements, and records ability to attain a certain level of a factor, even if not currently witnessed across a large portion of a species' range.

4.2 The framework

TABLE 4.1 The framework for assessing effectiveness of conservation attention. * denotes 'Level'. Questionnaire uses this exact wording for each of the multiple choice questions. Scope of species' range is assessed for each factor at each stage. NGO = non-governmental organisation; IUCN SSC-SCS = International Union for the Conservation of Nature Species Survival Commission Species Conservation Strategy; NBSAP = National Biodiversity Species Action Plan.

		Stage		
Factor	*	**Input**	**Output**	**Outcome**
Engaging stakeholders		**Stakeholders identified**	**Meetings/forums held, partnerships formed, involving:**	**Partnerships active**
	H	Experts, international NGOs, national/local government AND other local stakeholders e.g. local residents	Experts, international NGOs, national/local government AND other local stakeholders e.g. local residents	Experts, international NGOs, national/local government AND other local stakeholders e.g. local residents
	M	Experts, international NGOs AND national/local government	Experts, international NGOs AND national/local government	Experts, international NGOs AND national/local government
	L	Experts and international NGOs	Experts and international NGOs	Experts and international NGOs
	0	None / Unknown	None / Unknown	None / Unknown
Management programme		**Targets set**	**Identifying actions to meet targets outlined**	**Identified actions carried out**
	H	Officially recognised action plan e.g. IUCN SSC-SCS or NBSAP	Officially recognised action plan e.g. IUCN SSC-SCS or NBSAP	All of identified actions completed AND/OR being carried out
	M	Reports produced	Reports produced	Several actions completed AND/OR being carried out
	L	Informal efforts	Informal efforts	Informal, localised efforts
	0	None / Unknown	None / Unknown	None / Unknown

Factor	*	Stage		
		Input	Output	Outcome
Education & awareness		**Education programmes planned**	**Education programmes delivered**	**Changed behaviour**
	H	Dedicated programmes (with in-country educators)	Dedicated programmes (with in-country educators)	Message spreading to non-participants
	M	Dedicated programmes	Dedicated programmes	Present in over 25% of the targets
	L	One-off programmes as secondary outcomes to other interventions	One-off programmes as secondary outcomes to other interventions	Present in up to 25% of the targets
	0	None / Unknown	None / Unknown	None / Unknown
Funding & resource mobilisation		**Funding / resources sought**	**Funding / resources secured**	**Long-term funding stability**
	H	From at least one organisation's AND one government's long-term (3 years or more) commitment	From at least one organisation's AND one government's long-term (3 years or more) commitment	Funding sources diversified; allows continuous investment
	M	From at least one organisation's long-term (3 years or more) commitment	From at least one organisation's long-term (3 years or more) commitment	Several types of funding usually obtained; investment prioritised
	L	From one-off projects	From one-off projects	Funding available at least irregularly
	0	None / Unknown	None / Unknown	None / Unknown
Addressing threats		**Identifying threats**	**Ways of addressing threats identified for:**	**Some solutions/mitigations being implemented for:**
	H	Direct, indirect AND potential future threats known	Direct, indirect AND potential future threats	Direct, indirect AND potential future threats
	M	Direct threats AND indirect threats (that interact with and ultimately affect direct threats) known	Direct threats AND indirect threats (that interact with and ultimately affect direct threats)	Direct threats AND indirect threats (that interact with and ultimately affect direct threats)

Factor	*	Input	Output	Outcome
			Stage	
	L	Threats directly affecting species survival (direct threats) known	Threats directly affecting species survival (direct threats)	Threats directly affecting species survival (direct threats)
	0	None / Unknown	None / Unknown	None / Unknown
Communication		**Species news and data collated and stored centrally (all information in one [or more] location[s])**	**Regular updates to stakeholders (e.g. newsletters, consultations)**	**Widely disseminated reports; acknowledged by recipients (e.g. cited; used to update existing information/plans)**
	H	Annually OR reporting in CMS/CBD/CITES reporting cycles	Twice a year or more AND available in species range countries' languages	Reports cited by others AND the information in reports is used to update other documents/plans
	M	Information exchange at meetings	Twice a year or more	Reports cited by others
	L	Less than once a year	Once a year or less	Intended / Too early to tell
	0	None / Unknown	None / Unknown	None / Unknown
Capacity building		**Target people/organisations identified**	**Programme undertaken**	**Increased capacity in-country**
	H	Capacity/training required by each participant (organisation/people) identified	Training people to train others	Increased local specialised contribution to species conservation AND training of local people/organisations by local people/organisations
	M	Potential recipients identified (organisations/people)	Equipment provided AND training people AND/OR building organisational capacity	Increased local specialised contribution to species conservation
	L	Intended / Too early to tell	Equipment provided	Intended / Too early to tell

		Stage		
Factor	*	**Input**	**Output**	**Outcome**
	0	None / Unknown	None / Unknown	None / Unknown
Status knowledge		**Identifying gaps in current knowledge**	**Undertaking work to address knowledge gaps**	**Improved knowledge**
	H	Current knowledge reviewed, gaps identified AND plans to address gaps produced	Specific work has been planned that will address knowledge gaps	Adaptive management in place, using improved understanding to improve species conservation
	M	Current knowledge reviewed AND gaps identified	Existing work likely to address gaps i.e. no additional work planned	Many/all identified gaps have been filled AND/OR monitoring in place to report on progress
	L	Current knowledge reviewed	Intended	One or more identified knowledge gap(s) has been filled
	0	None / Unknown	None / Unknown	None / Unknown
Scope of species' range		**In which above inputs observed**	**In which above outputs observed**	**In which above outcomes observed**
	H	Over 75%	Over 75%	Over 75%
	M	25% to 75%	25% to 75%	25% to 75%
	L	Few random, scattered areas	Few random, scattered areas	Few random, scattered areas
	0	None	None	None

4.3 RESPONSE TO THE QUESTIONNAIRE

Contact was attempted with 185 people. Correct contact details could not be obtained for 28 people. Of those contacted, 60 responded: 7 felt they did not have adequate knowledge, 9 did not have time to answer the questionnaire, and 97 did not reply. Ten people forwarded the questionnaire onto others. Thirty-two people returned questionnaires, covering 35 species (21 mammals and 14 amphibians; some respondents covered more than one species).

Response rate for completed questionnaires was 17.02%. The response rate for the EDGE group (34.21%) was much higher than the IUCN group (12.72%; Fisher's exact test, $P<0.001$). Response rate for EDGE fellows was 40.00%.

There was no difference in mean EDGE rank of species assessed by each group of respondents (Wilcoxon rank test, $W=186$, $P=0.921$). Questionnaires for each taxon were no more likely to be completed by one respondent group than the other (Fisher's exact test, $P=1.000$).

4.4 SCORING

Six scoring methods were trialled on a subset of the completed questionnaires (Table 4.2). Methods were compared to identify biases.

TABLE 4.2 Scoring methods trialled on subset of completed questionnaires, highlighting main differences between approaches.

Scoring system	Level scores	Scope scores	Maximum total score	Notes
A	0 = 0 L = 1 M = 2 H = 3	0 = 0 L = 0.25 M= 0.75 H = 1	72	Emphasis on achieving higher level rather than scope. H = 1 implies complete coverage of range.
B	0 = 0 L = 0.25 M = 0.75 H = 1	0 = 0 L = 1 M = 2 H = 3	72	Use of proportions for level not intuitive. More sensitive to difference between lower total scores.
C	0 = 0 L = 1 M = 2 H = 3	0 = 0 L = 0.25 M = 0.5 H = 0.75	54	Emphasis on achieving higher level rather than scope.

Scoring system	Level scores	Scope scores	Maximum total score	Notes
D	0 = 0 L = 0.25 M = 0.5 H = 0.75	0 = 0 L = 1 M = 2 H = 3	54	Use of proportions for level not intuitive.
E	0 = 0 L = 1 M = 4 H = 13	0 = 0 L = 0.25 M =0.5 H = 0.75	234	Unlike A – D, species cannot score higher by having a lower level across a greater proportion of the range (than a higher level across less of the range).
F	LL = 1 MM = 5 LM = 2 MH = 6 LH = 3 HL = 7 ML = 4 HM = 8 HH = 9		216	Simple ranking system XY, where X = level, Y = scope. High level has greater emphasis than proportion of range. Minimises assumptions made by assigning more complicated values.

It is more intuitive to use proportions for scope of species' range (scoring systems A & C; Table 4.2), as it corresponds with MCQ options (*few, scattered areas*, *25% to 75%*, *over 75%*; Table 4.1), than for categorical factor levels (*L*, *M*, *H*). A & C place greater emphasis on achieving a higher factor level regardless of the range across which it is witnessed, an effect already exaggerated by the procedure recommended when more than one level of a factor is observed across the species' range.

Allocating the *H* category of range (over 75%) a score of 1 (system A; Table 4.2) implies total coverage of range has been achieved, which is unlikely. Range scores in C are more representative of the quantity implied by the category.

Scoring methods A – D performed similarly (but see Notes, Table 4.2); patterns in scores (e.g. highest scoring factor) were maintained. However, in these systems a species' total score can decrease over time, even where levels of conservation at each stage are improving (e.g. *L* over *H* range = 1 x 0.75 = 0.75, proceeding over time [as conservation attention increases] to *M* over *L* range = 2 x 0.25 = 0.5). Scores must be representative of real improvements. As categories are nested, a higher level over a small range proportion should be scored higher than a lower level across a greater part of the range –

selection of the higher level implies the lower level is already present, therefore the higher level always constitutes an improvement.

System E uses the lowest possible values that allow scores to increase as levels improve (Table 4.2). System F uses a simple ranking method to order possible combinations of level and range for each factor at each stage. It is the most transparent of the six systems. Scores presented here use system F, and are normalised to percentages.

4.5 METHODOLOGICAL PROCESS RESULTS

Modal time for questionnaire completion was 15-30 minutes. Time for completion increased as a species' total index score increased (Figure 4.3; Spearman's rank correlation ρ=0.340, P=0.014).

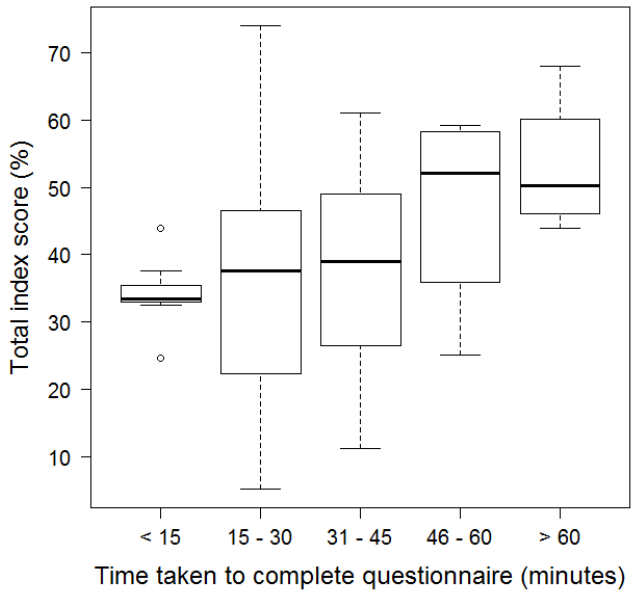


FIGURE 4.3 Time taken for respondent to complete questionnaire (self-reported) (total n=37; <15, n=7; 15-30, n=12; 31-45, n=10; 46-60, n=4; >60, n=4) in relation to total index score achieved by the species.

Time spent on the questionnaire was reflected in the presence and depth of supporting evidence and additional comments. Of the responses that took under 15 minutes, five (70%) provided no supporting evidence.

