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Perceptions of Conservation Introduction to Inform Decision Support Among U.S. Fish and Wildlife Service Employees

Scientific Investigations Report 2022–5092

U.S. Department of the Interior
U.S. Geological Survey

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Executive Summary

Around the globe, fish and wildlife managers are facing increasingly complex management issues because of multiscale ecological effects like climate change, species invasion, and land-use change. Managers seeking to prevent extinctions or preserve ecosystems are increasingly considering more interventionist techniques to overcome the resulting changes. Among those techniques, translocation methods that intentionally move species into new, less impacted habitats are being considered. These types of translocations are known by a range of terms, including "managed relocation" and "assisted migration," but the International Union for the Conservation of Nature's Species Survival Commission (IUCN SSC, 2013) has proposed "conservation introduction" (CI) as a standard term.

As defined by the IUCN SSC, CI is the intentional movement of a species or population outside its indigenous range for conservation purposes. CI can be divided into two forms: assisted colonization and ecological replacement. Assisted colonization is moving species outside its indigenous range to prevent extinction or extirpation of a population. Ecological replacement is moving species to fulfill an important niche that is necessary within an ecosystem. Proponents suggest these methods are necessary to address the ecological challenges managers are trying to overcome. Opponents point out the potential for species to become invasive, introduce disease or parasites, and cause other cascading impacts throughout the ecosystem. The result is controversy and disagreement. As such, it will be imperative to develop clear guidelines and best practices to be followed within wildlife management agencies to prevent potential unintended outcomes and reduce risk as much as possible.

To this end, the U.S. Fish and Wildlife Service (USFWS) partnered with the U.S. Geological Survey (USGS) to develop the current project. The intent was to describe the perceptions of USFWS personnel across many aspects of CI so that the USFWS could use this information in the planning and development of their own internal decision-support framework for CI.

This report is presented in five sections. Section 1 introduces the project and provides an in-depth overview of background literature related to CI. Section 2 describes the study design, methods, and study participant characteristics. Section 3 describes key results and recommendations related to the development of a USFWS decision framework. Section 4 investigates a range of perceptions held by participants and establishes baseline information for how USFWS personnel may view CI and its application. Types of viewpoints surveyed include preferred terms and definitions, perceived barriers, perceived risks and tradeoffs, and aspects of success. Perceived barriers refers to factors that may prevent successful implementation of CI and perceived risks refers to potential negative outcomes that may occur as a result of implementing CI. Section 5 provides an overview of our conclusions for this project.

Overall, we found that CI is likely to be viewed positively within the USFWS, but employees offered cautions and caveats. Most participants we interviewed feel that it is a necessary tool that will be indispensable in certain situations but also feel that there is more risk associated than with more traditional methods. For this reason, many participants are concerned about the assessment and planning that should be conducted prior to any CI effort. Our results indicate that many USFWS personnel will be open to CI being adopted more regularly but will be looking for clear guidance on how it should be implemented and what scenarios are appropriate for its use.

Reference Cited

International Union for Conservation of Nature Species Survival Commission [IUCN SSC], 2013, Guidelines for reintroductions and other conservation translocations: IUCN SSC, 57 p.

1. Introduction

Rapidly changing ecosystems require increasingly difficult decisions and consequential tradeoffs by fish and wildlife managers seeking to preserve habitat and protect endangered species (Manning and others, 2009). Such challenges compound over time, putting managers in a position where rapid and robust interventions must occur to prevent the extinction of a species or to address the decreasing resilience of desirable ecosystems (Loarie and others, 2009). Management actions that focus on incrementally improving available habitat, protecting existing populations, and reducing human impacts carry fewer risks but may also affect too slow a change to produce desired results under rapidly changing conditions (Schuurman and others, 2022).

