An evaluation of Species Action Plans and factors influencing conservation reintroduction success

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"*All of you with little children, and who have no need to count expense, or even if you have such need, take them somehow into the country, among green grass and yellow wheat – among trees – by hills and streams, if you wish their highest education, that of the heart and soul, to be completed.*

Therein they shall find a secret, a knowledge not to be found in books. They shall know the sun and the wind, the running water, the breast of the broad earth. They will forget their books. They will never forget the grassy fields.

If you wish your children to think deep things, to feel the holiest emotions, take them to the woods and hills and give them the freedom of the meadows"

— Richard Jefferies, The Dewy Morn

Author declaration

Gemma Harding wrote all the chapters, with editorial suggestion made by PhD supervisors R.A. Griffiths and S.A. Black.

Chapter 2 G. Harding conceived the idea during her MSc when assessing success of amphibian captive breeding and reintroduction programmes and wondering why only a few of them seemed to have species action plans supporting them. G. Harding, R.A. Griffiths and S.A. Black helped identify a source for the sample of plans, and G. Harding conducted the review, analysed the data, and wrote the chapter with input from R.A. Griffiths and S.A. Black.

Chapter 3 originated from discussions between G. Harding, R.A. Griffiths, and S.A. Black. Sampling and questionnaire design were developed by G. Harding with support from R.A. Griffiths and S.A. Black. All data analyses were conducted by G. Harding who also wrote the chapter with input R.A. Griffiths and S.A. Black.

Chapter 4 originated from discussions between G. Harding, R.A. Griffiths, and S.A. Black following the completion of chapter 2. G. Harding conducted the review, analysed the data, and wrote the chapter with input from R.A. Griffiths and S.A. Black.

Abstract

Through the Convention on Biological Diversity and the various approaches of governments and NGOs, Species Action Plans (SAPs) have become key in framing conservation action for threatened species. Despite their wide deployment in conservation, there have been no global comparative studies of SAP structure and content and how they are created, reviewed, and utilised. Species reintroductions often form a key part of SAPs and species recovery actions. Although species reintroductions are frequently assessed in terms of their outcomes, it is often unclear what 'success' or 'failure' mean and what factors might drive them. I aimed to establish (1) the key components and outputs of Species Action Plans, and how they compare across regions, taxa, and time; (2) how conservation practitioners utilise and perceive Species Action Plans; and (3) the factors that are influencing species reintroduction successes and failures. I did this by applying a mixed method approach utilising questionnaires and analysing case studies to establish practitioner perceptions, and patterns and relationships within the data. Results highlight the variation in SAP content across regions and time, finding that SAPs vary in structure and components across regions but less so across taxa, and that SAPs have evolved across time in line with scientific evidence, practice, and the associated development of guidance. Of note were the increased inclusion in recent years of success criteria and indicators, and that post-SAP reviews and evaluations were scarce and contained little information on SAP implementation or the success of actions in relation to indicators or monitoring. The development, value, utilization, and evaluation of SAPs was researched using data from an online questionnaire targeted at conservation practitioners. Conservation practitioners' perceptions of SAPs were positive, indicating that SAPs are highly valued and utilised widely. In relation to SAP content and structure, four principal components considered core to a SAP were identified. These were: (1) Strategic action and threats; (2) Species status; (3) Implementation, monitoring, and financial plans; and (4) Project vision.

An evaluation of species reintroduction success was undertaken based on a global analysis of 341 case studies. It identified geographical and taxonomic variations in success rates and factors relating to partnerships and support, and habitat and release site as influential in success or failure. Having too many programme goals also appeared to be linked to a negative outcome. In summary, SAPs are extremely valuable but could be improved by having more focussed components that include priority actions, and separate implementation and monitoring plans. Having clear outcomes, measurable indicators or success criteria within SAPs and seeking practitioner feedback allows actions to be assessed and adapted. A stronger focus on partnerships and support, and habitat may improve reintroduction success.

Keywords: species action plan, reintroduction, evaluation, success, conservation, species recovery, planning.

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Chapter 1. Introduction

1.1 Biodiversity crisis and species decline

Biodiversity loss, and specifically the decline of species, has been a growing concern for many decades (Primack 1998). Despite increased concern, human actions across the globe threaten more species with global extinction than ever before (IPBES, 2019). As pressures from human population needs and commercial development continue, species habitats are being diminished or lost, and increased emissions are causing pollution and climate change (Wilting *et al.*, 2017).

The term biodiversity as defined by Article 2 of the Biodiversity Convention is:

'*The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.'*

With this in mind, it is important to understand that as much as humans are at the root of the problems causing the loss of biodiversity, we can also work to provide the solution (European Commission, 2010; Milner-Gulland *et al.*, 2021). Although scientific and conservation communities are yet to find workable resolutions on a big enough scale. Solutions to halt biodiversity loss and the decline of species are continuing to evolve through the use of: (1) evidence and lessons learned, (2) a greater focus on more holistic ecosystem solutions, (3) involvement of human communities that rely on natural resources for survival, (4) wider socio-economic interactions with nature (Game *et al*. 2014; Sutherland et al. 2019; Rice *et al.* 2020; Catalano *et al.* 2021; SCBD 2021), and (5) species focussed recovery actions (Bolam *et al.*, 2022).

1.2 Response to the Biodiversity Crisis

1.2.1 Conservation Legislation and Policy

The majority of countries have had existing legislation in place relating to nature conservation and, or wildlife protection for the past few decades (SCBD, 2022a). In the UK, one of the earliest forms of protection came from the development of the National Trust Act in 1907, which promoted the permanent preservation of lands, their natural aspects, features, and animal and plant life (Evans, 1997). This Act was followed by numerous legal instruments over the following decades, the most prominent of which include: the National Parks and Access to the Countryside Act 1949, the Conservation of Wild Creatures and Plants Act 1975, and the Wildlife and Countryside Act 1981 (as amended) - which was the first notable legislation to provide protection for species, habitats and their management (Evans, 1997). The Wildlife and Countryside Act remains at the core of species protection in the UK but other policies such as the Countryside and Rights of Way (CRoW) Act 2000, the Natural Environment and Rural Communities Act 2006, and the influence of European Union (EU) legislation, have placed a duty on public bodies to conserve biodiversity and strengthen the protection of habitats (Clements, 2010). More recently, the UK's Environment Act 2021 has come into force which sets clear statutory targets for nature recovery and reversing the decline in species abundance by 2030 (Environment Act, 2021).

The first protection for species on an international scale came from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which was established in 1973 (Primack, 1998). This was an agreement between governments with the aim of ensuring that international trade in specimens of wild animals and plants do not threaten the survival of the species in the wild (CITES, 2023). Much of the legislation around this time was developed in response to a need to manage and protect species from persecution rather than to conserve biodiversity or recover species (McLean, Wight and Williams, 1999). A shift in the focus of legislation came when biodiversity loss became of greater concern to the public and countries were put under pressure to become accountable (Nebel and Wright, 1993). Perhaps one of the earliest elements of this change was the passing of the US Endangered Species Act (ESA) of 1973 which proposed to provide greater protection for all threatened and endangered species (Nebel and Wright, 1993). In Europe, wider scale change came in relation to the action-led conservation targets and reporting driven by the Convention on Biological Diversity (CBD) (1992) and the following EU Gothenburg agreement in 2001, which aimed to halt the loss of biodiversity by 2010 (Lawrence and Molteno, 2012).

1.2.2 United Nations Convention on Biological Diversity (CBD)

One of the key geo-political responses to the biodiversity crisis was the United Nations Convention on Biological Diversity (CBD). This convention was signed by 150 government leaders at the Earth Summit in Rio de Janeiro, Brazil, in 1992, and came into force in 1993. The objectives of the convention relate to the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources (SCBD, 2022a).

Although the global political response to the CBD was positive, no country met the target of significantly reducing the rate of biodiversity loss by 2010 (Adenle, 2012). Similarly, none of the 20 global biodiversity targets (Aichi targets) agreed in the CBD's Strategic Plan for Biodiversity 2011-2020, were fully achieved on a global level (SCBD, 2020). Reasons for not meeting these targets range from limited resources and not enough value of biodiversity (Adenle, 2012), to more recently, that national targets are not well aligned with Aichi biodiversity targets (SCBD, 2020). The CBD's most recent report does show progress towards the targets but members are not close to achieving them yet (SCBD, 2020). This has not deterred the CBD, who now require member states to work towards even more ambitious targets for the Post-2020 Global Biodiversity Framework (SCBD, 2021). A core requirement of the CBD is for each nation to develop and implement, a National Biodiversity Strategy and

Action Plan (NBSAP). Each NBSAP should set out how the nation will achieve the targets of the CBD. To date 194 of the 196 (99%) parties signed up to the convention have developed at least one NBSAP (SCBD, 2022b).

1.2.3 Species Management and Interventions

Aside from legislation, various species management actions and interventions are used to improve species habitats, numbers, and status. Those more commonly used, and relevant to this research, are habitat and species management; generally referred to as in-situ management, defined as conservation management within the species' natural ecosystem (Zegeye, 2017); and captive breeding and species reintroduction referred to as ex-situ management, defined as maintaining species outside of their natural habitat and conditions (IUCN/SSC, 2014).

Habitat management activities (i.e. interventions to protect, restore or maintain habitat in a suitable condition for species) are frequently applied as part of species conservation management. Such activities can range from the implementation of grazing regimes (to control habitat condition), active planting of vegetation, landscaping (e.g. to improve drainage or water retention), or securing site boundaries to prevent public access (Ausden, 2007; Conservation Standards, 2019). Species management involves targeted management actions relating to a species needs or to counteract threats (Scheele *et al.*, 2018) and can include actions such as, supplementary feeding, predator control, and disease management (Conservation Standards, 2019).

One aspect of ex-situ species management is captive breeding, which involves utilising wild or captive reared species to breed in specialised facilities to increase numbers, usually with the end goal of releasing of offspring back into the wild through species reintroduction (Braverman, 2014; Wakchaure and Ganguly, 2016). Species reintroductions for the purposes of species conservation involve the release of species into areas where they were once present (historic range) but have become extinct, or areas where species reintroduction can be used to supplement populations where numbers are significantly reducing. Reintroductions can be undertaken using stock from captive breeding or individuals taken directly from other wild populations (Ewen *et al.*, 2012; IUCN/SSC, 2013).

1.2.4 The Development of Species Conservation Planning

The term 'Conservation Planning' has been used for some years in the conservation sector as a label for a particular type of technical modelling of landscapes (using biological, geological, social and economic data) often associated with the process of designing, implementing, and maintaining protected areas for biodiversity (Margules and Pressey, 2000). For this study, I use the term 'Conservation Planning' in its wider sense which relates to establishing information about the needs of species through; the creation of objectives, the design, implementation and monitoring of actions, and consideration of stakeholders.

Conservation Planning as applied to the management and recovery of threatened species is derived from a combination of disciplines and fields ranging from academia to NGOs (non-governmental organisations) to government professionals (CPSG, 2020; The Conservation Measures Partnership, 2020). One of the first initiatives within species conservation planning was the Biodiversity Support Program (BSP) which was formed by a consortium of the World Wildlife Fund, The Nature Conservancy, and the World Resources Institute, and was started in response to the need to protect biodiversity on a global scale (Margoluis and Salafsky, 1998). The BSP worked on a number of different conservation approaches involving priority setting and partnerships and provided a facilitating role for conservation projects and initiatives (BSP, 2001). Similar approaches have developed over the past 30 years and various member organisations have become leaders in species planning, these include the Conservation Measures Partnership (CMP), The International Union for Conservation of

Nature Species Survival Commission (IUCN SSC) and, the Conservation Planning Specialist Group (CPSG). These groups continue to evolve in response to conservation needs, often shifting in prioritisation of aspects of their work. One example being the CPSG which was originally set up as a liaison group between field conservationists and the captive breeding community and was known as the 'Captive Breeding Specialist Group' before it evolved to focus more on conservation management planning. First renaming themselves the 'Conservation Breeding Specialist Group', and again in 2017 to the 'Conservation Planning Specialist Group' to better align with their work on wider species conservation management planning and facilitating species conservation workshops (Byers *et al.*, 2022; CPSG, 2022). The CPSG and IUCN/SSC undertake conservation planning in line with the One Plan Approach. One Plan is an approach adopted by CPSG to encourage planning in a wider context that considers all populations of a species, and both the in situ and ex situ conservation communities (Byers *et al.*, 2013; IUCN–SSC Species Conservation Planning Sub-Committee, 2017). Other changes in approach have included the application of management theories such as the Theory of Change (ToC) (The Conservation Measures Partnership, 2020). The ToC approach is both a way of thinking (the development of mental models to characterise options for interventions to change a given situation) and a process tool (a method of documenting ideas to develop written elements which form the basis of action plans). The ToC process can be used to identify how change is expected to happen (planning and implementation) and how change has happened (evaluation) so that it can inform or identify appropriate action (Rice, Sowman and Bavinck, 2020).

1.3 Species Action Plans (SAPs)

One of the key outcomes of the responses to biodiversity loss at the species level, with a focus of conservation planning, has been the production of Species Action Plans (SAPs) also referred to as species recovery plans or species conservation strategies (Machado, 2001). Such plans are created to record and detail the actions required to improve a species' conservation status and prevent any risk of extinction (IUCN–SSC Species Conservation Planning Sub-Committee, 2017).

1.3.1 Aims of SAPs

The IUCN SSC describes the intention of SAPs to be:

"*1. Serve the interests of the Specialist Group members; 2. Provide a baseline record against which to measure change; 3. Expand on the IUCN Red Lists of Threatened Species; 4. Provide scientifically-based recommendations for those who can promote and support species conservation; 5. Provide a common framework and focus for a wide range of players; 6. Provide a convenient and accessible conservation resource; 7. Establish priorities in species conservation; 8. Aid fundraising"* (IUCN/SSC 2002).

Whilst this may well be the intention of SSC driven plans and others, SAPs more closely linked to legislation and policy are likely to have more of a focus on meeting policy targets and maintaining or improving species status (Machado, 2001). However, the overall purpose of a SAP is to list actions that will contribute to the conservation of species. These actions can range from direct threat control to captive breeding and habitat management to lobbying for improved legal protection.

1.3.2 History of SAPs

SAPs form a major part of strategic planning and recovery management with many of the first SAPs originating from legislation and conventions. The first SAPs, known as species recovery plans, stemmed from the US Endangered Species Act of 1973, which required all species listed on the act to have a recovery plan developed (Boersma et al., 2001). The majority of the UK's first SAPs formed part of the 1994 UK Biodiversity Action Plan (UK BAP) which was the UK Government's response to its commitments under the Convention on Biological Diversity (CBD) commitment (JNCC, 2017). The UK BAP was developed between 1994 and 1996 and focussed on target based conservation, including priority habitats and species (Lawrence and Molteno, 2012). By 1999 the plan included 391 SAPs (covering 475 separate species) and 49 Habitat Action Plans (HAPs) (Defra, 2006). Many of the SAPs from European countries were established from the CBD as well as EU member states associated commitments to the EU led Habitats Directive (Council Directive 92/43/EEC) and Birds Directive 1979 (Directive 2009/147/EC), which were implemented by member states through means of their own choice (Evans, 1997; European Commission, 2017). Many of the species listed on Annex I of the Birds Directive have been subject to SAPs of which a large number have been facilitated by BirdLife International (BirdLife International, 2016).

Despite initial SAPs being driven by governments and legislation, larger NGOs, such as WWF and BirdLife have led the way on other SAPs often in partnership smaller NGOs (Machado, 2001). Another leader in the development of SAPs are the IUCN SSC who published its first SAP in 1987 (IUCN/SSC, 2008) and currently have over 200 species/taxa conservation plans and associated publications on the IUCN library webpage (IUCN/SSC, 2022), many of which also include second editions and updates.

In many regions, governments do not have legislation supporting SAPs (Machado, 2001) and in recent decades this has been the case in the UK where the use of SAPs, and certainly SAP revision and creation, has reduced significantly since the introduction of the UK Post-2010 Biodiversity Framework when SAPs created as part of the UK BAP were essentially withdrawn (JNCC and Defra, 2012). In the USA, and Australia, SAPs are still very much a key part of environmental legislation and are continuing to be developed (U.S. Fish and Wildlife Service, 2022; Australian Government, 2023). However, even with full legislative support for the implementation and development of SAPs, it is often the case that SAPs are not properly funded, resourced or evaluated (Lundquist et al., 2002; Fischman et al., 2018).

1.3.3 Use of SAPs

In spite of regional differences and changing approaches, SAPs are considered by many professionals in the conservation sector to be the foundation for endangered species recovery and management (McGowan, 2001). SAPs provide important information on species ecology and distribution, along with known threats, causes of decline and proposed actions to ensure species recovery and long-term survival (McGowan, Garson and Carroll, 1998). Many NGOs and specialist groups consider SAPs important for providing science-based recommendations to those in a position to implement them, such as resource managers, agency officials, funding organisations, and political leaders (Fuller *et al.*, 2003). SAPs can also prompt focussed scientific research, support the raising of funds, and act as important documents from which to measure change and help expand on data for the IUCN Red List of Threatened Species (IUCN/SSC 2002; Marren 2002). SAPs and the processes involved in their development are also useful in creating and developing partnerships and bringing together stakeholders such as NGOs and governments (Lawrence and Molteno, 2012). SAP development processes such as workshops also provide a forum for experts (both amateur and professional), governments, academics, land owners, communities, and other stakeholders (developers and land managers) to discuss setting realistic goals and actions. Such collaborations can be key for sharing knowledge and information (Lees *et al.*, 2021).

1.3.4 Monitoring and Evaluation of SAPs and Species Management

With most government-led or legislation driven SAPs there tends to be a requirement for monitoring plans and reporting on progress (USFWS, 1973; Machado, 2001; Lawrence and Molteno, 2012). However, for other SAPs there tends to be a mix of reporting and monitoring. Most SAPs include a monitoring and evaluation process, and although many propose to be reviewed or renewed every 5 years, this is not always the case (Clark *et al.*, 2002).

Lack of monitoring, or a lack of effective monitoring, is often cited as an negative issue for conservation projects (Stem *et al.*, 2005; Laycock *et al.*, 2009; Ortega-Argueta *et al.*, 2017), but excessive monitoring, in the absence of conservation action can also be detrimental, with examples of some well-monitored species becoming extinct due to lack of action

(Lindenmayer, Piggott and Wintle, 2013; Griffiths, 2016). Lindenmayer et al. (2013) suggest that adaptive monitoring can prevent this e.g. increasing surveys to detect declines and identifying their drivers earlier and using trigger points in recovery plans to identify points when the results of monitoring initiate action. A general consensus in the literature, and planning in general, is that a sound planning and implementation process will allow for more effective monitoring and evaluation (Margoluis and Salafsky, 1998; Stem *et al.*, 2005). However, in the absence of measurable outcomes and indicators, appropriate monitoring and evaluation can be extremely difficult and can prevent the results of action being identified (IUCN, 2013).

There have been a number of past reviews of SAPs, many of which were able to measure some relative success or implementation of actions, however in some cases it was hard to confirm if the action was linked to a plan or if it would have likely occurred anyway (McGowan, Garson and Carroll, 1998; Fuller *et al.*, 2003). Even if the target species is recovering it is important to consider counterfactuals and what might happen in the absence of intervention (Ferraro, 2009; Grace *et al.*, 2021). Employing experimental evaluation methods can help with measuring counterfactual outcomes and preventing potential biased estimates of an intervention or programme success (Ferraro, 2009; Curzon and Kontoleon, 2016). The process of designing and assigning indicators and evaluation systems is an integral part of action planning and SAPs, and needs to be created alongside the objectives and actions in order to establish a workable system (IUCN–SSC Species Conservation Planning Sub-Committee, 2017; The Conservation Measures Partnership, 2020). Whilst there has been substantial progress in species conservation with regards to evaluation, monitoring tools and guidance, it is still unclear how SAPs are contributing to species recovery and how they are utilised and valued by conservation practitioners.

1.4 Thesis Outline

This thesis focuses on the value of SAPs in terms of their importance, utilisation, content, implementation, and review. Whilst previous studies discuss the implementation of SAPs (McGowan, Garson and Carroll, 1998; Boersma *et al.*, 2001; Machado, 2001; Crouse *et al.*, 2002) there are few comparative studies that address how SAPs are created and utilised, or provide comparisons of key content. The overall success and implementation of a SAP is difficult to quantify. In order to overcome this the thesis focuses solely on 'species reintroductions for measuring success. Conservation reintroductions are a specific species management tool that often form a key part of many SAP actions and objectives. This approach was enabled by utilising a set of published case studies (Soorae, 2008, 2010, 2011, 2013, 2016, 2018) where a specific set of success scores had been assigned by the authors/ project managers. This thesis aims to assess the effectiveness of SAPs and conservation reintroductions by asking three critical questions: (1) What are the key components and outputs of Species Action Plans and how do they compare across regions, taxa, and time? (2) How do conservation practitioners utilise and perceive Species Action Plans? (3) What factors are influencing species reintroduction successes and failures and are we able to see a connection to SAPs?

The findings of this thesis provide insight into the factors influencing reintroduction success, the content of SAPs, and the views of conservation practitioners on SAP creation and how SAPs are reviewed and valued in the sector. These findings have implications for conservation planning, programme evaluation, and conservation policy and legislation.

The shifts in UK policy over the recent decades cause the thesis to focus more closely on a UK's perspective in relation to SAPs.

Chapter 2 reviews a sample of SAPs to obtain data on general characteristics, the common and key components of SAPs. I then interrogate the data to identify different approaches and compare them and their key components across taxa, IUCN region, and across time.

Chapter 3 explores practitioner views of SAPs and the processes linked to their creation, content, and evaluation. The findings are utilised to establish the most important components of SAPs and to understand how SAPs are valued within the conservation sector.

Chapter 4 interrogates published case studies of the conservation reintroductions including those associated with the SAPs reviewed in Chapter 2. The purpose is to draw out standard variables across each case study to establish if they are likely to impact the reintroduction's success. Published content and comments were utilised to gather further qualitative data about factors influencing success.

Chapter 5 provides a synthesis of the chapters bringing together the relevant findings, how they relate to each other, and their wider implications for species management and planning. Some general recommendations are made along with suggestions for future research.

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Chapter 2. Diversity in structure and content of Species Action Plans

2.1 Abstract

Species Action Plans (SAPs) are created to identify and prioritise measures to conserve species by setting goal-driven and accountable species and habitat management actions. SAPs are often underpinned by robust research and have been fundamental in conservation planning. However, their typical content, structure, and focus remains largely unexplored. I collated data from a sample of SAPs and analysed how their components, actions, and follow-up reviews varied in relation to IUCN region, taxa, and time. I found that SAP components and content varied across regions and time, but less so across taxa. Differences in IUCN region reflected variation in conservation cultures and context, which may be influencing priorities in planning. Research and monitoring activities were the focus of most actions within SAPs and in nearly all cases it was difficult to determine if SAP actions were evidence-based and measurable. The content of SAPs appears to be changing in line with developments in conservation planning methods; however, follow-up reviews and evaluations were generally inconsistent and provided limited information on action progress and implementation.

2.2 Introduction

Through the development of species conservation and management, there has become an increasing focus on conservation planning (Bottrill and Pressey, 2012) and the production of species recovery plans or species action plans (hereafter referred to as ''SAPs'' or singular ''SAP''). SAPs set out actions and objectives aimed at improving the conservation status of an individual species or multiple species within a given area or region. SAPs are created by governments, non-governmental organisations (NGOs), and specialist groups (McGowan *et al.*, 1998; IUCN–SSC Species Conservation Planning Sub-Committee, 2017). The initial necessity for the development of SAPs stemmed from a mixture of global species declines, legislation driven requirements, and a greater understanding for the need to record actions and involve stakeholders in the planning process (Machado, 2001). One of the first countries to incorporate SAPs within legislation was the USA; once a species is listed under the 1973 US Endangered Species Act, recovery criteria are set, a SAP is established and the species remains on the endangered species list until the recovery criteria are met and the species can be delisted (U.S. Fish and Wildlife Service, 2011). Australia has a similar system for species listed under the Environment Protection and Biodiversity Conservation Act 1999, where, in general, most listed species have a SAP (Seabrook-Davison, Ji and Brunton, 2010). In the UK many of the earliest SAPs were created as part of a government initiative established to deliver targets set out under the 1992 Convention on Biological Diversity (CBD). However, these were not enshrined in law and have not been a key part of the UK's environmental policy since the early 2000s. There are several countries where SAPs are created under some part of environmental legislation (Machado, 2001), but fewer examples of legislative driven plans from less developed countries. This could relate to conservation initiatives in less developed countries often being led and developed by external partners such as environmental NGOs and organisations such as IUCN (Ghazanfar, 2008; Sodhi and Ehrlich, 2010), or to more complex issues and challenges that surround the implementation of biodiversity policy such as development, poverty, and the inclusion of stakeholders (Barber *et al.*, 2014; Adenle, Stevens and Bridgewater, 2015b). Whilst SAPs are generally highly regarded within conservation management and planning, their quality and practical value of SAPs has been questioned in terms of their speed of development, level of detail, and feasibility of implementation (Boersma *et al.*, 2001).

For most SAPs the development process involves considerable preparation, often involving facilitated workshops that focus on establishing a vision, objectives, actions, and the bringing together relevant stakeholders. This process is particularly common for plans created by the International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC) and is often coordinated and facilitated by the IUCN Conservation Planning Specialist Group (CPSG, 2020a). In recent years, guidance has been developed to assist with the creation of plans, with the key guidance documents coming from IUCN SSC (IUCN/SSC, 2008; IUCN–SSC Species Conservation Planning Sub-Committee, 2017), The Conservation Measures Partnership (CMP 2007, 2013, 2020) and more recently the CPSG (2020b).

A conservation project or planning cycle forms the foundation of much of the guidance, with slight variation between different publications and authors. The most established of these is in the form of the Open Standards for the Practice of Conservation's Project Cycle (Figure 2.1) which was created as a guide for project management, decision-making, and learning, designed to assist with the implementation of conservation projects (CMP, 2020).

Figure 2.1 Open Standards for the Practice of Conservation Project Cycle (CMP, 2020).

The CMP and more recent guidelines also incorporate business-inspired theories derived from existing strategic management and project design frameworks (Margoluis and Salafsky, 1998). A significant basis of this guidance is around Theory of Change (ToC), and results chains that are grounded in mapping the assumptions behind actions and developing objectives and indicators to monitor and evaluate these assumptions at different stages of the project planning cycle (Margoluis *et al.*, 2013; Omonyo, 2015; CAML, 2021). ToC is a planning tool used to bring together existing evidence and consider the wider contexts such as, policy, economics, and social factors that may influence a project and its outputs and outcomes. A ToC is usually created with a working group that can identify potential links, risks, goals, and likely assumptions. This allows details to be captured and visualised to create a guiding framework to identify potential areas of focus and inform the questions needed to evaluate the project or intervention (van Es, Guijt and Vogel, 2015; HM Treasury, 2020). The practice of using a ToC as a basis for evaluating project outcomes is widespread within humanitarian NGO's and some governments and is becoming more frequently used within conservation practice.

The guidelines associated with SAP creation and planning provide a wealth of tools relating to the species recovery planning process but they do not stipulate a format for SAPs or a clear evaluation process. Although explicit guidelines and templates for SAPs do exist, these tend to relate to specific national legislation or specific taxa and do not focus on content (i.e., what information needs to be included) or global comparisons (i.e., what is used in different regions for similar species). Despite the proliferation of guidance on monitoring and evaluation, as well as increased access to evidence (i.e. research informing practice (Sutherland *et al.*, 2019)), recent reviews of SAPs continue to highlight both the lack of evaluation of plan-related data and inconsistent criteria for assessment (Roberts and Hamann, 2016; Ortega-Argueta *et al.*, 2017).

In this study I: (1) analysed a sample of SAPs to assess how SAPs are incorporating the key components of the Open Standards project planning cycle; (2) compared the actions and components of plans between regions, taxa and over time to identify different approaches and trends; and (3) determined how many SAPs had accessible and relevant reviews to establish how and if SAPs are being evaluated.

2.3 Methods

2.3.1 Data Collection

The Global Reintroduction Perspectives publications are a set of case studies, collated from conservation practitioners across the globe which are then edited and published by the IUCN Reintroduction Specialist Group. I utilised six editions of the IUCN publication 'Global Reintroduction Perspectives' (Soorae 2008, 2010, 2011, 2013, 2016, 2018) and searched through each of the case studies using the search terms 'plan' and 'strategy' to see if the study made reference to an associated 'species action plan' within the main narrative or the associated references. Of the 341 published case studies, 101 mentioned or referenced SAPs within the study: 86 referred to a plan in the text, 61 cited the plan in the references and 50 did both. The case studies used are assigned to the IUCN's statutory regions which consists of eight global regions as per article 16 and 17 of the Statutes and Regulation 36 of the Regulations (IUCN, 2019).

All 101 SAPs were searched for using the Ecosia internet search engine or directly through the relevant website (where known or cited). Of the 101, 77 plans were found, 21 were not able to be located, and 3 were duplicated by other case studies of the same species or genus. Each of the 77 located plans (see Table S1 in supplementary information) were then reviewed and the relevant information (species, IUCN region, organisation, number of actions, duration of plan, different components, and headings) recorded. During the analysis, each plan was checked to ascertain if it contained the five components that align with the CMP (2020) Open Standards for the Practice of Conservation Project Cycle (i.e., 1. vision, 2. a monitoring plan, 3. an implementation plan, 4. indicators or success criteria and, 5. a reporting procedure; Figure 2.1). Detailed analysis using the SAP IUCN region, taxa, and year was then conducted in relation to those five key components.

2.3.2 Data Analysis

Data gathered from the SAPs in relation to the five components were used as dependent variables in a generalised linear model (GLM) to identify which independent variables (taxa, IUCN region, and years) may influence the presence of the component modelled. Statistical analyses were carried out using the statistical software R, version R 3.5.3 (R Core Team, 2019). A GLM (GLM function with a binomial family distribution) was used to conduct analysis on each one of the five components. Seven models were constructed for each component: the component was set as the dependent variable against a different combination of predictor variables to determine whether the inclusion of that component in a SAP varied between IUCN region, taxa and over time (Table 2.1). North America and the Caribbean was set as the baseline for 'IUCN regions' and mammals were set as the baseline for 'taxa'. Model ranking using Akaike information criterion (AICc) was then carried out to find the best fitting models. Following a previously established protocol, models with a delta-AICc (the difference in AIC score between the best model and the model being compared) of <2 were considered to be the top-ranking models (Burnham and Anderson, 2004). Chi-square was used to compare deviances of top models to see how model fit was improved, and Nagelkerke's R^2 were calculated for the top models to determine explanatory power (Nagelkerke, 1991) and the overall significance of the model (Field, Field and Miles, 2012). GLMs were used in this study due to their ability to perform nonparametric tests and to examine a mix of variables and penitential random effects, which conventional statistical methods such as ANOVA do not take into account (Bolker *et al.*, 2009).

Table 2.1 List of models and associated variables used for the GLM

Model Number	Variables in Model
1	Year
2	Taxa
3	IUCN Region
4	Year and Taxa
5	Year and IUCN Region
6	Year, Taxa, and IUCN Region
7	Taxa and IUCN Region

2.3.3 Action Categorisation

I used the following existing methods for categorising and classifying actions.

Hierarchy of Actions

Each SAP was assigned to one of four category levels according to the level of detail that was provided in relation to the actions within the plan:

1. **Infer action** (largely anecdotal details) – provides no action details e.g., only states that actions should be undertaken to reach the objective.
2. **Guide action** (some evidence of sound, purposeful approach) – some generic detail e.g., survey, monitor, maintain.
3. **Justify action** (systematic approach aimed to prevent error) – A guide of actions plus step-by-step descriptions/narrative.
4. **Prescribe action** (integrated approach with refinement, checks/review) – detailed action with clear steps, assigned actors, success criteria/ indicators and an implementation plan.