4.5.1 USABILITY OF SOFTWARE FOR QUESTIONNAIRE

The medium used for the questionnaire worked well. Respondents could download the questionnaire and complete offline. Most respondents were proficient in Microsoft Excel and, combined with the instructions given, could complete all sections attempted.

One respondent received the questionnaire whilst at a field station whose computers did not support the document extension, but was able to complete the questionnaire on their return. Another respondent, using LibreOffice (open-source word processing software), was unable to utilise the questionnaire. The problem may have arisen from protection applied to the workbook; investigation is required to increase compatibility with open-source software, as many conservation practitioners may not have access to expensive computer packages.

One questionnaire was returned with all protection (including hidden sheets) and formatting (including drop-down boxes) removed. It is unclear how this occurred – protection was password-protected.

4.5.2 Comprehension of questionnaire

Feedback from a minority of respondents suggested they misunderstood the questionnaire's purpose. The questionnaire itself and the introductory email (Appendix I) described the purpose of the questionnaire but this text may need reviewing.

Evaluation at the species level

One response was excluded as it covered only one project on the species in question. The respondent's justification was that they had experience of only this project. However, this contradicts the purpose of the questionnaire (assessing all conservation efforts for a species).

Levels of confidence

Two respondents left blank all answers requested for confidence. This suggests a lack of understanding, or unwillingness to quantify uncertainty. The accompanying instructions (Appendix II) did not iterate the importance of quantifying potential uncertainty when eliciting expert knowledge.

Broadness of approach
For charismatic mammals, e.g. Asian elephant *Elephas maximus* and black rhino *Diceros bicornis*, respondents felt results of the questionnaire would not contribute to the conservation of the species, and categories were too broad to provide insight into the current situation for the species. They may have assumed information for these species is widely known. Similar critiques were not received from respondents regarding less well known species.

Consistency of interpretation
For four species (Asian elephant, black rhino, Ganges river dolphin *Platanista gangetica* and Bactrian camel *Bactrianus ferus*), multiple respondents completed a questionnaire. This allowed comparison of question interpretation.

Much of the disagreement in total scores resulted from discrepancies in scope of species' range. The second black rhino questionnaire dealt with the Kenyan subspecies *D. b. michaeli*. The scores for the two assessments of black rhino differ by 21% (Appendix III).

In another response, frequent mention of one PA in the large range of a species suggested the respondent was answering the questionnaire for only part of the species range. This may be the area with which they have the most familiarity, but it fails to address the questionnaire's purpose.

4.5.3 APPLICABILITY OF PROVIDED CHOICES
Some feedback stated the MCQ options were not applicable for certain species. This was often associated with amphibians where very little is known about the species.

4.6 PRELIMINARY ASSESSMENTS OF EFFECTIVENESS OF CONSERVATION ATTENTION

4.6.1 OVERALL SCORE FOR EFFECTIVENESS OF CONSERVATION ATTENTION
Mean score for species assessed was 39% (mammals: 42%, amphibians: 34%; not significantly different [$t=1.337$, $df=22.105$, $P=0.195$]). The highest score (74%) was for the Kenyan subspecies of black rhino and the lowest for the

cave squeaker *Arthroleptis troglodytes* (5%). Scores are recorded in Appendices III & IV.

The EDGE rank of a species, i.e. its place on the EDGE list, is negatively correlated with total index score (Figure 4.4; r^2=0.228, df=33, P=0.002); species which are highest priority on the EDGE list tend to achieve a higher total index score. This pattern is strong for amphibians (Figure 4.4; r^2=0.275, df=11, P=0.040). These results show correlation; causality of EDGE rank cannot be determined.

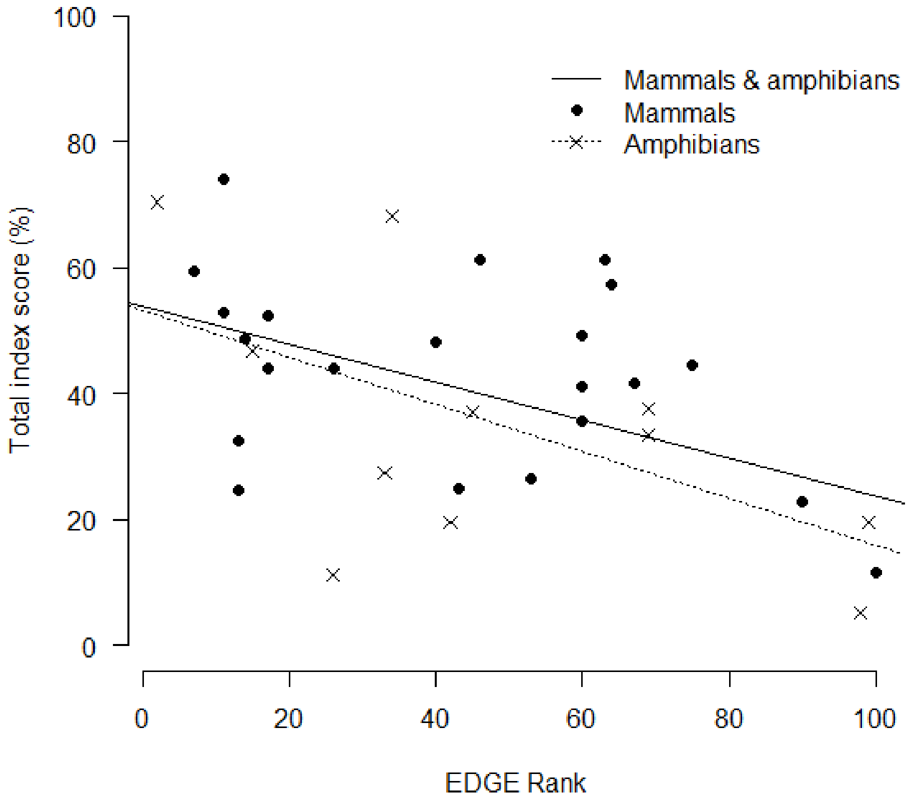


FIGURE 4.4 Total index score for top 100 mammals and amphibians assessed (mammals and amphibians shown separately) in relation to a species' rank on the EDGE list.

"Charismatic" mammals

Attention afforded 'charismatic' mammals is one imbalance the EDGE programme seeks to redress. Some of the highest ranking EDGE species are also charismatic, and have been the subject of conservation attention for many years prior to the introduction of the EDGE programme.

Notable examples are the black rhino, and the Asian elephant, ranked 11 and 17 respectively. Figure 4.5 shows the residuals of the mammals assessed with regard to the model relating EDGE rank to total index score. Charismatic mammals (Asian elephant, black rhino and Javan rhino *Rhinoceros sondaicus*) are shown in black.

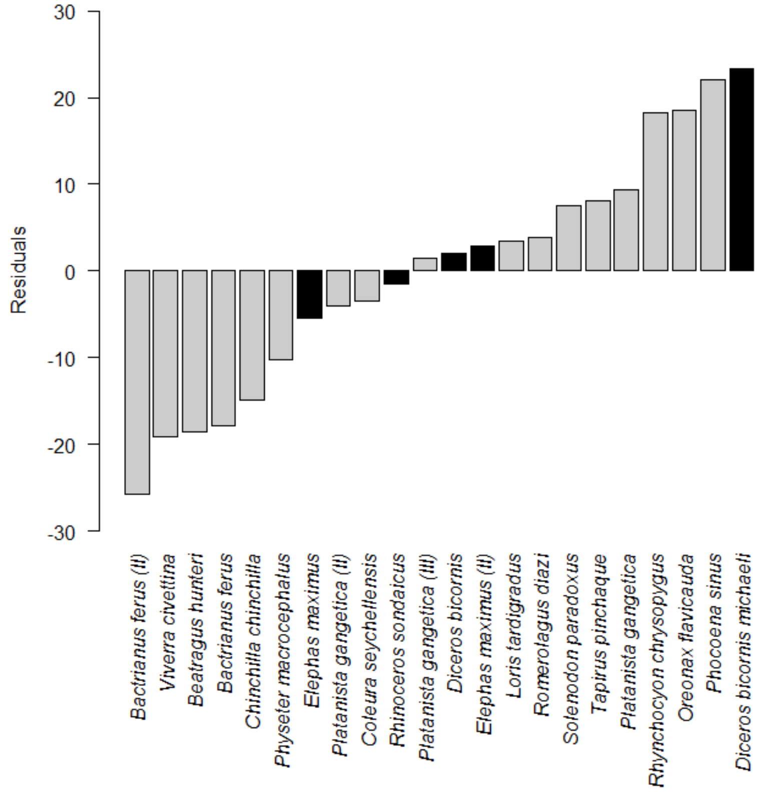


FIGURE 4.5 The residuals, for each species of mammal assessed, from the model of the relationship between EDGE rank and total index score. Bars for charismatic species are shown in black.

If charisma negated the relationship between EDGE rank and total index score the residuals for charismatic mammals would be high; they would not fit the model well. The residuals for four of the five charismatic mammal assessments are clustered around 0, the other being the Kenyan subspecies of black rhino. The mean of the charismatic mammals' residuals is not significantly different from the mean of the residuals of the other mammals (t=0.736, df=7.148, P=0.485).

Previous versions of the EDGE list

The direction and magnitude of a species' EDGE rank change between 2007 and 2011 has no relationship with its total index score (r^2=0.019, df=23, P=0.466).

Current population status

Experts were asked whether they felt the current population trend of their species was *'increasing'*, *'stable'*, *'decreasing'*, or *'unknown'*. Species with unknown trends had the lowest mean total index score (Figure 4.6) but this difference was not significant (Wilcoxon rank test, W=18, P=0.117). If so little is known about a species that an expert cannot speculate about its general population trend, it is unlikely the species is receiving effective conservation attention.

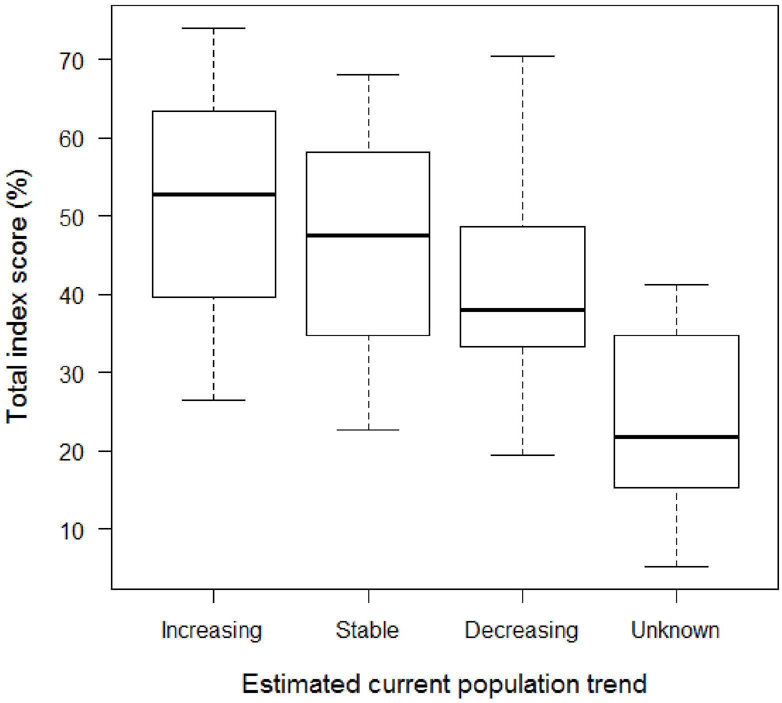


FIGURE 4.6 Current population status trend of assessed species (total n=31; increasing, n=3; stable, n=4; decreasing, n=17; unknown, n=7) as estimated by respondent.