In response to current management challenges, species translocation has been suggested as a potential method for helping endangered species persist or for improving the function of important ecosystems. In these cases, at-risk species may be moved outside their current range to areas that are more viable for the species to thrive or to fulfill ecological functions that were previously filled by a different species. In its formal guidelines, the International Union for the Conservation of Nature's Species Survival Commission (IUCN SSC, 2013) classifies these types of translocations as "conservation introductions" (CI), which it defines as "the intentional movement and release of an organism outside its indigenous range for conservation purposes" (p. 2). Although other synonymous terms and definitions have been used by different academic and management organizations, herein we will use CI as a representative term for these types of translocations, unless specifically referring to other terms cited in previous literature.

Many fish and wildlife managing agencies are beginning to investigate the potential benefits and consequences of using CIs to overcome the ecological challenges they are facing. CI has been perceived by some as risky and controversial because species moved outside their indigenous range may become invasive or disrupt existing ecosystems. As such, it will be imperative for any organization considering a CI project to establish or follow an existing decision framework and define best practices to be successful. Decision frameworks provide conceptual structures and principles designed to enhance decision making and integrating a variety of data sources (Graedal and others 2014) and are important tools that allow organizations to make decisions efficiently and with limited disagreement.

The U.S. Fish and Wildlife Service (USFWS) has partnered with the U.S. Geological Survey (USGS) to investigate the perceptions of USFWS personnel within the Pacific Northwest (region 9) and Hawaii and the Pacific Islands (region 12). In this study, we took the initial steps of gathering social-science information needed for efficient planning of future CI projects and, more importantly, for assisting the USFWS in developing an effective and comprehensive decisions-support framework. Our objectives were to

- Describe the range of perceptions and views of CI among USFWS employees in regions 9 and 12.
- Describe perceptions of previously published terms and definitions and identify preferences among the study regions.
- Identify USFWS employee perceptions that could lead to disagreement when developing a decision-support framework for CI within the USFWS.

This study was designed to focus on USFWS regions 9 and 12, but many of the findings are applicable beyond those two regions and even beyond the USFWS. As rapid shifts in ecosystem function continue to accelerate because of climate change and other broad-scale impacts, novel management actions may become necessary, and it will be imperative to understand the social implications prior to problems arising.

1.1. Background

1.1.1. What is Conservation Introduction?

Conservation introduction (CI) is one term in a web of terms and definitions referring to the intentional relocation of a focal species to a new, recipient community. Related terms include "assisted migration" (McLachlan and others, 2007; Dumroese and others, 2015), "managed relocation" (Schwartz and others, 2012), and "translocation," each of which has been defined in multiple ways (Hällfors and others, 2014). Haskins and Keel (2012, table 13.1, p. 231) trace the development of CI-related terminology, which started in the early 2000s. The IUCN SSC (2013) suggests the term CI and divides it into two forms based on intent: assisted colonization, which is conducted "to avoid extinction of populations of the focal species," and "ecological replacement," (p. 3) which is conducted so that the introduced species can "perform a specific ecological function." (p. 3) For example, assisted colonization might involve the CI of a population of a frog species to a location outside its indigenous range because its current range is inhospitable, and it is likely to soon be extirpated. In contrast, ecological replacement might involve the relocation of one tree-species frog population to replace another tree-species frog population that has declined, and thus, to prevent the decline of the ecological community overall. Much of the CI literature is focused on assisted colonization; however, some research specific to ecological replacement has been done, particularly related to forestry management. Pedlar and others (2012), Leech and others (2011), and Sansilvestri and others (2015) all cite that CI within the specialty of forestry should be considered as distinct from assisted colonization, because it has a different goal (for example, stable forest output for economic reasons), focus (for example, populations of common species), and history (for example, history of acceptability of species relocation within forestry and knowledge of the focal species' invasive potential).

CI projects have three major characteristics. First, the threat of climate change is often a central driver, although other existential threats (including pathogens, invasive species, and

land-use change) also play a role and may be the main trigger in specific cases (Sansilvestri and others, 2015). Second, CI always involves translocation of species outside their indigenous range. Defining the indigenous range and predicting species survival outside of it are key aspects to predicting CI success (Schwartz and others, 2012; Pedlar and others, 2012). Lastly, CI is an intentional translocation of species. It is distinct from modes of migration, such as by habitat corridors (Olden and others, 2011; Lawler and Olden, 2011).