The categorisation used is adapted from the Conservation Excellence Model (Black and Groombridge, 2010) and relates to the hierarchical categories of evaluation of content used in the scoring of criteria of the Conservation Excellence Model to evaluate effective project management (Black and Groombridge, 2010; Black, Meredith and Groombridge, 2011; Moore *et al.*, 2020; Amavassee *et al.*, 2022; Silva *et al.*, 2022).

Classification of Actions

Each action within a SAP was also assigned to the most relevant action classification level. The classification levels are defined in the CMP Conservation Action Classification v 2.0, initially described in Salafsky et al. (2008) and later updated by CMP. The ten classification levels used were:

1. *Land / Water Management (Actions directly managing or restoring sites, ecosystems, and the wider environment).*
2. *Species Management (Actions directly managing or restoring specific species or taxonomic groups).*
3. *Awareness Raising (Actions making people aware of key issues and/or feeling desired emotions, leading to behaviour change).*
4. *Law Enforcement & Prosecution (Actions monitoring and enforcing compliance with existing laws and policies at all levels to deter threats or compel conservation action).*
5. *Livelihood, Economic & Moral Incentives (Actions using livelihood, other economic and moral incentives to directly influence attitudes and behaviours).*
6. *Conservation Designation & Planning (Actions directly protecting sites and/or species).*
7. *Legal & Policy Frameworks (Actions developing and influencing legislation, policies and voluntary standards affecting conservation).*
8. *Research & Monitoring (Actions collecting data and transforming it into information to support conservation work).*
9. *Education & Training (Actions enhancing the knowledge and skills of specific individuals).*
10. *Institutional Development (Actions creating the institutions needed to support conservation work).*

In line with guidance from the CMP, complex actions in each SAP were classified under one category rather than assigning specific component tasks to different action categories (Salafsky *et al.*, 2008).

2.3.4 SAP Reviews & Evaluations

For each selected plan a search was conducted to identify follow-up documents such as reviews, evaluations, amendments, and new editions of the SAP. The data were gathered from the original SAP, the website where the SAP was found, and through an internet search for the species and a new plan, or update using the search terms of the species name and the term “action” or “recovery plan”. Reviews and additional plans that had been conducted or developed for the same species but focussed on a different region were not included. The reviews and evaluations that were located were analysed to record details relating to objectives met, actions completed, new actions and objectives, and general changes and observations.

2.4 Results

The SAPs analysed ranged in date between 1982 and 2018. Sixty-one SAPs were single species plans and 16 SAPs were either multi-species from a particular region, or a more general plan with an overview of an entire taxon. SAPs varied in the number of objectives/ goals with an average of 5.8 goals per plan (range: 0-26), and actions averaged 28.2 actions described per plan (range: 2-108). SAPs ranged in size from 2 to 289 pages (not including appendices) with an average of 7.2 sections (range of 2-33 sections). The average number of references within a SAP was 75 (discounting the 13 SAPs with no references at all) and all were within a range of 5 and 500 references. Eleven of the plans (i.e., one in seven of the sample) made explicit reference to a planning meeting or workshop as part of the plan preparation.

In 14% of cases the author(s) of the SAP was the same as the author of the IUCN Reintroduction Perspectives case study, however most (51%) had different authors. The remaining 35% had at least one author who also authored the case study, or the case study author was cited as a contributor to the SAP. In terms of the organisation publishing the plan, 64 were published by governments, six by NGOs and seven by multiple organisations.

However, in most cases the SAP was created as a partnership between various organisations, working groups, and individuals even though the SAP was published by one organisation.

Of the 77 SAPs, 59 were located on government websites (national, regional and government agencies), five on research platforms (Research Gate, Academia, and a personal research site), eight from NGO websites (IUCN and Rewilding Argentina), two from organisations (EU Life, Council of Europe), two from academic institutions, and one other (Google books).

SAPs were classed as 'difficult to find' if they were: not located during the initial search, the links had expired, or further searches were required to locate them. Thirteen plans from the 77 fell into this category, along with the 21 SAPs from the starting 101 that were not able to be located at all.

2.4.1 Type of Organisation

Government-driven SAPs dominated all regions, except for Meso and South America (which had more multi-organisation authored plans), East Europe, North and Central Asia (which had more NGO driven SAPs), and South and East Asia, which was the only IUCN region to have no government driven SAPs. Whilst West Europe had no NGO driven SAPs.

2.4.2 Taxa and IUCN region

The taxa represented in the SAPs included all the taxa represented in the reintroduction case studies (Figure 2.2). The taxon with the largest number of SAPs was mammals, although in terms of percentage in relation to the number of case studies, plants were higher with 32% of all case studies citing an associated SAP. Reptiles and invertebrates represented 22% of case studies and all other taxa 21% or lower.

Seven of the eight IUCN regions (Figure 2.3) were represented in the SAPs. The IUCN region that did not reference SAPs in any of its 23 case studies was West Asia. South and East Asia, and Africa also showed a low percentage of SAP references, and the largest number of SAPs were from the case studies in North America and the Caribbean, and Oceania.

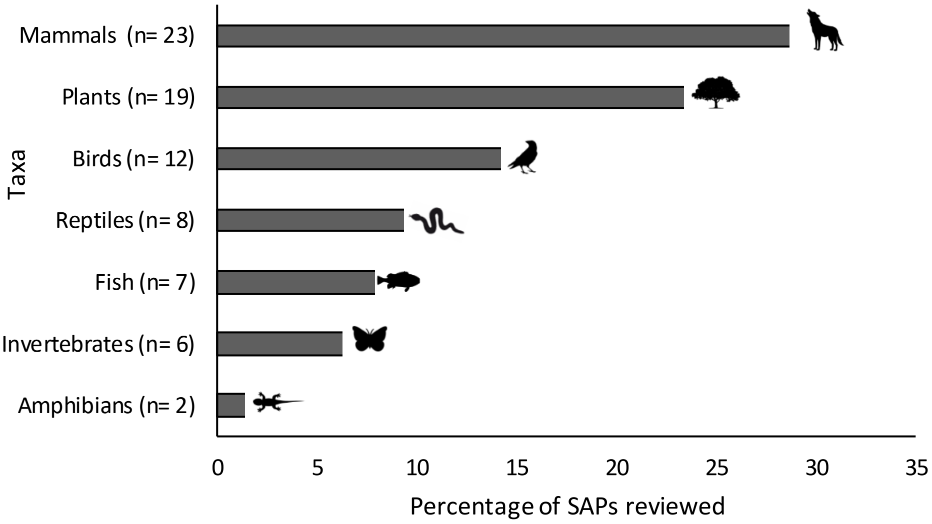

Figure 2.2 Percentage of different taxa represented in the 77 SAPs analysed as identified from published cases in the IUCN 'Global Perspectives' (Soorae, 2008, 2010, 2011, 2013, 2016, 2018) (n = number of SAPs analysed from the taxon).

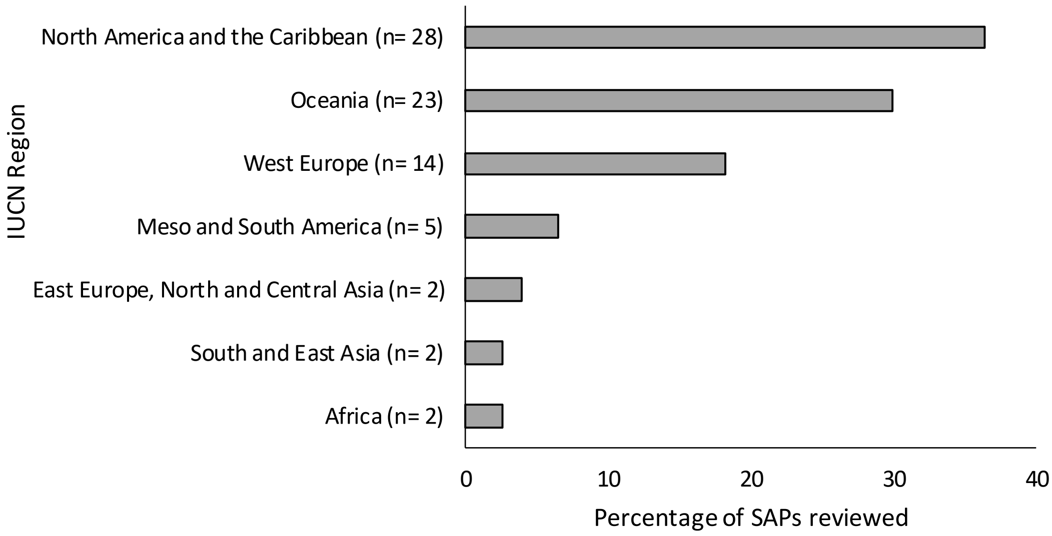

Figure 2.3 IUCN Regions represented in the 77 SAPs analysed as identified from published cases in the IUCN 'Global Perspectives' (Soorae, 2008, 2010, 2011, 2013, 2016, 2018) (n = number of SAPs analysed from that IUCN region).

2.4.3 Species Action Plan Components

The most common SAP components across plans are summarised in Figure 2.4. 'Current status of the species' was the only component present in all the SAPs, 'legal protection and species distribution' was present in 99% of plans, and 'threats 'in 95%. At the other end of the scale; 'exit strategies', 'risks', 'funding strategies', and 'guidance for decision makers' were present in less than 15% of plans.

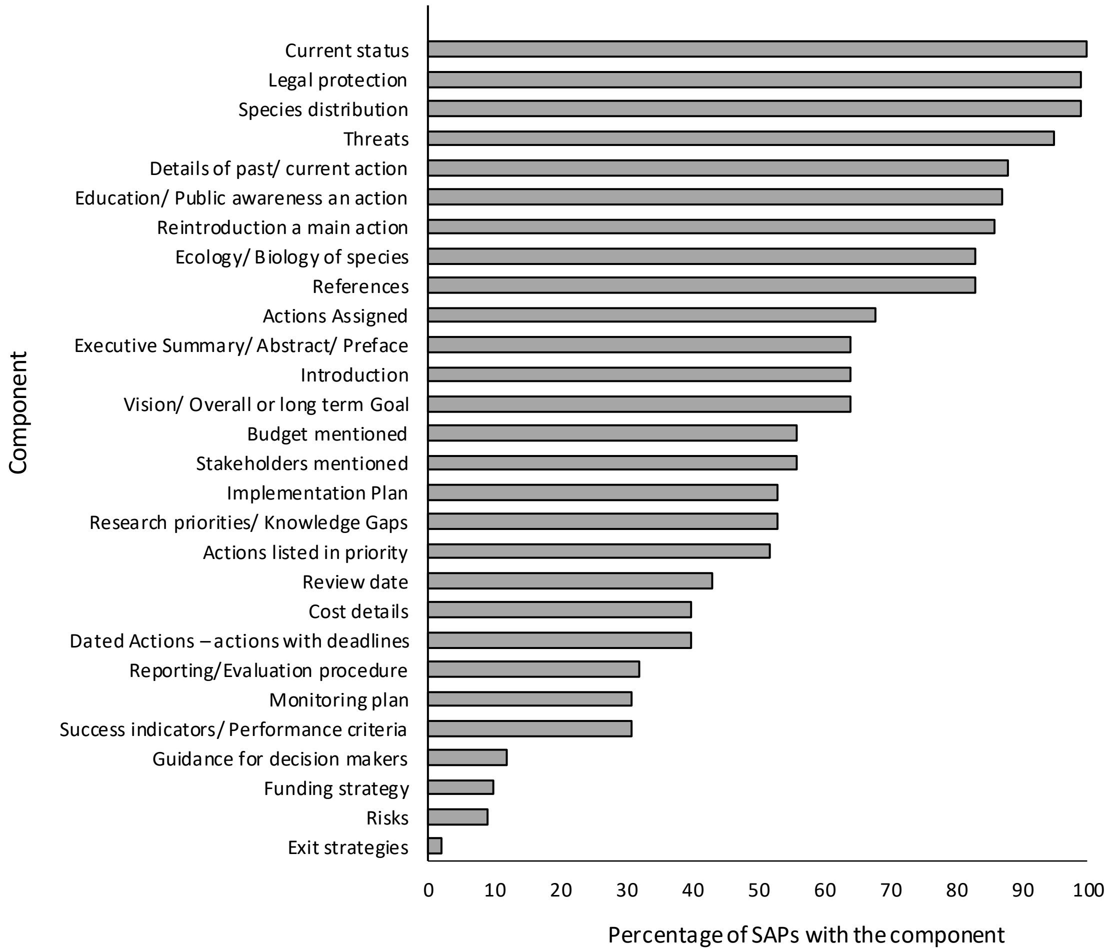

Figure 2.4 Common components found within the 77 SAPs analysed as identified from published cases in the IUCN 'Global Perspectives' (Soorae, 2008, 2010, 2011, 2013, 2016, 2018).

2.4.4 Regional Comparisons and Key Components

As 84% percent of the SAPs analysed were from just three of the IUCN regions it was difficult to compare differences between all the regions. I therefore confined statistical comparisons to the three IUCN regions with the most SAPs: North America and the Caribbean, West Europe, and Oceania. Figure 2.5 highlights the differences between the regions showing that SAPs from West Europe are less likely to have a vision, a monitoring plan, or an implementation plan, and plans from North America and the Caribbean were less likely to have indicators or performance criteria. The GLM analysis (Table 2.2) confirms this pattern showing that having a vision, or a monitoring or implementation plan is significantly less likely to occur in SAPs from West Europe compared to those from North America and the

Caribbean. The best fitting model for indicators showed that SAPs from Oceania were significantly more likely to have indicators or performance criteria than those from North America and the Caribbean.

Whilst the results were significant in models with IUCN region alone, some of the best fitting models also included years and IUCN region, highlighting a significant relationship across time. Table 2.3 provides further context for this showing the spread of SAPs across decades.

Table 2.2 Generalised Linear Model results showing key components of SAPs in relation to IUCN region, taxa, and years. Variables in bold are those that are putatively predictor variables (p values ***0.001, ** 0.01, * 0.05). Some variables have two best fitting models, the AIC tables relating to the results can be seen in see **Table S2** in supplementary information.

		95% CI for odds ratio		
	B (SE)	**Lower**	**Odds Ratio**	**Upper**
Vision				
Model 6				
Taxa, IUCN Region, and Year (North America and Caribbean and Mammals set as reference categories)				
Intercept	- 349.17(166.81)	0.00	2.28×10^{-152}	1.80×10^{-30}
Year	**0.18 (0.08) ***	**1.04**	**1.19**	**1.46**
Birds	19.17 (2948.18)	8.34×10^{98}	2.11×10^{08}	NA
Plants	0.35 (1.0)	0.18	1.42	10.08
Oceania	-3.19 (1.72).	6.29×10^{-04}	4.13×10^{-02}	0.74
West Europe	**-4.82 (1.96) ***	$\mathbf{5.03 \times 10^{-05}}$	$\mathbf{8.09 \times 10^{-03}}$	**0.18**
R^2 =.55 (Nagelkerke). Model χ2 (5) 21.35, p<0.001				
Monitoring Plan				
Model 3				
IUCN Region (North America and Caribbean set as reference category)				
Intercept	2.83 (1.03)	3.49	16.99	306.32
Oceania	-0.06 (1.46)	0.04	0.94	25.16
West Europe	2.32 (1.26).	0.00	0.09	0.95
R^2 = .21 (Nagelkerke). Model χ2 (2) 4.99, p<0.1				
Model 5				
IUCN Region and Year (North America and Caribbean set as reference category)				
Intercept	-180.87 (154.54)	2.08×10^{-233}	2.81×10^{-79}	4.3×10^{42}
Year	0.09 (0.08)	0.95	1.10	1.31
Oceania	-1.23 (1.84)	5.09×10^{-03}	0.29	12.12
West Europe	-3.19 (1.55) *	1.03×10^{-03}	4.09×10^{-02}	0.61
R^2 = .27 (Nagelkerke). Model χ2 (3) 6.60, p<0.05				
Implementation Plan				
Model 3				
IUCN Region (North America and Caribbean set as reference category)				
Intercept	2.83 (1.03)	3.49	16.99	306.32
Oceania	-0.08 (1.27)	0.02	0.44	5.06
West Europe	**-3.34 (1.26) ****	**0.0**	**0.04**	**0.31**
R^2 = .36 (Nagelkerke). Model χ2 (2) 10.69, p<0.01				
Indicators/ Performance Criteria				
Model 5				
IUCN Region and Year (North America and Caribbean set as reference category)				
Intercept	-415.71 (167.58) *	0.00	2.88×10^{-181}	3.77×10^{-59}
Year	**0.21 (0.08) ***	**1.07**	**1.23**	**1.50**
Oceania	**2.14 (1.04) ***	**1.18**	**8.47**	**77.32**
West Europe	-1.94 (1.59)	0.00	0.14	2.39
R^2 = .67 (Nagelkerke). Model χ2 (3) 29.75, p<0.001				

			95% CI for odds ratio	
	B (SE)	**Lower**	**Odds Ratio**	**Upper**
Reporting Procedure				
Model 4				
Taxa and Year (Mammals set as reference category)				
Intercept	143.79 (95.57)	$8.32x10^{-15}$	$2.79 x10^{62}$	$5.66 x10^{153}$
Year	-0.07 (0.05)	0.84	0.93	1.02
Birds	1.28 (0.97)	0.59	3.60	28.76
Plants	-1.68 (1.22)	$8.59 x10^{-03}$	0.19	1.65
R^2 = .33 (Nagelkerke). Model $\chi 2$ (3) 10.75, p<0.1				

Table 2.3 IUCN Regions and distribution of SAPs across decades

IUCN Region	Percentage of SAPs in 1980-1989	Percentage of SAPs in 1990-1999	Percentage of SAPs in 2000-2009	Percentage of SAPs in 2010-2018
North America and the Caribbean	32%	29%	21%	18%
Oceania	0	13%	70%	17%
West Europe	0	64%	14%	21%

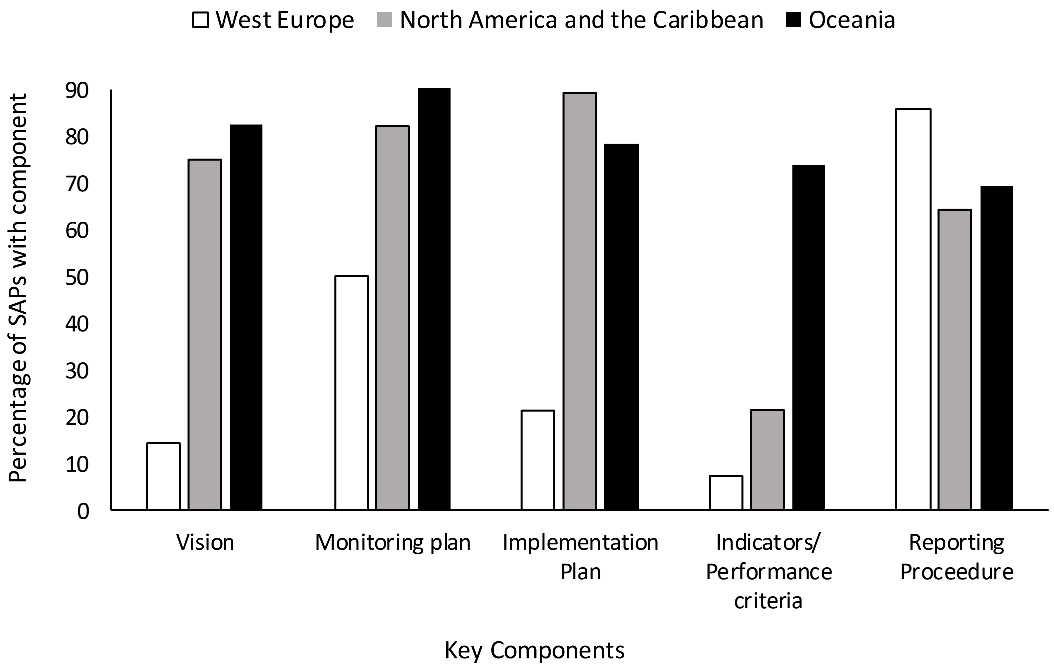

Figure 2.5 A comparison of the inclusion of five key components within 65 different SAPs from three different IUCN Regions.

2.4.5 Taxa and Key Components

Like regions, 71% percent of the SAPs analysed were from just three taxa - taxon statistical comparisons were therefore confined to the three taxa with the most SAPs: mammals, plants, and birds. No large variation was seen between the different taxa except that plants were more likely to detail a reporting procedure (Figure 2.6), although this was not shown to be significant in the GLM when plants were compared to mammals (Table 2.2).

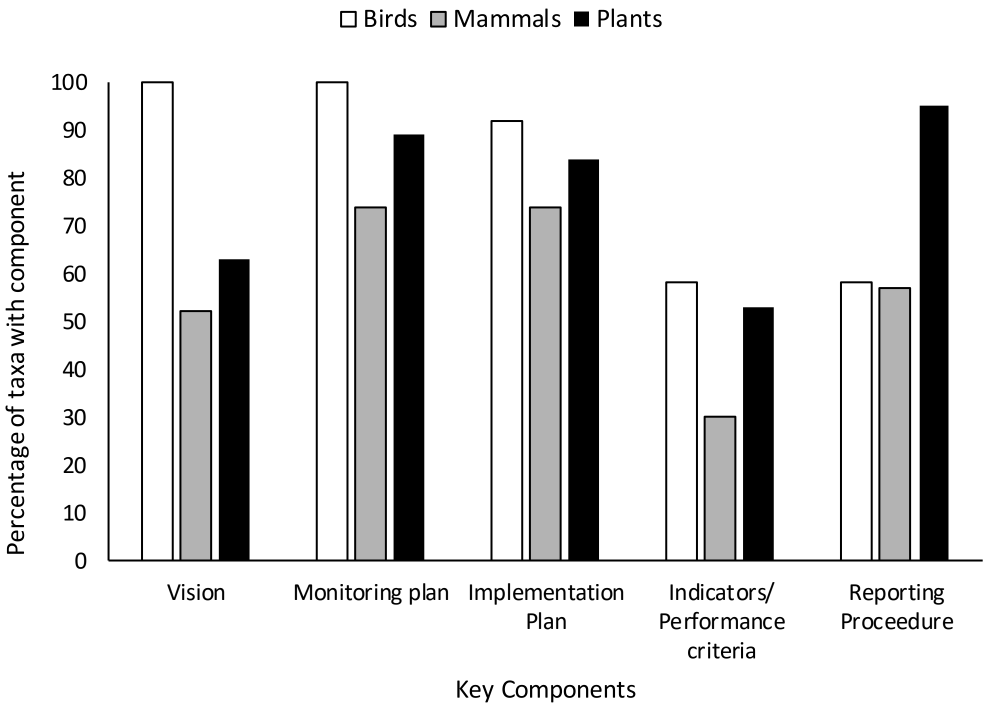

Figure 2.6 A Comparison of the inclusion of five key components within 54 different SAPs from three different taxa.

2.4.6 Years and Key Components

Although there was some variation on a year-to-year basis, a general increase overtime was observed for all the key components (Figure 2.7). The results of the GLM supported this confirming that differences in years were positively associated with SAPs having a vision and indicators (Table 2.2).

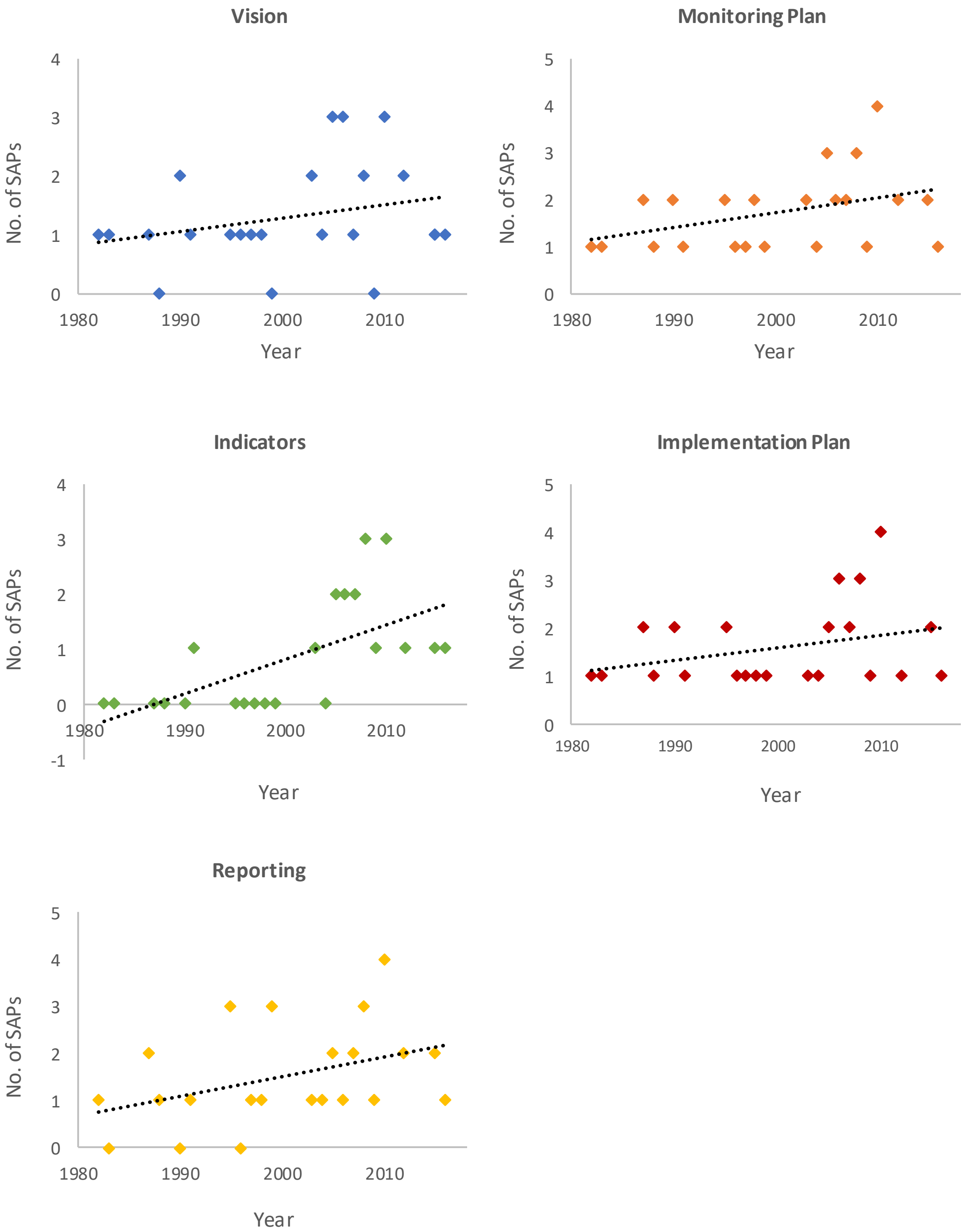

Figure 2.7 Key Components of SAPs and how they differ across publication years.

2.4.7 Hierarchy and Categorisation of Actions

After applying the action hierarchy to the SAPs, 62.3% were categorised at the 'justify' level (i.e., provides a guide and stepdown/ narrative of action), followed by 22.1% at the 'guide' level (i.e., some generic detail e.g., survey, monitor, maintain), 14.3% at the 'prescribe' level (i.e., detailed action with clear steps assigned actors, success criteria/ indicators and an implementation plan) and 1.3% at the 'infer' level (i.e., provides no action details). Looking at the levels in relation to taxa and IUCN region, all had 'justify' as the most frequent level except for West Europe which had a higher percentage of SAPs at the 'guide' level (77%), and none at the 'prescribe' level indicating a more generic approach. Mammals, birds, North America and the Caribbean, and Oceania had a higher number of SAPs at the 'prescribe' level compared to the 'guide' level, inferring that there is a greater level of detail in these plans. Although this study did not look at how different actions were prioritised within SAPs, 33 of the 77 SAPs listed actions in priority order.

The actions of each plan were categorised using the Conservation Standards Conservation Actions Classification system (Conservation Standards, 2019) and analysed to show the percentage spread of actions across all 77 SAPs (Figure 2.8) and the dominant taxa (Figure 2.9) and regions (Figure 2.10).

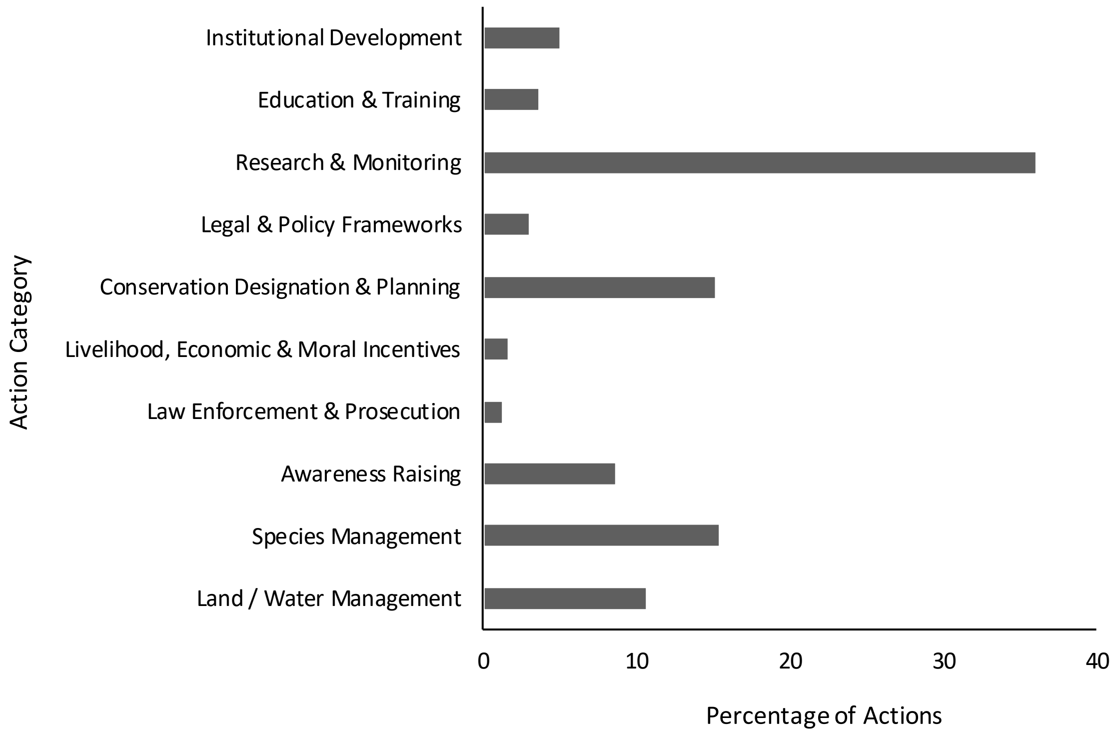

Figure 2.8 The different action categories actions from SAPs were assigned to, based on the Conservation Standards Conservation Actions Classification system (Salafsky *et al.*, 2008; Conservation Standards, 2019).