There is no difference between mean index scores of increasing and decreasing populations (Wilcoxon rank test, W=33, P=0.458); patterns in Figure 4.6 are an artefact of differing sample size.

Type of respondent

There is no significant difference between mean total index scores of assessments completed by EDGE or IUCN group respondents (Wilcoxon rank test, W=139, P=0.228).

4.6.2 TOTAL SCORES FOR DIFFERENT FACTORS

EDGE programme goals

Total scores for status knowledge and management programme have no relationship with the EDGE rank of a species (Figure 4.7; Table 4.3).

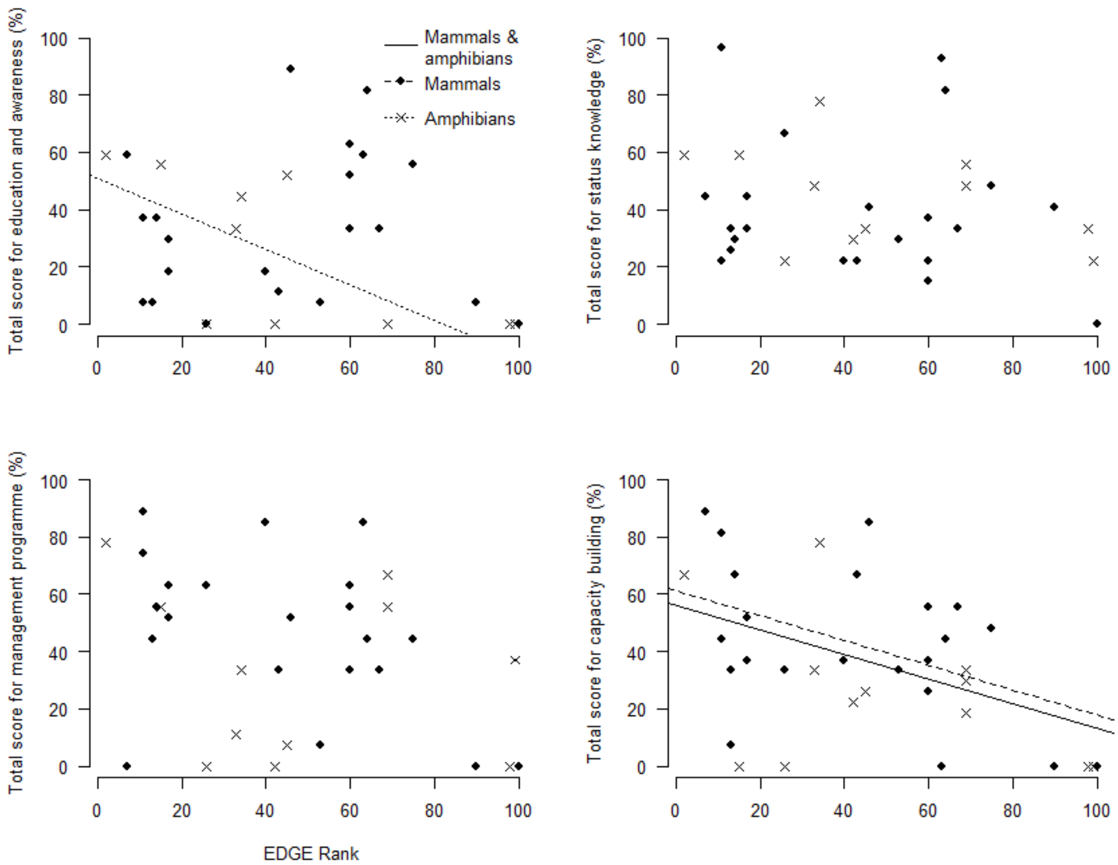


FIGURE 4.7 Species' total scores for factors covered by the goals of the EDGE programme: education & awareness, status knowledge, management programme and capacity building, in relation to the rank of the species on the current EDGE list (mammals and amphibians shown separately). Regression lines show significant relationships.

EDGE scores are a sum of phylogenetic diversity and global endangerment. A species must be listed as other than Data Deficient on the RL to have a GE score. Species ranked highly on the EDGE list must have a certain degree of status knowledge, in order to classify as threatened. This interdependence means all species ranked highly on the EDGE list may be more likely to have increased status knowledge before the EDGE programme began, explaining the lack of correlation between EDGE rank and status knowledge scores.

TABLE 4.3 Selected linear regression results for four factors relating to EDGE programme goals.

Factor	Taxon	r^2	df	P
Status knowledge	Both	0.005	33	0.286
Management programme	Both	0.061	33	0.082
Education and awareness	Mammals	-0.030	20	0.541
	Amphibians	0.489	11	0.004
Capacity building	Mammals	0.175	20	0.030
	Amphibians	0.102	11	0.153

The management programme category requires existence of an officially recognised action plan (Table 4.1), creation of which can take several years. For EDGE species there may not yet be a positive effect of increased conservation attention on achievement of a high score in the management programme category.

Amphibian total scores for education and awareness are significantly correlated with EDGE rank (Figure 4.7; Table 4.3). Amphibians that rank highly on the EDGE list may benefit more from increased education and awareness efforts than those that are ranked lower; whereas the score for mammals is not related to EDGE rank (Table 4.3). Mammals show a strong negative correlation between EDGE rank and total score for capacity building (Figure 4.7; Table 4.3).

Variation by geographic location

One respondent claimed capacity building was not a necessary consideration in their species' range countries in the Neotropics. Figure 4.8(g) shows total score for capacity building when species are grouped by biogeographic realm. Capacity building scores are lowest for Nearctic species but the sample size is small.

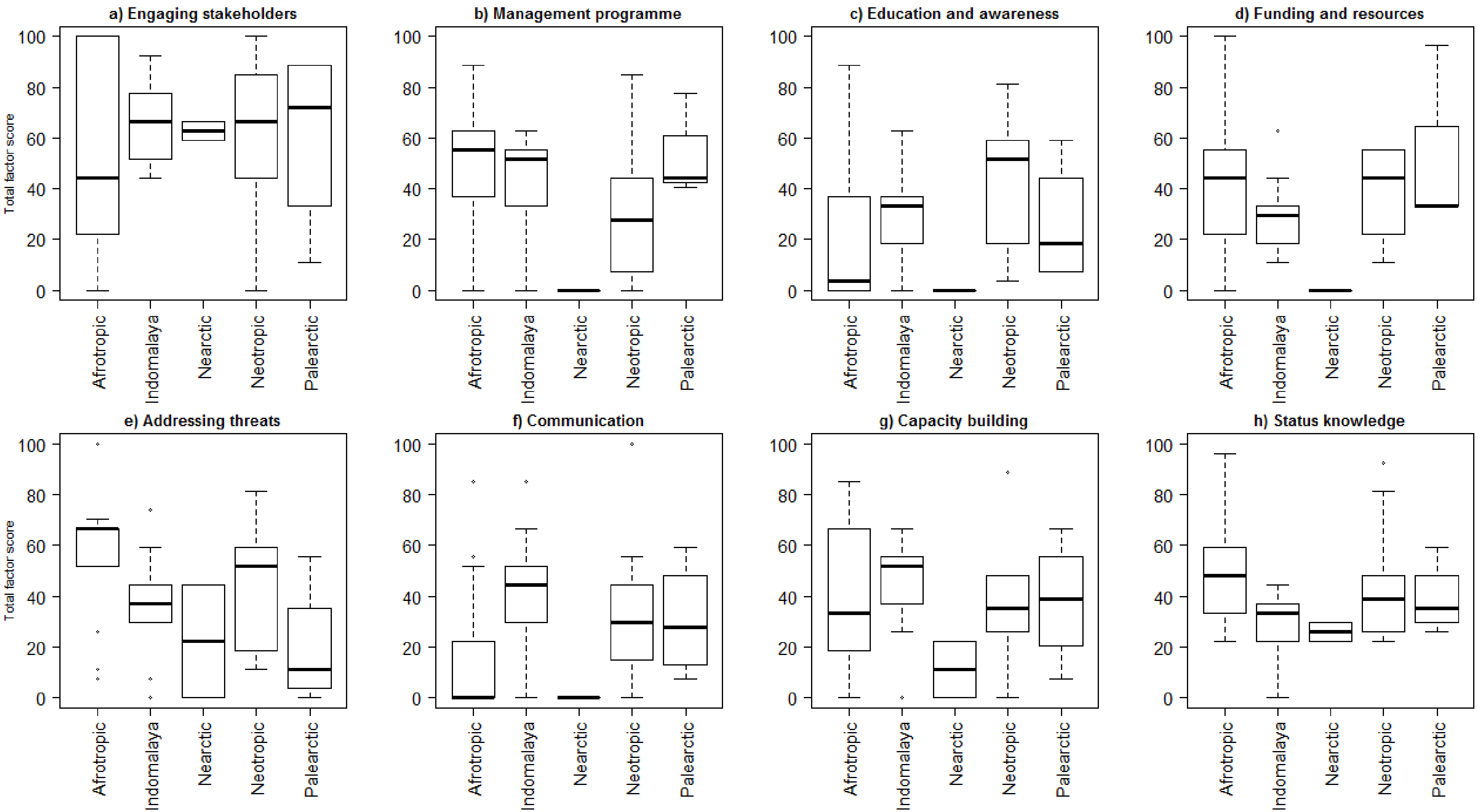


FIGURE 4.8 Total scores for each factor, shown by the terrestrial biogeographic realms which each species inhabits (none of the species assessed are found in more than one realm): Afrotropic, n=14; Indomalaya, n=9; Nearctic, n=2; Neotropic, n=10 and Palaearctic, n=4. The sperm whale *Physeter macrocephalus* excluded as found in marine environments globally.

Variation within Afrotropical species is high, which could be expected with a larger sample size (n=14) than the other realms (Figure 4.8). For addressing threats, the variation is minimal even compared with other realms where sample size is much smaller, e.g. Palaearctic (n=4) and Nearctic (n=2; Figure 4.8[e]). This suggests lack of variation in Afrotropical species is not an artefact of sample size. The total score for addressing threats is on average higher for Afrotropical species (around 70%; Figure 4.8) than for species in other realms, and exhibits less variation among Afrotropical species than total scores for other factors.

The score for management programme was much higher for Afrotropical species than other realms (Figure 4.8[b]). Total scores for status knowledge were least variable between realms (Figure 4.8[h]).

Type of respondent

For capacity building the EDGE group gave significantly higher scores (Figure 4.9). There were no other differences in mean factor scores between respondent groups (Table 4.4).

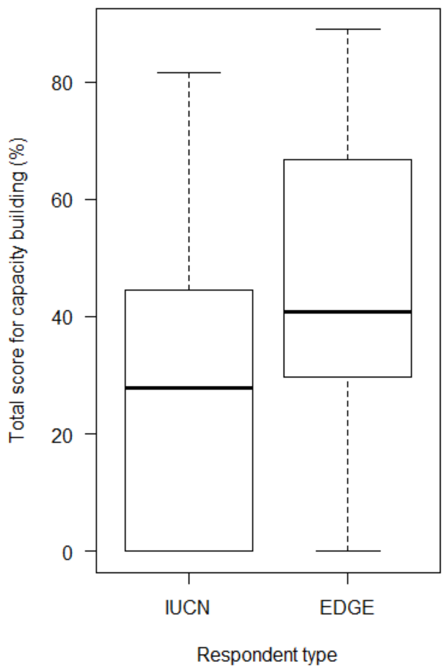


FIGURE 4.9 Total score for capacity building is significantly higher on average in those questionnaires completed by respondents from the EDGE group than the IUCN group.

TABLE 4.4 Results of Wilcoxon rank tests looking for differences between respondent groups (EDGE and IUCN) in total scores for each factor. Significant differences found in capacity building only.