1.1.2. Alternatives to Conservation Introduction

To fully understand perceptions of CI, it is helpful to understand the alternative options available, since peoples' perceptions of a given management strategy may be significantly shaped by what they are comparing it to. An initial alternative is what the IUCN SSC (2013) describes as a population restoration: the translocation of species within the species' indigenous range, where scientists might be better able to predict its success. Other alternatives bear less resemblance to CI and vary in degree of human intervention. One of the least interventionist alternatives is to leave species to adapt, if necessary or possible, on their own. If funding is available, habitat protection and management of competitor species may aid species survival (Keane and Parsons, 2010; National Fish Wildlife and Plants Climate Adaptation Partnership, 2012). Another frequently mentioned alternative to CI is the creation of habitat corridors, which involves protecting and ensuring the quality of land along a migration pathway, such that species can "naturally" migrate to new locations (see Lawler and Olden, 2011 for an analysis of this option). Another alternative is the collection and storage of seeds, eggs, or sperm to preserve genetic diversity of a species for future use (Williams and Dumroese, 2013; Dumroese and others, 2015; Hoegh-Guldberg and others, 2008). A final, more technologically focused alternative is to help species adapt to climate change by genetic manipulation for climate-resilient traits (Dumroese and others, 2015). Given the rising interest in the fate of climate-threatened species, new alternatives may also arise, because even at present, the above listed alternatives are not exhaustive.

1.1.3. Defining and Predicting Conservation Introduction Success

Broadly speaking, CI success entails the establishment of a viable population that persists over time without too much external aid (Olden and others, 2011; Morris and others, 2021). However, measuring the success of CI depends on many factors, including the species, the goal of the project, the life stage evaluated, and the metrics chosen to best represent success at that stage. There are many metrics for success, such as increase in mass (Bouma and others, 2020; Nigh and others, 2004), mortality rates (Benito-Garzon and Fernandez, 2015), and biotic interactions (Liu and others, 2012). Some of these metrics are more difficult to measure for longer-lived species for whom key biological processes, such as reproduction, do not occur frequently (Liu and others, 2012; Burbidge and others, 2011; Williams and Dumroese, 2013). Beyond species establishment, some scientists have also measured the translocated population's ability to recover after extreme weather, such as a substantial drop in temperature (Liu and others, 2012; Martín-Alcón and others, 2016). This metric might help predict survival if the species is sensitive to extreme weather associated with climate change.

CI success definitions might also include a lack of negative impacts on the recipient community. For example, when the translocated species has not become invasive, hybridized in unintended ways with other species in the new habitat, caused the extirpation of another species, or, more broadly, disturbed preexisting food webs (Olden and others, 2011).

Predicting CI success depends on many factors, but two of the most important are relative factors of distance and location of the project. The distance from the source population—in terms of latitude, change in elevation, or location relative to sea level—must be short enough that the species can successfully adapt to new conditions, but long enough to ensure its survival as new conditions arise over time because of climate change (Fortini and others, 2017; Williams and Dumroese, 2013; Leech and others, 2011). Furthermore, the location must be similar enough for the species to find an appropriate niche (Liu and others, 2012; Burbidge and others, 2011). Other variables affecting CI success include the species' current or indigenous range, its genetic diversity within that range (Williams and Dumroese, 2013; Olden and others, 2011; Leech and others, 2011; Benito-Garzon and Fernandez, 2015), whether the relocation occurs in the same geographic region (Williams and Dumroese, 2013), and difference in temperature between the indigenous and translocated sites (Martín-Alcón and others, 2016). Importantly, however, none of these metrics is completely reliable on its own in all contexts. For example, Benito-Garzon and Fernandez (2015) found that a shift northward or an increase in elevation to achieve lower temperatures may not be ideal for all species. Distance factors affecting CI success become more salient as the relocation distance increases, affecting deviations from the indigenous zone in a wide range of variable ways for which it is difficult to find consistently reliable data (Seddon, 2010; Haskins and Keel, 2012).