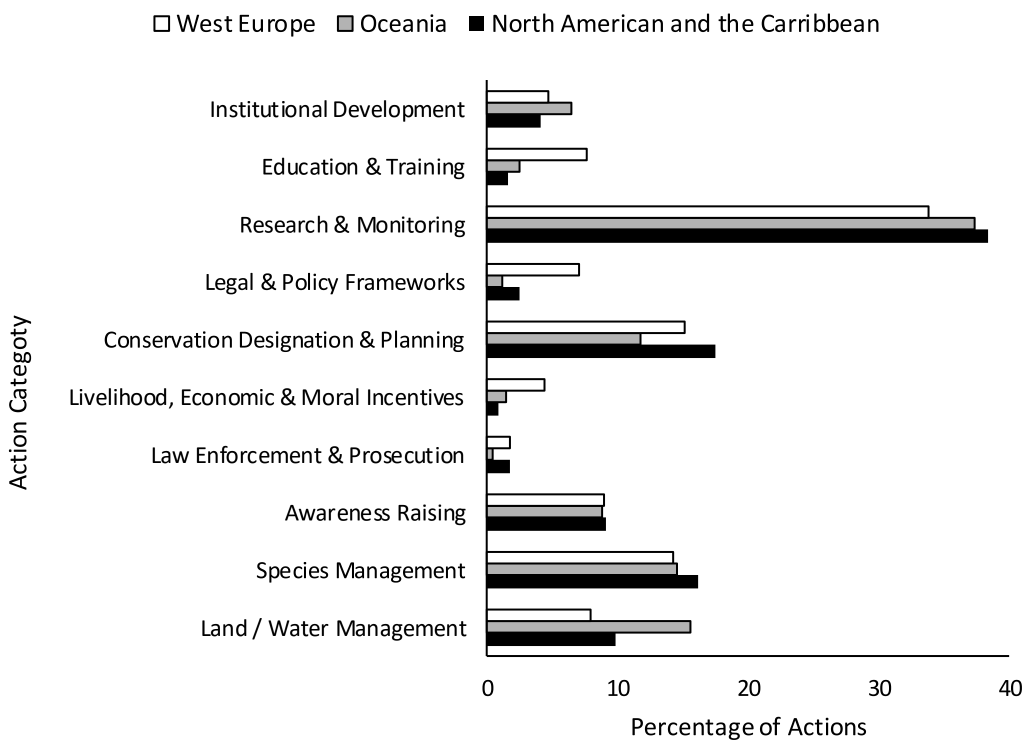

Figure 2.9 Action classification of 65 SAPs from three IUCN Regions.

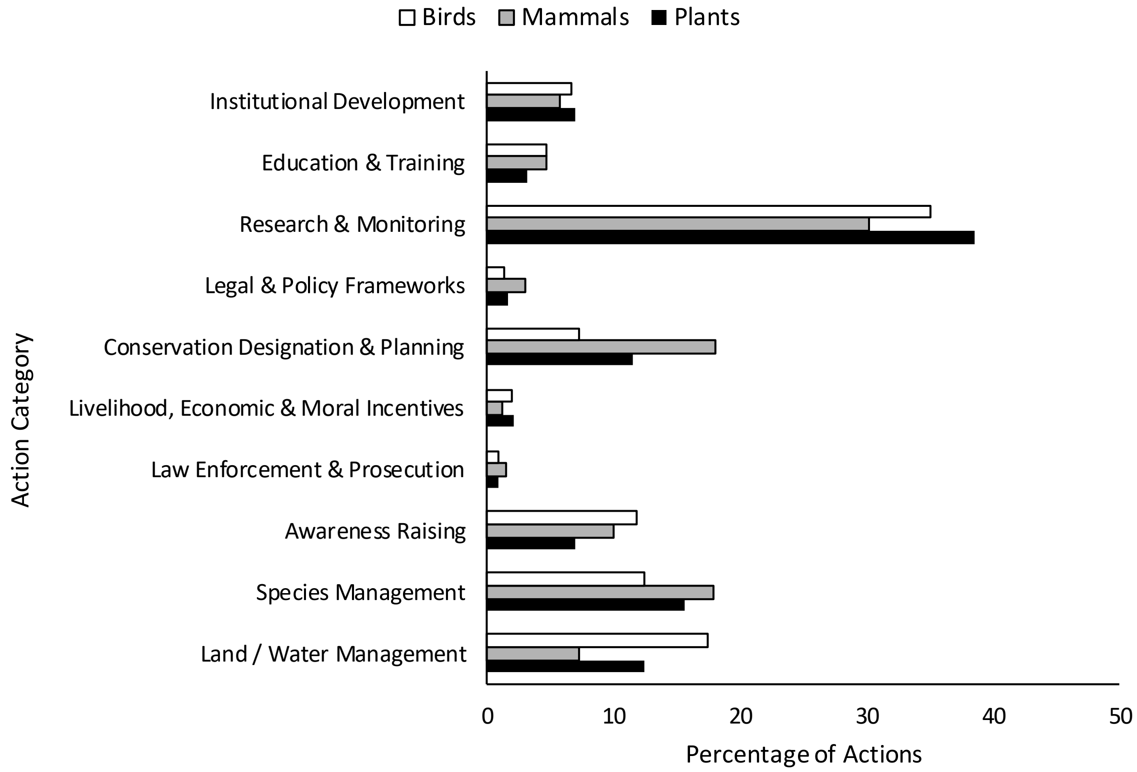

Figure 2.10 Action classification of 54 SAPs from three different taxa.

2.4.8 Species Action Plan Reviews

Since their publication, 13 of the 77 SAPs had produced new or updated SAPs, seven had issued amendments to SAPs, and 36 had accessible species reviews. Of the 36 reviews, 33 of these were directly related to the SAP actions and objectives, whilst three were status reviews that were independent of the SAP. Of the 36, 35 were from government-driven plans and one from an NGO. The 36 reviews represented four of the IUCN regions: 22 were from North America and the Caribbean, 11 from West Europe, two from Oceania, and one from East Europe, North and Central Asia. As many of the SAP reviews were from the same country, some shared the same review process, as a result only six different review methods were recorded across the 36 reviews (Table 2.4). The range in years between SAP creation date and the latest review found was between 2 and 37 years with an average of 16 years (N.B. as the most recent reviews were selected this does not infer that no additional reviews were undertaken in this time period). Seventeen reviews stated or made reference to the method used to conduct the review. Six of the reviews explicitly stated how many actions, criteria or objectives were met, 29 made reference to some actions or criteria and if they were met, and one made no reference at all to any actions or criteria.

Only one review had met all the criteria set for delisting the species and another two had nearly met all criteria for down-listing the species. Six of the reviews concluded or recommended a change in the species conservation status: one concluded the species had been down-listed from Vulnerable to Near Threatened, another was removed from the "Critical Situation or Situación Crítica" category, three reviews proposed down-listing from Endangered to Threatened status, one recommended the species be removed from the Endangered species list, and one review proposed up-listing from Threatened to Endangered. Commenting on the species population status: four plans said the population was stable, eight declining, and nine increasing, two reported fluctuating populations, two had mixed results depending on which population, and one had insufficient data. Fourteen of the reviews specified additional actions for the species and 12 did not. Overall, the reviews provided progress updates but very few reported on meeting criteria, indicators, or which actions were completed.

Table 2.4 Summary of different review/ evaluation methods

Review Method	Country/ IUCN Region	Authority	Summary of Structure and Content	No. of Reviews
5-year status review	USA/ North America and the Caribbean	United States Fish and Wildlife Service (Part of the United States Federal Government)	The use of delisting criteria in the USFWS make the reviews easy to follow but they do not provide a breakdown of progress or any measurement. The reviews are therefore useful for assessing species status but provide very little data on actions implemented and how the actions influenced the conservation objectives.	21
Periodic status review	USA/ North America and the Caribbean	United States Fish and Wildlife Service (Part of the United States Federal Government)	The reviews are not explicitly focussed on the recovery or delisting criteria. More focus is given on progress and implementation of certain management actions and threat control.	1

Review Method	Country/ IUCN Region	Authority	Summary of Structure and Content	No. of Reviews
3-year scorecard	Australia/ Oceania	Australian Government	A focussed and measured review which follows a specific metric for progress for the species. Although this is not directly aligned to the SAP.	2
The Biodiversity Action Reporting System (BARS)	UK/ West Europe	UK Biodiversity Partnership (UK Government Driven)	The reporting sheet is very limited and in most cases was filled out with little detail and no metric to measure progress. Useful information was often included but hard to quantify. The detail was very much dependant on a single person completing the form.	9
Technical report	Spain/ West Europe	Government of Valencia	Provides an overview of the progress and actions completed and required. No metric on progress was used in the review.	2
IUCN Red List assessment	East Europe, North and Central Asia	IUCN Assessors	IUCN assessments are not directly linked to SAPs. SAPs are taken into account but it does not assess indicators or evaluate. Provides a summary of actions in place and actions needed but no metric in relation to progress.	1

2.5 Discussion

Our study explored the content of SAPs, the focus of SAP actions and the influences behind them. Our results show that the components of SAPs are evolving, most likely in line with best practice, research, and guidance, and that the tendencies for this vary between regions, but less so between taxa. The biggest focus of actions across all SAPs were linked to research and monitoring activities, although it was difficult to tell if actions were being developed using evidence and data from reviews. Follow-up reviews and evaluations of SAPs were generally inconsistent and provided limited information on action progress and implementation.

2.5.1 Species Action Plan Components (regional, taxa and time comparisons)

The three dominant IUCN regions from our sample that could be compared were all largely developed regions: Oceania, West Europe, and, North America and the Caribbean. It is hard to quantify if this dominance is due to unintended regional bias within the sample (e.g. if routes to publication are easier for agencies and authors from developed countries), or if there are simply more SAPs produced in developed regions/ countries, or in countries (such as the USA and Australia) where SAPs are driven by policy and legislation. Whilst I do not have a comparable sample, there is evidence that less developed countries are not as well equipped to meet targets around biodiversity - such as those linked to CBD goals on the creation of National Biodiversity Strategies and Action Plans (NBSAPS) (Ghazanfar, 2008; Adenle, Stevens and Bridgewater, 2015a). Reasons for this can be complex but often relate to issues around legislation and policy and having access to finance, technology and innovation, and resources (Adenle, 2012; Griffiths and Dos Santos, 2012; Barber *et al.*, 2014).

The comparison of regions showed that SAPs from West Europe were significantly less likely to have a vision, implementation plan and monitoring plan when compared to SAPs from North America and the Caribbean. Although not thoroughly understood, the reasons for this are most likely linked to time, as most of the plans from West Europe were developed between 1990 and 1999 - a time when conservation planning and guidance on the creation of SAPs was in its infancy, and well-developed visioning to inspire and stretch aspirations was not prevalent in the sector (Black, 2015). An additional observation which could explain the lack of visions and implementation plans in West Europe may relate to the US centric nature of the conservation planning guidance which still appears to be underutilised in Europe. The results also showed a general trend in increases of conservation planning components across years, showing that monitoring and implementation plan inclusion grew substantially from 2004, which was not long after the CMP was formed in 2002. Relative to this, SAPs from Oceania were more likely to include indicators and performance criteria than those from North America and the Caribbean. This difference may be attributed to 70% of SAPs from Oceania being produced post-2000 when, most likely due to lessons learned and new guidance and research, an increase in SAPs with indicators was observed.

Additionally, the legislative framework may have an impact on SAPs, however this varies greatly between regions and the countries within them. Therefore, determining the impact of legislation on SAPs is problematic. Whilst there are clear driving forces for SAP creation in countries such as the US and Australia it is not as simplistic elsewhere. In West Europe for example, the lack of conservation planning components could be related to the lack of legislative support for SAPs as even though many SAPs in West European countries were driven by a commitment to CBD goals, their incorporation is often not statutory - meaning legislative approaches varied, with many relying on existing legislation such as the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (McLean, Wight and Williams, 1999; Hermoso *et al.*, 2019). However, with the UK set to launch species conservation and local nature recovery strategies as part of the recent UK Environment Act 2021 it will be interesting to see if this act, along with the ambitious developments of rewilding across Europe, lead to legal and conservation movement based changes over the coming decades (Brown, Mcmorran and Price, 2011; Sandom *et al.*, 2013).

Like regions, the spread across taxa was limited in our sample and statistical comparisons were only made between birds, mammals, and plants. This taxonomic bias towards mammals and birds is well documented (Seddon *et al.*, 2005) and explicit examples have been recognised in relation to conservation planning in the USA (Metrick and Weitzman 1996), Canada (Creighton and Bennett, 2019) and Australia (Walsh *et al.*, 2013). In our sample, amphibians and invertebrates were the least likely taxa to have a SAP - a similar finding to that of a Canadian study on species at risk where they found that arthropods and amphibians were less likely to have SAPs than other species (Creighton and Bennett, 2019). It therefore appears that whilst plants are perhaps starting to break with this standard (at least in some regions), the taxonomic bias in species recovery or over-representation in publications appears to be continuing. Addressing this imbalance is seen as an important phase in working towards effective conservation of biodiversity (Donaldson *et al.*, 2017).

2.5.2 Categorisation of Actions

'Research and monitoring' was by far the most frequent category actions were assigned to. As many threatened species are often under-studied, identifying the need for further research is not surprising, however an over-focus on research and monitoring can also be detrimental to species conservation (Lindenmayer, Piggott and Wintle, 2013). Buxton et al. (2020) reported a similar result concerning funding allocation and research, finding that 50% of proposed species recovery plan budgets were allocated to research and monitoring. Their analysis showed that SAPs with more funding allocated to research actions often had less successful outcomes, and suggested that such poorly weighted funding can lead to direct actions, such as species and habitat management, not being implemented (Buxton et al., 2020). This, somewhat institutionalised, approach presents a challenge for action-setting within species conservation, and highlights the need to find a way to prioritise and balance 'what we need to find out about a species or threat' against 'what we already know and if it's enough'. Conservation planning guidance states that direct actions should be well-researched to ensure they are based on what is known to work (CMP, 2020; Conservation Learning Initiative, 2022). However, if the action has not been tested, the action ultimately becomes a research activity. Prioritising actions and actively making sure non-research tasks are included can ensure actions are evidence led and necessary and ensure SAPs do not become a "shopping list" of wide-ranging and potentially gratuitous activities (Machado, 2001). There are however parts of this argument that create a narrative that goes back to excess research - if we only choose actions where there is good evidence for their success, or inaction because of absence of evidence, then we are missing everything in between and potentially leaving species vulnerable. Therefore, the key here is to use evidence (data, publications, experience) where it exists and act on the weight of knowledge and necessity where it does not (Meek *et al.*, 2015; Sutherland *et al.*, 2019). Adaptive management is often seen as the solution to this impasse, but this can also bring problems as success in conservation is multifaceted and hard to measure (Kapos *et al.* 2008; Meredith *et al.* 2018). Adaptive management therefore needs to be fed by focussed monitoring of key uncertainties as well as creative solutions and effective decision making, in combination with feedback from conservation managers on the ground (Game *et al.*, 2014; Meek *et al.*, 2015).

Out of the 77 SAPs only five had actions supported by citations from literature. Whilst it is understandable that not all actions can be referenced, or indeed need to be, the benefits of evidence-based decision making are well established (Pullin *et al.*, 2004; Sutherland *et al.*, 2004; Hunter *et al.*, 2021). However, our results indicate that the incorporation of supporting conservation literature in SAPs, particularly in relation to action, is relatively limited (Stinchcombe *et al.*, 2002).

2.5.3 Species Action Plan Reviews

There is large variation in the way SAPs are reviewed and evaluated, even when the same methodology is applied. The reasons for this can relate to: poor training, lack of resources, personal preference, lack of planning (Kleiman *et al.*, 2000) and shifting government agendas (Crouse *et al.*, 2002; Watson *et al.*, 2010; Black and Copsey, 2018). Many of the reviews I analysed were very general and did not relate back to the actions or indicators within the original SAP. Although many of the reviews contained the necessary information, the key points were often hidden in large swathes of text, or too brief to be meaningfully interpreted. Such lack of clarity can make it difficult to establish what actions have been delivered and if they have had a positive, negative, or neutral impact on the species conservation objectives. Having clarity and ensuring reporting describes and measures the value of actions and recovery planning can ensure appropriate and adaptive management (Bottrill *et al.*, 2011; Gant, Mair and McGowan, 2021). Metrics (i.e., measuring population trends and number of actions implemented or objectives met) are useful in evaluating a programmes overall success and implementation (Boersma *et al.*, 2001) and combining these with qualitative but focussed responses from conservation managers on the ground can help to assure all information and perspectives are recorded (Stem *et al.*, 2005).

2.6 Conclusions

It is very difficult to assess the effectiveness and implementation of SAPs as many actions and results are hard to quantify. Setting out a Theory of Change and clear outcomes prior to devising the plan, and making actions specific and measurable have been proven to be useful for developing goals, actions, and indicators (Kapos *et al.*, 2008; CMP, 2020). The inclusion of indicators or performance criteria is essential for allowing a measurable evaluation and a review process with a clear purpose (Saterson *et al.*, 2004). Implementation plans are also seen as a key part of the process. Presenting an implementation plan in a separate section can give the SAP a clear purpose and provide actors with clear tasks and timescales (Machado, 2001).

The data gathered for analysis could potentially have been widened to include all SAPs located for each of the reintroduction case studies. Although this may have provided a greater diversity of SAPs, the method of utilising only the referenced SAPs provided a well-designed and consistent sampling frame.

2.6.1 What is important in a Species Action Plan?

Establishing the necessary detail for key components within a SAP is a challenging task. There are undoubtedly common components required, but the detail is likely to vary depending on the species or taxon, the region, legislation, and ultimately the end-user. For example, although they all followed the same format, the UK SAPs I analysed were brief and lacked context to the overall objectives of the plan. Whilst this approach has merits in conciseness and format (McGowan, 2001) it could also render the plan open to misinterpretation, particularly in relation to monitoring - due to the lack of detail and indicators. Similarly, very prescriptive plans could be viewed as too time consuming, too complex to monitor and not open to adaptation (Boersma *et al.*, 2001). So, does there need to be a trade-off between the approaches? Probably not, as ultimately there are pros and cons to both. For example, whilst the UK SAPs are simplistic, they are linked to wider regional action plans and habitat plans which can create a complementary approach that has been championed for its benefits in the past (Lindenmayer *et al.*, 2007). Equally, detailed and informative SAPs can make for useful tools to engage policy makers and influence planning even if they do not contain legal obligations (Adenle, 2012).

A balanced approach that is becoming more common is the production of a summary document alongside the full SAP. The kiwi (*Apteryx haasti*) action plan (Germano *et al.*, 2018) and its associated summary document is an excellent example of this, with the summary providing informative illustrations and summaries of actions designed to be better received by decision makers and the public, and a detailed SAP which provides specific elements for conservation practitioners. However, with time being of the essence in terms of addressing species loss, the approach needs to be dynamic so that actions can be put into practice as quick as possible. Producing summary documents in advance of detailed plans is one way to do this.

Guidelines for conservation planning are constantly evolving and the opportunities for the sharing of information constantly improving (Salafsky *et al.*, 2008; Sutherland *et al.*, 2019), thereby creating a resource base for those undertaking evidence-based conservation planning. However, with limited funding and resources available for some projects the planning needs to be cost-effective and allow for the use of best practice as well as creativity and experimentation (Game *et al.*, 2014). Utilising these resources and taking advantage of the available tools and networks (e.g. CMP and CPSG) are appropriate starting places for the creation of SAPs. Here I summarise some recommendations based on the results of this study and from key literature:

1. When creating a SAP, ensure the team involved are diverse in terms of representation and ability to make and action decisions.
2. Set established evidence-based actions where possible and relevant to the species: Utilise team/ stakeholder knowledge of previously implemented actions as well resources such as CPSG, conservation evidence, CMP evidence base and conservation learning (Conservation Learning Initiative, 2022).
3. Prioritise actions to help identify those that are most important. This should be project-specific and based on time, cost, evidence, impact, species sensitivities etc.
4. Where relevant to threats, provide extra information in the SAP for stakeholders (e.g., guidance for decision makers – which can be aimed at government or developers).
5. Ensure the review process is consistent and measurable with quantitative feedback in place so that plans can be updated and adapted, and knowledge can be improved. Some supporting analytical technology or planning tools can be of value (e.g. some organisations use prescriptive software such as Miradi 2019).
6. Ensure research output from SAPs is shared and linked to accessible evidence databases by creating actions within the plan that link to sharing evidence. An example could be to link SAPs (national ones at least) to Red Lists, particularly when National Red listing becomes more established.
7. Where they exist, strengthen the link to habitat plans and National Biodiversity Strategies and Action Plans NBSAPs so that SAPs can be more visible in policy and legislation particularly in less developed countries.
8. Make SAPs and associated data accessible: SAPs and species information in the USA and Australia were found to be easily accessible through government websites that were equipped with databases that provide immediate access to current and historic species plans, reviews, and to an extent, conservation advice and progress. Creating

such a resource in the UK, for example, would be beneficial for engaging and assisting stakeholders including developers, policy makers and legislators.

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2.8 Supplementary Information

Table S1 Complete list of the 77 species and their action plans that were reviewed

Species Name	Action Plan Details
Adriatic sturgeon (*Acipenser naccarii)*	Action plan per la gestione di *Acipenser naccarii*, dei suoi siti riproduttivi e della pesca. Available from: https://www.regione.lombardia.it/wps/wcm/connect/3c163386-8762-4f6c-a93f-1d5d41be3314/Gestione+di+Acipenser+naccarii%2C+dei+siti+riproduttivi+e+della+pesca.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-3c163386-8762-4f6c-a93f-1d5d41be3314-ly6C9f8
American alligator (*Alligator mississippiensis)*	Elsey, R. M. & A. R. Woodward. 2010. American Alligator (*Alligator mississippiensis*). In: Crocodiles. Status Survey and Conservation Action Plan. Third Edition. S. C. Manolis and C. Stevenson (eds). pp. 1 - 4. Crocodile Specialist Group: Darwin
Antillean manatee (*Trichechus manatus manatus)*	ICMBio (2011) Plano de ação nacional para a conservação dos sirênios: peixeboi-da-amazônia *Trichechus inunguis* e peixe-boi-marinho *Trichechus manatus*. Luna, F.O.; de Andrade, M.C.M.; Reis, M.L. (Org.). Brasília. Editora ICM Bio. 80 p.
Autumn buttercup, *(Ranunculus acriformis var.aestivalis* L. Benson)	U.S. Fish and Wildlife Service. 1991. Autumn buttercup (*Ranunculus acriformis var. aestivalis*) Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado. 20 pp.
Bakersfield cactus (*Opuntia basilaris var. treleasei)*	U.S. Fish and Wildlife Service. 1998. Recovery plan for upland species of the San Joaquin Valley, California. Region 1, Portland, OR. 319 pp.
Black-footed ferret (*Mustela nigripes)*	U.S. Fish and Wildlife Service. 1988. Black-footed ferret recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado. 154 pp.
Brown bear (*Ursus arctos*)	PACOBACE (2010) Piano d'Azione interregionale per la Conservazione dell'Orsobruno nelle Alpi centro-orientali. Quad. Cons. Natura, 33, Min. Ambiente - ISPRA. Swenson, J. E., Gerstl, N., Dahle, B. & Zedrosser, A. (2000) Action Plan for the Conservation of the Brown Bear (Ursus arctos) in Europe. Council of Europe, Strasbourg.
Bull trout (*Salvelinus confluentus*)	USFWS (U.S. Fish and Wildlife Service). 2002. Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon. 137 pp.
Bush stone-curlew (*Burhinus grallarius*)	DEC (2006) NSW Recovery Plan for the Bush Stone-curlew *Burhinus grallarius*. Department of Environment and Conservation, Sydney, Australia.
Chalky wattle *(Acacia cretacea)*	Pobke, K 2007, Draft recovery plan for 23 threatened flora taxa on Eyre Peninsula, South Australia 2007-2012, Department for Environment and Heritage, South Australia.
Chimpanzees *(Pan troglodytes)*	Kormos, R., Humle, T., Brugière, D., Fleury-Brugière, M.-C., Matsuzawa, T.,Sugiyama, Y., et al. (2003). Status surveys and recommendations: country reports: The Republic of Guinea. In R. Kormos, C. Boesch, B. M.I. & T. M.Butynski (Eds.), Status Survey and Conservation Action Plan: West African Chimpanzees (pp. 63-76). Gland, Switzerland and Cambridge, UK: IUCN/SSC Primate Specialist Group.
Cistus heterophyllus	Plan de Recuperación de Cistus heterophyllus. Documento Técnico available from: https://agroambient.gva.es/es/web/biodiversidad/cistus-heterophyllus
Cocos buff-banded rail (*Gallirallus philippensis andrewsi)*	Commonwealth of Australia. 2005. National Recovery Plan for the Buff-banded Rail (Cocos (Keeling) Islands) *Gallirallus philippensis andrewsi*. Department of the Environment and Heritage, Canberra.
Dactylanthus (*Dactylanthus taylorii*)	La Cock, G. D., S. Holzapfel, D. King & N. Singers. 2005. *Dactylanthus taylorii* recovery plan, 2004-2014. Threatened Species Recovery Plan 56. Department of Conservation, Wellington
Desert bighorn sheep (*Ovis canadensis mexicana)*	Goldstein, E. & E. Rominger. (2003) Plan for the recovery of the desert bighorn sheep in New Mexico, 2003-2013. New Mexico Department of Game and Fish, Santa Fe.
Eastern barred bandicoot (*Perameles gunnii)*	Hill, R., Winnard, A., Watson, M. (2010). National recovery plan for the eastern barred bandicoot (mainland) *Perameles gunnii* unnamed subspecies. Victorian Government Department of Sustainability and Environment (DSE), Melbourne.
Eastern black rhinoceros (*Diceros bicornis michaeli)*	KWS (2012). Conservation and Management Strategy for the Black Rhino (*D. b. michaeli*) in Kenya, (2012-2016), 5th edition. pp.57, Kenya Wildlife Service, Nairobi, Kenya

Species Name	Action Plan Details
Eremophila resinosa (Myoporaceae)	Department of Environment and Conservation (2008). Resinous Eremophila (*Eremophila resinosa*) Interim Recovery Plan 2008 - 2013. Interim Recovery Plan No.266. Department of Environment and Conservation, Western Australia.
European bison *(Bison bonasus)*	Pucek, Z. (ed), Belousova, I. P., Krasiska, M., Krasiski, Z. A. & Olech, W. (2004) European bison. Status Survey and Conservation Action Plan., IUCN Gland, Switzerland and Cambridge, UK, 55 pp.
European water vole (*Arvicola amphibius)*	European water vole Species Action Plan in Biodiversity: The UK Steering Group Report - Volume II: Action Plans (December 1995, Tranche 1, Vol 2, p82)
Fen raft spider (*Dolomedes plantarius)*	Fen raft spider (*Dolomedes plantarius*) (Order: Araneae) Action Plan in UK Biodiversity Group Tranche 2 Action Plans - Volume IV: Invertebrates (March 1999, Tranche 2, Vol IV, p429)
Field cricket *(Gryllus camprestris)*	Species Action Plan for Field Cricket *(Gryllus campestris*) in: UK Biodiversity Group Tranche 2 Action Plans - Volume IV: Invertebrates (March 1999, Tranche 2, Vol IV, p449)
Fijian crested iguana (*Brachylophus vitiensis)*	Harlow, P.S., Hudson, R. & Alberts, A. (2008) Fijian Crested Iguana *Brachylophus vitiensis* Species Recovery Plan 2008-2012. IUCN Species Survival Commission, Iguana Specialist Group. Pp 26. http://www.iucn-isg.org/publications/actions-plans/
Fisher (*Pekania pennanti*)	Hayes, G. E., and J. C. Lewis. 2006. Washington State Recovery Plan for the Fisher. Washington Department of Fish and Wildlife, Olympia. 62+ viii pp.
Florida ziziphus, (*Ziziphus celata)*	U.S. Fish and Wildlife Service. 1999. South Florida multi-species recovery plan. Atlanta, Georgia. 2172 pp.
Giant anteater (*Myrmecophaga tridactyla)*	Jiménez-Pérez, I. (ed.) (2006) Plan de recuperación del oso hormiguero gigante en los Esteros de Iberá, Corrientes (2006 - 2010).
Giant kokopu (*Galaxias argenteus)*	Department of Conservation (2005) New Zealand large galaxiid recovery plan, 2003-13: Shortjaw kokopu, giant kokopu, banded kokopu, and koaro. Threatened Species Recovery Plan 55. Department of Conservation, Wellington, New Zealand. p. 34
Gray wolves (*Canis lupus*)	U.S. Fish and Wildlife Service 1987. Northern Rocky Mountain Wolf Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado. 119pp.
Grevillea scapigera (Proteaceae)	Department of Environment and Conservation (2008). Corrigin grevillea (*Grevillea scapigera*) Recovery Plan. Interim Recovery Plan No. 224. Department of Environment and Conservation, Perth, Western Australia.
Hawaiian goose (*Branta sandvicensis)*	U.S. Fish and Wildlife Service (2004) Draft revised recovery plan for the nēnē or Hawaiian goose (Branta sandvicensis). U.S. Fish and Wildlife Service, Portland, OR. 148 + xi pp.
Helmeted Honeyeater (*Lichenostomus melanops* cassidix)	Menkhorst, P. 2008. National Recovery Plan for the Helmeted Honeyeater *Lichenostomus melanops cassidix*. Department of Sustainability and Environment, Melbourne.
Hungarian meadow viper (*Vipera ursinii rakosiensis)*	Edgar, P. & Bird, D. (2005) Action Plan for the Conservation of the Meadow Viper (*Vipera ursinii*) in Europe. Bern Convention European Action Plan, 32 pp.
Juniper (*Juniperus communis* ssp.)	Juniper (*Juniperus communis*) Action Plan in UK Biodiversity Group Tranche 2 Action Plans - Volume III: Plants and fungi (February 1999)
Kangaroo Island phebalium *(Leionema equestre)*	Taylor, D.A. (2008). Draft Recovery Plan for 15 Nationally Threatened Plant Species on Kangaroo Island, South Australia (2nd edn): 2003-2013. Department for Environment and Heritage, Government of South Australia.
Lesser short-tailed bat (*Mystacina tuberculata)*	Molloy, J. 1995. Bat (Peka Peka) Recovery plan. Threatened Species Recovery Plan Series. Department of Conservation, Wellington, New Zealand.
Loggerhead shrike (*Lanius ludovicianus migrans)*	Environment Canada. 2010. Recovery Strategy for the Loggerhead Shrike, migrans subspecies (*Lanius ludovicianus migrans*), in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. viii + 35 pp.
Mangrove finch (*Camarhynchus heliobates)*	Fessl, B., Vargas, H., Carrion, V., Young, R., Deem, S., Rodriguez-Matamoros, J., Atkinson, R., Carvajal, O., Cruz, F., Tebbich, S., & Young, H. G. (Eds.). 2010. Galápagos Mangrove Finch *Camarhynchus heliobates* Recovery plan 2010 –2015, Durrell Wildlife Conservation Trust, Charles Darwin Foundation, Galàpagos National Park Service.
Mexican wolf (*Canis lupus baileyi*)	U.S. Fish and Wildlife Service [USFWS]. 1982. Mexican Wolf Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico, USA. 103 pp.