Factor	W	P
Capacity building	247.5	0.032
Engaging stakeholders	202.5	0.570
Management programme	193.0	0.765
Education and awareness	223.5	0.240
Funding and resource mobilisation	237.5	0.058
Addressing threats	221.0	0.273
Communication	181.0	0.988
Status knowledge	235.5	0.131

Modal highest scoring factor

Engaging stakeholders was most often the highest scoring factor for a species (in 50% of the 40 assessments; Figure 4.10).

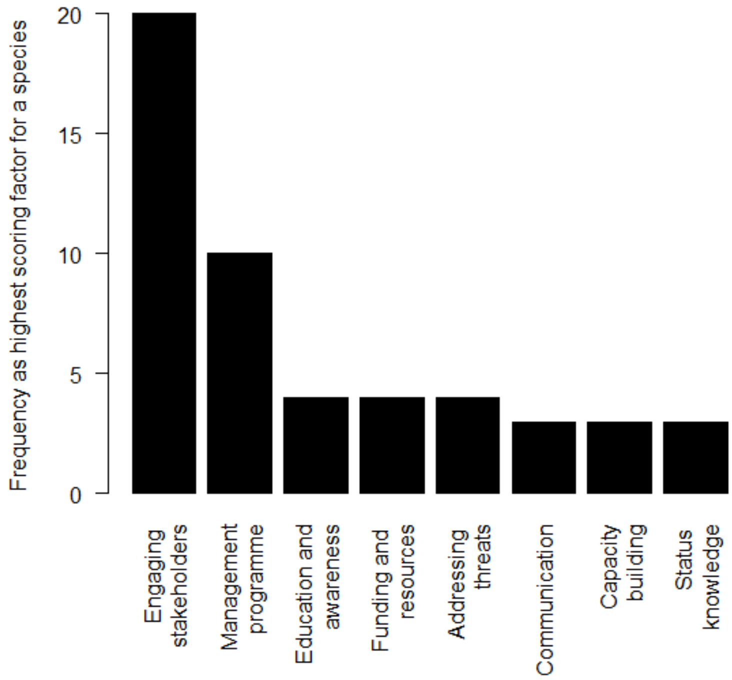


FIGURE 4.10 Cumulative frequency with which each factor was the highest scoring for a species assessed.

4.6.3 TOTAL SCORES FOR DIFFERENT STAGES

Total scores for inputs were significantly higher than outcomes (Figure 4.11; Wilcoxon paired signed rank test, V=778.5, P<0.001).

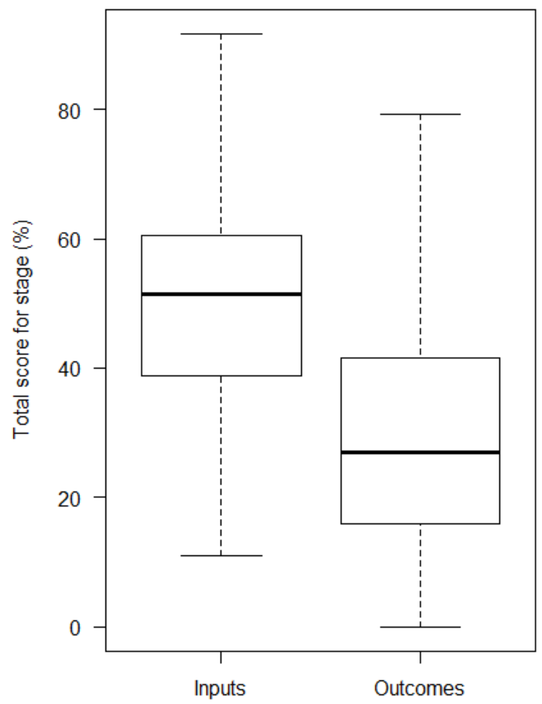


FIGURE 4.11 Distribution of total scores for input and outcome stages.

Mammals

Table 4.5 shows each mammal's total scores for IOO. Species above the dashed line (n=19) exhibit the expected pattern: inputs achieve the highest score, followed by outputs then outcomes. Those below the line (n=7) do not.

TABLE 4.5 Total scores for each stage for each of the mammal species assessed. Where more than one assessment has been carried out for a species, numerals in brackets following the species name discriminate the different assessments (see Appendix III). Species are arranged in alphabetical order either side of dashed line. Species below the dashed line exhibit unexpected pattern in total scores for each stage (expected pattern is, in order of decreasing magnitude: inputs, outputs, outcomes).

Species	**Total score for inputs (%)**	**Total score for outputs (%)**	**Total score for outcomes (%)**
Bactrianus ferus (I)	38	35	25
Bactrianus ferus (II)	40	22	11
Beatragus hunteri	31	31	14
Cephalophus adersi	58	53	28
Coleura seychellensis	54	50	28
Diceros bicornis	57	51	50
Dromiciops gliroides	38	24	4

Species	Total score for inputs (%)	Total score for outputs (%)	Total score for outcomes (%)
Elephas maximus (I)	63	39	31
Elephas maximus (II)	56	53	49
Euchoreutes naso	38	36	17
Nycticebus pygmaeus	43	39	28
Phocoena sinus	82	47	46
Physeter macrocephalus	29	22	17
Platanista gangetica (II)	51	33	22
Rhinoceros sondaicus	63	42	42
Rhynchocyon chrysopygus	69	60	54
Romerolagus diazi	67	47	31
Solenodon paradoxus	69	63	46
Tapirus pinchaque	51	51	31
Chinchilla chinchilla	29	24	26
Diceros bicornis michaeli	76	67	79
Loris tardigradus	53	28	44
Oreonax flavicauda	58	69	44
Platanista gangetica (I)	74	36	38
Platanista gangetica (III)	42	40	42
Viverra civettina	17	6	13

For some species below the line, e.g. short-tailed chinchilla *Chinchilla chinchilla* and Ganges river dolphin III (the third assessment completed) the discrepancy is small and may represent respondent error – this possibility is supported by the second assessment of the river dolphin fitting the expected pattern (Table 4.5).

The Malabar civet *Viverra civettina* shows a different pattern to that expected (Table 4.5); inputs are highest but outcomes (13%) are much higher than outputs (6%). The civet respondent noted that nothing specific is being done for this species, whose taxonomy is under question, and any benefits afforded it are likely unintentional side-effects of general ecosystem-based interventions.

Amphibians

Most amphibians show the expected pattern of IOO total scores (Table 4.6). Hewitt's ghost frog *Heleophryne hewitti* has a small deviation from the expected; with outputs total score two points greater in magnitude than inputs.

TABLE 4.6 Total scores for each stage for each of the amphibian species assessed. Species are arranged in alphabetical order. Hewitt's ghost frog *Heleophryne hewitti* exhibits unexpected pattern in total scores for each stage (expected pattern is, in order of decreasing magnitude: inputs, outputs, outcomes).

Species	Total score for inputs (%)	Total score for outputs (%)	Total score for outcomes (%)
Andrias davidianus	92	83	36
Anhydrophryne ngongoniensis	40	18	0
Arthroleptis troglodytes	11	4	0
Necturus alabamensis	17	8	8
Phaeognathus hubrichti	36	22	0
Rhinoderma darwinii	56	43	15
Rhinoderma rufum	57	38	17
Somuncuria somuncurensis	51	18	13
Sooglossus gardineri	42	36	22
Sooglossus pipilodryas	46	42	25
Sooglossus sechellensis	42	36	22
Sooglossus thomasseti	44	35	21
Xenopus longipes	79	63	63
Heleophryne hewitti	49	51	40

There is no correlation between total index score and the difference between input and outcome scores (r^2=-0.026, df=33, P=0.714).

Type of respondent

Total stage scores do not vary by respondent type (Wilcoxon rank tests, inputs: W=216, P=0.342; outputs: W=240.5, P=0.100; outcomes: W=214, P=0.371).

4.6.4 PRESENCE OF UNCERTAINTY IN QUESTIONNAIRE RESPONSES

Confidence in different factors

Figure 4.12 presents frequency of responses in the five categories of confidence for each factor. Levels of confidence are similar across factors.

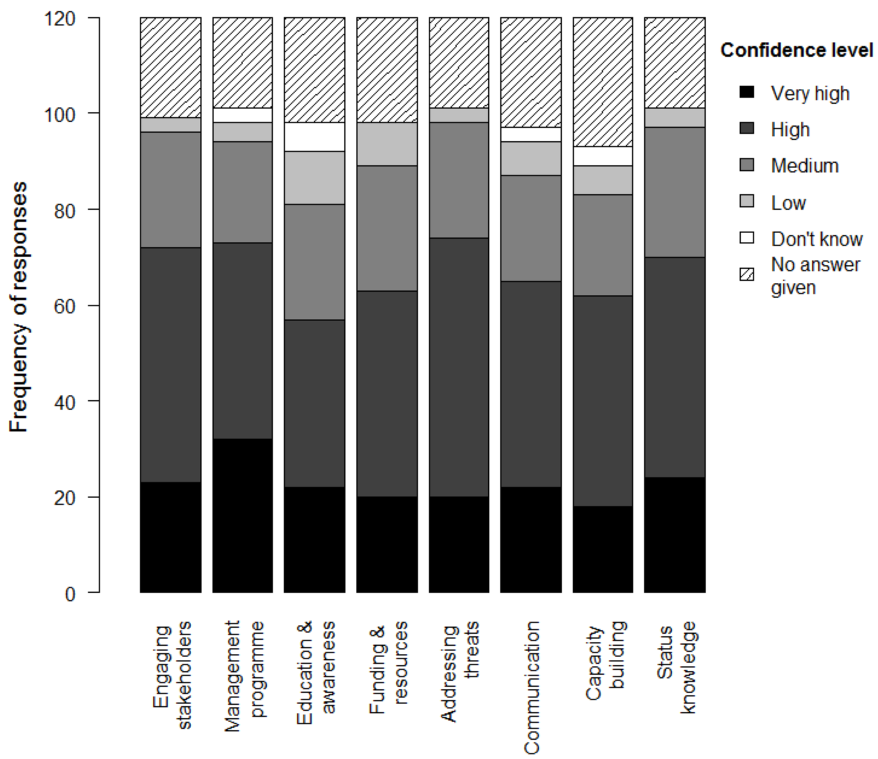


FIGURE 4.12 Levels of confidence provided by each respondent for each of the eight factors (confidence in answer given was requested for each factor at each stage).

The management programme category has the most *very high* responses (Figure 4.12). Existence of an officially recognised action plan should be something of which a respondent could be highly confident. For mammals where multiple questionnaires were received, the biggest discrepancies related to the existence, or not, of an officially recognised species action plan.

Confidence at different stages

When confidence options are ranked on an ordinal scale (*very high* = 4, *high* = 3, *medium* = 2, *low* = 1, *don't know* = 0), responses for confidence in inputs were significantly higher than those for outcomes (Wilcoxon paired signed rank test, $V=3759.5$, $P<0.001$; Figure 4.13).