Given the difficulty associated with predicting CI success, some research indicate experimentally releasing a species into the recipient community to study the effects (Sansilvestri and others, 2015; Williams and Dumroese, 2013; Olden and others, 2011; McLane and Aitken 2012). Mozelewski and Scheller (2021) suggest that forecasting success by using simulation models may also help predict the costs and benefits of CI; however, it is important to note that predicting the optimal relocation site for a particular species will remain inherently uncertain because of uncertainty in climate forecasting and in predicting species responses (Hällfors and others, 2016; Lawler and Olden, 2011; Ferrarini and others, 2016).

1.1.4. Arguments For and Against Conservation Introduction

Within the literature, CI has garnered both qualified support and cautious dissent. Arguments for and against CI generally focus on benefits and risks to either the focal species or the recipient community. Other arguments address its ethical, legal, and cultural dimensions.

1.1.4.1. Benefits and Risks to Focal Species and Recipient Communities

The primary benefit of CI for the focal species is that it increases its chances of survival in the face of climate change and other existential threats. Some species do not have the adaptations necessary to remain in place and adapt to climate change (Kreyling and others, 2011) or have a limited range that will shrink (Hällfors and others, 2016). While some species can migrate to new habitat on their own, CI can help species with limited dispersal abilities to move to a location with a more suitable future climate (Kreyling and others, 2011). The dispersal capacity of a given species may be limited for several reasons, including mobility challenges, such as in plant species with long life cycles (Leech and others, 2011; Nigh and others, 2004); geographic barriers, such as in aquatic species living downstream or in discrete bodies of water; and habitat fragmentation such as urban sprawl and traffic congestion limiting movement (Fontaine and Larson, 2016; Lopez, 2015).

Risks of CI for the focal species include risks to its original, endemic population, as well as risks to its translocated population. Sometimes the population of a rare species is not big enough to split between the new and old locations while ensuring the survival of the populations in both locations (Kreyling and others, 2011). There may also be uncertainty about whether a focal species will survive in its new habitat. Many factors in the proposed location may affect chances of survival, including whether it is a stable, less-disturbed ecosystem (Olden and others, 2011; Peterson and Bode, 2020), whether the presence of genetic diversity is representative of the source population (Kreyling and others, 2011; Schäfer and others, 2020), whether there is the presence of ecotypes that are already adapted to a climate like that which is projected in the new location (Kreyling and others, 2011); and even the geographic region itself being an inherently harsher environment (Morris and others, 2021).

There are also risks and benefits of CI to the recipient community. Proponents of CI generally either focus on the benefits of ecological replacement or support that relocating a species may be less risky than some may think (Mozelewski and Scheller, 2021; Pedlar and others, 2012, Abeli and others, 2014). For example, taking a step back from the direct risks and benefits, Kreyling and others (2011) cite that the risk to biodiversity posed by inaction is arguably higher than the risk posed by CI. Similarly, Lawler and Olden (2011) cite that climate change will alter ecosystems so much that the introduction of a new species is not worth worrying about.

Regardless of how they are weighted, the risks of CI for the recipient community include the potential for species invasion, disease introduction, and extirpation of species endemic to the recipient community. In a review of 63 articles, 35 percent found the potential for the focal species to become invasive was the most frequently mentioned argument against CI (Hewitt and others, 2011); however, proponents of CI support that it is rare for an introduced species to become invasive (Kreyling and others, 2011; Bellemare and others, 2017), in part because invasive species have a common set of characteristics that may make it possible to predict their invasion potential (Olden and others, 2011; Burbidge and others, 2011; Pedlar and others, 2012; Schwartz and others, 2012). Nevertheless, the risk of species invasion is still a concern, given that it may be the second biggest driver of species extinction worldwide (Leech and others, 2011; Bellard and others, 2016), has high potential impact (Peterson and Bode, 2020), and is generally irreversible (Hewitt and others, 2011). A second risk to the recipient community is the potential of the focal species to carry new diseases into the recipient community. To our knowledge, this is a problem rarely addressed in a substantive manner in the literature (Simler and others, 2019). Another risk of CI is that the focal species might extirpate species living in the recipient community, such as through genetic hybridization with closely related species (Olden and others, 2011; Burbidge and others, 2011).