Species Name	Action Plan Details
Mexican wolf Sierra Madre *(Canis lupus baileyi)*	Programa De Acción Para La Conservación De La Especie Lobo Gris Mexicano *(Canis lupus baileyi)* 2009 Available from: https://www.gob.mx/conanp/documentos/programa-de-accion-para-la-conservacion-de-la-especie-lobo-gris-mexicano-canis-lupus-baileyi
Monarto mintbush (*Prostanthera eurybioides)*	Obst, C. 2005. South Australian Murray Darling Basin Threatened Flora Recovery Plan. Report to the Threatened Species and Communities Section, Australian Government Department of the Environment and Heritage, Canberra
Noisy scrub-bird (*Atrichornis clamosus)*	Danks, A., Burbidge, A. A., Burbidge, A. H. & Smith, G. T. 1996. Noisy Scrub-bird Recovery Plan. Western Australian Wildlife Management Program No. 12. Department of Conservation and Land Management, Perth, Western Australia
Northern aplomado falcon (*Falco femoralis septentrionalis)*	U.S. Fish and Wildlife Service. 1990. Northern aplomado falcon recovery plan. U.S. Fish and Wildlife Service. Albuquerque, New Mexico. 56pp.
Northern leopard frog (*Lithobates pipiens)*	Northern Leopard Frog Recovery Team. 2012. Recovery plan for the Northern Leopard Frog (*Lithobates pipiens*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC
Oregon silverspot butterfly (*Speyeria zerene hippolyta)*	U.S. Fish and Wildlife Service. 2001. Oregon silverspot butterfly (*Speyeria zerene hippolyta*) revised recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 113 pp.
Pampas deer (*Ozotoceros bezoarticus*)	Proyecto de Conservación, Rescate y Restauración Del Venado de Las Pampas en La Provincia de Corrientes
Peep Hill hop-bush (*Dodonaea subglandulifera)*	Moritz, K.N. & Bickerton, D.C. (2010) Recovery plan for the Peep Hill hop-bush *Dodonaea subglandulifera* 2010. Report to the Recovery Planning and Implementation Section, Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra.
Pine hoverfly (*Blera fallax*)	Species Action Plan for a Hoverfly (*Blera fallax*) in: UK Biodiversity Group Tranche 2 Action Plans - Volume IV: Invertebrates (March 1999, Tranche 2, Vol IV, p145)
Puaiohi (*Myadestes palmeri*)	US Fish and Wildlife Service. (1983) Kaua'i forest birds recovery plan. U.S. Fish and Wildlife Service. Portland, OR.
Puerto Rican crested toad (*Peltophryne lemur*)	U.S. Fish and Wildlife Service. 1992. Recovery Plan for the Puerto Rican crested toad (*Peltophryne lemur*). Atlanta, Georgia. 19 pp.
Pygmy hog (*Porcula salvania*)	Oliver, W. L. R. & Deb Roy, S. 1993. The pygmy hog (*Sus salvanius*). In: W. L. R.Oliver (ed.): Pigs, Peccaries and Hippos: Status Survey and Conservation ActionPlan. IUCN, Gland: 121-129.
Pygmy rabbit (*Brachylagus idahoensis*)	U.S. Fish and Wildlife Service (USFWS) (2012) Recovery plan for the Columbia Basin distinct population segment of the pygmy rabbit (*Brachylagus idahoensis*). U.S. Fish and Wildlife Service, Portland, Oregon, USA.
Red squirrel (*Sciurus vulgaris*)	Species Action Plan Red Squirrel (*Sciurus vulgaris*) in: Biodiversity: The UK Steering Group Report - Volume II: Action Plans (December 1995, Tranche 1, Vol 2, p91)
Red wolf (*Canis rufus*)	U.S. Fish and Wildlife Service (1990) Red Wolf Recovery/Species Survival Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 110 pp.
Red-cockaded woodpecker (*Picoides borealis)*	U.S. Fish and Wildlife Service (2003) Recovery plan for the red-cockaded woodpecker (*Picoides borealis*): second revision. U.S. Fish and Wildlife Service, Southeast Region, Atlanta, Georgia, USA.
Regent honeyeater (*Anthochaera phrygia)*	Ingwersen, D.A., Geering, D.J. & Menkhorst, P. (in press). National Recovery Plan for the Regent Honeyeater *Anthochaera phrygia*. Department of the Environment, Canberra.
Saker falcon (*Falco cherrug*)	Nagy, S. & Demeter, I. (2006) Saker Falcon: European Single Species Action Plan. Bern Convention: TVS/Inf (2006) 2 revised
Savannas mint, (*Dicerandra immaculata) Lakela var*. savannarum Huck (Lamiaceae),	U.S. Fish and Wildlife. 1987. Recovery Plan for Three Florida Mints U.S. Fish and Wildlife Service. Atlanta, Georgia 21pp
Sea lavender (*Limonium perplexum*)	Plan de Recuperación de *Limonium perplexum*. Documento Técnico available from: http://www.agroambient.gva.es/va/web/biodiversidad/limonium-perplexum

Species Name	Action Plan Details
Shore skink (*Oligosoma smithi*)	D.R. Towns; K Neilson; A.H. Whitaker 2002, North Island Oligosoma spp. skink recovery plan 2002-2012 (2002) Series: Threatened Species Recovery Plan no.48
Small cow-wheat (*Melampyrum sylvaticum)*	Species Action Plan Small Cow-wheat (*Melampyrum sylvaticum*) in: UK Biodiversity Group Tranche 2 Action Plans - Volume III: Plants and fungi (February 1999, Tranche 2, Vol III, p335)
Smoky madtom (*Noturus baileyi*)	U.S. Fish and Wildlife Service. 1985. Smoky Madtom Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 28 pp.
Smooth coneflower (*Echinacea laevigata*, Boyton & Beadle)	U. S. Fish and Wildlife Service (1995) Smooth coneflower recovery plan. U.S. Fish and Wildlife Service. Atlanta, Georgia.
Southern damselfly (*Coenagrion mercuriale*)	Species Action Plan for southern damselfly (*Coenagrion mercuriale*) in: Biodiversity: The UK Steering Group Report - Volume II: Action Plans (December 1995, Tranche 1, Vol 2, p132)
St. Croix ground lizard (*Ameiva polops*	U.S. Fish and Wildlife Service. 1984. St. Croix Ground Lizard Recovery Plan. U.S.Fish and Wildlife Service, Atlanta, GA
Stinking hawk's-beard (*Crepis foetida foetida)*	Stinking hawk's-beard (*Crepis foetida*) Action Plan in UK Biodiversity Group Tranche 2 Action Plans Volume I: Vertebrates and vascular plants (June 1998, Tranche 2, Vol I, p157)
Sunda pangolin (*Manis javanica*)	Lee PB, Chung YF, Nash HC, Lim NT-L, Chan SKL, Luz, S., Lees, C., 2018. Sunda Pangolin (*Manis javanica*) National Conservation Strategy and Action Plan: Scaling up pangolin conservation in Singapore. Singapore Pangolin Working Group, Singapore.
Swift fox (*Vulpes velox*)	Kahn, R., Fox, L., Horner, P., Giddings, G. & Roy, C. (1997) Conservation assessment and conservation strategy for swift fox in the United States. South Dakota Department of Game, Fish, and Parks, Pierre.
Symonathus bancroftii (Solanaceae)	Department of Environment and Conservation (2006). Bailey's Symonanthus (*Symonanthus bancroftii*) Interim Recovery Plan 2006-2011. Interim Recovery Plan No. 225. Department of Environment and Conservation, Western Australia
The Fartet/ Spanish killifish (*Aphanius iberus)*	Plan for the Recovery of the Fartet in the Valencian Community. [2007/826] Available from: https://agroambient.gva.es/documents/91061501/355256202/Pla+de+recuperaci%C3%B3+del+Fartet.pdf/ffff75c2-4e9f-4287-bea4-1bbab0677ac1?t=1646205750909
Trout cod (*Maccullochella macquariensis)*	Trout Cod Recovery Team 2008a. National Recovery Plan for the Trout Cod *Maccullochella macquariensis*. Department of Sustainability and Environment, Melbourne.
Tuatara (*Sphenodon punctatus*)	New Zealand Department of Conservation (2001) Tuatara Recovery Plan 2001-2011. Threatened Species Recovery Plan 47
Turks and Caicos rock iguanas (TCRI; *Cyclura carinata carinata*)	Gerber, G. & J. Iverson. 1999. Turks and Caicos iguana, *Cyclura carinatacarinata*. Pp. 15 - 18 in A. Alberts (comp. and ed.) West Indian iguanas: status survey and conservation action plan. IUCN/SSC West Indian Iguana Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. 6 +111 pp.
Virgin Islands boa (*Epicrates monensis granti)*	U.S. Fish and Wildlife Service. 1986. Virgin Islands Tree Boa Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 26 pp.
Western barred bandicoot (*Perameles bougainville)*	Richards, J.D. (2012). Western Barred Bandicoot *Perameles bougainville*, Burrowing Bettong *Bettongia lesueur* and Banded Hare-Wallaby *Lagostrophus fasciatus* National Recovery Plan. Department of Environment and Conservation (Western Australia) and the Australian Government Department of Sustainability, Environment, Water, Population and Communities.
Wetapunga (*Deinacrida heteracantha*)	Department of Conservation (1998) Threatened Weta Recovery Plan. Threatened Species Recovery Plan. 25, Department of Conservation, New Zealand, 45 pp.
Whibley wattle (*Acacia whibleyana)*	Pobke, K. 2007. Draft recovery plan for 23 threatened flora taxa on Eyre Peninsula, South Australia 2007-2012. Department for Environment and Heritage, South Australia additional report with actions
Yellowfin madtom (*Noturus flavipinnis)*	U.S. Fish and Wildlife Service. 1983. Recovery Plan Yellowfin Madtom. U.S. Fish and Wildlife Service, Atlanta, Georgia.

Table S2 AIC data showing the ranking of the models

	Model no.	AICc	DeltaAICc	AICcWt	Cum.Wt	Log Likelihood
Vision	6	45.69	0	0.53	0.53	-15.68
	5	47.06	1.37	0.27	0.8	-19
	7	49.35	3.66	0.08	0.88	-18.86
	3	50.38	4.69	0.05	0.93	-21.88
	2	50.74	5.05	0.04	0.97	-22.06
	4	52	6.31	0.02	1	-21.47
	1	55.73	10.04	0	1	-25.71
Monitoring Plan	3	32.53	0	0.32	0.32	-12.96
	5	33.37	0.83	0.21	0.54	-12.16
	2	33.95	1.42	0.16	0.7	-13.67
	1	34.71	2.18	0.11	0.8	-15.2
	7	34.92	2.38	0.1	0.9	-11.65
	4	36.16	3.63	0.05	0.96	-13.55
	6	36.5	3.97	0.04	1	-11.08
Implementation Plan	3	37.24	0	0.48	0.48	-15.31
	5	38.09	0.85	0.32	0.8	-14.52
	7	39.86	2.62	0.13	0.93	-14.12
	6	41.61	4.37	0.05	0.99	-13.64
	1	45.55	8.31	0.01	0.99	-20.63
	2	46.44	9.2	0	1	-19.91
	4	48.88	11.64	0	1	-19.91
Indicators/ Performance Criteria	5	37.76	0	0.53	0.53	-14.36
	6	38.36	0.6	0.39	0.92	-12.01
	4	43.12	5.36	0.04	0.96	-17.03
	3	44.71	6.94	0.02	0.98	-19.05
	1	45.07	7.31	0.01	0.99	-20.38
	7	45.49	7.72	0.01	1	-16.93
	2	57.85	20.08	0	1	-25.62
Reporting Procedure	4	44.95	0	0.41	0.41	-17.95
	2	45.07	0.12	0.39	0.8	-19.22
	1	47.95	3	0.09	0.89	-21.82
	6	49.22	4.27	0.05	0.94	-17.44
	7	50.04	5.09	0.03	0.97	-19.21
	5	51.38	6.43	0.02	0.99	-21.16
	3	52.46	7.52	0.01	1	-22.92

Chapter 3. The best laid plans? Conservation practitioner perceptions of Species Action Plans

3.1 Abstract

Species action plans (SAPs) underpin much of conservation management. The purpose of such plans is to define the actions needed to achieve species recovery goals, and crucially, to build consensus among organisations and individuals that are in a position to influence outcomes. Systematic reviews are conducted for some SAPs, particularly where large NGOs provide support, but their value and utilisation have not been compared on a broader scale. Equally, there is little consistency in the structure and content of action plans, and limited research to evaluate their effectiveness and impact. Our research aims to assess how SAPs are developed, valued, utilised, and evaluated. Data were collected through an online questionnaire aimed at conservation professionals, ecological consultants, and policy makers. Analysis of the responses showed that: guidelines and templates were used to form the basis of SAPs in 65% of cases; most conservation professionals referenced SAPs extensively for their work and believed that SAPs play an important role in species conservation; and 31% of respondents had used monitoring or evaluation tools to measure the effectiveness of SAPs. These results lay the foundations for a comprehensive review of SAPs by providing information on the relationships between organisations, SAPs, and their core components. I make recommendations to inform improvements, highlight potential gaps in the SAP processes and allow a more focussed approach for conservation organisations, policy makers, zoos, and conservation professionals.

3.2 Introduction

Species conservation in its earliest conception was driven by passionate individuals in a somewhat ad hoc and responsive manner - later becoming more formalised and featuring in legislation that was initially largely focussed on habitat protection and the creation of nature reserves (Primack, 1998; Machado, 2001). The development of species conservation into an outcome-driven activity requiring systematic planning and intervention design came much later, partially through the first species recovery plans from the USA Endangered Species Act 1973, and partially through the more focused work of organisations such as the Biodiversity Support Program (BSP) in the 1990s (Clark, Reading and Clarke, 1994; BSP, 2001).

The development of systematic planning approaches was in part due to increased concern over biodiversity loss worldwide and partly due to the realisation that conservation recommendations needed to be focussed and measurable in order to understand their impact (IUCN 2002).

Species Action Plans (SAPs) are considered one of the key instruments used in the design and organisation of species conservation efforts (Machado, 2001; IUCN–SSC Species Conservation Planning Sub-Committee, 2017). SAPs are known by differing titles including; species recovery plans, threatened species plans, and species conservation strategies or plans (Machado, 2001). Essentially all these types of documented plans serve the primary purpose of outlining the actions required to protect and recover a species and guide their implementation (Crouse *et al.*, 2002; Hoekstra *et al.*, 2002a; IUCN/SSC, 2008). For the purposes of this study the term 'SAP' encompasses all these titles.

SAPs typically consist of a comprehensive review of all available information on the conservation status of the species (ecology, range, threats) together with objectives and actions required to ensure the species recovery and long-term survival (Machado, 2001; IUCN/SSC, 2008). The conception of SAPs largely stems from legislation and conventions that have led to the evolution of plans led by governments, specialist groups, and NGOs. The first SAPs, known as Species Recovery Plans, came from the US Endangered Species Act of 1973, which required all species listed on the act to have a recovery plan developed (Boersma *et al.*, 2001). In the United Kingdom some of the first SAPs formed part of the 1994 UK Biodiversity Action Plan (UK BAP), which was the UK Government's response to the 1992 Convention on Biological Diversity (CBD) (JNCC, 2017). Most of Europe's SAPs were established from the same international convention and the EU member states' associated commitments to the Habitats Directive (Fuller *et al.*, 2003) and the Birds Directive, which was signed up to by member states in 1979 (European Commission, 2017).

Whilst the underlying basis for SAPs is to plan action, many organisations also consider SAPs useful for providing science-based recommendations to those in a position to implement them - such as resource managers, agency officials, funding organisations, and political leaders (Fuller *et al.*, 2003). SAPs can also act as an aid to support the raising of funds, and as important documents from which to measure change and help expand on data for the IUCN Red List of Threatened Species (IUCN/SSC, 2002).

There have been numerous and wide-ranging reviews of SAPs focussing on a variety of species, countries, and regions, but few reviews of the utilisation, benefits, and conservation practitioner views on SAPs. Previous reviews were largely undertaken in the 1990s and early 2000s - the first was a study led by Gimenez-Dixon and Stuart (1993) that reported on the results of a questionnaire sent to chairs of SSC (Species Survival Commission) groups to gather data on the implementation of SAPs. From the responses received, the study concluded that although SAPs were viewed positively there appeared to be little action arising from such plans and the action that occurred would most likely have taken place in the absence of the plan (McGowan, Garson and Carroll, 1998). Shortly after the Gimenez-Dixon and Stuart (1993) study, a critique of the SAP approach by Collar (1994) stated that the IUCN plans were biased towards certain species, and that planning efforts would be potentially more cost effective if they focussed on multiple threatened species in a specific region (McGowan, Garson and Carroll, 1998). Another evaluation study of IUCN SSC plans undertaken by McGowan (2001) concluded that the main negative issues with SAPs were linked to the changing objectives of the SSC itself, such as differing target audiences for the plans, varying resources, and recommendations, but that overall, they do result in conservation action. The study produced a series of recommendations and options for future SAPs, one of which included the adoption of the UK BAP format. McGowan's (2001) evaluation started a process within the IUCN SSC to create a Species Conservation Planning Task Force and produce a handbook to assist with the production of SAPs (IUCN/SSC, 2008).

A European-focused study by Machado (2001) commissioned by the Council of Europe, examined legislation and the different structure of SAPs, and made overall recommendations and guidance for consideration in future SAP development. Key recommendations related to the importance of gaining legal support, employed resource being available, creating objectives that allow the species recovery to be evaluated, and the inclusion of conservation managers in SAP creation to ensure results are not academically bias or unrealistic (Machado, 2001). Machado's guidelines were created under contract for the Council of Europe and in line with the Bern Convention, although it is not clear from any literature how widely the guidelines were and are utilised.

In the USA there have been several reviews of the recovery plans created under the Endangered Species Act 1973. Perhaps the most comprehensive of which was by Hoekstra *et al.* (2002a) who undertook a systematic review of United States Fish and Wildlife Service (USFWS) recovery plans to identify and compare common elements, differences, and trends amongst a representative sample of species and multi-species plans. They assessed correlations between plan attributes and species recovery. From the data they created a series of papers that made recommendations relating to numerous aspects of recovery planning (Brigham, Power and Hunter, 2002; Campbell *et al.*, 2002; Schultz and Gerber, 2002; Clark and Harvey, 2002; Gerber and Hatch, 2002; Harvey *et al.*, 2002; Hatch *et al.*, 2002; Hoekstra, Fagan and Bradley, 2002b; Lawler *et al.*, 2002; Lundquist *et al.*, 2002; Morris *et al.*, 2002).

There have been limited reviews of SAPs in the UK. Reports by the UK's JNCC (Joint Nature Conservation Committee) on the UK BAP progress showed varying successes in species decline recovery and highlighted issues with meeting action plan targets, citing lack of funding as the main constraint (Defra, 2002, 2006; JNCC, 2010). In the case of the UK Biodiversity Action Plan SAPs, the lack of reviews were most likely linked to a lack of monitoring data (Defra, 2006) and the absence of a standardised approach to measure success or identify outcomes (Pheasey and Foster, 2021; Bruyere, Copsey and Walker, 2022). In the absence of measurable indicators and a lack of resources (Levrel *et al.*, 2010) when data is fed back there is often no means to: a) Identify the issues causing lack of action or success and b) to act upon these issues when they are known.

As the reviews highlight, the planning, content, and the way action plans are created depends on who creates them, who uses such plans, and how much funding the subsequent work receives (Machado, 2001). SAPs are still created and updated but perhaps not at the rate they once were (Boersma *et al.*, 2001; Hayhow *et al.*, 2019; Natural England, 2023). There has been a clear move away from SAPs in the UK (JNCC, 2019) and the IUCN strategies in recent times have not tended to provide as much emphasis on plans of this type as it once did. Instead a focus towards ecosystem and multi species-plans was favoured in the hope that they are likely to drive the largest conservation action (Machado, 2001; IUCN, 2021).

The shift towards ecosystem-focused planning may explain why there have been very few reviews of SAPs within recent years. To fill this gap, I examined the current status of SAPs and how they are valued and utilised by different stakeholders and organisations working within conservation.

The aim of this study was to gather information on the structure, use and value of SAPs to provide insights into how they are created, what works, and what could be improved. To meet this aim, I needed to answer the following questions:

1. How are SAPs utilised and valued within the conservation and ecology sectors?
    - Which conservation sector uses/creates them the most?
    - Which regions are the SAPs and respondents focussed in?
    - How are SAPs valued as a resource by conservation practitioners?
    - How could SAPs be improved?

2. Which components are important in creating and implementing SAPs?
3. What other methods of implementing conservation are effective?

3.3 Methods

3.3.1 Data Collection

A questionnaire (see Figure S1 in supplementary information) was developed and distributed via the platform Online surveys (Jisc, 2021). The questionnaire was comprised of 24 questions with a mix of multiple choice, fixed choice, Likert scale and open-ended questions. Questions related to different aspects of SAPs to try and understand how respondents used and created SAPs and which elements of SAPs they thought were important. Questions also requested participant information such as profession, nationality, and experience.

3.3.2 Participants

The questionnaire was tested on a pilot group of 15 people with varying levels of experience in species conservation to gather feedback on content, clarity, and usability of the survey instrument (Newing *et al.*, 2011). These included; conservation practitioners and academics who had contributed to SAPs, PhD students with species conservation knowledge but no experience of contributing to SAPs and PhD students with little species knowledge. Data from the pilot study were then used to amend and refine the questionnaire into its final form. The questionnaire was a targeted towards a sample of ecologists and conservation professionals, both in government roles (i.e. public sector employees), non-government, and private sector roles. This was executed by sending the questionnaire link in an email which was sent to 341 recipients using addresses from the IUCN SSC website and personal contacts within the conservation and ecology sector. The questionnaire was also shared on social media and via the IUCN SSC newsletter with chain referral sampling encouraged by respondents via colleagues (Newing *et al.*, 2011). Ninety-one questionnaires were received from emailed contacts and 125 from social media and the IUCN Newsletter - totalling 216 completed questionnaires. The questionnaire was open to responses from the 15 December 2017 to the

31 January 2018. The sampling approach was chosen to ensure that conservation professionals with interest, expertise, and experience in species action planning were consulted.

3.3.3 Analysis

All responses to the 24 questions were collated and downloaded from the online survey platform (Jisc 2021) and analysed in relation to the question type (i.e. open ended, multiple choice or Likert scale) and subject. Initial data was collated from multiple choice questions on how respondents contributed to SAPs (in what capacity, how many SAPs, which species groups, and which activities during SAP creation). Data on the use of templates and guidelines, monitoring and evaluation tools, additional SAP creation activities, effectiveness, and improvement of SAPs, were gathered from open ended responses on the types used and grouped into themes (3.3.5). Data on the utilisation of SAPs were gathered from multiple choice and an open-ended response question for '*other'.* Data on the importance and value of SAPs were gathered from closed checklist answers. Additional data in relation to regions worked in, organisation employed by, and level of experience were gathered from closed and multiple-choice questions.

3.3.4 Principal Component Analysis

Principal component analyses (PCA) were conducted in SPSS (IBM Corp., 2017) to extract factors for the 13 answer options of Q13 '*Which do you think are the most important components* to *include in a Species Action Plan?'* and the 12 answer options of Q15 '*How do you rate the following in terms of their importance for influencing the successful implementation of Species Action Plans?'*. Responses were on a Likert-type scale, ranging from 1 = "Not important", 2 = "Somewhat important", 3 = "Important", 4 = "Very important", 5 = "Essential", 6 = "Don't know". PCA was deemed an appropriate method for the data as it allows correlated items to be reduced into a set of distinct components (or factors) whilst maintaining most of the key information. Its main objective being to summarise the variation present in the original items in decreasing order of importance (Jolliffe, 2002; Newing *et al.*, 2011). In this case the PCA aim was to identify which answers best describe the variation in responses across items and how patterns relate to the importance of an item within the structure or implementation of a SAP. To determine the relationship between the answers being analysed, items were initially tested for correlation - a PCA was then run with an oblique rotation (oblimin) to rotate the principal components in order to more clearly represent the relationships between the items. The oblique rotation was chosen as it was expected that factors identified in SAPs would be somewhat correlated (have some relationship) with each other (Thurstone, 1947). A factor loading cut off was set at 0.4, based upon items with a loading above 0.4 being considered more important in explaining the variance in the data (Maskey, Fei and Nguyen, 2018) and a fair representation because it indicates a moderate relationship between the item and the underlying factor (Comrey 1973). The results were checked for reliability using orthogonal rotation and unifactorial tests to identify any different patterns in the data and confirm the suitability of the analysis (Field, Field and Miles, 2012).

In order to accurately name the principal components identified, and for them to have appropriate content validity as suggested by Rummel (1970), the results were sent to a panel of five experts from different countries who work in the field of species conservation. Each panel member was asked to suggest one or two names that reflect the meaning of each factor within the component. Their suggestions were then used to name each of the components.

3.3.5 Qualitative Analysis

The qualitative research coding software NVivo 12 Pro (QSR International Pty Ltd., 2018) was used to manually code open ended question responses (questions 7, 8, 16, 17 and 18) into relevant recurring themes using thematic analysis. Thematic analysis is a method that identifies patterns of meaning (themes) within qualitative data, allowing analysis through the common themes (Clarke and Braun, 2017).

3.4 Results

3.4.1 Survey Responses

Question: *Have you created, or been involved in the creation of a Species Action Plan?* Of the 216 respondents, 141 (65%) had created, contributed, or been involved in the creation of a SAP. Of the 141, just over half had created four or more SAPs and 27 creating more than 10. Seventy (50%) of these had been lead authors of a SAP but most (103, 73%) were contributors. Eighty-seven (61%) contributed as part of an organisation with action/ implementation responsibilities; 75 (53.2%) were attendees of an action planning workshop and 31 (22%) were workshop facilitators. Many respondents had acted in more than one capacity and selected multiple answers in these cases.

Question: *How important do you think Species Action Plans are in achieving effective conservation of species?*

- 27 (13%) felt that SAPs were 'Not important' or only 'Somewhat important'
- 139 (64%), thought that SAPs were either 'Very important' or 'Essential', whilst
- 48 (22%) considered them 'Important' and 2 (1%) were 'unsure'.

Seventy-nine (37%) respondents stated that they thought SAPs had a positive impact on species recovery, four (2%) thought they did not, whilst the majority, 113 (52%) said they sometimes did, and 19 (9%) were unsure.

Most respondents believed that not enough emphasis is put on SAPs, with 119 (55%) feeling there was 'Too Little' or 'Far Too Little' emphasis given to SAPs, and 15 (7%) that thought there was 'Too Much' emphasis but none that thought there was 'Far Too Much'. Seventy respondents (32%) thought the emphasis was 'About right' and 12 (6%) stated that they

‘Didn’t know’. When asked if there should be a SAP for every species 130 (60%) said ‘Yes’, 37 (17%) said ‘No’ and 17 (8%) said they ‘Didn’t know’. Thirty-two respondents (15%) stated ‘Other’ and provided reasons for this, examples of which included: “I would prioritize Critically Endangered species for planning”, “I believe they should be developed for groups of similar species and/or species facing similar threats, especially in species-rich countries”, and “There is a danger that SAPs can be over prescriptive, and inflexible, and in some cases, slowing down conservation. SAPs can defeat the purpose for which they were created - saving species!”

3.4.2 Nationality and Regions

Almost half of respondents (48%) were from the UK, with US nationals making up 10%, Australians 5% and the remainder across various countries. As over half of respondents were European nationals, it was unsurprising that much of their work was focused in Europe, but the survey also showed that the regions of Africa, South and Southeast Asia, South America, and the Caribbean Islands had relatively high numbers of people who had worked on SAPs in those regions (Figure 3.1). This connection was also observed when ‘regions worked in’ were compared to ‘organisation employed by’ showing that most of the work in Africa, South and Southeast Asia, South America, and the Caribbean Islands was carried out by foreign nationals employed by NGO’s and Academic Institutions.

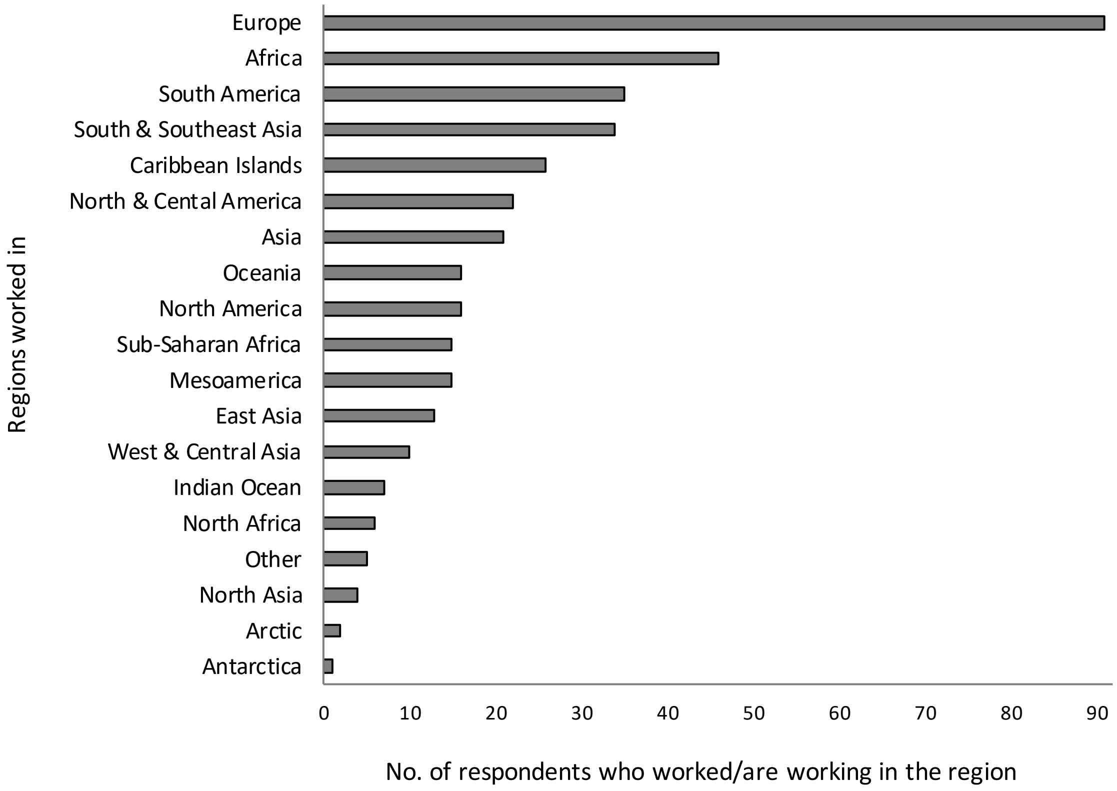

Figure 3.1 Regions in which survey respondents have previously worked in or currently work in

3.4.3 Type of Organisation

When asked what type of organisation respondents were employed by when contributing to the largest number of SAPs, the majority were employed by NGOs, and the least were employed by museums. When these were broken down into the number of SAPs contributed to, the largest percentage of SAPs were contributed to by those employed at government organisations; with 20% of these producing >10 plans (Table 3.1). Museums also counted for a large percentage but as there were only three in total this was not considered representative. Respondents employed by private companies produced a low number of SAPs in relation to the number of respondents.

Table 3.1 Experience of participants expressed in number of SAPs to which they have contributed in relation to the organisation type in which they work.

What type of organisation best describes who you worked for when contributing to Species Action Plans?	How many Species Action Plans have you contributed to?							
	0	1	2	3	4	>5	>10	Total
Non-governmental organisation	27 (31%)	11 (13%)	9 (10%)	7 (8%)	4 (5%)	17 (20%)	11 (13%)	86
Government organisation	11 (37%)	2 (7%)	4 (13%)	0	1 (3%)	6 (20%)	6 (20%)	30
Zoo, Aquarium or Wildlife Park	4 (20%)	5 (25%)	4 (20%)	0	2 (10%)	3 (15%)	2 (10%)	20
University or Academic institution	12 (29%)	6 (14%)	7 (17%)	6 (14%)	0	5 (12%)	6 (14%)	42
Private company	15 (68%)	2 (9%)	1 (5%)	0	3 (14%)	0	1 (5%)	22
Museum	1 (33%)	1 (33%)	0	0	0	0	1 (33%)	3

3.4.4 Templates & Guidelines

Sixty-five percent of respondents used guidelines or templates to create SAPs, and 17% (24) were not sure if they had. Those that had used templates or guidelines provided details of the template or guidelines that they used. A variety of responses were received which were grouped into guidelines, templates, and other and coded into themes (Table 3.2). The most frequently cited template was a government, country or regional template, examples of which included national action plans, state or government and departmental forms. The most frequently cited guidelines utilised for the creation of SAPs were IUCN Guidelines which included: Conservation Planning Specialist Group Guidelines, Reintroduction Guidelines and most frequently, the IUCN SSC Strategic Planning for Species Conservation.