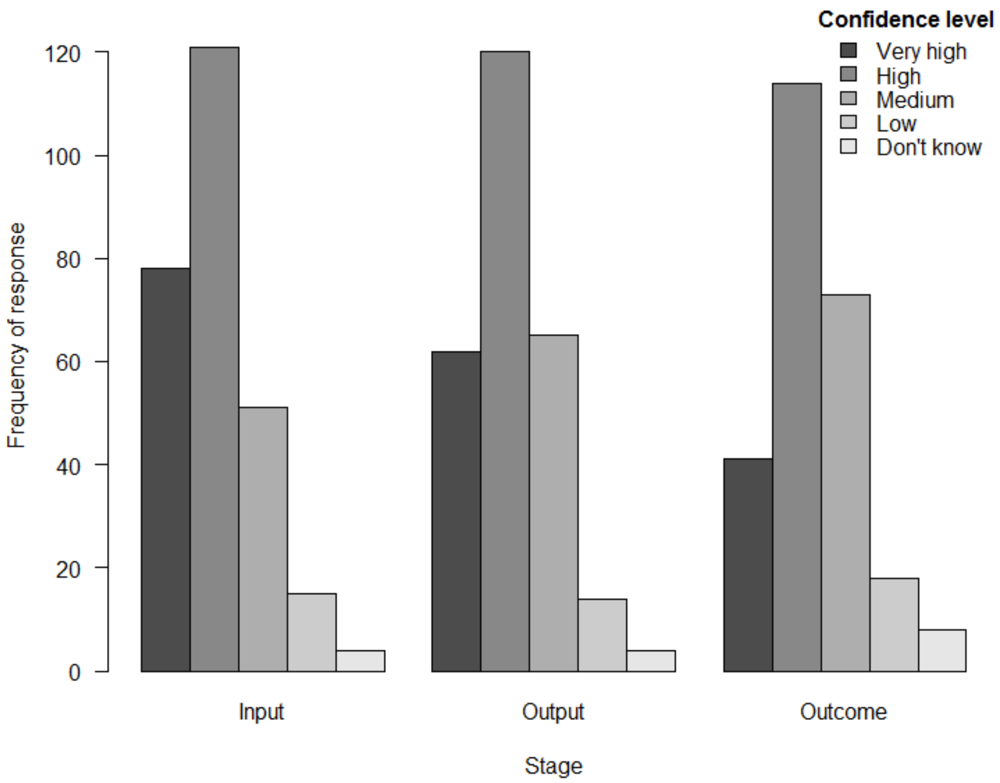


FIGURE 4.13 Responses given for confidence species experts held that each of their answers was correct. A total of 172 (17%, n=960) response boxes were left blank for confidence.

Median confidence level for each factor was *high*.

Type of respondent

EDGE group respondents had higher confidence in inputs and outcomes than the IUCN group (Wilcoxon rank tests: inputs: W=9390.5, P=0.034; outcomes: W=9103.5, P<0.001).

4.7 VISUALISING ASSESSMENT RESULTS

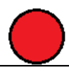
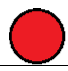
Tables 4.7 & 4.8 visualise assessment results for the highest EDGE ranking mammals and amphibians respectively. The traffic light system, combined with quarter circles representing range coverage, presents most of the assessment results in an easy-to-understand method.

TABLE 4.7 The ten highest EDGE ranking mammal species assessed with visualisations of their scores for the different stages. Colour corresponds to a traffic light scale (with black<25% total stage score, red<50%, amber<75% and green>75%), and the portion of the circle shaded indicates the rough proportion of the species' range across which this level is seen. Over time, the Input column should turn green, the output move largely to amber, and also the range proportions should increase.

Species	**Input**	**Output**	**Outcome**
Solenodon paradoxus			
Diceros bicornis			
Bactrianus ferus			
Rhinoceros sondaicus			
Elephas maximus			
Coleura seychellensis			
Romerolagus diazi			
Beatragus hunteri			
Rhynchocyon chrysopygus			
Chinchilla chinchilla			

Each circle represents the total score for a species at that stage, as a percentage: a score of less than 25% is black, 25%-49% red, 50%-74% amber and 75% and over green. Range proportions are the lowest of the four range levels (*0*, *L*, *M*, *H*) present in responses for a species at each stage. This represents a worst-case scenario. A quarter of colour corresponds with "few random scattered areas" within the species' range (*L*; Table 4.1), a half with "25%-75%" of the range (*M*) and a filled circle with "over 75%" of the species' range (*H*).

TABLE 4.8 The eleven highest EDGE ranking amphibian species assessed (four *Sooglossus* spp. hold an equal ranking) with visualisations of their scores for the different stages. Colour corresponds to a traffic light scale (with black<25% total stage score, red<50%, amber<75% and green>75%), and the portion of the circle shaded indicates the rough proportion of the species' range across which this level is seen. Over time, the input column should turn green, the output move largely to amber, and the black disappear from the outcomes. Also the range proportions should increase.

Species	**Input**	**Output**	**Outcome**
Andrias davidianus			
Heleophryne hewitti			
Necturus alabamensis			
Somuncuria somuncurensis			
Xenopus longipes			
Phaeognathus hubrichti			
Rhinoderma rufum			
Sooglossus sechellensis			
Sooglossus thomasseti			
Sooglossus gardineri			
Sooglossus pipilodryas			

DISCUSSION

5.1 USEFULNESS OF THE INDEX

This framework, and its accompanying questionnaire, provides a solid grounding from which to assess effectiveness of conservation attention directed at the level of species. As well as incorporation onto ZSL's SRCs, it will be useful for others evaluating conservation of species. It uses common language (Stem et al. 2005) developed with relation to results chains and conceptual models (Salafsky et al. 2002; Margoluis et al. 2009) to provide a logical and transparent method of evaluating conservation attention directed at a species. Expert responses were overwhelmingly positive, highlighting willingness of experts to participate in simple evaluation exercises, particularly when not time-demanding (Leverington et al. 2008). Utilisation of the framework produces a record of conservation actions taken for a species thus far and highlights opportunities for further actions.

5.2 INTERACTIONS BETWEEN FACTORS

Engaging stakeholders

Engaging stakeholders was most often the highest scoring factor. Partnerships are necessary precursors for conservation action (Kainer et al. 2009), and thus for other factors.

Officially recognised management programmes such as SCSs stipulate all stakeholders must be involved (IUCN/SSC 2008). Successful education and awareness, involving in-country educators or presented in a locally appropriate cultural context (Bickford et al. 2012), will not occur without collaboration within a species' range countries.

Level *H* for funding and resource mobilisation input and output is defined by commitment of governments (Table 4.1). A high score in funding categories is at least a medium score for some stages of stakeholder engagement (level *M* is 'Experts, international NGOs and national/local government'). To undertake capacity building, contact must be made with organisations within a species' range. Knowledge of threats, status and extent of communication are less clearly related to a firm grounding in stakeholder engagement, though plausible links can be imagined, e.g. through additional knowledge stakeholders provide (Kainer et al. 2009).

Engaging stakeholders will often be more developed than other factors. Thus, scores in this factor could be used as early notification of increasing conservation attention for a species. Over time assessments would show a high score emerging in engaging stakeholders first, then subsequent assessments would begin to show high scores across other factors.

Status knowledge

Status knowledge had the least variable score across realms. Filling gaps in knowledge is linked to original research more closely than other factors. Reduced variation may be a manifestation of the research-implementation gap (Knight et al. 2008). Original ecological research is being undertaken in all realms covering many species, even those which are not well known, allowing population status, habitat use and life history to be observed, whereas the more practical factors necessary for species conservation may be left to in-country practitioners (Knight et al. 2008) and may be more variable between realms according to resource access. If this is the case, status knowledge may not be a good indicator of conservation attention, though it will capture cases where there is primary research interest in a species.

5.2.1 RECOGNISING MANAGEMENT PROGRAMMES

The score for management programmes was higher for Afrotropical species than any other realm. More officially recognised action plans have been formulated for species from this realm, reflecting the historical prevalence of conservation initiatives in the Afrotropics, and the relatively recent focus of conservation in Indomalaya (Jepson & Whittaker 2002).

NBSAPs and SCSs give goals which either require no change in state, or aim for the minimum necessary to prevent extinction (Redford et al. 2011), rather than striving for the more difficult task of species recovery. However, IUCN action plans have catalysed conservation attention into action: many proposed actions are undertaken less than five years from a plan's creation (Fuller et al. 2003).

There were discrepancies in answers regarding action plans for species assessed by multiple experts. There may be problems with dissemination of SCSs, and the level of access that practitioners have to these plans (Fuller et al. 2003).

5.2.2 The most important factors for species conservation

Findings of these assessments suggest capacity building may be the most important contribution of raised conservation attention for most species, and EDGE group respondents are seeing this impact on the ground (the EDGE group scored capacity building much higher than the IUCN group). Education and awareness components could be beneficial for amphibians in particular, given the strong relationship between EDGE rank and education and awareness scores for amphibians assessed. Amphibians may benefit from an elevated EDGE rank more than mammals do.

Many programmes employ local people to undertake educational activities (e.g. Butler 2000; Trewhella et al. 2005). The framework assigns this the highest level possible for education inputs and outputs. However, there has been little investigation of whether this is preferable to a foreign educator, who can have more of an impact through being from another place (J. Baillie, pers. comm.). Research into the most effective methods for conservation education is desperately needed (Jacobson 2010).

Addressing threats is an important reactive response to ensure persistence of a species whilst a more complete programme of action is developed (Redford et al. 2011). When conservation attention is first raised a species may score highly in addressing threats, but over time the higher scoring factors will be those which are more important for long-term viability of the species.

Education and capacity building are essential to ensure species conservation will continue if international funding runs out and overseas staff move on (Butchart et al. 2006). Behaviour change is the only way conservation can be a realistic end point (Bride 2006). Thus, these factors should be the ultimate focus of species conservation.

5.3 REPORT CARDS FOR TOP 100 EDGE SPECIES

These assessments can be presented in a traffic light summary form in the response section of the SRCs for EDGE top 100 mammals and amphibians on the EDGE website. Different methods for selecting range displayed could be trialled, e.g. showing modal range for each stage. This would frame the index summary differently i.e. average case rather than worst-case scenario. Following revisions applied to the questionnaire, assessments can be sought for species not assessed here. Results of consecutive assessments over time will allow progress to be tracked. Partially filled circles should increase their colour proportions to whole, and then change to the next colour in the traffic light sequence.

Additional metrics developed by ZSL will be displayed, such as media and research attention (Sinfield 2011). These provide a detailed background to the general results shown by the framework.

Assessment results will be available on the EDGE website once the SRCs go live, becoming a valuable resource to focus future research, and highlight gaps in conservation action. SRCs will be attached to a species profile allowing non-conservationists to learn about conservation of a species. This unparalleled access to information may help enthuse people into a passion for conservation, especially for species that are not well known or traditionally charismatic (Martín-López et al. 2009).

5.4 STRENGTHS AND LIMITATIONS

5.4.1 THE SPECIES LEVEL APPROACH

It is traditionally difficult to evaluate conservation effectiveness because all programmes have varying, subjective goals (Patton 2008). This framework transcends this limitation by operating at the level of species conservation, an aim to which all projects and interventions for a particular species are ultimately committed: though intermediate goals of conservation success may vary (Howe & Milner-Gulland 2011), the goal of persistence or recovery (Redford et al. 2011) is a commonality.

There have been few efforts thus far to unite information regarding a species' conservation at all scales (Sitas et al. 2009). Successful local protection of a species must be viewed within the global context to ensure range-wide persistence (Saterson et al. 2004). This framework provides the necessary link between these two scales – results of evaluations at a project level, e.g. whether an education programme has changed the behaviour of its targets, can be fed into the broader evaluation this framework represents.

5.4.2 The scorecard approach

The framework is broad, in order to be applicable to all species, regardless of taxon and range (Mace & Lande 1991). Ordering of the importance of different factor levels may not be suitable in some situations. For example, for the Chinese giant salamander *Andrias davidianus*, local governments are the most important stakeholders to engage (level *M*; Table 4.1), whereas local people (level *H*) have little control over threats to, and conservation of, the species (H. Meredith pers. comm.). In this case, achievement of the optimal situation for engaging stakeholders will be scored as level *M*. An indicator can never be perfect, so tradeoffs will be necessary (Jones et al. 2011).

By using descriptive text for each level, I have reduced subjectivity arising from the use of 'high', 'medium' and 'low' categories (Regan et al. 2006).