1.1.4.2. Ethical, Social, and Cultural Perspectives

The central ethical debate related to CI is the conflict between those who support preserving species whenever possible, given their aesthetic, ecological (Kreyling and others, 2011; Olden and others, 2011), and intrinsic value (McDonald-Madden and others, 2011), and those who support that moving one species could harm other species and ecosystems that are also valuable (Palmer and Larson, 2014; Schwartz and others, 2012). As Palmer and Larson (2014) state, “The most common objection to assisted migration is not that we lack good, value-based reasons to do it *** but that we have good, value-based reasons *not* to do it” (p. 651). In particular, no one can be certain about the ecological risks posed by CI (Albrecht and others, 2013; Schwartz and others, 2012; Ahteensuu and Lehvävirta, 2014). As such, CI decision making is a matter of perspective and values (Neff and Carroll, 2016). Beyond this central issue, Albrecht and others (2013) highlight many other ethical considerations, such as those related to interspecies competition and ecosystem resilience, which may also be taken under consideration. Despite these issues, many support that careful reasoning may help identify cases in which CI is ecologically and socially acceptable (Seddon, 2010; Palmer and Larson, 2014; Pedler and others, 2012, Richardson and others, 2009).

Public perceptions are another component of CI decision making and are a growing focus of scholarship. Peterson St-Laurent and others (2018) surveyed Canadian attitudes toward CI and found that respondents preferred strategies that

seemed more "natural," or less interventionist, such as moving species within their current or indigenous range; however, these preferences may be quite malleable (Findlater and others, 2020), perhaps depending on context (Hagerman and others, 2021) or trust in natural resource managers (Peterson St-Laurent and others, 2018). Public judgment may also be altered by climate change. Pedler and others (2011) cited that climate change may alter the importance placed on saving native species, because the value of native species may change amidst transforming ecosystems. Therefore, for example, in an unstable ecosystem the use of the term invasive species may be inappropriate because for a species to be invasive, it would need to be disrupting a stable ecosystem.

In our search there was little research published on cultural considerations for CI. Pelai and others (2021) cite that CI decision making is primarily informed by biophysical types of scientific knowledge, disregarding the perspective of indigenous groups and the public, with the result that these perspectives are largely understudied in the CI literature. Rayne and others (2020) also identify the absence of indigenous perspectives in CI decision making and present a framework for engagement. Hagerman and others (2021) cite that CI scholarship has yet to fully examine the human dimensions of CI and to demonstrate deliberative methods for engaging diverse perspectives.

1.1.5. Governance and Legal Issues

The laws, policies, and administrative rules that govern CI are variable, depending on location, jurisdiction, and the species in question, among other factors (McLachlan and others, 2007; Schwartz and others, 2012). The Endangered Species Act (ESA) is the main piece of Federal legislation governing CI in the United States. The ESA can create difficulties for the relocation of endangered species, because of stringent regulation of protected species (Sansilvestri and others, 2015). As a result, many programs desiring to perform CI rely on the status designation of "experimental population" (50 CFR §17.81[a]) within the ESA. According to USFWS, "the FWS may designate a population of a listed species as experimental if it will be released into suitable natural habitat outside the species' current range, but within its probable historical range, absent a finding by the Director of the FWS in the extreme case that the primary habitat of the species has been unsuitably and irreversibly altered or destroyed." (USFWS, 2022, p. 2). CI projects may also have to comply with National Environmental Protection Act (NEPA) requirements. Other Federal regulations that may affect CI efforts include Executive Orders 13112 (1999) and 13751 (2016), which regulate invasive-species introductions, and Executive Order 11987 (1977), which regulates exotic-species introductions (Shelton and others, 2016). As a result of Executive Order 13112, the National Invasive Species Council established a Managed Relocation Task Team, which published a list of recommendations for CI meant to reduce the risk of species invasion (ISAC, 2017). In the forestry sector, there are also seed-transfer regulations that determine the official movement of seeds from a particular species (Williams and Dumroese, 2013; Benito-Garzon and Fernandez, 2015). According to Brichieri-Colombi and Moehrenschlager's (2016) study of North American conservation translocation projects, which includes CI, most projects were requested, supported, or funded by the government. Thus, the government plays a role not just in regulating CI, but also in funding it.