Table 3.2. Summary List of Guidelines and templates utilised by questionnaire respondents involved in producing SAPs

Type of template or guideline used	No. of references made to them
Guidelines	
IUCN Guidelines	29
e.g. Conservation Planning Specialist Group, IUCN Handbook "Strategic Planning for Species Conservation"	
NGOs (Zoos, charities)	4
e.g. Amphibian Survival Alliance,	
Association of Zoos and Aquariums, AZA's Amphibian Taxon Advisory Group,	
EAZA guidelines for studbooks	
Regional or Country Guidelines	7
e.g. Guidelines relating to national legislation	
Templates	
Biodiversity Action Plan (BAP) Standard Template	9
e.g. Denbighshire Local BAP template,	
Regional BAP templates	
Country/ Government or Regional Format/ Template	16
e.g. Country Plan used as template for local Plans	
Template taken from another Action Plan	10
e.g. Template from another SAP used	
International Treaty	7
e.g. AEWA Template revised format and guidelines international species action and management plans,	5
Convention on the Conservation of Migratory Species	1
East Asian - Australasian Flyway Partnership (EAAFP)	1
IUCN SSC template	4
NGO template used	12
e.g. Amphibian Ark,	
Birdlife International SAP Template,	
Butterfly Conservation,	
RSPB concise SAP Template	
Used a previous version of SAP	4
Other	10
e.g. Council of Europe Machado,	
Global Strategy for Plant Conservation,	
Guidelines concerning captive breeding of endangered species,	
Methodology for bird Species Recovery Planning in the EU,	
Open Standards for the Practice of Conservation,	
Unknown	2

3.4.5 Utilisation of SAPs

When asked whether they had referenced/utilised SAPs for their work, 201 (93%) respondents stated that they had. Each of these respondents then selected the reason, or reasons SAPs were utilised from a multiple-answer list. The primary reasons for use were; 'to inform conservation management actions for the species' and 'to gather information on the species (ecology, distribution etc.) (Figure 3.2). When compared against the organisation they worked in when contributing to the most SAPs it showed that: NGOs and Government tend to utilise them for management actions, private organisations mostly utilised them for gathering information and to inform mitigation measures; academic organisations for gathering information; whilst museums and zoos or aquaria tended to focus equally on both management and information gathering. Results indicate that museums and private organisations rarely use SAPs to assist in funding proposals and that private organisations are the mostly likely to utilise SAPs to inform species mitigation measures (Figure 3.2 Additional reasons given for utilising SAPs generally related to their use to assist with report/ publication writing and assessments (scientific papers, part of wider projects and IUCN Red List assessments); in a legal capacity (permitting activities, obtaining permits, and giving evidence at a public inquiry); and to raise awareness and educate.

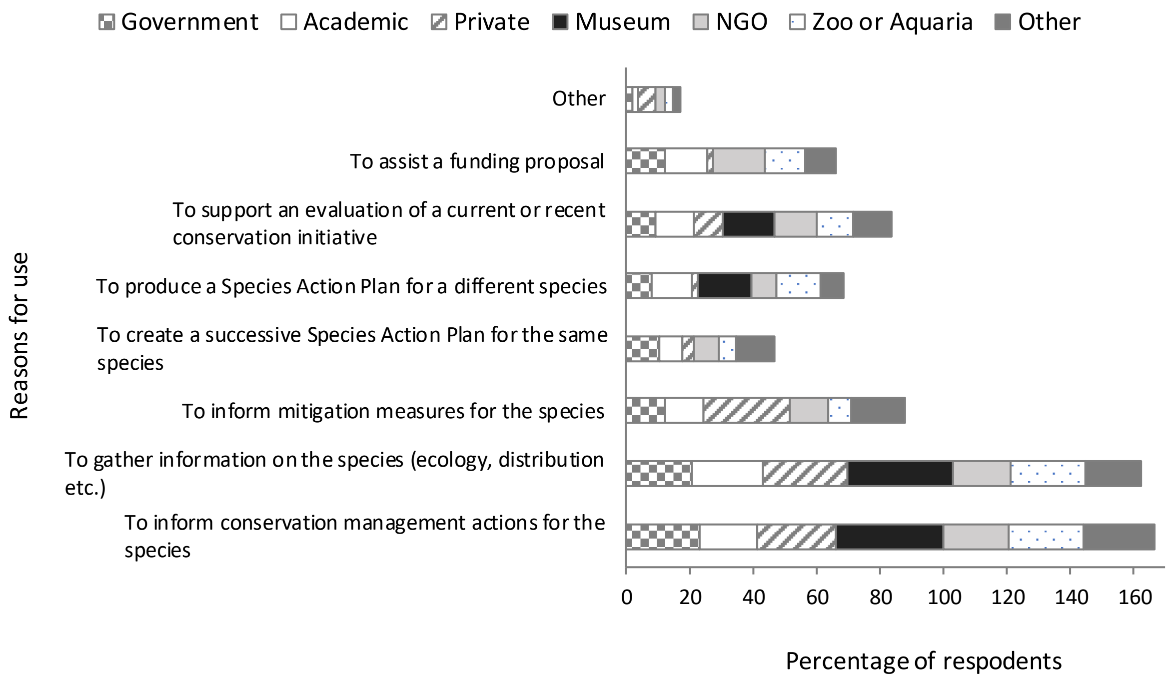

Figure 3.2 How organisations utilise SAPs

3.4.6 Important Components to Include in a Species Action Plan

A principal component analysis (PCA) was undertaken for question 13: 'Which *do you think are the most important components to include in a Species Action Plan?'* to which responses were given on a scale of 1 = “Not important”, 2 = “Somewhat important”, 3 = “Important”, 4 = “Very important”, 5 = “Essential”, 6 = “Don’t know”. The Kaiser-Meyer-Olkin (KMO) test to measure variance and assess suitability for PCA returned a value of 0.78 (‘good’ according to Kasier, 1974) and Bartlett’s test of sphericity, which determines probability that there are significant correlations between at least some of the variables in the dataset, returned a value of X^2 (78) = 923, $p < .001$, indicating that correlations between items were sufficient to conduct a PCA.

Table 3.3. A summary of principal component analysis for question 13: *Which do you think are the most important components to include in a Species Action Plan?* Shaded cells show the groupings arising from the analysis based upon each components highest factor loading (shown in bold).

	Rotated Factor Loadings* from Pattern Matrix			
Component/ Variable	***Strategic action and threats***	***Species status***	***Implementation, monitoring, and financial plans***	***Overall vision***
Current conservation action	**0.737**	0.194	0.043	-0.165
Threats	**0.780**	0.180	-0.084	-0.152
Actions	**0.786**	-0.095	-0.074	0.223
Prioritisation of actions	**0.544**	-0.079	0.291	0.277
Actions assigned to a specific organisation/ person	**0.409**	-0.149	0.339	0.258
Species distribution	0.005	**0.849**	0.062	0.048
Species ecology	-0.128	**0.828**	-0.067	0.253
Population status	0.177	**0.715**	0.058	-0.143
Relevant legislation (national and/or international)	0.234	**0.541**	0.216	-0.098
An implementation plan	-0.161	0.015	**0.932**	0.037
An evaluation and monitoring plan	-0.051	0.109	**0.784**	0.047
Funding/ budget	0.134	0.007	**0.716**	-0.156
Overall vision	0.055	0.164	-0.018	**0.866**
Eigenvalues	4.256	1.810	1.379	1.032
% of variance	32.737	13.925	10.605	7.939
Cronbach’s α	0.754	0.776	0.739	-

*****Loadings (+/-) between 0.45–0.54 are considered fair, 0.55 to 0.62 are considered good, 0.63 to 0.70 are considered very good, and above 0.71 are considered excellent (Krishnan, 2016).

The PCA analysis scree plot (Figure 3.3) identified eight principal components to be dropped (scree) (Cattell, 1978) and four principal components with eigenvalues over Kaiser's criterion of 1 - which in combination explained 65.21% of the variance. The four principal components identify important patterns formed from combinations of the original variables (Table 3.3) with clear relationships seen between the SAP components and how they are valued. The loadings indicate each variable's importance to the principal component and the larger the loading (+/-) the more important its presence or absence is. The principal components were named based on our panel's responses and can be regarded as the four key components required within a SAP:

1. *Strategic action and threats*

   This component could be considered the main element of the plan as it contains the actions needed and who is responsible for them. Threats may seem unrelated but understanding threats is key, as most actions are driven by what threatens or may threaten the species. Examples of threats and actions include: habitat degradation – which may be assigned a management action; predation threat – which may have an action to secure a site or control predators and; threat of persecution – which may have an action to educate or lobby for enforcement of legislation.

2. *Species status*

   The species status component grouped together all the variables that provide existing and essential background knowledge for the SAP. This component is important for: developing the plan, checking the current situation and providing background and current information for the reader (IUCN–SSC Species Conservation Planning Sub-Committee, 2017; CPSG, 2020b).

3. *Implementation, monitoring, and financial plans*

   This principal component includes the variables relating to planning and implementation that form a logical grouping. Having an implementation plan and an evaluation and monitoring plan as part of the SAP was seen as an 'essential' component by more than 50% of survey respondents. However, some of the open-ended comments relating to SAP components indicated that implementation plans work better as separate documents. The argument for this was that it allowed a focus on action and can allow for more streamlined (faster developed) SAPs with specific details in a separate plan or strategy. Funding had a lower number of respondents who regarded it as an 'essential' (33%) component within a plan.

4. *Overall vision*

This was the only component that was comprised of just one variable, indicating that whilst valued as 'essential' by 47% of respondents, vision also has construct validity as a detached part of the SAP.

All the groupings showed high reliabilities, (Cronbach's α = > 0.70), except for overall vision which could not be calculated as it was the only item in the group (Table 3.3). The variable component 'Actions assigned to a specific organisation/person' had a relatively low factor loading of 0.527 (structure matrix) and 0.409 (pattern matrix). Whilst loadings above 0.4 are often considered significant and a fair representation (Comrey, 1973), a higher loading suggests that the variable is a better representation of the factor (Maskey, Fei and Nguyen, 2018). The lower loading in this case is most likely explained by the nature of the question which refers to assigning actions to a specific organisation or person. This may have caused some confusion as the respondent may be unclear or place different levels of importance on actions assigned to individuals and actions assigned to organisations. When asked about additional components, the most frequently mentioned theme related to the streamlining of SAPs, with respondents suggesting that implementation plans, monitoring plans, and funding details should be created as separate documents.

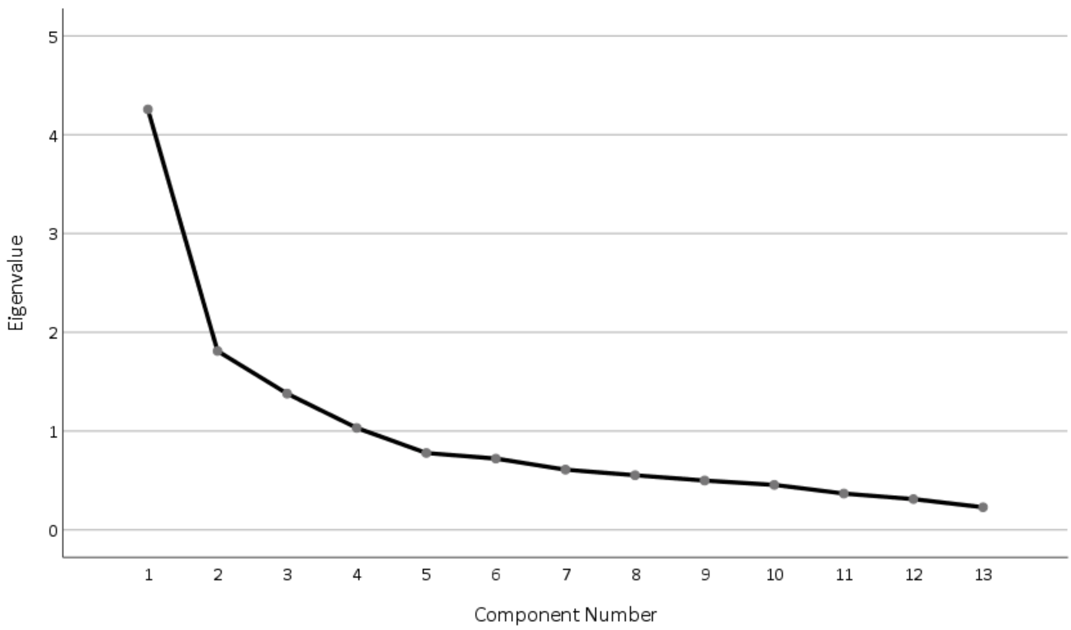

Figure 3.3 Scree plot of eigenvalues for the principal components for Q13: Important Components to Include in a Species Action Plan.

3.4.7 Important Components in the Implementation of Species Action Plans

A principal component analysis was undertaken for Q15 '*How do you rate the following in terms of their importance for influencing the successful implementation of Species Action Plans?*' to which responses were given on a scale of *1 = "Not important", 2 = "Somewhat important", 3 = "Important", 4 = "Very important", 5 = "Essential", 6 = "Don't know"*. The Kaiser-Meyer-Olkin (KMO) test to measure variance and assess suitability for PCA returned a value of 0.87 ('great' according to Kasier, 1974) and Bartlett's test of sphericity, which determines probability that there are significant correlations between at least some of the variables in the dataset, returned a value of X^2 (66) = 755, $p < .001$, indicating that correlations between items were sufficient to conduct a PCA. The PCA analysis scree plot (Figure 3.4) identified nine principal components to be dropped (scree) (Cattell, 1978) and three principal components with eigenvalues over Kaiser's criterion of 1 - which in combination explained 56.45% of the variance. The loadings indicate each variable's importance to the principal component, the larger the loading (+/-) the more important its presence or absence is. The negative loadings associated with the *Engaged stakeholders and policies* variables (Table 3.4) indicate that the absence of the variable would impact negatively on the success of a SAP.

Table 3.4. Summary of exploratory factor analysis for question 15: How do you rate the following in terms of their importance for influencing the successful implementation of Species Action Plans? Shaded cells show the groupings that came out of the factor analysis based upon each components highest factor loading (shown in bold).

	Rotated Factor Loadings from Pattern Matrix*		
Variable	***Key elements***	***Engaged stakeholders and policies***	***Leadership and management***
Having all relevant stakeholders involved	0.026	**-0.420**	0.291
Funding secured	**0.706**	-0.108	-0.393
Having sufficient expertise	**0.623**	0.048	0.025
Clear deadlines	**0.695**	-0.119	0.086
Clear responsibilities	**0.774**	-0.036	0.149
Clear and detailed actions	**0.659**	0.035	0.352
Legislation enforcing the plan	0.138	**-0.727**	-0.171
Government support	-0.049	**-0.818**	0.074
NGO support	0.023	**-0.777**	0.073
Private industry support	-0.045	**-0.752**	-0.052
Regular reviews and adaptive management	0.165	-0.237	**0.592**
An individual or organisation driving the implementation of the plan	0.087	0.001	**0.694**
Eigenvalues	4.48	1.29	1.01
% of variance	37.29	10.75	8.41
Cronbach's α	0.765	0.772	0.394

*Loadings (+/-) between 0.45–0.54 are considered fair, 0.55 to 0.62 are considered good, 0.63 to 0.70 are considered very good, and above 0.71 are considered excellent (Krishnan, 2016).

The three principal components identified important patterns in the data formed from combinations of the original variables (Table 3.4). The principal components were named based on responses and can be regarded as the three key elements required for implementing a SAP:

1. *Key elements*

This component included all the variables relating to deadlines, actions, funding, responsibilities and expertise - all of which are considered the core elements needed for effective SAP implementation (CMP, 2020).

2. Engaged stakeholders and policies

This component related to support from government, NGOs and private industry, as well as involvement of all relevant stakeholders and legislation to enforce the plan. The component takes into consideration all items that provide support for and influence the SAP implementation.

3. Leadership and management

The third component of 'Leadership and management' relates to the real drivers of the plan; the variables that relate monitoring the actions and targets and reviewing and adapting where necessary. Adaptive management and an individual or organisation driving the plan, were both seen as an "essential" component by over 40% of respondents.

All the groupings showed high reliabilities, Cronbach's α = > 0.70, except for leadership and management which had a low reliability, Cronbach's α = 0.394 (Table 3.4). This may indicate the scale used is not reliable, or that the value is low due to their being fewer variables (Cortina, 1993).

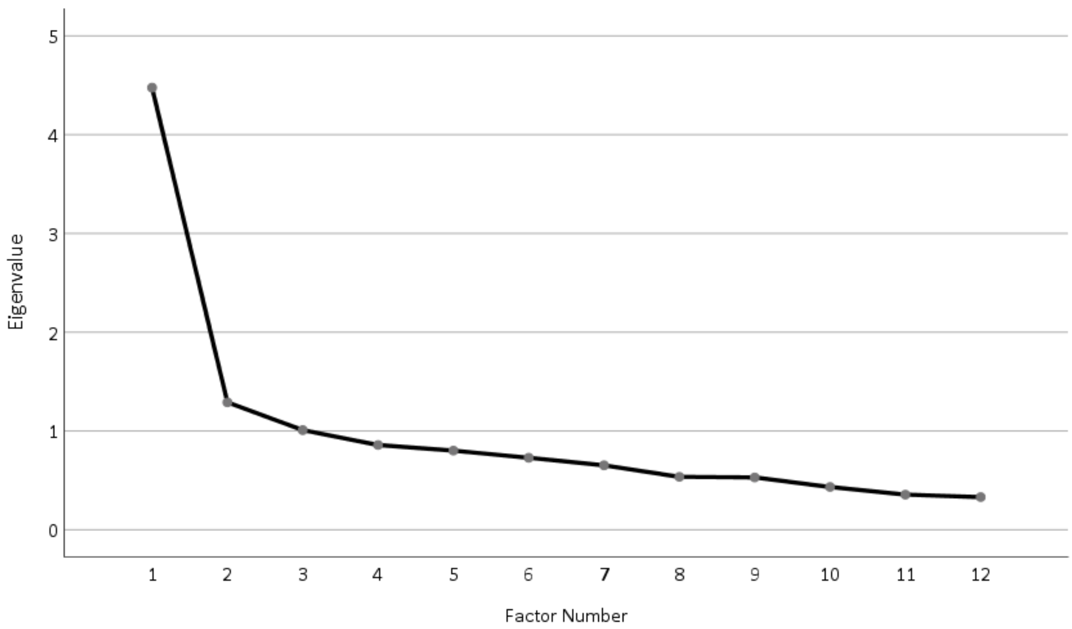

Figure 3.4 Scree plot of eigenvalues for the principal components for Q15: Important Components in the Implementation of Species Action Plans.

3.4.8 Qualitative Analysis

The answers received from the open-ended question "*What could be done to improve the implementation of Species Action Plans?"* were coded into themes using Nvivo software and are summarised in Table 3.5. The key themes that developed were focussed on Assigning Actions and Responsibly, Resources, Reviews & Adaptive Management, Policy & Legislation, and, Design & Creation.

Table 3.5. Themes and sub-themes created from open ended responses to *'What could be done to improve the implementation of Species Action Plans?'*

Theme	***No. of comments***	***Quotes***
Assigning Actions & Responsibilities	Total = 40	*"Successful implementation involves coordination from key stakeholders, proper socialization of the program, and continued monitoring of the progress and Actions accomplished. Establishing a set of deliverables and deadline is crucial, but these have to be flexible."*
Commitment & continuity	5	
Consequences for lack of action	5	
Follow up meetings	3	
Host a live plan online	1	
Key Lead and driver	8	
National co ordination	1	*"Choose a leader who coordinates all the actions and supervises every organisation or individual involved in them."*
Organisations overseeing actions	1	
Targets & Goals	4	
Coordinated approach	2	

Theme	***No. of comments***	***Quotes***
Resources Funding	Total = 27 21	*"Dedicated funding" "A great deal more staff and financial resources."*
Reviews & Adaptive Management Evaluation & Monitoring Lessons learned Update plans Use of evidence	Total = 21 5 1 1 1	*"Monitoring and evaluation processes are often discussed but rarely done with the frequency required for proper adaptive management. More focus needs to be placed on revisions of the strategy as key threatening processes change over time."*
Policy & Legislation Government Lead Planning	Total = 20 2 5	*"Communications to demonstrate the value of SAPs. In the UK, we need government to accept the value of SAPs (following reversal of position). Resourcing for groups to engage with SAP delivery. Resourcing for SAP co-ordination is critical."*
Design & Creation Interpretation Simplify and reduce length Species planning	Total = 16 3 1 3	*"Some species plans are too long and cumbersome and hence never get read. I also feel a lot of effort is often placed on producing the plan itself, but then tends to stop once the plan is out and published."*
Promotion, Awareness & Communication	10	*"Better promotion and awareness that they exist."*
Habitat approach, Links to other plans & projects	7	*"We need to be looking at networks of healthy habitats across landscapes which support a range of priority species. Sometimes focusing on one species to the exclusion of all else can be very damaging to other species / habitats. We need to be a lot more holistic about species conservation and work a lot more closely with those battling to save the habitats that those species require for their survival."*
Stakeholders Community involvement	Total = 5 2	*"Capacity-building at the local level to create local champions who can take ownership of implementation of the plan."*
Support & Advice Guidelines IUCN support	Total = 5 2 1	*"Improved skills and training in action planning"* *"A more clearly defined step by step guidelines for production."*
Data Sharing data	Total = 5 1	*"Encourage data sharing. Sometimes competition for funding leads to data hoarding. Also, open access publications. We need to foster collaboration. Essential for species conservation."*
Country specific	5	*"These have fallen out of favour in the UK and/or are not communicated well."*
Challenges	4	*"One challenge, not directly answering this question, is the need to make planning cheaper and quicker, so there is a reasonable prospect of the huge number of 'species that need SAPs' getting them. So, we need short-cuts, learning from planning for similar species. standardised threats, greater reliance on expert opinion, and conservation's willingness to take greater risks and try things: provided they have bought into adaptive management"*
General	4	*"Their use has declined in recent years. Producing SAPs as an activity needs to be revitalised as there are many threatened species with no plan, and many others with out-of-date plans. "*

3.4.9 Other Approaches

The main themes and sub-themes relating to other effective conservation approaches were Landscape Scale, Ecosystem Approach, Links to Habitat plans, Legislation & Regulation, Outreach & Education, Strong Partnerships & Coordination, and Research.

Table 3.6. Themes and sub-themes created from open ended responses to 'In the absence of Species Action Plans, which other approaches do you feel contribute to effective species conservation?'

Theme	*No. of comments*	*Quotes*
Landscape, Ecosystem Approach, Links to Habitat plans Habitat Conservation, Creation and Management	34 10	*"Habitat-focused conservation initiatives where the needs of species have been incorporated and responses and effectiveness are monitored 'e.g., Natural England's work dividing species into bespoke /mosaic /habitat-dependent classifications)."* *"Securing and managing habitats to mitigate threats to all taxa within the habitat whenever possible."*
Legislation, Regulation Offsetting Protected sites Protected Species Licencing	Total = 19 1 1 2	*"Monetising their conservation such as with EPS (European Protected Species)."* *"More emphasis in planning applications."*
Outreach & Education Good Media Public Profile Species Champions Social Change	Total = 17 1 2 1	*"Inform the national authorities and communities that could affect the species status with environmental education and propose conservation actions."*
Strong Partnerships & Coordination Multi institutional Partnerships Stakeholders	Total = 14 2 7	*"Generating coherent and effective partnerships with relevant stakeholders. Conservation measures need to have well defined roles of the stakeholders, actions, and associated deadlines, along with open and honest communication."*
Leadership Strong Organisational Lead Passionate Individuals Individual knowledge	Total = 13 6 5 2	*"Focussed, obsessed, like-minded groups or individuals! Because without some sort of structure, you will be doing it without any buy-in or support from central or local government and so it takes persistent and focussed individuals to persuade and influence the key stakeholders."*
Research Field research	Total = 6 1	*"The delivery of data from scientific works and their subsequent dissemination among the community."* Translated from Spanish
Simplistic form of SAP	7	*"Small ecology summaries for all protected / Red List threatened or worse status species which help officials who give out permits on the areas where these species live. These small summaries (~2 pages) would help a person to decide if a planned action might be harmful for the species."*
Funding & Resources	5	*"Adequate funding incentives for biodiversity conservation so that it is not seen as a 'cost'."*
SAPs are the best solution	5	*"I think that SAPs are an essential tool in species conservation."*
Specialist & Working Groups	4	*"The formation of a Taxon Management Group, or a Species Recovery Group, which includes representatives from all relevant stakeholders is a good substitute in the absence of an action plan."*
Knowledge Species Knowledge Knowledge sharing Managers having on the ground knowledge	Total = 3 1 1 1	*"Managers being close to the work on the ground and so understanding and being able to respond most effectively."* *"Local knowledge including sharing of local records and info on condition of key sites for species."*
Monitoring & Evaluation	3	*"Document what you try. Collaborate to maintain species level efforts (not just a population)."*
Status lists	3	*" IUCN Redlist assessment - local (National) red list assessment."*
Other Planning Tools	3	*"A new model of species conservation pioneered by organisations like The Species Recovery Trust".*

Theme	*No. of comments*	*Quotes*
Volunteers	2	*"Active local species groups based on conservation aims who are supported by NGOs/SAs and other organisations including private sector, who can help with funding for equipment, surveys and other activities, or can assist with landowner engagement etc."*
Objectives and Actions	2	*"The creation of cohesive objectives agreed on by both Governmental and non-Governmental stakeholders during planning meetings."*
Unplanned Approach	1	*"Any of the actions outlined in a plan can be carried out on their own in an uncoordinated manner, and this may be needed if there is no time to develop an action plan to prevent extinction. Sometimes taking this approach is the only option because there are not enough resources/time/ personnel to make the plan before a species will drastically decline or go extinct. I don't know what to call this approach, perhaps "last ditch effort"*

3.4.10 Evaluation and Monitoring

Sixty-seven respondents (31%) stated that they had used an evaluation or monitoring tool to assess the implementation of conservation actions. All 67 respondents listed the tool they used, the most frequent of which were: 'General surveys and population monitoring', and 'Regular reviews of actions and targets'. The only specific tools that were mentioned more than once were the Conservation Measures Partnership/ Open Standards and the BARS (Biodiversity Action Reporting System).

3.5 Discussion

This study gathered data from contributors, creators, and end users of SAPs with the aim of identifying the key components of SAPs and understanding how they are utilised and valued across the conservation and ecology sectors. Overall feedback from the survey shows a good deal of support for SAPs, but also criticism regarding the often-lengthy processes of creating them and frustration about how SAPs are undervalued and unsupported, particularly by governments.

3.5.1 Components of Species Action Plans

The survey findings and subsequent analysis in relation to SAP components and how they are valued produced four principal components that can be interpreted as the key components required in a SAP (Table 3.3). The first component, *Strategic action and threats* forms the bulk of the plan, with the second, *Species status* providing context and data. The third component, *Implementation, monitoring, and financial plans* is important in delivering the plan; however, its separate grouping indicates that perhaps it can stand alone as a follow up section or as a separate implementation plan. Such thinking was backed up by the comments received from survey respondents relating to a preference for separate implementation plans, and that funding was only seen as an essential part of a plan by 33% of survey respondents. Funding is unarguably needed for every plan, but the plan may need to be produced before funding is available. For example, a recent study into funding allocation indicates that focussing the majority of funding to research and monitoring rather than to direct action can lead to poorer recovery outcomes (Buxton *et al.*, 2020). Whilst it is important to know as much as possible about a species, it can be possible to focus too much on monitoring and too little on action (Lindenmayer, Piggott and Wintle, 2013).

Overall vision, although highly valued (in terms of participants' ratings on this item), came out as a separate factor. As discussed by Black (2015, 2021) and Englefield et al. (2019), the vision could be seen as the human inspiration aspect of a conservation plan – the component that tries to encompass all stakeholders' concerns and objectives (IUCN–SSC Species Conservation Planning Sub-Committee, 2017; CPSG, 2020). Although the vision may not be considered central to the mechanics of a plan, it has a direct influence on the overall direction of the conservation effort, and could be considered a key start point in any plan and a useful exercise for engaging stakeholders.

Whilst templates were utilised by many conservation practitioners to create SAPs, a standardised template is unlikely to be favoured across the sector. However, the key sections and components discussed are desirable in order to be able to evaluate a project effectively and keep track of outputs and outcomes.

3.5.2 Implementation of SAPs

The analysis of responses in relation to components that are important in the successful implementation of SAPs identified three components: (1) Key elements, (2) Engaged stakeholders and policies, and (3) Leadership and management. Arguably all these factors are essential for a SAP to be implemented successfully. However, the correlation matrix showed that component 2. 'Engaged stakeholders and policies' is negatively correlated with the other two components. This negative correlation is understandable given how the variables relate to each other i.e. components 1 and 3 are foundation elements that are, to an extent, within the control of the plan. Whereas external support and legislation falls into a different area of implementation i.e., stakeholder support, social factors and policy can be vital to get the project approved or gather key knowledge (Fox *et al.*, 2006; IUCN/SSC, 2008) even if the direct implementation and hard work does not always come directly from this.

3.5.3 What other approaches that contribute to effective species conservation?

The themes surrounding responses to this question (Table 3.6) show strong advocacy for a landscape, ecosystem approach. This is by no means a new concept and has been discussed and progressed in conservation management for some time (Simberloff, 1998) with many SAPs providing or establishing the biological framework for Habitat Conservation Plans (Crouse *et al.*, 2002). Tackling the conservation of multiple species and their habitat can bring greater benefits for biodiversity preservation (Machado, 2001), connecting SAPs to habitat and ecosystem plans has always been at the heart of their initial growth from the Convention on Biological Diversity (United Nations, 1993). This holistic approach will be vital to drive forward the goal of halting biodiversity loss and the growth of rewilding (Corlett, 2016; Jepson, 2016; Perino *et al.*, 2019).

Legislation was a strong theme arising from the survey data, particularly from respondents in countries without SAPs, or where SAPs do not form part of the legal system. Respondents (from the UK in particular) voiced frustration with regards to the lack of respect for and utilisation of SAPs. Although legislation does not guarantee action plans will be implemented, or that they will achieve their goals there is some evidence that legislation helps to deliver conservation action and there is benefit to SAPs having a legal basis (Machado, 2001). Two studies in the USA indicated that the Endangered Species Act (ESA), which generally requires listed species to have a Recovery Plan in place, has, and continues to make a difference (Crouse *et al.*, 2002). One of the studies estimated that the ESA helped to prevent the extinction for over 100 species (Schwartz, 1999) and clearer guidance created by government departments regarding the content of recovery plans has assisted in improving recovery (NMFS and FWS 2010, Malcom and Li 2018). However, it is unclear as to whether SAPs that are part of the legislative process led to better implementation and support than SAPs not supported by legislation.

3.5.4 Conclusions

Our mixed method approach to analysing the questionnaire data produced clear information on SAP structure and how SAPs are valued and utilised. The principal component analysis of the level of importance respondents put on different components, processes and issues revealed a clear focus of SAP content. Whereas the qualitative analysis of respondent's views led to an insight that enabled key concerns and recommendations to be revealed. As there may have been a UK bias in the responses, a targeted random sample may have led to a greater mix of responses from different countries. Face to face interviews were planned but were unable to be undertaken due to covid recommendations.

Some of the issues that were voiced in the questionnaire findings are not new, and conservation practitioners are expressing similar concerns that were raised in reviews undertaken over 20 years ago (such as those by Machado, 2001; McGowan, 2001; Brigham, Power and Hunter, 2002; Clark and Harvey, 2002). There have been recent improvements on a number of these issues, for instance there are now improved levels of guidance (The Conservation Measures Partnership, 2020) and support (CPSG, 2020). Although lack of evidence within plans and access to that evidence remains a barrier (Pullin *et al.*, 2004; Cvitanovic *et al.*, 2014), access to scientific evidence and literature (such as, conservation evidence and open access) is improving.