5.4.3 Use of expert knowledge

Asking respondents to provide quantitative confidence levels discourages survey completion (Martin et al. 2005). 94% of respondents were undeterred by the qualitative categories used in this questionnaire.

The type of people most likely to respond to a study such as this may have introduced bias (Krosnick 1999). People in the EDGE group were much more likely to return a questionnaire than the IUCN group. EDGE fellows, who have received funding and training through the EDGE programme, had the highest response rate. This could represent motivational bias (Martin et al. 2012).

Alternatively, the difference in response rate may be because contacts in the EDGE group were species-specific. The initial email would have reached a person with appropriate expertise. Emails sent to the IUCN group would have been less likely to reach someone with appropriate expertise. A global contact for a whole species group may ascribe lower priority to forwarding the questionnaire than a practising species expert would ascribe to completing it for the species with which they constantly work – motivational bias of a different kind.

Over time, as the EDGE network develops, response rate will increase; appropriate people will be contacted directly. Formation of the network will benefit from obtaining relevant contact details from IUCN/SSC SSG chairs to allow dissemination of questionnaires directly to those who have the knowledge to complete them.

The partial anonymity afforded by lack of disaggregation of interventions by organisation or project may foster honesty and candidness regarding success of an individual's project, as any negative effects will be absorbed into the whole species case. However, there may be a perceived loss of accountability (Christensen 2003).

Differences between responses for the same species may relate to different ways in which each practitioner experiences conservation (Martin et al. 2005; Giannetti et al. 2009), e.g. a respondent who has just had a grant proposal refused may record progress of funding and resource mobilisation less favourably than someone working on a multi-million pound project. These differences will be minimised if multiple experts are contacted for each species; a median of responses can be taken (Martin et al. 2012). Although multiple responses for one species were rare in this study, development of the EDGE network will provide the opportunity to contact multiple experts.

5.4.4 Encouraging best current practice

By focusing on the highest level of a factor attained for a species, the framework helps to identify current best achievements for a species, demonstrating what is possible within a species' range. This can facilitate those in a less highly scoring area to investigate current effective practice (Sutherland & Peel 2011) and try to replicate it.

5.4.5 Trading off complexity & applicability

Time to questionnaire completion increased with total index score. Both respondents for the Asian elephant, a species with a long history of conservation attention, took over one hour to complete the questionnaire. If a species is scoring more highly, and therefore receiving more conservation attention, there is more data to process in order to complete the questionnaire. This means for each subsequent assessment over time, the time to complete would increase. If subsequent assessments were completed by the same expert, it may be prudent to ask only to give details of newly acquired evidence, so records can be updated but time to completion remains low. Experts may become quicker at completing the questionnaire as they become more familiar with it.

5.4.6 Assigning numerical values

When assigning numerical values to qualitative data, inferences drawn from scores should be the same regardless of the scale applied (Wolman 2006). The ranking system used to score this framework is the most parsimonious of those proposed. For the subset of species on which all scoring systems were trialled, all systems displayed the same patterns in scoring between stages and factors, demonstrating that conclusions drawn are not numerical artefacts of the system (Wolman 2006) but reveal information about the relationships between components of conservation attention.

5.4.7 Correlation & causality

Assessment results suggest higher ranking EDGE species enjoy a greater level of conservation attention than lower ranking ones. This does not show the EDGE programme has stimulated effective conservation attention; correlation does not equate to causality. Additional analyses, or more responses (especially at subsequent points in time), are necessary to tease apart the effects of conservation attention specifically generated by the EDGE programme as opposed to any other organisations or individuals. Some respondents felt ZSL had no part in conservation actions currently underway for their species.

5.4.8 The effects of uncertainty

As a species is tracked over time, it may not always improve through the levels of the index. This may not represent a lack of attention; it may be that experts can now say with more confidence that attention is within the level assigned. A comparison of the full information from each assessment may show an increase in the confidence of a level before the species moves up a level. This represents an improvement: it is a better representation of the state of affairs if e.g. there is a very high level of confidence that changed behaviour is present in a small portion of the target human population, than low confidence that a large portion are displaying changed behaviour. Higher confidence makes it more likely that a perceived change in level is a true change.

5.5 The way forward

5.5.1 Use by the EDGE programme

Revisions before application

This framework will be applied to the EDGE top 100 mammals and amphibians as part of the SRC initiative following some improvements (J. Baillie, pers. comm.).

The private sector is becoming more important as a stakeholder (Salcido et al. 2008). The framework includes this within the *H* category of engaging stakeholders though business is not specifically named; the level refers to "local" stakeholders. The most important contributions from the private sector may be from multinational companies (MacDonald 2010), and the framework makes no specific allowance for this. Levels within 'engaging stakeholders' should be revised to include national or multinational businesses.

Loosening the specificity of the officially recognised action plans may be beneficial to ensure the management programme factor captures all that is being done for a species. Many species do not have their own plan, but are included in an ecosystem plan; these are gaining popularity (Bottrill et al. 2011a), though plans including more than one species may not be as effective at promoting species recovery as single species plans (unless each species is covered in appreciable detail [Taylor et al. 2005]).

The communication category should place more emphasis on the people with which information is shared (J. Baillie, pers. comm.). Information should be made available to practitioners (Fuller et al. 2003), and also shared with a wider audience who may not usually hear such information and may not already be passionate about conservation (Nadkarni 2004). It is with these people that the most impact could be made.

The questionnaire should include a question regarding expert knowledge of current population trends. This will be more up-to-date than population trends reported by the RL or in peer-reviewed literature. Broad categories (increasing, decreasing, stable, unknown) increase the likelihood that the true population trend could be captured (Salafsky & Margoluis 1998), and would provide a useful accompaniment to the assessment results.

A glossary of terms such as stakeholders should be included to ensure consistent interpretation in the context of the questionnaire (Doherty-Bone pers. comm.).

5.5.2 TRACKING CHANGE OVER TIME

SRCs will be updated biennially for each of the top 100 mammals and top 100 amphibians (Sinfield 2011). The conservation attention effectiveness framework is beneficial as it is not resource demanding.

The assumption made by the EDGE programme (if it is successful) is that being an EDGE species will increase the amount and effectiveness of conservation attention received. Future assessments will track changes in the effectiveness of conservation attention over time. Retrospective assessments were not attempted; the phenomenon of shifting baselines is well documented (Stoner et al. 2007; Papworth et al. 2009; James et al. 2010; Rittenhouse et al. 2010; Turvey et al. 2010) and would likely result in biased assessment results.

Given the time necessary to plan and complete actions, it may be that some species ranked highly in 2007 that moved further down the list are only now enjoying the effects of conservation actions planned in 2007 when they were a high focus of the EDGE programme. A decrease in conservation attention that may occur as a result of a decrease in rank may not have any effect for several years. Effects of the changing EDGE rank of some species will become apparent in subsequent assessments, though this effect will be masked if the direction of change in a species rank is not constant.

Subsequent evaluations should show an increase in total index score, with IOO total scores progressively increasing. The difference between total score for inputs and outcomes may decrease; as the maximum score is achieved in inputs the total input score will remain fairly constant as the output and outcome scores gradually increase to a similar value. After this the conservation status of the species should improve.

What is currently unknown is whether a decrease in total score for inputs will be observed as conservation attention is transferred to the outcome stage (thus increasing the difference between input and outcome scores again, but in the opposite direction). If the input score does decrease, is this an accurate representation of the real state for a species? To answer this question it must be determined whether or not inputs in each factor must be maintained when conservation attention is effective through to the outcome stage.

5.5.3 DISSEMINATION OF DATA

Central access to data, particularly for less well-known species, although logistically difficult (E.J. Milner-Gulland, pers. comm.), can save resources by preventing duplication of effort and making it easier for conservationists from developing countries to access data (Sunderland et al. 2009).

Data generated from this study documents current conservation actions for some of the EDGE top 100 mammals and amphibians. The easiest way to make this widely available is through the EDGE network.

5.5.4 FURTHER WORK

With more completed assessments it may be possible to ascertain whether the factors should be weighted to make the framework more representative. Factors that may warrant higher weighting are capacity building and education and awareness. Opinion of multiple experts can rank factors in order of importance for effective species conservation, providing a basis for weighting (Giannetti et al. 2009).

Subsequent assessments will allow for the discovery of signature patterns denoting certain situations. For example the pattern seen in the Malabar civet, where the total score for outcomes is much higher than for outputs, may be indicative of benefits accruing to a species as a result of ecosystem-level interventions rather than species-specific programmes. Given the increasing popularity of ecosystem approaches (Bottrill et al. 2011a) it is important to be able to recognise where ecosystem-wide efforts are contributing towards conservation of a species, to support assumptions that targeting an ecosystem as a whole ensures the persistence of those species it contains (Hassan et al. 2005).

5.6 THE FRAMEWORK AS PART OF A COMPLEMENTARY TOOLKIT

There are applications for evaluating effectiveness at all scales within conservation: at programme, organisation and species levels. Evaluating at only one scale may miss important processes acting at another (Cundill & Fabricius 2009). This framework can be used in combination with other methods to capture all dimensions of conservation. The broad approach can be supplemented by in-depth investigations of factors highlighted as being of special interest (A. J. Desai, pers. comm.). Where a species scores highly for a factor in one portion of its range, detailed assessment of the effectiveness of a programme underway in this area can shed light on best current practice (Sutherland & Peel 2011) to be transferred elsewhere.

This project aimed to develop improved methods for evaluating, and monitoring over time, the effectiveness of conservation attention using EDGE species as a case study. Production and testing of a calibrated, robust index for evaluating the effectiveness of conservation attention at the species level has contributed to the ongoing development of EDGE SRCs, and has provided preliminary assessments of effectiveness of conservation attention directed at 30 of ZSL's top 100 EDGE mammals and amphibians. Successful contact was made with 51 conservation researchers and practitioners, who will either join the EDGE network themselves, or have expressed an interest in providing contact details of other experts.

The work presented here is an important step in the development of methods to measure effectiveness of conservation attention at the species level, using expert knowledge to reduce resource demands. Experts can assess the progress of their species against an ideal 'recipe' defining the characteristic conservation actions needed to ensure that, all else being equal, successful conservation will follow. Definition of this intermediate goal of effective conservation attention provides a measurable goal that is realistically achievable within the lifetime of extended projects. Likely future conservation of a species can be predicted without waiting for the corresponding lag in a population response following harmful or beneficial actions. The broad-brush approach of this tool is a significant step forward in uniting all available information about a species, in a standard format that can be compared across any species, and supplemented by more detailed focal evaluations where necessary. As part of a toolkit of conservation evaluation techniques, this framework can help to improve the state of species conservation for the future.

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APPENDICES

I EMAIL TEXT REQUESTING PARTICIPATION

Questionnaires were emailed to respondents as attachments with the following text (depending on respondent type) in the accompanying email.

Sent to members of the EDGE online community

I am an MSc student undertaking research with the Zoological Society of London (ZSL) and Imperial College London, looking at the effectiveness of the conservation attention that ZSL's Evolutionarily Distinct and Globally Endangered (EDGE) species have been receiving (from both ZSL and other organisations/individuals). I am contacting you because of your expert knowledge of *[species X]*, an EDGE [mammal/amphibian].

I would be very grateful if you would complete the attached questionnaire for *[species X]* using your expert knowledge and opinion, and return it to me by email. The questionnaire is designed to be simple and quick – it should take no longer than thirty minutes to complete. All questions refer to the species *as a whole*, rather than the work of any particular organisation or project. Please answer each question considering all conservation attention directed at the species. Please forward this for completion to any other people you may know who are also specialists in *[species X]* conservation.

Your response will help me to both assess the progress of conservation for *[species X]* and further develop methods of reporting conservation progress in useful, accurate ways that don't take up too much time. Also, your responses may help to identify areas requiring further conservation attention for improved conservation of your species.

If you would like to provide me with any general feedback about using the questionnaire, please feel free to write it in the email when returning the completed spreadsheet.

If you have any queries please contact me.

Thanks in advance for your participation.

Sent to members of IUCN/SSC SSGs

I am an MSc student undertaking research with the Zoological Society of London (ZSL) and Imperial College London, looking at the effectiveness of the conservation attention that ZSL's Evolutionarily Distinct and Globally Endangered (EDGE) species have been receiving (from both ZSL and other organisations/individuals). I am contacting you regarding *[species X]*, an EDGE mammal/amphibian covered by your IUCN/SSC Species Specialist Group.

I would be very grateful if you would complete the attached questionnaire for *[species X]* using your expert knowledge and opinion, and return it to me by email. The questionnaire is designed to be simple and quick – it should take no longer than thirty minutes to complete. All questions refer to the species *as a whole*, rather than the work of any particular organisation or project. Please answer each question considering all conservation attention directed at the species. Alternatively, or in addition, please forward this for completion to any other people you may know who are specialists in *[species X]* conservation.

Your response will help me to both assess the progress of conservation for *[species X]* and further develop methods of reporting conservation progress in useful, accurate ways that don't take up too much time. Also, your responses may help to identify areas requiring further conservation attention for improved conservation of this species.

If you would like to provide me with any general feedback about using the questionnaire, please feel free to write it in the email when returning the completed spreadsheet.

If you have any queries please contact me.

Thanks in advance for your participation.

II THE QUESTIONNAIRE

Instructions for completion

At the top of the Excel spreadsheet the following instructions explain how to complete the questionnaire:

Looking at a species as a whole, across all of its range, evaluate each of the following factors at the stages of Input, Output, and Outcome.

All questions refer to the species as a whole, rather than the work of any particular organisation or project.

Please answer each question considering all conservation attention directed at the species.

- *Select the level from each drop-down box which best describes the situation for this species and the scope (of the species' range) across which this level of the factor has been observed. If you cannot read an option in the drop-down list, select it and the whole option will be displayed; you can then change it to the correct answer.*
- *The levels are nested, so when selecting a level, those levels above your choice in the drop-down list must also be true.*
- *Where more than one level may be relevant across various parts of the species' range, select the most complete option, specifying the range across which this most complete level is observed.*
- *For each answer, select how confident you are of the answer you have given.*
- *For each selection indicate where the evidence for this choice can be found (e.g. Species Action Plan, management report, field notebook, personal observation etc.). Provide additional information here if you feel it is necessary.*
- *Use the spaces at the end to record any other information that you think might be useful, and roughly how long the questionnaire took to complete.*

All boxes outlined in blue should be filled.

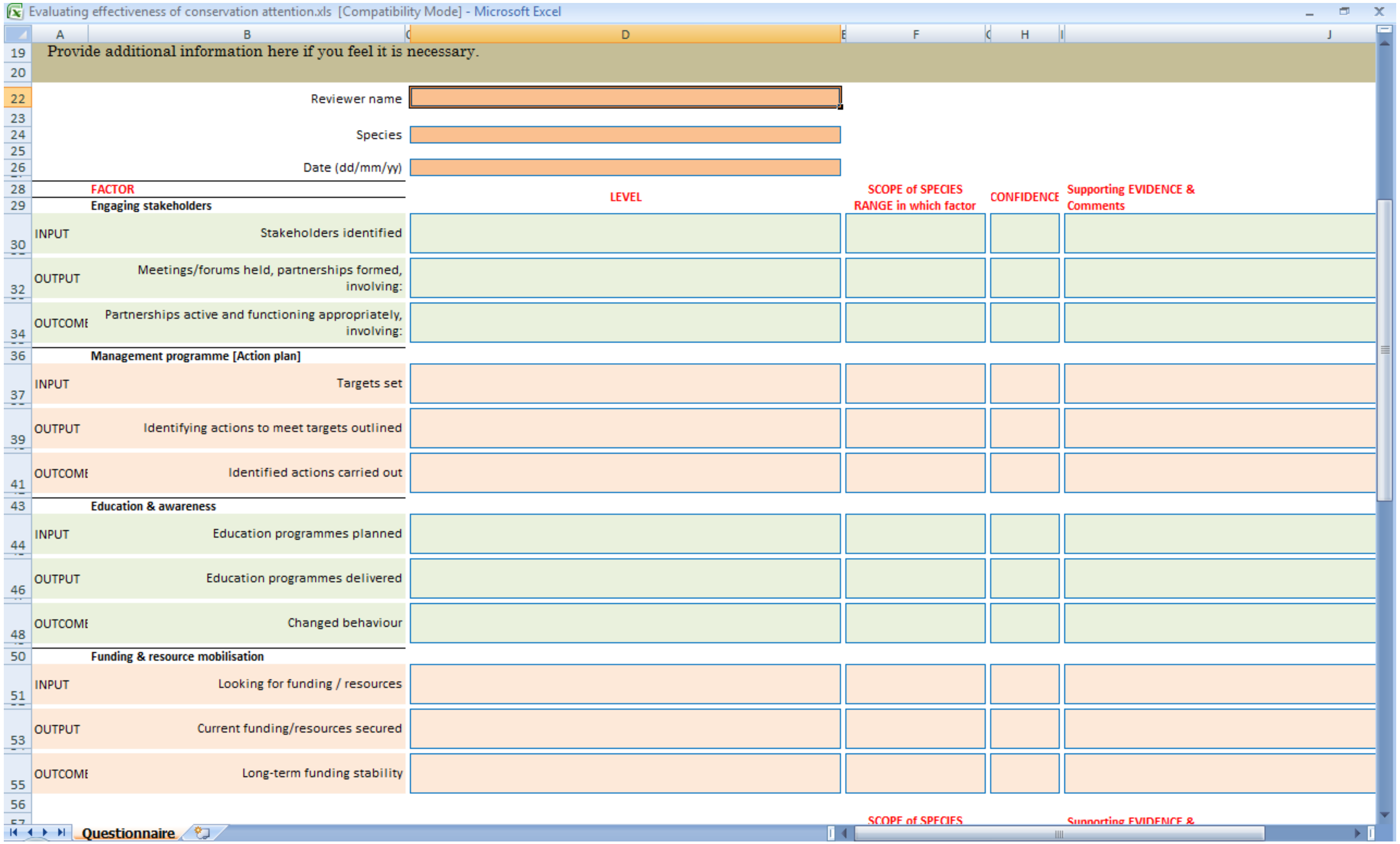
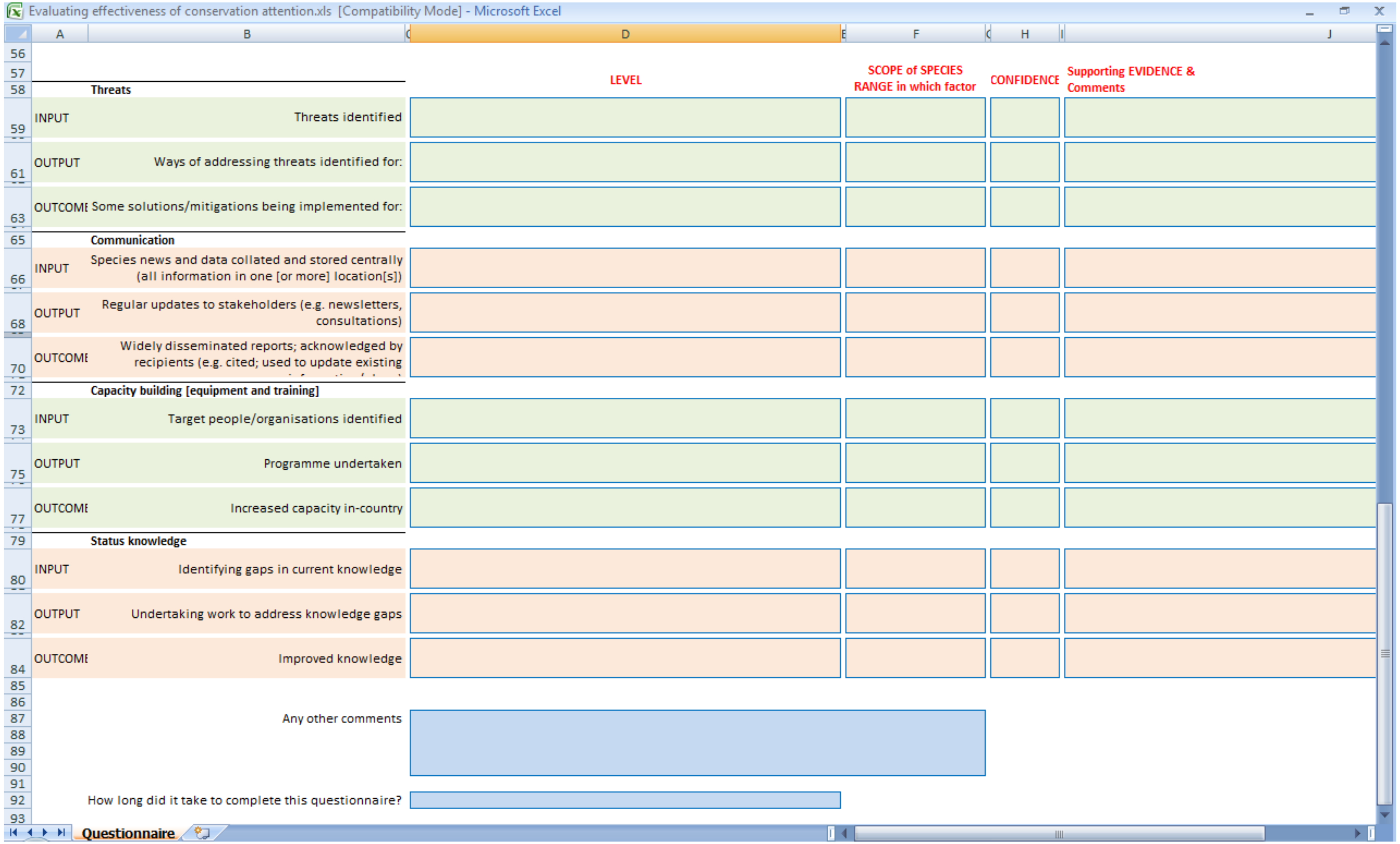


FIGURE II.1 Screen dump of first half of questionnaire (Microsoft Excel spreadsheet). Print screen excludes instructions for completion quoted on previous page; these are found in the brown box at the top of the visible screen here. The top three boxes have unrestricted text entry. For all other boxes outlined in blue (excluding 'Supporting evidence & comments'), respondent must select from a drop-down menu corresponding to levels in the framework.



Evaluating effectiveness of conservation attention.xls [Compatibility Mode] - Microsoft Excel

		LEVEL	SCOPE of SPECIES RANGE in which factor	CONFIDENCE	Supporting EVIDENCE & Comments
Threats					
INPUT	Threats identified				
OUTPUT	Ways of addressing threats identified for:				
OUTCOME	Some solutions/mitigations being implemented for:				
Communication					
INPUT	Species news and data collated and stored centrally (all information in one [or more] location[s])				
OUTPUT	Regular updates to stakeholders (e.g. newsletters, consultations)				
OUTCOME	Widely disseminated reports; acknowledged by recipients (e.g. cited; used to update existing				
Capacity building [equipment and training]					
INPUT	Target people/organisations identified				
OUTPUT	Programme undertaken				
OUTCOME	Increased capacity in-country				
Status knowledge					
INPUT	Identifying gaps in current knowledge				
OUTPUT	Undertaking work to address knowledge gaps				
OUTCOME	Improved knowledge				

Any other comments

How long did it take to complete this questionnaire?