Concerns relating to SAPs and their time-consuming planning process, whilst plan specific, are also a universal problem. Steering away from trying to create a conservation manual, and towards reducing the content of SAPs based on individual needs could provide a solution. Most guidance is not designed to be prescriptive and producers of SAPs are encouraged to think about what is relevant and what is not (IUCN–SSC Species Conservation Planning Sub-Committee, 2017). For example, a vision can be vital in getting stakeholders to focus on a common goal, but where the stakeholders are already engaged this may not always be needed (CPSG, 2020). Threats, objectives and the necessary actions to achieve those objectives should be the primary purpose of a plan along with ensuring these actions are clear, feasible to implement, and evidence-based (McGowan, Garson and Carroll, 1998; Fuller *et al.*, 2003; Sutherland *et al.*, 2004; Stewart, Coles and Pullin, 2005). Focussing on these elements and creating separate implementation and monitoring plans could assist with reducing SAP size and the initial planning needed. Creating shorter plans that can be produced quickly can help to establish a baseline document to develop strategic action with stakeholders and guide management decisions - both of which are known to assist with species recovery (Pullin and Knight, 2003; Cook *et al.*, 2016; Lees *et al.*, 2021).

Issues relating to lack of plan ownership, accountability for actions, and how the policy and legislative process supports and endorses SAPs are difficult to address - particularly in countries where SAPs do not form part of policy and where SAP creation is reliant on volunteers. Short of convincing all governments to adopt policies on SAPs, there are some small actions that may assist. One example is ensuring SAPs are easily accessible and that future stakeholders and end users of the SAP are considered during the creation process. For instance, by including basic considerations for private organisations who may utilise SAPs to inform development mitigation (Figure 3.2). These were issues raised by practitioners in relation to development and planning and could provide a useful context for development and relevant contacts to liaise with will improve the utility of the plan, create greater awareness, and encourage communication. McGowan's (2001) review cited the lack of clarity on target audiences as one of the issues for preventing action, stating that different audiences will want different levels of information and that finding a one fits all approach is almost impossible (McGowan, 2001). With this in mind – taking account of the four key components for content and adapting them based on threats would seem a sensible approach.

Extensive amounts of time, expertise and knowledge have gone into the creation of SAPs across the world and these plans provide a baseline for species conservation and a great information resource. Creating a SAP for every species is not feasible or indeed necessary - there needs to be a prioritisation of which species are most in need and what are the most urgent actions required. This study showed that SAPs remain highly valued and relevant to conservation practitioners. Considering this and the key part SAPs play in the post 2020 biodiversity targets (SCBD, 2021) both national and local governments should play a greater role in enshrining them in policy and encouraging their consultation, particularly for development related threats and action prioritisation.

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3.7 Supplementary Information

Figure S1 Species Action Plan Questionnaire

University of Kent

Survey: Species Action Plans

About the Survey

This survey forms part of a PhD project being carried out within the Durrell Institute of Conservation and Ecology at the University of Kent, UK. The study focusses on understanding how Species Action Plans are developed, used, valued, and monitored.

Although some familiarity with Species Action Plans is necessary, you are not required to have any direct experience of creating Species Action Plans to complete the survey.

The survey should take between 10 and 15 minutes to complete depending on the detail of your responses.

The data is collected anonymously and will be used solely for the purpose of this study. You will be asked for some personal details, however these will be entirely confidential and your responses will be anonymised so they cannot be traced or attributed to you individually. The findings of this research will be published as part of a PhD thesis and within peer-reviewed scientific literature.

Participation is voluntary and you are free to stop completing the survey at any time.

Should you have any questions regarding the survey or its content please contact Gemma Harding via email at gh312@kent.ac.uk

1. If you are happy to complete the survey in line with the terms stated above, please consent by selecting **Yes**. Should you no longer wish to take part in the survey or give your consent please select **No** and you will be directed away from the survey. * ***Required***

○Yes ○No

CONTRIBUTION TO SPECIES ACTION PLANS

A Species Action Plan can be defined as a plan created to assist in the recovery and or conservation of a single species, species group or for multiple species within a habitat or region. For the purpose of this survey I will only refer to the term Species Action Plans, however please be aware that this term encompasses a variety of terms such as a Species Recovery Plan or Species Conservation
Strategy or Plan and Priority Species Plans linked to Biodiversity Action Plans and Ecosystem Plans etc. Other variations in terminology may also occur.

2. Have you created, or been involved in the creation of a Species Action Plan?

SPECIES ACTION PLAN DEVELOPMENT

3. If you answered Yes to question 2 please state in what capacity you have been involved in the creation of Species Action Plans. ***Select all that apply***

- ☐ As a lead author
- ☐ As a contributor
- ☐ As part of an organisation with action/ implementation responsibilities
- ☐ As an attendee of an action planning workshop
- ☐ As a workshop facilitator
- ☐ Other

3.a. If you selected Other, please specify:

4. How many Species Action Plans have you contributed to?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 or more
- ☐ 10 or more
- ☐ Don’t know

5. In relation to Species Action Plan creation/ contribution which species groups have you worked with? ***Select all that apply***

- ☐ Mammals
- ☐ Birds
- ☐ Reptiles
- ☐ Amphibians
- ☐ Fish
- ☐ Invertebrates
- ☐ Plants
- ☐ Other

5.a. If you selected Other, please specify:

6. Which of the following activities were undertaken during the creation of the Species Action Plans you were involved with? ***Select all that apply***

- ☐ Action planning workshop
- ☐ A working group was formed
- ☐ Group meetings were held
- ☐ The Species Action Plan was led by one individual
- ☐ Specific sections were drafted by different individuals
- ☐ Drafts of the species action plan were distributed for comment
- ☐ Other

6.a. If you selected Other, please specify:

7. Were any guidelines or templates used during the creation of the Species Action Plan?

- ☐ Yes
- ☐ No
- ☐ Don't know

7.a. If you answered Yes to the previous question please specify, if known, which guidelines or templates were used?

8. Were there any specific activities that were not included in the Species Action Plan creation that you feel would have benefitted the process? *Optional*

SPECIES ACTION PLAN USE

9. Have you referenced/ utilised Species Action Plans for your work (e.g. for research, conservation, planning)?

- ☐ Yes
- ☐ No

9.a. For which purpose did you utilise the Species Action Plan? *Select all that apply*

- ☐ To gather information on the species (ecology, distribution etc.)
- ☐ To inform conservation management actions for the species
- ☐ To inform mitigation measures for the species
- ☐ To create a successive Species Action Plan for the same species
- ☐ To produce a Species Action Plan for a different species
- ☐ To support an evaluation of a current or recent conservation initiative
- ☐ To assist a funding proposal
- ☐ Other

9.a.i. If you selected Other, please specify:

10. How important do you think Species Action Plans are in achieving effective conservation of species?

- ☐ Not important
- ☐ Somewhat important
- ☐ Important
- ☐ Very important
- ☐ Essential
- ☐ Don't know

11. Within species conservation planning, which of the following best describes your feelings about how much emphasis is given to Species Action Plans?

- ☐ Far Too Little
- ☐ Too Little
- ☐ About Right
- ☐ Too Much
- ☐ Far Too Much
- ☐ Don't know

12. Do you feel every endangered species should have a Species Action Plan created for them?

- ☐ Yes
- ☐ No
- ☐ Don't know
- ☐ Other

12.a. If you selected Other, please specify:

SPECIES ACTION PLAN COMPONENTS

13. Which do you think are the most important components to include in a Species Action Plan? *Please provide an answer for each line*

	Not important	Somewhat important	Important	Very important	Essential	Don't know
Overall vision	☐	☐	☐	☐	☐	☐
Species ecology	☐	☐	☐	☐	☐	☐
Species distribution	☐	☐	☐	☐	☐	☐
Population status	☐	☐	☐	☐	☐	☐
Relevant legislation (national and/or international)	☐	☐	☐	☐	☐	☐
Threats	☐	☐	☐	☐	☐	☐
Current conservation action	☐	☐	☐	☐	☐	☐
Actions	☐	☐	☐	☐	☐	☐
Prioritisation of actions	☐	☐	☐	☐	☐	☐
Actions assigned to a specific organisation/ person	☐	☐	☐	☐	☐	☐

	Not important	Somewhat important	Important	Very important	Essential	Don't know
Funding/ budget	☐	☐	☐	☐	☐	☐
An implementation plan	☐	☐	☐	☐	☐	☐
An evaluation and monitoring plan	☐	☐	☐	☐	☐	☐

13.a. Please specify any additional components you may feel are relevant and state the importance of each of your suggestions in line with the above scale (from 'Not important' to 'Essential'): ***Optional***

EFFECTIVENESS AND IMPLEMENTATION

14. Based on your personal experience, would you say Species Action Plans have a positive impact on species recovery?

- ☐ Yes
- ☐ No
- ☐ Sometimes
- ☐ Don't know
- ☐ Other

14.a. If you selected Other, please specify:

15. How do you rate the following in terms of their importance for influencing the successful implementation of Species Action Plans? ***Please provide an answer for each line.***

	Not at all important	Somewhat important	Important	Very important	Essential	Don't know
Having all relevant stakeholders involved	☐	☐	☐	☐	☐	☐
Funding secured	☐	☐	☐	☐	☐	☐
Having sufficient expertise	☐	☐	☐	☐	☐	☐
Clear deadlines	☐	☐	☐	☐	☐	☐
Clear responsibilities	☐	☐	☐	☐	☐	☐
Clear and detailed actions	☐	☐	☐	☐	☐	☐
Legislation enforcing the plan	☐	☐	☐	☐	☐	☐
Government support	☐	☐	☐	☐	☐	☐
NGO support	☐	☐	☐	☐	☐	☐

	Not at all important	Somewhat important	Important	Very important	Essential	Don't know
Private industry support	☐	☐	☐	☐	☐	☐
Regular reviews and adaptive management	☐	☐	☐	☐	☐	☐
An individual or organisation driving the implementation of the plan	☐	☐	☐	☐	☐	☐

15.a. Please specify any additional components you may feel are relevant and rate their importance in line with the above scale:

IMPROVEMENT OF SPECIES ACTION PLANS

16. What could be done to improve the implementation of Species Action Plans? ***Optional***

17. In the absence of Species Action Plans, which other approaches do you feel contribute to effective species conservation? ***Optional***

MONITORING AND EVALUATION OF SPECIES ACTION PLANS

- **Evaluation or Monitoring Tools** can be defined as a tool or process that monitors and or evaluates the outcome of a species action plan or conservation target. For example: using the Conservation Measures Partnership or the BirdLife Species Action Plan Tracking Tool.

18. Have you used an evaluation or monitoring tool to assess the implementation of conservation actions?

- ☐ Yes
- ☐ No

18.a. If you answered **Yes** please provide further information on which evaluation tool or monitoring method was used:

ADDITIONAL COMMENTS

19. Should you have any additional comments regarding **any aspect of Species Action Plans,** please add them here. ***Optional***

ADDITIONAL INFORMATION

20. What type of organisation best describes who you worked for when contributing to Species Action Plans? (*If this applies to more than one organisation please state most recent. If you have not contributed to Species Action Plans, please state your current employer).*

- ☐ Non-governmental organisation
- ☐ Government organisation
- ☐ Zoo, Aquarium or Wildlife Park
- ☐ University or Academic institution
- ☐ Private company
- ☐ Museum
- ☐ Other

20.a. If you selected Other, please specify:

21. Which of the following best describes your job role?

- ☐ Field Researcher
- ☐ Conservation Practitioner
- ☐ Animal Husbandry
- ☐ Conservation Scientist
- ☐ Professional Consultant
- ☐ Student
- ☐ Academic
- ☐ Volunteer
- ☐ Conservation Planner
- ☐ Government Officer
- ☐ Other

21.a. If you selected Other, please specify:

22. How many years have you worked in species conservation/ species research?

- ☐ 0-2 years
- ☐ 2-5 years
- ☐ 5-10 years
- ☐ 10-15 years
- ☐ 20 years plus
- ☐ Other

22.a. If you selected Other, please specify:

23. What is your Nationality?

23.a. If you selected Other, please specify:

24. Which region* is your work with protected species largely focussed? ***Select all that apply***

- [ ] Africa
- [ ] Antarctica
- [ ] Asia
- [ ] Caribbean Islands
- [ ] East Asia
- [ ] Europe
- [ ] Mesoamerica
- [ ] North & Central America
- [ ] North Africa
- [ ] North America
- [ ] North Asia
- [ ] Oceania
- [ ] South & Southeast Asia
- [ ] South America
- [ ] Sub-Saharan Africa
- [ ] West & Central Asia
- [ ] Other

24.a. If you selected Other, please specify:

Chapter 4. Factors influencing species reintroduction success and failure

4.1 Abstract

In this study I evaluate the aspects of species reintroduction that may influence success and how conservation practitioners measure reintroduction success. I analysed trends and reasons for failure and success across 341 reintroduction case studies from across the globe. I found that reintroductions in Africa were more likely to be scored at a lower success level when compared to East Europe, North & Central Asia; fish were more likely to be given a high success score when compared to invertebrates; and reintroductions involving zoos or aquaria were more likely to be given a low success score. Goals and Indicators did not appear to influence the success score, although results indicated that too many goals may have a negative influence on success. Qualitative analysis of the reason for failure and success showed that activities linked to Partnerships & Support (e.g. community support, government partnerships) were the most regularly cited reason for success and Habitat & Release site (e.g. poor habitat connectivity, lack of suitable release sites) were the most frequently cited reason linked to failure, or failed elements. I make some recommendations and observations based on our findings to improve the chances of reintroduction success. Our data also indicated that current conservation efforts follow a disproportionately high number of reintroductions for mammals and birds compared to other taxa, and the number of reintroductions in developed countries outweigh those of developing countries.

4.2 Introduction

In response to biodiversity loss, species reintroductions have continued to increase over recent decades and have now become an accepted management tool in species conservation often forming a key part of species action and recovery plans (Seddon, Armstrong and Maloney, 2007; Bubac *et al.*, 2019). Species action plans (SAPs) are enormously wide ranging and usually contain many conservation management actions and interventions. As there is no centralised assessment of SAPs, focusing on one intervention - in this case reintroduction, is a logical approach to understanding success levels. The purpose of this study therefore, is to contribute to the data on aspects of species reintroduction that may influence success, how conservation practitioners measure reintroduction success, and if this can be related to SAP outcomes and reviews. The term reintroduction is used to describe the intentional movement and release of an organism inside its indigenous range from which it has disappeared with the aim of re-establishing a viable population (IUCN/SSC, 2013).

Despite their growing application, species reintroduction remains challenging (Armstrong and Seddon, 2008; Linhoff *et al.*, 2021) and can often take years to plan. The core principles of planning and implementing a reintroduction involve (1) Planning (deciding on goals, objectives, actions, a monitoring programme and an exit strategy); (2) Feasibility (biological, ecological and social aspects, compliance with regulations and legal requirements, availability of resources); (3) Release strategies (finding suitable release sites, deciding on the best release protocols and stock); and (4) Monitoring and management (collecting data, habitat and adaptive management, responding to unexpected outcomes) (IUCN/SSC, 2013).

However, even when all of these stages and their components are met, many reintroductions fail or are unable to determine whether the intervention has been successful in enabling the sustained recovery of a population (Muths and Dreitz, 2008; Sutherland *et al.*, 2010). Whilst it is generally recognised that reintroductions are deemed successful after breeding in the wild is observed (White *et al.*, 2012; Harding, Griffiths and Pavajeau, 2016) or a viable population is established (Seddon, 1999; Germano and Bishop, 2009; IUCN/SSC, 2013), there are no clear definitions for success (Fischer and Lindenmayer, 2000). However, current guidance relates success to long term cyclical monitoring and, if necessary, regular adjustment until the goals of the reintroduction are met (IUCN/SSC, 2013; Taylor *et al.*, 2017).

Timescales and monitoring determine success, but protocols depend on the species and project goals. For example, for bird reintroductions it is recommended that monitoring is carried out for at least 5 years, and for between 10 and 20 years for longer lived species

(Sutherland *et al.*, 2010). For amphibians it has been recommended that in order to determine success, a population should be monitored for at least 10-15 years (Dodd, 2005). A study looking at the success of 42 amphibian reintroductions supported this suggestion by demonstrating that high levels of success were only seen in reintroduction programmes running for more than 7 years, with the majority of successful reintroductions having been in place for 10 years or more (Harding, 2014). The benefits of long-term monitoring are also reflected in bird reintroductions. The red kite *(Milvus milvus)* a relatively long-lived species, was first reintroduced in the UK in 1989. Despite successful breeding early on at some locations there remained problems at others (Carter and Newbery, 2004) and it was not until 30 years later, after 1,800 breeding pairs were established at numerous sites across the UK, that the reintroduction was cited as a success (RSPB, no date; Barkham, 2020; Evans, 2020). Such examples highlight the importance of long-term monitoring as well as the reality that initial signs of success do not always constitute population stability due to the population dynamics and ecology of each species.

There are an increasing number of reintroduction case studies available (Griffith *et al.*, 1989; Brichieri-Colombi and Moehrenschlager, 2016; Bubac *et al.*, 2019). Reviews looking at reintroduction outcomes have identified several factors relevant to success: release site, species diet, species status and numbers of individuals released *(*Griffith *et al.,* 1989*;* Wolf *et al.,* 1998; Fischer & Lindenmayer 2000; Bellis *et al.* 2019; Bubac *et al.,* 2019). These have highlighted failure to address threats (Fischer and Lindenmayer, 2000) and initial causes of decline, (Cochran-Biederman *et al.*, 2015; Bubac *et al.*, 2019) and funding dynamics (Ewen, Soorae and Canessa, 2014; Berger-Tal, Blumstein and Swaisgood, 2020) as the main causes of failure. Reviews that focussed on success outcomes were conducted using a variety of sources with no consistent level of assessment for success. Whilst some studies have focussed on taxa-specific issues of success (Cochran-Biederman *et al.*, 2015; Bellis *et al.*, 2019) and particular global regions (Resende *et al.*, 2020), there remains a gap in evaluating whether success can be compared or contrasted across taxa and geographical regions. Consequently, I analysed case studies to identify success factors and compare them to common variables (IUCN region, taxa, organisation) across case studies. I also undertook a mixed method approach to the analysis by conducting an assessment of both consistent quantitative data (common variables across the case studies) and qualitative data (practitioner comments and experiences).

Here, I use case studies from the IUCN Global Reintroduction Perspectives to analyse determinants of reintroduction success. Specifically, I ask:

1. What factors influence reintroduction success?
2. What are the most frequently cited reasons/ characteristics that relate to success and failure?
3. What are the most frequently cited reasons for assigning a particular success score?

4.3 Methods

4.3.1 Data Collection

Data were collected from the six editions the IUCN publication 'Global Reintroduction Perspectives' (Soorae, 2008, 2011, 2013, 2016, 2018). This data source offers the most comprehensive set of reintroduction case studies currently available, covering a variety of taxa and regions and assigning an overall success score for each reintroduction. The published case studies are submitted by practitioners on a standard template and are not subject to peer-review beyond that provided by the series editor. All the reintroductions were carried out for the purpose of species recovery and included reintroductions, and population reinforcement (IUCN/SSC, 2013).

The six publications comprise between 50 and 74 case studies per edition, giving an overall total of 351 published cases. The following data were extracted from each case study: species name, taxa, type of organisation(s), author affiliation, number of different organisations, country (filtered into IUCN region, (IUCN, 2019)), goals, indicators, success score, and if there was reference to a species action plan. Success scores were assigned by the authors of each study on a four-point scale: 1. Highly Successful, 2. Successful, 3. Partially Successful, and 4. Failure. The following qualitative data was extracted from each section of the case study: Project summary, Major Difficulties Faced, Major Lessons Learned, and Reasons for Success/ Failure.

4.3.2 Profile of Cases

Out of the 351 case studies, 11 were not included in the data analysis as the success score was either not given; irrelevant, or multiple scores were given for a single project. A further case study covered two species within one project and provided independent success scores for each, so it was considered as two case studies. This gave a total of 341 case studies that were included in the final analysis. Of these, 18 were amphibians, 63 birds, 34 fish, 27 invertebrates, 104 mammals, 59 plants and 36 reptiles. The studies covered eight different IUCN regions comprising 38 studies from Africa, 13 from East Europe, North and Central Asia, 19 from Meso and South America, 69 from North America and the Caribbean, 63 from Oceania, 48 from South and East Asia, 23 from West Asia, 67 from West Europe and one which crossed more than one IUCN region. Success scores are assigned to the case studies by the authors themselves; of the 341 studies reviewed, eight were recorded as Failures, 131 as Partially Successful, 133 as Successful and 69 as Highly Successful.

4.4 Data Analyses

4.4.1 Quantitative

Exploratory tests to identify trends and relationships between the common variables and success were undertaken using Kruskal-Wallis tests and in R 3.5.3 (R Core Team, 2019) and post-hoc comparison using the 'kruscalmc' command in the 'pgirmess' package (Giraudoux, 2018). To explore relationships further and to establish factors influencing success levels assigned to the reintroduction projects, I ran a multinomial linear regression model using 'multinom' command in the 'nnet' package in R (Venables and Ripley, 2002). Success score was the dependent variable in our model, predicted by the variables: Taxon, IUCN Region, Goals, Indicators, and Type of organisation. These variables were chosen as they were the most consistently reported data for each case study. An additional consistent variable: 'Number of different organisations' was included in an earlier model but as the results indicated multicollinearity after a variance inflation factor (VIF) analysis was carried out (Zuur et al. 2010). The results showed the multicollinearity between the 'number of organisations' and 'types of organisations' were too high, and as number of different organisations showed the highest VIF this was taken out and the model was run again without it. Odds ratios from the model output were used to assess the importance of each potential predictor.

As only eight projects were classed as failures (according to the IUCN publication's defined success score scale) the overall distribution of scores (and therefore cases) resulted in some poorly fitting models. Therefore, models and some comparative analyses were undertaken without the case studies scored as failures to avoid the small sample size influencing the data and outputs.

4.4.2 Qualitative

The data were imported into NVivo 12 Pro (QSR International Pty Ltd., 2018) for coding and analysis. Open ended questions relating to the reasons given for success and failure of the reintroduction project were analysed and coded into relevant recurring themes using thematic analysis. Thematic analysis is a method that identifies patterns of meaning (themes) within qualitative data, allowing analysis through the common themes (Clarke and Braun 2017). Some responses from 'lessons learned' and 'difficulties faced' sections were also coded where relevant additional information was provided. An initial coding framework was developed based on known and common reasons for success and failure. This was then expanded with new codes and subcodes created from emerging themes during the coding process. Themes were then refined and organised to create consistency and merge duplicates. Additional codes were created for success and failure ratings to identify the most frequent reasons given. These were taken from reasons for success/ failure rather than an analysis of the objectives.

4.5 Results

4.5.1 Success and Taxa

Success scores were collated and divided by taxon (Figure 4.1) which showed that across 341 reintroductions, fish had the highest percentage of highly successful projects (26%, n=9) and birds had the highest percent of projects classed as failures (8%, n=5). Success levels were significantly affected by the taxon involved when failures were included ($H(6) = 14.372$, $p = 0.026$); and excluding failures ($H(6) = 11.812$, $p = 0.066$). Post-hoc comparisons did not show any taxon to be significantly different from any other.

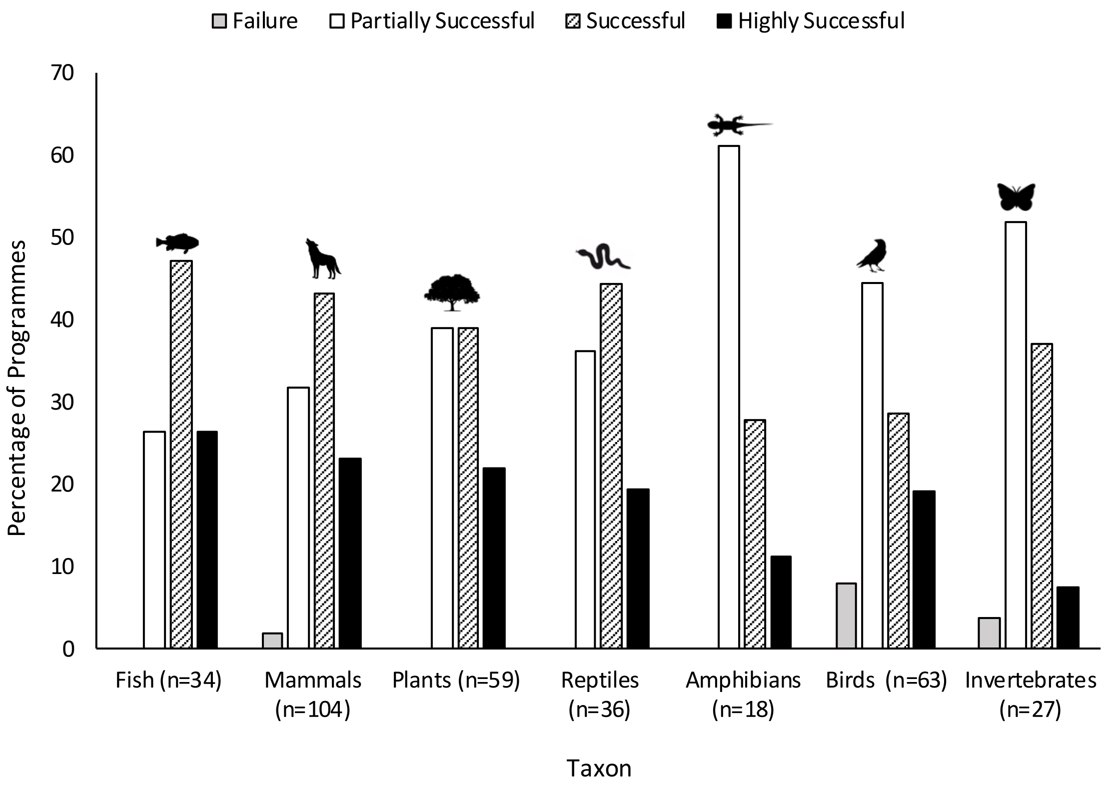

Figure 4.1 Success categories according to taxa, as assigned by the authors of the case studies (n= number of case studies from the taxon).

4.5.2 Success and Regions

Success scores were compared across the different regions. The greatest percentage of highly successful and failed reintroductions both came from East Europe, North & Central Asia (Figure 4.2). However, IUCN region did not appear to affect the success level overall (including failures H (7) = 5.0, p = 0.660; excluding failures H (7) = 6.519, p = 0.481).

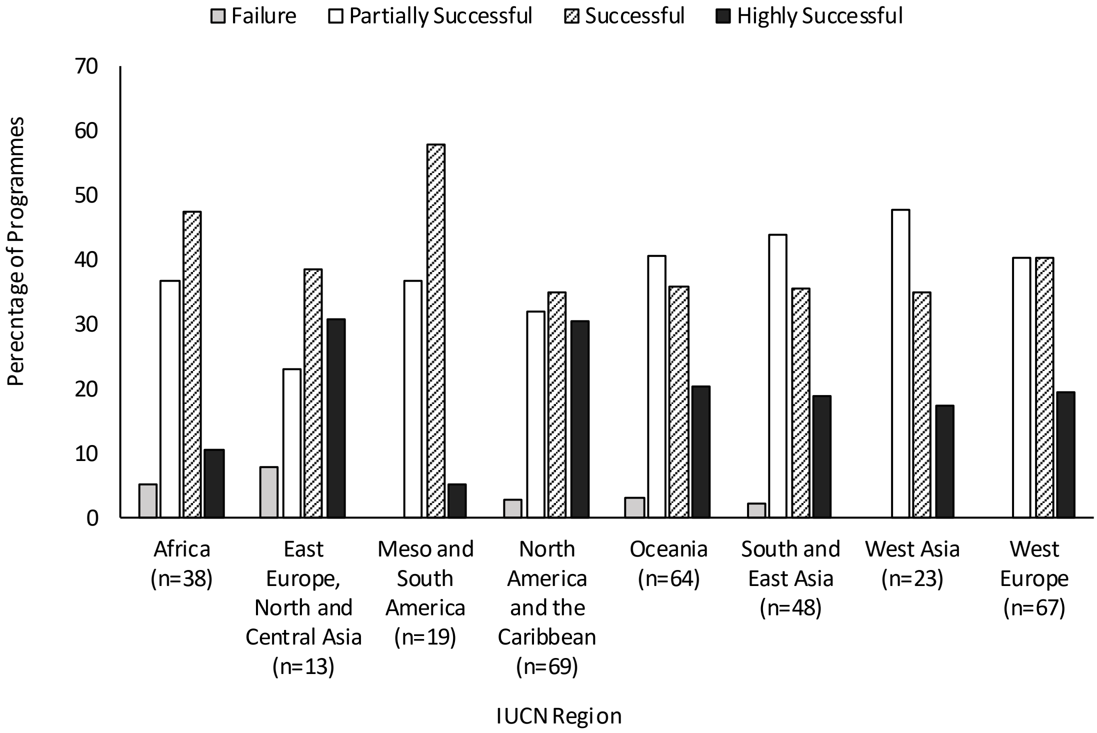

Figure 4.2 Success categories by IUCN Region, as assigned by the authors of the case studies (n= number of case studies from the IUCN region).

Type of Organisation

The type(s) of organisation involved in each case study was identified indirectly using the organisations to which each author was affiliated with the assumption being that each author's listed affiliated organisation reflects the institutions involved in the reintroduction work. Government agencies were involved in 50% of the 341 reintroduction projects studied, whilst zoos and aquaria were involved in 24% (Figure 4.3). Success levels were similar for all organisations except for Zoos and Aquaria which saw a higher percentage of partially successful projects and a lower percentage of successful projects although this was not significant ($H(3)$ = 2.8513, p = 0.4151).

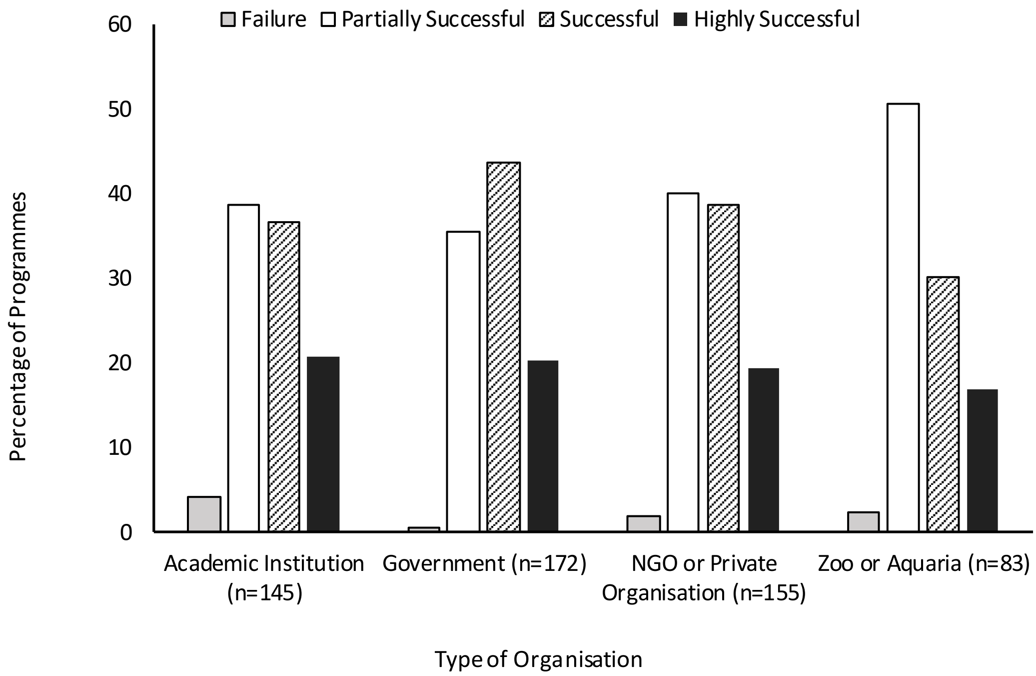

Figure 4.3 Success categories in relation to type of organisations based on authors' affiliated organisation, as assigned by the authors of the case studies (n= number of case studies from the organisation).

4.5.3 Success and Number of Organisations

No significant relationship was shown between the different number of contributing organisations and programme success levels (Figure 4.4), (*H* (2) 0.6102, p = 0.7371 *H* (3) = 8.4022, p=0.038.)

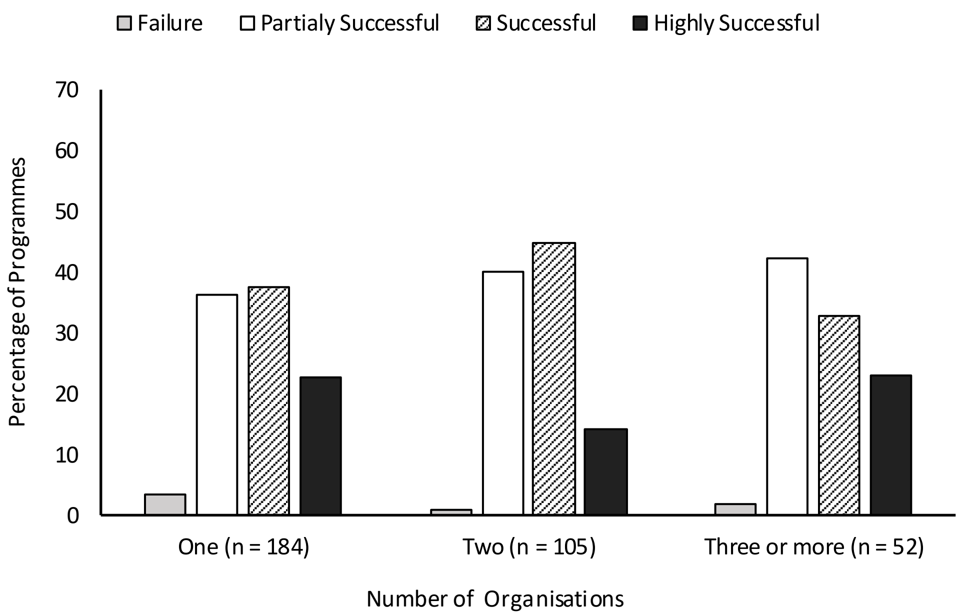

Figure 4.4 Success categories in relation to number of organisations based on authors' affiliated organisation, as assigned by the authors of the case studies.

4.5.4 Success and Number of Goals

The number of goals set within a project ranged between 1 and 8 with a mean of 3.8 goals set (Figure 4.5). Although a trend was seen relating to increasing number of goals and initial increased success, followed by decreased success after 5 goals this was not significant ($H(4) = 1.3627$, $p = 0.8507$).

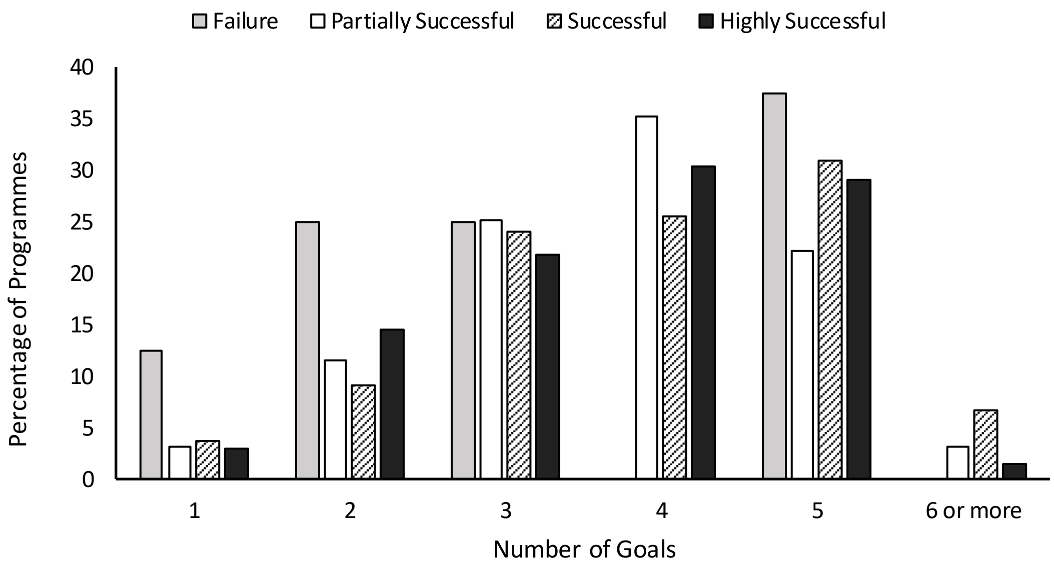

Figure 4.5 Success categories in relation to number of goals set, as assigned by the authors of the case studies.

4.5.5 **Success and Number of Indicators**

The number of indicators used ranged between 0 and 10 with a mean of 3.9 indicators created (Figure 4.6) (H (4) = 2.5987, p = 0.6271).

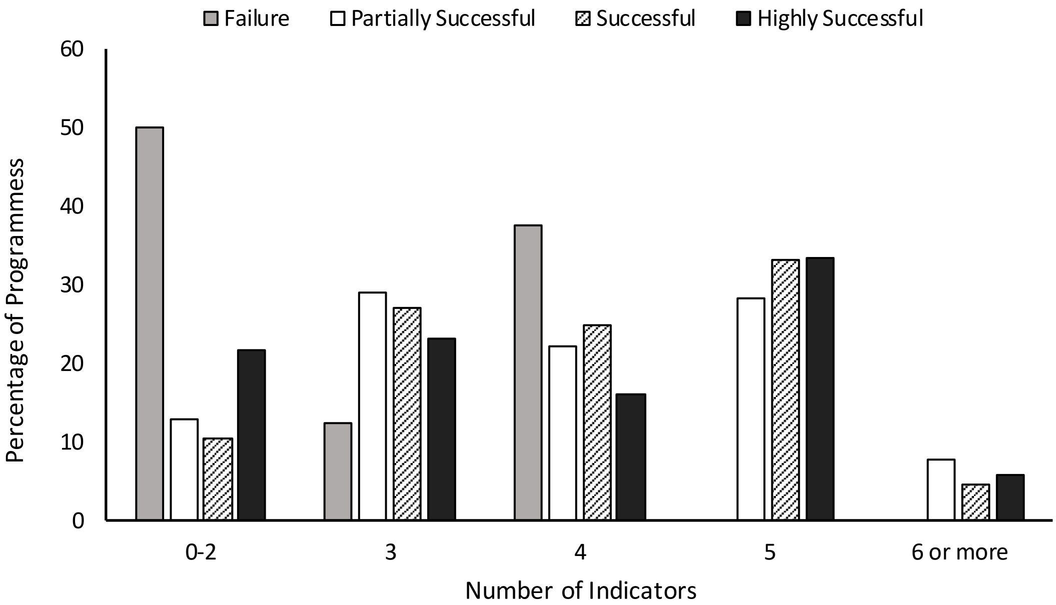

Figure 4.6 Success categories in relation to number of indicators set, as assigned by the authors of the case studies.

4.5.6 SAPs and Success

Species action plans relating to the reintroduction were mentioned in 101 of the case studies. However, as it was not possible to confidently conclude that the other reintroduction case studies did or did not have an associated SAP, it was not possible to establish if the presence of a SAP was a potential factor in success. Of the 101 case studies that referenced SAPs the number scored as failure was 2 (25%), partially successful 37 (28%), successful 44 (33%) and highly successful 18 (26%). Sixty-eight of the 77 SAPs that were reviewed (Chapter 2) had reintroduction as an objective. Seven did not mention reintroduction at all, one listed reintroduction as a low priority action and one listed reintroduction as an action in relation to development mitigation only.

4.6 Multinomial logistic regression results

Using multinomial logistic regression analysis, I examined the odds of a reintroduction being scored 'successful' or 'highly successful' when compared to the base category of 'partially successful' (Table 4.1). Failures were not included in this analysis as there were too few cases to fit the model.

Having a zoo or aquarium involved in the reintroduction significantly predicted if the reintroduction was scored as partially successful or successful. If a reintroduction involved a zoo or aquaria, it was more likely to be scored as partially successful than successful.

When compared to fish, reintroductions involving invertebrates were shown to be more likely to be scored as partially successful rather than highly successful. Similarly, when compared to East Europe, North & Central Asia, reintroductions in Africa were more likely to be scored at a lower success level.

Table 4.1 Multinomial logistic regression output table (Residual Deviance: 659, AIC: 739) *<0.05

		95% CI for odds ratio		
	B (SE)	***Lower***	***Odds Ratio***	***Upper***
Successful against a base category of Partially Successful				
Taxa: Fish set as the reference category				
Intercept	0.86 (1.0)	0.301	2.4	18.45
Amphibians	-1.0 (0.72)	0.090	0.37	1.51
Birds	-0.94 (0.55)	0.132	0.39	1.15
Invertebrates	-0.92 (0.62)	0.119	0.40	1.33
Mammals	-0.045 (0.51)	0.351	0.96	2.60
Plants	-0.4 (0.54)	0.231	0.67	1.94
Reptiles	-0.025 (0.59)	0.304	0.97	3.12
IUCN Region: East Europe, North & Central Asia set as the reference category				
Africa	-0.74 (0.87)	0.087	0.48	2.63
Meso and South America	-0.34 (0.93)	0.114	0.710	4.43
North America and the Caribbean	-0.71 (0.84)	0.094	0.49	2.54
Oceania	-0.9 (0.84)	0.078	0.41	2.13
South and East Asia	-1.2 (0.85)	0.055	0.29	1.57
West Asia	-1.5 (0.95)	0.034	0.22	1.40
West Europe	-0.74 (0.83)	0.094	0.48	2.41
Indicators	-0.062 (0.13)	0.735	0.94	1.20
Goals	0.212 (0.12)	0.968	1.2	1.58
Zoo/ Aquaria	**-0.78 (0.32) ***	0.244	0.46	0.86
Academic	-0.27 (0.29)	0.428	0.76	1.354
NGO/ Private	0.12 (0.29)	0.502	0.89	1.56
Government	0.39 (0.28)	0.844	1.5	2.56
Highly Successful against a base category of Partially Successful				
Taxa: Fish set as the reference category				
Intercept	1.41 (1.2)	0.412	4.1	40.76
Amphibians	-1.4 (0.94)	0.037	0.24	1.51
Birds	-0.67 (0.63)	0.149	0.51	1.75

		95% CI for odds ratio		
	B (SE)	*Lower*	*Odds Ratio*	*Upper*
Invertebrates	**-2.02 (0.91) ***	0.022	0.13	0.79
Mammals	0.144 (0.58)	0.368	1.15	3.63
Plants	-0.5 (0.62)	0.179	0.61	2.07
Reptiles	-0.239 (0.70)	0.198	0.79	3.13
IUCN Region: East Europe, North & Central Asia set as the reference category				
Africa	**-2.03 (1.01) ***	0.018	0.13	0.95
Meso and South America	-2.64 (1.36)	0.005	0.071	1.02
North America and the Caribbean	-0.48 (0.88)	0.110	0.62	3.49
Oceania	-1.1 (0.90)	0.056	0.33	1.93
South and East Asia	-1.6 (0.92)	0.034	0.21	1.26
West Asia	-2.0 (1.05)	0.018	0.14	1.10
West Europe	-1.16 (0.89)	0.055	0.31	1.79
Indicators	-0.145 (0.15)	0.639	0.86	1.17
Goals	0.079 (0.15)	0.803	1.1	1.46
Zoo/ Aquaria	-0.63 (0.39)	0.245	0.53	1.15
Academic	0.12 (0.36)	0.442	0.89	1.78
NGO/ Private	-0.16 (0.35)	0.427	0.85	1.69
Government	0.20 (0.34)	0.620	1.2	2.39

4.7 Qualitative Analyses

The qualitative analysis showed that the same themes were related to both success and failure. A Pareto analysis (Juran, 1989) of success and failure shows that 80% of the reasons given for successful projects are covered by just a few of the themes, many of which cross over with reasons for failure (Table 4.2).

Table 4.2 Reasons given as contributing to success and/ or failure in the reintroduction programmes

Theme contributing to Success or Failure	No. of programmes reporting theme as a reason for Success	No. of programmes reporting theme as a reason for Failure
Partnerships & Support	157	8
Active Management	83	17
Habitat & Release site	80	48
Resource & Funding	73	37
Planning & Feasibility Studies	70	19
Data & Knowledge	55	20
Stakeholders & Community	51	16
Release & Methods	46	5
Captive breeding & Rehabilitation Methods	43	9
Monitoring	41	8
Species Specific Issues (behaviour)	40	15
Founders & Genetics	35	9
Adaptive management	24	1
Staff (relations, attitude & leadership)	21	1
Long term Commitment or Long running project	20	18
Threats	8	2
Predation & Competition	5	17
Weather Events & Conditions	4	15

Theme contributing to Success or Failure	No. of programmes reporting theme as a reason for Success	No. of programmes reporting theme as a reason for Failure
Legislation & Politics	2	12
Human-wildlife conflict (controversial species)	1	14
Animal health	0	10
Mortality	0	9

4.7.1 Reasons for Success

The theme of 'Partnerships & Support', which included community, government support and partnerships, was the most frequently cited reason for a reintroduction being considered successful. 'Active Management' (e.g., supplementary feeding, predator control and habitat enhancement) and 'Habitat & Release Site' (e.g., site selection, quality of habitat and release site within native range) were the next most frequently cited themes, closely followed by 'Resource & Funding' (e.g., staff, facilities, and adequate funds) and 'Planning & Feasibility Studies' (e.g., pilot studies, protocols, and modelling).

4.7.2 Reasons for Success in relation to Taxon and IUCN Region

Reasons relating to the themes 'Partnership & Support' and 'Active Management' were most frequently cited for mammal reintroductions and reintroductions in North America and the Caribbean. In contrast, 'Habitat & Release Site' was most frequently cited for Mammal and Plant reintroductions and reintroductions in Oceania and West Europe. Highly Successful reintroductions involving Fish, which had the most success overall, frequently cited Partnership & Support as a reason for success and included the following examples:

> **European mudminnow *(Umbra krameri)* reintroduction in East Europe.** *Extensive collaboration among different NGOs–(e.g. Tavirózsa and Nimfea A–sociations - Hungary, Umbra Association - Slovakia), Directorates of National Parks, Universities, authorities and Government Institutes, Local government of Szada village, "VITUKI" Institute (ceased operation from 2012) and media (national and local TVs, radios, gazettes etc.).*

> **Cutthroat Trout (*Oncorhynchus clarkia*), USA.** *An effective collaborative partnership between private conservation organizations and public resource management agencies created a shared vision, spread financial obligations, and pooled resources.*

4.7.3 Reasons for Failure

'Habitat & Release Site' were the most cited reasons for failed or partially successful reintroductions. This included reasons such as; lack of roosting features for birds, poor connectivity for frogs, and lack of suitable release sites for gibbons. 'Resource & Funding' was the next most common and included lack of or exhaustion of funds, costs being higher than anticipated, no premises on site or additional facilities being required. The third most frequent theme cited in relation to failure, or failed elements was insufficient Data & Knowledge (e.g., lack of expertise, more research needed).

4.7.4 Reasons for Failure in relation to Taxon and IUCN Region

'Habitat & Release Site' was most cited by Birds and West Europe in relation to failure. 'Resource & Funding' was most frequently cited for plant reintroductions and reintroductions in South and East Asia. Data & Knowledge was most frequently cited for mammals and South and East Asia. Failed reintroductions for Birds, which had the most failures overall, included the following statement in relation to Habitat & Release Site:

> **White-headed duck (*Oxyura leucocephala*), Hungary.** *The release sites were not suitable. Lake Péteri was not a past breeding site for white-headed duck and, moreover, it is a fishing area with human disturbance. Lake Kondor had been largely dry for several years before the reintroduction, and there may not have been enough food for a species preferring eutrophic, productive habitats.*
>
> **Northern aplomado falcon *(Falco femoralis septentrionalis),* USA.** *Habitat, as defined by prey populations and the abundance/distribution of predators, was of insufficient quality.*

4.7.5 Success Rating

Most programmes considered success to be achieved when natural recruitment or breeding had occurred, or when reintroduced species had survived in the wild (Table 4.3).

Table 4.3 Reasons given for considering a reintroduction, or part of a reintroduction a success

Reason Given for Success Rating	No. of programmes stating as a contributing reason
Natural recruitment/breeding	95
Present/Surviving in wild	57
Captive breeding or animal transit success	37
Population increasing	26
Population established	25
High survival or Low mortality	18
Goals and Indicators Met	17
Useful data & protocols created	17
Increased species range	15
Successful release	13
Good health in wild	11
Normal behaviour post release	10
Research published/created	10
Wild and released animals mixing	7
Socio economic benefits	6
Improvement to Biodiversity	6
Raised awareness	5
Breeding behaviour observed	5
Species threatened status down listed	4
Sexual maturity reached	4
Natural dispersal had occurred	4
Good health/ surviving in captivity	3
Increased genetic diversity	3
Species saved from extinction	3
No serious conflict with other wildlife or livestock	3
No human assistance in wild required	2
Conservation strategy implemented	2
Trophic chain restored	2
No signs of inbreeding	2
Noted Success (external public media)	1
Re-established following extinction	1
Award Winning	1
No adverse impact on existing ecosystem	1

4.7.6 Failure Rating

Most programmes gave 'no or low survival' or 'goals not yet met', as the reason they did not consider a project to be highly successful (Table 4.4). Sixty-three programmes, despite giving a score, acknowledged that it was too early to assign success or failure to a project.

Table 4.4 Reasons given for considering a reintroduction or part of a reintroduction to be of lower success

Reason Given for Failure Rating	No. of programmes stating as a contributing reason
Low survival	15
Goals not met	8
Reintroduction failed or partially failed	6
No breeding observed	5
Limited evidence of survival	4
Population unstable	4
Viable metapopulations yet to be established	3
Population not yet viable	2
Population supplementation still required	2
Low reproduction	1
Released animals have not joined wild population	1
Poor dispersal/colonisation	1
Released animals not yet free ranging	1
Slow growth rate of population	1
Species still declining	1
Wild population not increased	1

4.8 Discussion

Species reintroductions can be a valuable tool for conserving and restoring populations of endangered or extinct species. While success rates for species reintroductions vary, several factors such as habitat quality, partnership and support, and the availability resources, can influence the outcome. The results also suggest the relative success of reintroductions can be influenced by taxa, geographical region, project goals, and the types of organisations involved.

4.8.1 Relevance of taxa

Fish were the most successful taxa overall and birds had the highest number of failures. Success scores varied significantly between taxa and there appear to be differences in the factors relating to the success of reintroductions for different taxa.

A previous study of 260 fish reintroductions found that the species' intrinsic characteristics were not a crucial factor in their success (Cochran-Biederman *et al.*, 2015). Similarly, reintroductions in our data that involved fish were generally more reliant on factors that fell into the themes of ‘Partnership & Support’, ‘Stakeholders & Community’, and ‘Active Management’, and did not depend so heavily on factors relating to 'Habitat & Release Site’ or species-specific issues. Generalist species with broader niches are likely to be less complex and more responsive to general best practice recommendations (IUCN/SSC, 2013). In contrast, reintroduction efforts involving taxa that tend to have complex social structures, such as mammals and birds, often need to consider additional measures, such as pre-release training, enrichment and supplementary feeding (White *et al.*, 2012; Reading, Miller and Shepherdson, 2013; Berger-Tal, Blumstein and Swaisgood, 2020).

Twenty-one of the case studies that involved mammals or birds stated that the resilience or adaptability of the species was a reason for success. Part of the reasoning for this may be that with endangered mammals and birds, clutch sizes are generally small and it is not feasible to release large numbers. In the absence of a high initial release population, success rates can be lower (Fischer and Lindenmayer, 2000; Germano and Bishop, 2009) and mortality a major issue. In the case of reintroductions, species with a high degree of resilience, and adaptability are more likely to be successful in establishing a viable population in their new environment (Sarrazin and Barbault, 1996; IUCN/SSC, 2013). Whilst other behavioural traits can put an individual at greater risk. One example involving the reintroduction of the swift fox (*Vulpes velox*) found that released individuals that showed greater boldness (lack of fear) in captivity were less likely to survive and thus less suited for release (Bremner-Harrison, Prodohl and Elwood, 2004). Consideration of such traits is crucial to ensure species can overcome the challenges of their new habitat, such as finding food and mates, avoiding predators (Kaye, 2009; Houde, Garner and Neff, 2015).

Whilst reintroductions involving mammals and birds may appear to have more complexities relating to conditioning and social structure, there remains a positive bias towards them, that has been observed within conservation reintroductions over many decades (Seddon *et al.*, 2005; Bubac *et al.*, 2019). Thirty percent of the case studies I reviewed involved mammals and 18% birds, whilst these ratios are not high compared to previous reviews which reported >40% for mammals and >30% for birds (Fischer and Lindenmayer, 2000; Seddon *et al.*, 2005; Resende *et al.*, 2020) the bias continues to be an issue within conservation management and prioritisation.

4.8.2 Relevance of IUCN Region

From the case studies analysed, almost 60% came from the largely developed regions of North America and the Caribbean, West Europe, and Oceania. This is a trend that has continued for many years (Seddon *et al.*, 2014; Bubac *et al.*, 2019; Resende *et al.*, 2020), with higher numbers in developed regions likely driven by tougher conservation legislation, better access to funding, and the fact that programmes from developed regions typically also include species threatened at a national rather than global level (Seddon *et al.*, 2005; Brichieri-Colombi and Moehrenschlager, 2016; Bubac *et al.*, 2019). Although developed regions had the highest numbers of reintroductions in our dataset, they did not show the highest numbers of failures, in fact they had some of the lowest. For North American reintroductions this may follow a trend noted in previous studies (Fischer and Lindenmayer, 2000; Brichieri-Colombi and Moehrenschlager, 2016) where very few reintroductions are considered failures, or are reported as such. However for Oceania this may be a change in trend: as Fischer & Lindenmayer (2000) reported that a high number of failures were published for reintroduction projects in Oceania. Suggestions for this bias towards reintroduction success, particularly in developed regions, has been linked to the tendency of developed regions to focus on IUCN low risk species which in turn tend to have a lower rate of failure (Bubac *et al.*, 2019), and inconsistencies relating to definitions of success (Fischer and Lindenmayer, 2000; Miller, Bell and Germano, 2014).

The model output showed Africa to be significantly less likely to be highly successful when compared to East Europe, North & Central Asia - which had the most success overall. Qualitative analysis showed that factors relating to 'Resource & Funding', and 'Species Mortality' were the main reasons for low success in Africa, whereas higher levels of success in the region were mostly attributed to factors relating to 'Partnership & Support'. Current and future reintroductions in Africa could therefore be supported by focussing on known success factors such as partnerships and support and ensuring adequate resources and funding is in place.

4.8.3 Goals and Indicators

Conservation management theory suggests that clear short-term goals are important to success (Black, Groombridge and Jones, 2011), but where multiple goals and associated indicators occur, they can often compete, causing 'goal-displacement' which can undermine commitment and make monitoring unfeasible, confounding best efforts to succeed (Dalton and Spiller, 2012; Ewen, Soorae and Canessa, 2014; Hunter *et al.*, 2020). The data from our study suggests a discrete number of goals (from 2 to 4 per project) appear to be most useful, and less useful once they exceed 5. Establishing which goals to prioritise can be a challenge, but other studies have shown decision analysis techniques and tools can support this process (Ewen, Soorae and Canessa, 2014; Hunter *et al.*, 2020), and that aligning goals and indicators to non-biological components, such as funding and partnerships, would be beneficial (Ewen, Soorae and Canessa, 2014).

4.8.4 Number and type of Organisation involved

Results of our analysis indicated that the involvement of zoos and aquaria was associated with lower success and the involvement of government was associated with higher success. This may have historical origins, particularly where zoo involvements were focused on ex-situ elements with perhaps less consideration of in-situ conservation (Stanley Price and Fa, 2007; Gilbert *et al.*, 2017). However, since the first World Zoo Conservation Strategy in 1993, zoos have had increasing levels of commitment and involvement in the conservation of threatened species (Mace *et al.*, 2007; Stanley Price and Fa, 2007; Gilbert *et al.*, 2017). It is therefore perhaps more likely that lower levels of success linked to zoos are due to their involvement in riskier projects often involving captive bred animals and more threatened and less- charismatic species (Gilbert *et al.*, 2017). Riskier projects carry a higher risk of failure for which zoos are conscious of the importance of reporting. In contrast, governments may be more conservative, focussed on projects with wider public support, greater possibilities of success, and possibly sensitive to the political implications of reporting failures. Partnerships between organisations and stakeholders can be a key factor in reintroduction success (Kleiman, Stanley Price and Beck, 1994), our results showed that the number of organisations involved in a SAP had no significant influence on success.

4.8.5 Reasons attributed to success

The qualitative analysis of the case studies (Table 4.2) forms a narrative from a diverse range of practitioner perspectives that describes the issues that arise when reintroduction projects are reviewed post-hoc by their managing teams. The two most frequently cited reasons are discussed in detail below.

Reasons related to the 'partnership & support' theme were most frequently attributed to success. Most of these were focussed on community support, with examples such as active engagement, the forming of specialist groups, and the involvement of private landowners – all topics of which are frequently discussed in reintroduction literature (Lopes-Fernandes, Espírito-Santo and Frazão-Moreira, 2018; Auster, Barr and Brazier, 2020; Hawkins *et al.*, 2020). This theme also captured the importance of partnerships and good working relationships with the private sector, government, NGOs, volunteers and the media, something that is discussed less frequently within reintroduction literature (Westrum and

Clark, 2014) but has emerged as key to this theme. The establishment of relevant and productive partnerships with a clear decision making structure is perhaps the strongest foundation for any reintroduction initiative (Kleiman, Stanley Price and Beck, 1994; Black and Groombridge, 2010)().

The next most frequently cited reasons for success were those linked to the 'active management' and 'habitat & release site' themes - which are often considered the building blocks to reintroduction success (Cheyne, 2006; Vaissi *et al.*, 2019; Berger-Tal, Blumstein and Swaisgood, 2020). The most quoted sub-categories given in our dataset in relation to habitat were; good availability and quality of habitat, and increased site protection. In relation to active management; habitat enhancement and control of predators and alien species were the sub-categories most frequently linked to success. Ensuring these habitat elements are correct at the planning and feasibility stage and allowing resource for long term management can, in many cases, improve reintroduction success (Cheyne, 2006; Moorhouse, Gelling and Macdonald, 2008; Ewen *et al.*, 2012; Albrecht and Long, 2019).

4.8.6 Reasons attributed to failure

Reasons relating to inadequacies in the habitat & release site were most frequently associated with failure or failed elements. This is unsurprising given that habitat management and suitability are a frequently reported issue for lack of success in many reintroductions (Cheyne, 2006; Moorhouse, Gelling and Macdonald, 2008). What was perhaps surprising, was the number of reintroductions within the study that reintroduced species without considering habitat quality or securing long term funding to maintain suitable habitat. Such an oversight may be due to lack of ecological knowledge or access to expertise, a theme that also featured heavily in our dataset, or it could be down to poor planning, or to pressure to reintroduce species before all causes of decline are known (Bubac *et al.*, 2019). In recent years, trial releases have been valuable in identifying novel threats and assessing the likelihood of successful population establishment (Jones & Campbell-

Palmer 2014; Kemp *et al*. 2020; Wilson *et al*. 2020). The use of trial releases, along with the application of well researched guidance could be one solution to such problems (Kemp *et al.*, 2015).

4.8.7 Assigning a success score

Reasons given for assigning a particular success score were extracted from the data and split into common themes. For reintroductions scored as partially successful, species presence or survival in the wild was the most frequent reason given, and for projects scored as successful and highly successful, observed breeding was the main reason for the score. These results reflect those observed in previous studies where short term/ high level outcomes tend to be the most likely driver of success measurement (Ewen, Soorae and Canessa, 2014; Brichieri-Colombi and Moehrenschlager, 2016). Indeed, 18% of the case studies stated that it was 'too early to say' if the reintroduction was a success in their reasons for success/ failure. This indicates that many programme managers were making an effort to fit the reintroduction assessment into a success category that may not yet be applicable. Within the 18% that stated it was too early to say, 6% scored the outcome as successful (n=19) or highly successful (n=2). Of the eight failures within the data, all gave either low or no survival, unstable population, or abandonment of the programme as one of the reasons for scoring it as a failure.

4.8.8 Relationship with wider species conservation actions and plans

The methodology used to review the reintroductions could be used as a model to review wider conservation actions. The self-selecting success score is an inherent limitation associated with the IUCN reintroduction case studies. One approach to mitigate this could be to develop a standardised process of assigning a score based on the percentage of objectives or indicators met.

4.8.9 Conclusions

The measurement of reintroduction success varies according to goals, criteria and personal judgement (Seddon, 1999; Ewen, Soorae and Canessa, 2014; Cochran-Biederman *et al.*, 2015; Brichieri-Colombi and Moehrenschlager, 2016). It is therefore important that these drivers are recognised alongside the general reluctance within the conservation community to document failures (Seddon, Armstrong and Maloney, 2007; Catalano *et al.*, 2019; Resende *et al.*, 2020; Catalano, Jimmieson and Knight, 2021) which could be a potential explanation for the low number of failures in the studies. There is no single factor that drives reintroduction success; predictors of success are complex issues and difficult to assess with any certainty. However, both the quantitative and qualitative analyses in our study suggest that taxa that are more typically hard-wired, and/ or have broader niches, have more success, and that active species management is highly influential. Comparisons by Griffith *et al.*, (1989) and Wolf *et al.*, (1996, 1998) found that that some traits such as varied diet may influence success, but traits such as reproductive potential, which were initially thought to be significant, were not found to increase success (Wolf *et al.*, 1998). These analyses support many of the conclusions made in previous studies, particularly those relating to habitat quality and management which seem to be an undisputable factor in success (Griffith *et al.*, 1989; Cochran-Biederman *et al.*, 2015; Brichieri-Colombi and Moehrenschlager, 2016; Bellis *et al.*, 2019).

With the continuing need for conservation management and increasing pressure on threatened species from development, species reintroductions are likely to continue to increase (Reading, Miller and Shepherdson, 2013; Resende *et al.*, 2020). It is therefore vital that reintroduction initiatives are well-planned, resourced, executed, and recorded. This study showed active management, habitat & release site, resource & funding, planning & feasibility studies, data & knowledge, and stakeholders & community are linked to both success and failure.

These actions will not guarantee success, but will open up innovative opportunities that will enable conservation practitioners to proactively manage and improve the effectiveness of reintroduction initiatives. Species reintroductions may be considered a last resort but at this current point of biodiversity crisis, where time is of the essence, and a proactive approach backed by science and knowledge is ever more important.

4.9 References

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Chapter 5. Discussion & Conclusions

This chapter reviews the main findings of the thesis, its limitations, how each of the chapters are interconnected, and the relevance of the overall research study to species conservation and wider biodiversity issues.

5.1 Summary of research findings

The thesis focused on two areas of species conservation; species action plans (SAPs) and conservation reintroductions. I aimed to understand (1) how SAPs are used and valued (Chapter 2), (2) how they are initiated and developed (Chapter 2 & Chapter 3), and (3) if there are differences in SAP design and implementation across regions, taxa, and time (Chapter 3). In focusing on reintroductions, a key element of many SAPs used as a management tool for enhancing sustainability of species populations and range, I aimed to (4) establish which factors (human and biological) have influenced the level of success in reintroduction efforts (Chapter 4). These aims were designed to determine how SAPs fit into the wider conservation spectrum, policy, and legislative processes, and to make recommendations on how SAPs could be improved and better utilised. The aims were met by adopting a mixed method approach, using case studies, data searches, and questionnaires to gain insight into what is done, what is achieved, and what makes a difference to species conservation.