Questionnaire

FIGURE II.2 Screen dump of second half of questionnaire (Microsoft Excel spreadsheet). For all boxes outlined in blue (excluding 'Any other comments'), respondent must select from a drop-down menu corresponding to levels in the framework.

III EDGE TOP 100 MAMMALS

EDGE rank	Species	Species expert	Preliminary assessment result Raw	%
1	*Zaglossus attenboroughi*			
1	*Zaglossus bartoni*			
1	*Zaglossus bruijnii*			
4	*Mystacina robusta*			
5	*Lipotes vexillifer*			
6	*Burramys parvus*			
7	*Solenodon cubanus*			
7	*Solenodon paradoxus*	Jose Nunez-Mino	128	59
9	*Dicerorhinus sumatrensis*			
10	*Bunolagus monticularis*			
11	*Diceros bicornis*	Benson Okita-Ouma	160	74
		Richard Emslie	114	52
12	*Lasiorhinus krefftii*			
13	*Bactrianus ferus*	Richard Reading	70	32
		Lucy Boddam-Whetham	53	25
14	*Rhinoceros sondaicus*	Sarah Brook	105	49
15	*Laonastes aenigmamus*			
16	*Bradypus pygmaeus*			
17	*Elephas maximus*	Ajay A Desai	95	44
		Bhichet Noonto	113	52
18	*Octodon pacificus*			
19	*Ailuropoda melanoleuca*			
20	*Tapirus indicus*			
21	*Abrocoma boliviensis*			
22	*Monachus monachus*			
22	*Monachus schauinslandi*			
24	*Ailurops melanotis*			
25	*Natalus jamaicensis*			
26	*Coleura seychellensis*	Justin Gerlach	95	44
27	*Natalus primus*			
28	*Choeropsis liberiensis*			
29	*Indri indri*			
30	*Galagoides rondoensis*			
31	*Myrmecobius fasciatus*			
32	*Pharotis imogene*			

EDGE rank	Species	Species expert	Preliminary assessment result Raw	%
33	*Aproteles bulmerae*			
34	*Phalanger matanim*			
35	*Potorous gilbertii*			
36	*Marmosops handleyi*			
37	*Varecia variegata*			
38	*Amorphochilus schnablii*			
39	*Tapirus bairdii*			
40	*Romerolagus diazi*	Alejandro Velazquez	104	48
41	*Prolemur simus*			
42	*Pentalagus furnessi*			
43	*Beatragus hunteri*	Abdulllahi Hussein Ali	54	25
44	*Pseudoryx nghetinhensis*			
45	*Pongo abelii*			
46	*Rhynchocyon chrysopygus*	Grace Wambui Ngaruiya	132	61
47	*Hapalemur alaotrensis*			
48	*Tokudaia muenninki*			
49	*Gymnobelideus leadbeateri*			
50	*Dugong dugon*			
51	*Neohylomys hainanensis*			
52	*Podogymnura aureospinula*			
53	*Chinchilla chinchilla*	María Eugenia Copa Alvaro	57	26
54	*Chinchilla lanigera*			
55	*Spilocuscus rufoniger*			
56	*Mystacina tuberculata*			
57	*Sminthopsis aitkeni*			
58	*Lepilemur septentrionalis*			
59	*Micropotamogale lamottei*			
60	*Platanista gangetica*	Gopal Khanal	106	49
		Nadia Richman	77	36
		Brian Smith	89	41
61	*Bradypus torquatus*			
62	*Hipposideros lamottei*			
63	*Phocoena sinus*	Randall Reeves	132	61
64	*Oreonax flavicauda*	Sam Shanee	124	57
65	*Propithecus perrieri*			
66	*Equus africanus*			
67	*Loris tardigradus*	S. N. Gamage	90	42

EDGE rank	Species	Species expert	Preliminary assessment result Raw	%
68	*Cavia intermedia*			
69	*Gorilla gorilla*			
70	*Trichechus inunguis*			
71	*Nilopegamys plumbeus*			
72	*Catagonus wagneri*			
73	*Neamblysomus gunningi*			
74	*Balaenoptera physalus*			
75	*Tapirus pinchaque*	Diego J. Lizcano	96	44
76	*Balaenoptera musculus*			
77	*Dendromus kahuziensis*			
78	*Chrysospalax trevelyani*			
79	*Leporillus apicalis*			
80	*Hypogeomys antimena*			
81	*Tylomys bullaris*			
82	*Callicebus barbarabrownae*			
83	*Sorex sclateri*			
84	*Sorex stizodon*			
85	*Tylomys tumbalensis*			
86	*Bettongia penicillata*			
87	*Cryptotis nelsoni*			
88	*Mesocapromys sanfelipensis*			
89	*Mesocapromys nanus*			
90	*Physeter macrocephalus*	Hal Whitehead	49	23
91	*Manis pentadactyla*			
92	*Manis javanica*			
93	*Brachyteles hypoxanthus*			
94	*Trichechus manatus*			
95	*Trichechus senegalensis*			
96	*Potorous longipes*			
97	*Cremnomys elvira*			
98	*Millardia kondana*			
99	*Crateromys australis*			
100	*Viverra civettina*	Divya Mudappa J. W. Duckworth	25	12

IV EDGE TOP 100 AMPHIBIANS

EDGE Rank	Species	Species expert	Preliminary assessment result Raw	%
1	*Leiopelma archeyi*			
2	*Andrias davidianus*	Helen Meredith	152	70
3	*Boulengerula niedeni*			
4	*Nasikabatrachus sahyadrensis*			
5	*Telmatobufo bullocki*			
6	*Ambystoma lermaense*			
7	*Ambystoma mexicanum*			
8	*Ambystoma amblycephalum*			
9	*Ambystoma andersoni*			
10	*Ambystoma bombypellum*			
11	*Ambystoma dumerilii*			
12	*Ambystoma granulosum*			
13	*Ambystoma leorae*			
14	*Ambystoma taylori*			
15	*Heleophryne hewitti*	Werner Conradie	101	47
16	*Heleophryne rosei*			
17	*Leiopelma hamiltoni*			
18	*Proteus anguinus*			
19	*Taudactylus acutirostris*			
20	*Taudactylus eungellensis*			
21	*Taudactylus pleione*			
22	*Taudactylus rheophilus*			
23	*Insuetophrynus acarpicus*			
24	*Parvimolge townsendi*			
25	*Philoria frosti*			
26	*Necturus alabamensis*	Michael Lannoo	24	11
27	*Pipa myersi*			
28	*Petropedetes dutoiti*			
29	*Conraua derooi*			
30	*Telmatobufo venustus*			
31	*Mixophyes fleayi*			
32	*Mixophyes iteratus*			
33	*Somuncuria somuncurensis*	Federico Pablo	59	27

EDGE Rank	Species	Species expert	Preliminary assessment result Raw	%
		Kacoliris		
34	*Xenopus longipes*	Thomas Doherty-Bone	147	68
35	*Lyciasalamandra billae*			
36	*Pelobates varaldii*			
37	*Scaphiophryne gottlebei*			
38	*Leiopelma hochstetteri*			
39	*Hyloscirtus chlorosteus*			
40	*Ambystoma altamirani*			
41	*Ambystoma ordinarium*			
42	*Phaeognathus hubrichti*	Michael Lannoo	42	19
43	*Cryptotriton monzoni*			
44	*Dendrotriton cuchumatanus*			
45	*Rhinoderma rufum*	Claudio Soto-Azat	80	37
46	*Paradactylodon mustersi*			
47	*Paradactylodon gorganensis*			
48	*Stumpffia helenae*			
49	*Chiropterotriton lavae*			
50	*Chiropterotriton magnipes*			
51	*Chiropterotriton mosaueri*			
52	*Boehmantis microtympanum*			
53	*Nototriton lignicola*			
54	*Praslinia cooperi*			
55	*Alytes muletensis*			
56	*Alytes dickhilleni*			
57	*Melanobatrachus indicus*			
58	*Leiopelma pakeka*			
59	*Leptodactylodon erythrogaster*			
60	*Thorius aureus*			
61	*Thorius infernalis*			
62	*Thorius magnipes*			
63	*Thorius minutissimus*			
64	*Thorius minydemus*			
65	*Thorius narismagnus*			
66	*Thorius narisovalis*			
67	*Thorius pennatulus*			

EDGE Rank	Species	Species expert	Preliminary assessment result Raw	%
68	*Echinotriton chinhaiensis*			
69	*Sooglossus sechellensis*	Justin Gerlach	72	33
70	*Sooglossus pipilodryas*	Justin Gerlach	81	38
71	*Sooglossus thomasseti*	Justin Gerlach	72	33
72	*Sooglossus gardineri*	Justin Gerlach	72	33
73	*Astylosternus nganhanus*			
74	*Oedipina altura*			
75	*Oedipina maritima*			
76	*Oedipina paucidentata*			
77	*Cardioglossa trifasciata*			
78	*Cardioglossa alsco*			
79	*Oreolalax liangbeiensis*			
80	*Neurergus kaiseri*			
81	*Leptobrachella palmata*			
82	*Callulina kisiwamsitu*			
83	*Scutiger maculatus*			
84	*Minyobates steyermarki*			
85	*Microhyla karunaratnei*			
86	*Micrixalus kottigeharensis*			
87	*Indirana gundia*			
88	*Indirana phrynoderma*			
89	*Pseudoeurycea nigra*			
90	*Pseudoeurycea parva*			
91	*Pseudoeurycea aquatica*			
92	*Pseudoeurycea exspectata*			
93	*Pseudoeurycea lynchi*			
94	*Pseudoeurycea naucampatepetl*			
95	*Pseudoeurycea nigromaculata*			
96	*Pseudoeurycea praecellens*			
97	*Pseudoeurycea smithi*			
98	*Arthroleptis troglodytes*	James Harvey	11	5
99	*Anhydrophryne ngongoniensis*	James Harvey	42	19
100	*Nannophrys marmorata*			

V STATISTICAL TEST RESULTS

	EDGE Rank	Total outcome scores	Confidence in outcomes	Respondent type
Response rate				Fisher's exact test P=0.0002
Total index score (%)	All: p=0.002207 Mammals: p=0.05542 Amphibians: p=0.03812			Wilcoxon rank test: W=139, P=0.228
Total education & awareness score (%)	All: p=0.2265 Mammals: p=0.5406 Amphibians: p=0.004666			Wilcoxon rank test, W=223.5, P=0.240
Total status knowledge score (%)	All: p=0.2863 Mammals: p=0.5545 Amphibians: p=0.1797			Wilcoxon rank test, W=235.5,P=0.131
Total management programme score (%)	All: p=0.08217 Mammals: p=0.06529 Amphibians: p=0.7764			Wilcoxon rank test, W=193, P=0.765
Total capacity building score (%)	All: p=0.00497 Mammals: p=0.03014 Amphibians: p=0.1529			Wilcoxon rank test, W=247.5, P=0.032
Total engaging stakeholders score (%)				Wilcoxon rank test, W=202.5, P=0.570
Total funding and resource mobilisation score (%)				Wilcoxon rank test, W=237.5, P=0.058
Total addressing threats score (%)				Wilcoxon rank test, W=221, P=0.273
Total communication score (%)				Wilcoxon rank test, W=181, P=0.988
Total input scores		Wilcoxon paired signed rank test, V=778.5, p=0.00000003032		
Confidence in inputs			Wilcoxon paired signed rank test, V=3759.5, p=0.00000006196	Wilcoxon rank test, Inputs: W=9390.5, P=0.034, Outcomes: W=9103.5, P=0.0004214