5.1.1 Chapter 2 Diversity in structure and content of Species Action Plans

This chapter looked at conservation planning guidance and the content of SAPs to explore commonalities and differences in approach and how these compare across regions, time, and taxa. The comparison and analysis of components provided an insight into approaches across regions and time and what the potential drivers of these are. I found that SAP components varied across IUCN regions and time, but less so across taxa. The reasons for differences across IUCN region were not clear but may have reflected variation in conservation cultures and context, which may be influencing priorities in planning. Content of SAPs appears to be changing in line with developments in conservation planning methods. However, follow-up reviews and evaluations were generally lacking, inconsistent, and provided limited information on action progress and implementation. The focus of actions across SAPs were related to research and monitoring activities, yet it was difficult to identify whether actions were evidence-based and evaluated. The sample of SAPs was chosen to cover a wide range of regions and taxa - although the sample was representative of different regions and taxa, it could have benefited from the inclusion of more developing countries, and more underrepresented taxa to allow for broader comparisons.

5.1.2 Chapter 3 The best laid plans? Conservation practitioner perceptions of Species Action Plans

Responses to the questionnaire found that contemporary conservation practitioners viewed SAPs in a generally very positive light. Respondents placed a high level of importance and value on SAPs both as a planning tool and as a resource. Whilst SAPs themselves were held in high regard, there was frustration with the often-lengthy creation process, resource issues, and lack of legislative and government support. Analysis of the questionnaire responses regarding SAP content identified four principal components by aggregating common patterns in respondents' views, which illustrated the following key sections and content of SAPs: 1. Strategic action and threats, 2. Species status, 3. Implementation, monitoring, and financial plans, and 4. A Vision. Although practitioner views on SAPs had been sought previously, this had not been achieved on a wider basis nor regarding content and use. The outputs from this chapter provide a baseline for SAP structure and content as well as highlighting practitioner views.

5.1.3 Chapter 4 Factors influencing species reintroduction successes and failures

This chapter explored interpretation and factors relating to success in conservation reintroductions. I found that success scores, although subjective, differed significantly across different taxa and regions. Reasons given for success were most likely to be associated with

‘Partnerships & Support’, examples of which included elements linked to community, government support, collaborations, and engagement of key stakeholders. Reasons for failure, or failed elements, were most frequently linked to issues relating to ‘Habitat & Release site’ such as lack of roosting features for birds, poor connectivity, and lack of suitable release sites. I also established reasons for regarding a reintroduction as a success or failure: most success was judged by observed breeding and survival, and failure was judged on low species survival or goals not being met. Results from this chapter provide a novel insight into success both in terms of factors that influence success and how goals and indicators relating to the assigned level of success are set or interpreted. It was not possible to show if having a SAP linked to the reintroduction influenced success. However, the study provides a format for how components of SAPs could be assessed. Future research could apply this or a similar case study review to SAPs and assess individual objectives or actions.

5.2 Contributions to the research field

5.2.1 Regional trends in SAPs and reintroductions

In our sample of SAPs I saw a dominance of SAPs from more developed regions (West Europe, Oceania, and North America and the Caribbean). Despite there being a fair representation of case studies from Africa (11%) in the reintroduction perspective case studies, only two of the case studies made reference to a SAP. Although not conclusive, I surmised from knowledge and published literature that this may be linked to resource issues (Adenle, Stevens and Bridgewater, 2015a) and the influence of neo-colonialism on conservation projects and programmes within Africa and other developing regions (Garland, 2008). Evidence to support the influence of neo-colonialism was seen in the questionnaire response data of Chapter 3, where Africa was cited as the second most frequent region respondents worked in, despite only 5% being of African nationality. Data analysis from Chapter 3 also showed reintroductions in Africa were less likely to occur and were significantly less likely to be highly successful than those in North America and Europe. There is an increasing awareness with regards to the influence and impacts of neo-colonialism in wildlife conservation (Hart, Leather and Sharma, 2021), particularly in Africa (Nelson, 2003; Jones, 2021) and whilst neo-colonialism in conservation is not the subject of this thesis, it is important to acknowledge historical and cultural influences and how they may impact species conservation and associated processes.

5.2.2 Taxa trends in SAPs and reintroductions

Bias towards birds and mammals was seen within the SAP sample and the reintroduction case studies. Species bias is an ongoing issue in conservation that highlights the prioritisation of charismatic species in terms of funding and resources and has been raised in the literature many times (Clark and Harvey, 2002; Seddon *et al.*, 2005; Laycock *et al.*, 2011; Walsh *et al.*, 2013; Donaldson *et al.*, 2017). With increasing research highlighting these issues and a greater spotlight on less charismatic species this trend will hopefully be reversed (Adamo *et al.*, 2022).

5.2.3 Creation and structure SAPs

SAPs are often the collaboration of many organisations and stakeholders, and guidelines have been produced to help structure conservation planning and decision making. Such guidance appears to be important within SAP creation with 65% of our questionnaire respondents stating they used guidelines or templates within the SAP creation process. Reviewing some of the key guidance used in SAP creation (CMP, IUCN and CPSG) and a sample of SAPs published between 1982 and 2018, there appears to be a relationship between the evolution of guidance and the key components of SAPs – suggesting that guidance influences SAP content. Based on the analysis of conservation practitioner feedback on key SAP components I was able to establish four principal components for SAP content: (1) Overall vision, (2) Species Status (3) Strategic action and threats, and (4) Implementation, monitoring, and financial plans, which are illustrated along with the sections they encompass in Figure 5.1. Whilst the elements in our illustration are simplistic, they draw out the basic components of a SAP and can act as a template for SAP creation. The issue remains that completing these sections, particularly in line with guidance, is complex and time consuming. This issue of time is not easy to address, but with the average process of creating a SAP taking 1 - 2.5 years for single species plans and several years for multi-species plans (BirdLife International, 2012) it is a critical issue for a crisis discipline. Whilst studies have shown that the processes of conservation planning does contribute to species conservation (Lees *et al.*, 2021), it is hard to establish if the time spent on them is proportional to that value

Chapter 2 showed that reviews and evaluations of SAPs are lacking, and that the reviews that are undertaken do not appear to provide the data/evidence needed to measure/record success and allow adaptive management. Fuller et al. (2003) acknowledge the limitations of SAPs, stating that it is impossible to demonstrate their effectiveness and that SAPs often contain over-optimistic expectations and are best viewed within a wider conservation context. Whilst these points are relevant, particularly in relation to IUCN plans, SAPs now have a greater potential to be measured in terms of effectiveness using indicators and success criteria linked to actions and outcomes (Stem *et al.*, 2005; Roberts and Hamann, 2016; The Conservation Measures Partnership, 2020). But what Fuller et al. (2003) argue is that SAPs are not designed to deliver the action but to recommend actions that are then taken forward by governments and those who are able to translate science into policy. Although this is true for many SAPs, the argument that SAPs are a place for research proposals and recommendations, rather than action, is perhaps a luxury we can no longer afford. This is why conservation planning is now evolving to include consultation with all stakeholders through steering groups and workshops, so that recommendations, commitments, and action go hand in hand (Azat *et al.*, 2021; Lees *et al.*, 2021). However, inclusion of these steps also adds to the length of the process and can make action prioritisation harder. Therefore, for SAPs and their extensive process to remain relevant they absolutely have to demonstrate that they add value, by being measurable, accountable and responsive (Martin *et al.*, 2012). If their effectiveness cannot be measured, they must be streamlined into actionable, priority focussed documents, so that what they document can be resourced and measured (Game 2013).

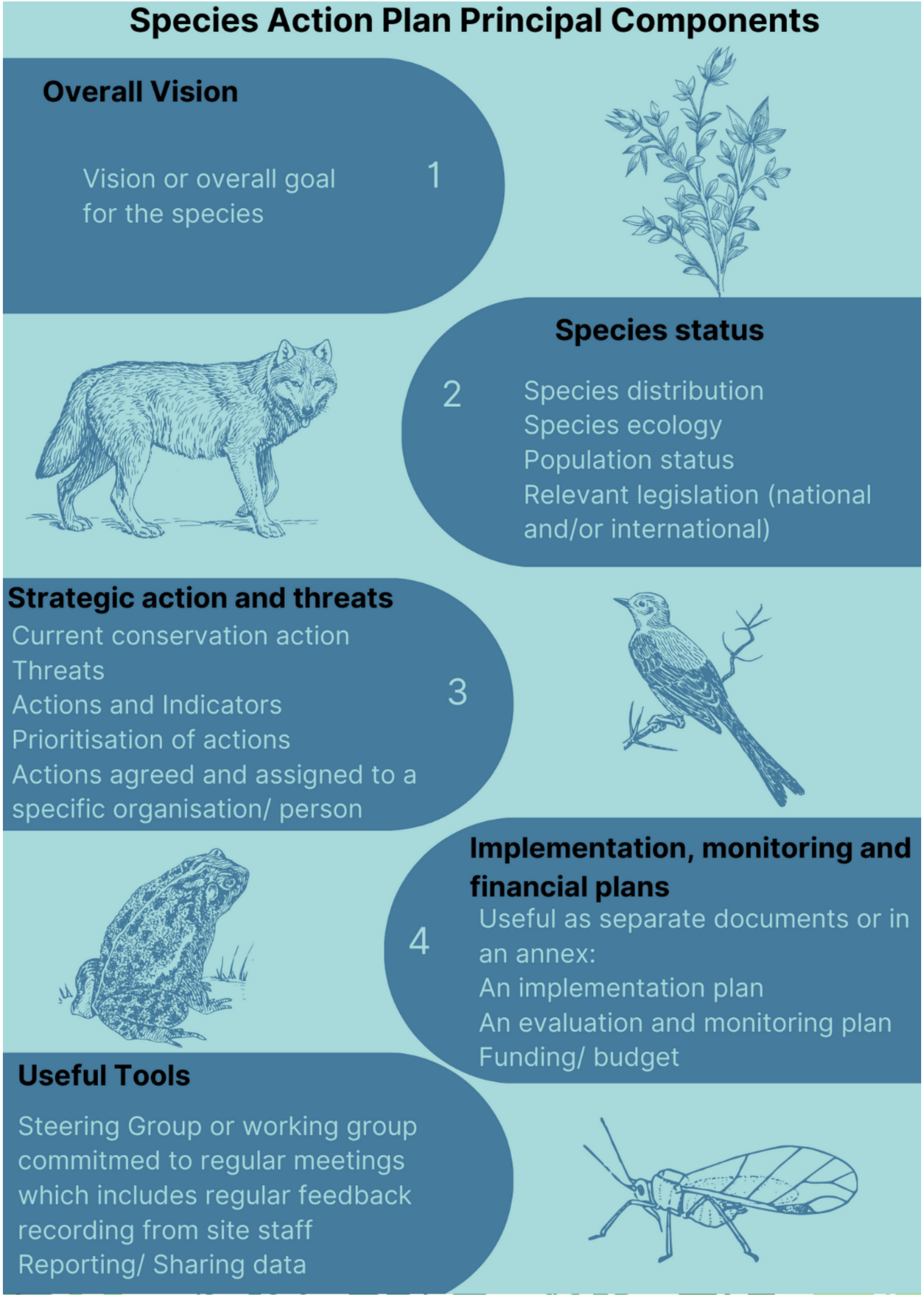

Figure 5.1 Principal Components of a Species Action Plan

5.2.4 Actions and Implementation

Results from our SAP analysis in Chapter 2, echoed previous literature with regard to the excessive focus (and funding) on actions associated with research and monitoring (Buxton *et al.*, 2020). There is increasing awareness of the need to streamline monitoring (Stem *et al.*, 2005; McDonald-Madden *et al.*, 2010) and the need to utilise and source evidence based information (Pullin *et al.*, 2004; Sutherland *et al.*, 2004; Adams and Sandbrook, 2013). There is not so much known or published about the dominance of research - although a lack of action based on the results of such research (McGowan, 2001; Prip *et al.*, 2010; Lindenmayer, Piggott and Wintle, 2013; Berger-Tal, Blumstein and Swaisgood, 2020) or how effective it is has been highlighted (Laurance *et al.* 2012; Robinson *et al.* 2018). In terms of SAPs and reintroductions there is clearly a need for a trade-off that allows evidence based actions and objectives to be prioritised (Ewen, Soorae and Canessa, 2014; Sutherland *et al.*, 2019) before research actions. Incorporating this trade-off into the decision-making processes would be useful.

Due to the complexities surrounding the evaluation of SAPs it is difficult to draw conclusions on SAP implementation. Our results from the limited reviews available showed general improvement to species status with 50% of the reviews stating: criteria had been met, the species had been down-listed, or the population was increasing. These results add to a limited but growing number of studies detailing SAP implementation rates and the meeting of criteria (McGowan, Garson and Carroll, 1998; Boersma *et al.*, 2001; Machado, 2001; Crouse *et al.*, 2002). This thesis also echoes findings from other studies showing that lack of resources (funding, staff etc.) has a large influence on SAP implementation and continuity (Clark and Harvey, 2002; Schwartz, 2008; Laycock *et al.*, 2011; Martin *et al.*, 2018). Even with government funded SAPs there are issues concerning funding allocation (Laycock *et al.* 2011), and the reliance on experts who are in many cases contributing in their own time.

5.2.5 Utilisation

The literature surrounding SAPs focuses on the species, the actions, and outputs. Whilst there is no question that this is their main purpose, the results regarding their utilisation and value beyond this is wide ranging. Survey respondents stated that in addition to species management SAPs were utilised and valued as a resource for species information, assessing impacts, and informing mitigation for developments. Conversely, as only 101 of the 341 reintroduction case studies made reference to a SAP in relation to the species reintroduction, this may reflect the utilisation of SAPs within species programmes - implying that SAPs are not needed or utilised beyond the action setting phase. This thesis therefore highlights the value of SAPs outside of conservation (development and planning) as well as the potential lack of utilisation from direct stakeholders within conservation and species management.

5.2.6 SAP Evaluation & Review

The responses to the questionnaire showed a low percentage of respondents (31%) used evaluation and monitoring tools. Likewise, out of the 77 SAPs reviewed in Chapter 2 I was only able to locate reviews for 26 (34%) of them. Although some existing reviews may have remained unlocated, the data indicate the number of SAPs being reviewed is low – suggesting that this is an area of conservation planning that still requires further attention. A positive outcome (Chapter 2) is the observation of a moderate increase in indicators in SAPs over time. However, the results from the reviews and evaluations of SAPs analysed in this thesis were less encouraging - accessible reviews were not only limited in numbers but also in their methodology, content, and outcomes. Assessing the function of indicators and success criteria in conservation remains under-researched, and a subject this thesis was unable to evaluate due to the lack of reference to indicators in the SAP reviews. There have been a number of studies applying indicators to projects (Stem *et al.*, 2005; Bottrill and Pressey, 2012; Schwartz *et al.*, 2012; Young *et al.*, 2014; Roberts and Hamann, 2016) but it is difficult to apply these retrospectively, and to understand how the meeting of objectives contributes to the species conservation overall. Roberts and Hamann (2016) did this by applying criteria to evaluate marine turtle recovery plans. Their results showed a lack of integration of adaptive management and measurable objectives – further highlighting the need for inclusion of indicators within a plan. Further research to find ways to apply SMART actions and a greater emphasis on reviews and evaluation is still needed in order to establish robust structures for measurable SAPs (Maxwell *et al.*, 2015; Tanentzap, Walker and Stephens, 2017).

Chapter 4 explicitly dealt with success and failure in species conservation reintroductions. The reasons most frequently given for success in reintroductions were in relation to Partnership & Support. The most cited reasons for failure were in relation to 'Habitat & Release site', closely followed by 'Resource & Funding'. Whilst Chapter 3 did not review the success of SAPs, practitioners expressed views on how the implementation of SAPs might be improved. The most frequent responses to this question were focussed around 'Assigning Actions & Responsibilities', and 'Resources'. Practitioner responses citied coordination from stakeholders, strong leadership and dedicated funding as being paramount to successful SAP implementation. A continuing theme in relation to conservation success is resource. Whilst resource is a broad term and can cover aspects from staff to funding to infrastructure, the emphasis on resource in a relation to partnership, leadership, and the involvement of stakeholders is very relevant to SAPs. Funding to keep project staff employed and create continuity and retention of information is a core aspect of successful project management and one that becomes a problem in conservation where staff turnover due to lack of funding can be high (Defra, 2006).

Although not statistically significant, a relationship between the number of goals and success of reintroductions was noted (Chapter 4). Showing that when goals increased over a certain number the less likely a reintroduction was likely to be 'highly successful' (Black and Copsey, 2018). Whilst I do not have a comparison for SAPs the observation has relevance in relation to the feedback from practitioners (Chapter 3) and studies that are critical of SAP length or complexity of goals and actions (McGowan, Garson and Carroll, 1998; Clark *et al.*, 2002; Fuller *et al.*, 2003; Defra, 2006). Although there are no comparable studies on the influence of the number of goals on reintroduction success, the implied impact of too many goals could be compared to studies that discuss how action prioritisation (i.e. having a few well researched actions rather than too many) can be an influential factor on species conservation (Bottrill *et al.*, 2008; Dalton and Spiller, 2012; Le Berre *et al.*, 2019; Gillespie *et al.*, 2020).

The other important element in relation to failure are the refreshingly honest practitioner accounts in the reintroduction case studies. Failure is something that is not widely discussed in conservation, and is rarely published (Redford and Taber, 2000; Catalano *et al.*, 2019). Being able to draw from practitioner experiences is an essential part of species conservation, and insights into failures should form part of project evaluations and publications (Sutherland *et al.*, 2019). There have been steps forward in this area, with platforms such as conservation evidence providing a route to record failures (i.e. what works and what doesn't) and published case studies (Bottrill and Pressey, 2012; Catalano *et al.*, 2018; Sutherland *et al.*, 2021; Christie *et al.*, 2022; Webber, Cotton and McCabe, 2022). However, there remains a significant gap in reporting and discussing failures in conservation (Redford and Taber, 2000; Game, Kareiva and Possingham, 2013; Catalano, Jimmieson and Knight, 2021).

Alongside evidence-led conservation (Sutherland *et al.*, 2004), the conservation sector is gradually realising that impact needs to be assessed (Baylis *et al.*, 2016).These efforts have been spearheaded by organisations such as the Conservation Measures Partnership, CPSG, and Foundations of Success. However, recent years have seen governments and their agencies incorporating evaluation into species recovery and conservation projects, which was once a remit reserved for social science and medicine (HM Treasury, 2020; Natural

England, 2020). These evaluative approaches should help understand what is working or not working within species programmes. However, outputs should be relevant to nature recovery and not orientated toward self-gratification or solely focused on targets.

5.3 Implications for policy and practice

5.3.1 How might SAPs be better aligned with policy and legislation?

Data from Chapter 2 indicates that SAPs linked to specific legislation, such as in the USA and Australia, tend to be created more prolifically, and are more likely to be reviewed. Despite this, there is little evidence to show that they have better implementation rates than SAPs that are not directly linked to legislation. Seabrook-Davison *et al.* (2010) investigated the benefits of the USA and Australian threatened species legislation and highlighted strengths and weaknesses in relation to SAPs. Strengths included a requirement for recovery plans for all threatened species, and a more integrated approach between agencies. Weaknesses included delays in implementing objectives, lack of enforcement and funding, and that many plans were outdated, ineffective, and use poor science. It seems therefore that more research regarding the influence of legislation in SAP implementation is needed before a comparison can be made.

In countries where SAPs are not linked to legislation (and indeed where they are), aligning SAPs with the CBD and the NBSAPs (National Biodiversity Strategies and Action Plans) could be a way to heighten their status and funding. This approach has been championed by a number of authors (McLean, Wight and Williams, 1999; IUCN, 2021; Byers *et al.*, 2022; Vercillo *et al.*, 2023), with one study demonstrating how it can successfully link conservation measures that resulted from SAP actions to the CBD's Aichi targets (Vercillo *et al.*, 2023).

5.3.2 A UK Perspective

The thesis has had a UK focus because of the long and well documented history surrounding UK policy and SAPs.

Although some of the first SAPs within the UK stemmed from the NBSAP, they were not aligned with the Aichi targets as these were not introduced until 2011 (SCBD, 2022). The latest report by the UK on the Aichi targets acknowledges there is significant work to be done in preventing species decline, and the progress to this target was occurring at an insufficient rate (JNCC, 2019a). The report also states the conservation status of 18% of species was improving in 2007 but this later decreased to 10% in 2013. The most recent reporting located for the UK BAP SAPs stated that 52% of species targets were met, 17% were not, and the remainder unknown or not reported (JNCC, 2010). Without fully understanding the mechanisms for evaluating and reporting, or the allowance for locating new populations, it is difficult to establish if the initial SAPs in the late 1990's helped with the initial improvement in species decline. However, it is known that those SAPs, created for priority species listed within the UK BAP, became largely redundant post 2009 after the introduction of the UK Post-2010 Biodiversity Framework (JNCC and Defra, 2012). The UK BAP and its associated SAPs and HAPs (Habitat Action Plans) created a sense of purpose and unity with the nature conservation sector (Marren, 2002) and the withdrawal of support for SAPs and species recovery in the UK has been criticised (Chapter 3). The recent UK Environment Act (2021) will create some SAPs, albeit they are now referred to as "species conservation strategies", as the UK works towards halting the decline in species by 2030 (GOV.UK, 2021). It is not known how the 'species conservation strategies' will align with the UK NBSAPs or Aichi targets but there is a strong focus on CBD goals. The UK Environment Act provides provision for the UK to focus on new Local Nature Recovery Strategies (LNRS) (GOV.UK, 2022), although it is not clear how species strategies will fit into these. There is likely to be some overlap between the LNRS and the historic and current Local Biodiversity Action Plans (LBAPS) and their associated SAPs. The data from these should, therefore, be utilised and built upon where appropriate. Using this resource would support the governments focus on being evidence-led, as detailed in Natural England's 2020-2025 Science, Evidence and Evaluation Strategy (Natural England, 2020).

5.4 Limitation and Future Prospects

As described in other literature (Fuller *et al.*, 2003), there were significant limitations in estimating the impacts of SAPs. This was partly due to reviews either not being undertaken or not being accessible, or where they were accessible the content was, in many cases, not measurable against indicators or actions completed. Additionally, changes in species status are varied, hard to ascertain and cannot always be contributed to one set of actions or one time period (Schmeller *et al.*, 2008).

The sample of SAPs utilised may have benefited from the inclusion of more developing countries and underrepresented taxa which would have enabled broader comparisons. Although this was outside the original scope of the thesis the limited number of SAP reviews restricted the insight into this process. Having a comparable dataset to see what percentage of SAPs are reviewed and evaluated would have been useful.

5.4.1 The future of Conservation Planning and SAPs

The future of conservation planning is positive and its use as a structured tool is growing, with many organisations now focusing on implementing measurable actions and evaluation methods (Bubac *et al.*, 2019; Pressey *et al.*, 2021). Conservation planning guidelines are well established and seem to be well utilised, particularly in the USA and by NGOs linked to zoos (such as the Zoological Society of London and Durrell). The increasing use of results chains and theories of change are arming organisations with tools to support and aid the decision process, prioritise actions, and undertake retrospective planning (Byers *et al.* 2022; Lees *et al.* 2021; Vercillo *et al.* 2023). However, understanding these elements is time consuming and involves a period of learning - the risk being that projects may ignore the guidance completely, abandon the project as too difficult, use the guidance selectively or retro-fit the project outcomes to the guidance (NHMRC, 2018). Initiatives such as online resources, simplified guidance and training from CPSG and CMP help with this issue (Schwartz *et al.*, 2012; CPSG, 2020; Foundations of Success, 2021) but there is a need for initiative, knowledge, and prioritisation when considering planning and implementation (Game, Kareiva and Possingham, 2013). Although much of the guidance is aimed at detailed project design rather than SAP creation, the results of Chapter 2 and Chapter 3 show that despite the SAP being one part of a larger conservation project, much of the planning cycle guidance can be applied and aligned. The data gathered in this thesis can therefore provide useful information for those creating SAPs, and guidance for SAP content (Figure 5.1). It is also important for government agencies and policy makers to utilise tools, such as Theory of Change to look at the wider implications of change from SAPs as a collective; as put by Marren (2002) it is important to "Stand back from the details and look at where this self-replicating mountain of plans maybe taking us".

5.5 Recommendations

Although SAPs have a fundamental role to play in species and habitat conservation, evaluating their role in delivering conservation outcomes remains elusive. This is down to variation in design and implementation, and shortcomings in evaluation and monitoring. Moreover, the timeframes for design, delivery and evaluation may be incompatible with the timeframes needed to save critically endangered species from extinction. Fortunately, an increasing number of tools are becoming available to allow practitioners to navigate these issues and trade-offs. Hopefully, in the longer term the practical use of these tools will allow more positive conservation outcomes for the species and habitats concerned.

This thesis demonstrates that SAPs instigate research, provide a source of data and management information, and are highly valued by conservation practitioners. However, finding unequivocal demonstrations that SAPs themselves are effective or aid species recovery is problematical, but emerging from the results of this thesis are potential recommendations that can inform the delivery of SAPs, and provide an insight into the factors influencing reintroduction success.

The detail required in the creation of any SAP should relate to the urgency of the actions and the resources available. Therefore, a trade-off between creating a detailed and evidence-based action plan with the need to act quickly is required. Using the findings of this thesis, the following recommendations can be made to help achieve this balance:

- Focus on the four key components: (1) Species status, (2) Strategic action and threats, (3) Implementation, monitoring, and financial plans (4) An overall objective or vision.

- Prioritise a small number of actions/ goals that can be initiated in in a realistic timeframe with indicators that can be monitored.

- Undertake regular reporting and evaluation of the priority actions. Ensure that qualitative feedback (successes and failures) and observations are recorded. These will inform adaptive management and help improve future conservation plans.

Additionally, conservation studies and literature conclude that including the following elements can create better opportunities for success in species conservation:

- Be led by a working group that can influence and implement, provide continuity, and complete regular reviews that feedback into the plan.

- Utilise guidance and processes for identifying the results needed but do not get lost in the methodological detail.

- Consider a holistic approach: be aware of the impact/change associated with all actions being delivered.

5.6 References

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Appendix: Co-authored publications

Peer-reviewed journal articles and publications to which I contributed throughout my PhD programme. Each publication is broadly relevant to the main themes presented within this thesis.

Here I present the abstracts for reference in reverse chronological order, full text copies are available online.

Book Chapter: Chapter 14. Translocations

IUCN SSC Amphibian Specialist Group: 2022

Pages: 755-793 in The Amphibian Conservation Action Plan (ACAP): A status review and roadmap for global amphibian conservation. Preprint. DOI: 10.32942/osf.io/brfas

Jen Germano, **Gemma Harding**, Jeff Dawson, Luke Linhoff, Lea Randall and Richard Griffiths

Abstract Species translocations are highly complex and challenging and those involving amphibians are no exception to this. While outcomes have improved over the decades, the last review of published herpetofauna translocations found a success rate of 41%. This is likely due to the interplay of numerous factors that need to be addressed to give releases the greatest opportunity to thrive. Some of these factors include source population, animal behaviour, habitat quality, disease risks, genetics, welfare, and ensuring that the root cause of decline has been addressed. Where questions exist around key factors, trial releases and experimental research can help to address uncertainties. Additionally, it is critical that sufficient time and resources are put into planning and monitoring, with a contingency or exit strategy in place if the project does not go as planned. Future challenges that need to be addressed by the amphibian reintroduction community include the use of translocations in the mitigation space to deal with habitat destruction and human development as well as the application of assisted colonisation in the face of the global climate change crisis.

Guidelines: IUCN Guidelines for amphibian reintroductions and other conservation translocations, First edition.

IUCN: Gland, Switzerland. 2021
ISBN: 978-2-8317-2111-8

Linhoff, L.J., Soorae, P.S., **Harding, G.,** Donnelly, M.A., Germano, J.M., Hunter, D.A., McFadden, M., Mendelson III, J.R., Pessier, A.P., Sredl, M.J. and Eckstut, M.E. (eds.)

Executive summary: The number of amphibian reintroductions and other conservation translocations has increased in recent decades. Clearer guidance to plan, implement, and obtain resources for amphibian reintroductions is needed to improve conservation outcomes. The vast diversity within Class Amphibia, which contains 8000+ species, makes generalisations difficult, but many common themes exist concerning amphibian reintroductions. This document is designed to provide guidance, best practices, and links to helpful resources that will be useful for a wide variety of practitioners involved in amphibian reintroductions. Reintroductions are highly interdisciplinary. Information useful for undertaking amphibian reintroductions is scattered, and the available information may not be known to many conservation practitioners. Therefore, we have included links to numerous resources and planning tools that were collated by multiple experts. We understand that each amphibian species will likely require unique strategies for successful translocation. Furthermore, poorly known species may require a large amount of novel research, creativity, and trial and error. The technologies required to successfully reintroduce some species may not even exist yet. Amphibian reintroductions are challenging and may not always work, but amphibian reintroductions may be the best or only option for conserving some species. This document outlines the most important considerations for each stage of an amphibian reintroduction and provides a brief overview of each topic with references to numerous specific resources for further information.

Research Article: A flagship for Austral temperate forest conservation: an action plan for Darwin's frogs brings key stakeholders together

Oryx: 2021

Volume: 55, Issue 3; DOI: 10.1017/S0030605319001236

Claudio Azat, Andrés Valenzuela-Sánchez, Soledad Delgado, Andrew A. Cunningham, Mario Alvarado-Rybak, Johara Bourke, Raúl Briones, Osvaldo Cabeza, Camila Castro-Carrasco, Andres Charrier, Claudio Correa, Martha L. Crump, César C. Cuevas, Mariano de la Maza, Sandra Díaz-Vidal, Edgardo Flores, **Gemma Harding,** Esteban O. Lavilla, Marco A. Mendez, Frank Oberwemmer, Juan Carlos Ortiz, Hernán Pastore, Alexandra Peñafiel-Ricaurte, Leonora Rojas-Salinas, José Manuel Serrano, Maximiliano A. Sepúlveda, Verónica Toledo, Carmen Úbeda, David E. Uribe-Rivera, Catalina Valdivia, Sally Wren and Ariadne Angulo.

Abstract: Darwin's frogs *Rhinoderma darwinii* and *Rhinoderma rufum* are the only known species of amphibians in which males brood their offspring in their vocal sacs. We propose these frogs as flagship species for the conservation of the Austral temperate forests of Chile and Argentina. This recommendation forms part of the vision of the Binational Conservation Strategy for Darwin's Frogs, which was launched in 2018. The strategy is a conservation initiative led by the IUCN SSC Amphibian Specialist Group, which in 2017 convened 30 governmental, non-profit and private organizations from Chile, Argentina and elsewhere. Darwin's frogs are iconic examples of the global amphibian conservation crisis: *R. rufum* is categorized as Critically Endangered (Possibly Extinct) on the IUCN Red List, and *R. darwinii* as Endangered. Here we articulate the conservation planning process that led to the development of the conservation strategy for these species and present its main findings and recommendations. Using an evidence-based approach, the Binational Conservation Strategy for Darwin's Frogs contains a comprehensive status review of *Rhinoderma* spp., including critical threat analyses, and proposes 39 prioritized conservation actions. Its goal is that by 2028, key information gaps on *Rhinoderma* spp. will be filled, the main threats to these species will be reduced, and financial, legal and societal support will have been achieved. The strategy is a multi-disciplinary, transnational endeavour aimed at ensuring the long-term viability of these unique frogs and their particular habitat.