1.1.6. Current Decision-Support Frameworks

In 2013, the IUCN SSC published a commonly referenced CI decision-making framework entitled "Guidelines for Reintroductions and Other Conservation Translocations," which defines CI (see "What is a conservation introduction?" (p. 2) for a summary of these definitions) and outlines key considerations at every stage of the process, from deciding whether or how to do a CI, to the key considerations of biological, social, regulatory, and resource feasibility when designing a project, to monitoring and sharing results.

In 2021, the National Park Service (NPS) published a report focusing on evaluating risk associated with CI (Karasov-Olson and others 2021), walking through considerations associated with six questions: "1) What is the risk of no action? 2) What is the risk of the action to the target and the source population? 3) What is the risk of the action to species in the recipient ecosystem? 4) What is the risk of the action to higher order attributes of the recipient ecosystem? 5) What are the risks associated with potential invasion of the target to non-target ecosystems? 6) What are the ecological risks to species and services valued by society?" (p. 10).

There are also many other decision-making frameworks published in the literature, such as Karasov-Olson and others (2021) risk-assessment framework, which was codeveloped between university researchers, agency scientists, and resource managers; Richardson and others (2009) evaluation of social and ecological dimensions of CI, and Hoegh-Guldberg and others (2008) decision framework.

2. Methods

This study uses qualitative social-science methods to describe the perceptions of employees in Department of Interior (DOI), USFWS regions 9 and 12. The strengths of qualitative research allow for exploratory studies that do not require a deep, preexisting understanding of the topic being investigated (Aspers and Corte, 2019). We focused our objectives on understanding USFWS employee's perceptions of CI rather than describing them. Perceptions can vary widely and may include unique, minority views at all levels within the USFWS. This study is qualitative in nature and is not intended to be representative but is instead meant to describe the range of perceptions that exists within the USFWS. Qualitative data collection also allows researchers to flexibly ask how and why participants hold unique perceptions (Aspers and Corte, 2019). Investigating how and

why perceptions are held—even minority perceptions—is important to identify potential areas of disagreement so that they can be addressed directly in the future.

The following subsections describe the study design and data-collection methods employed for this study. Section 2.1 describes the data-collection effort, section 2.2 describes the data analysis, and section 2.3 describes the characteristics of the participants in this study.

2.1. Data Collection

The qualitative data were collected by using remote, semistructured interviews that were conversational and that elicited information from another person within predetermined topics. Semistructured interviews are well-suited to exploratory qualitive research because they allow flexibility to explore unknown topics while following a consistent format between interviews. Semistructured interviews are also well-suited to using a remote interview format (in other words, phone or video), which was necessary in order to maintain appropriate health and safety practices related to the Coronavirus Disease 2019 (COVID-19) pandemic.

The Microsoft Teams platform was used to conduct and record 30 interviews from January to June 2021. Best practices and ethical standards for human subjects' research were followed, including obtaining explicit consent to participate. All interviews were conducted one-on-one by a single researcher. Interviews were 45–60 minutes in length. Each participant was asked for permission to record audio but was asked to turn off their video. Permission was granted by all participants. To preserve the conversational nature of the interviews and to avoid the risk of overly interpreting participant responses, direct quotes provided here have not been corrected for grammar, mechanics, and style.

There were seven main topics that we addressed throughout the interviews: (1) professional characteristics and background of the respondent, (2) preferred definitions and terms, (3) personal perceptions and views of CI, (4) potential risks and tradeoffs associated with CI, (5) thresholds for success when conducting CI, (6) implications of ethical and cultural values associated with CI, and (7) the institutional culture and opinions centered on CI.

2.2. Data Analysis

Audio recordings from the semistructured interviews were transcribed by a professional transcription service. Analysis of qualitative data relies on a robust, systematic process called "coding" (Saldaña, 2013), wherein concepts are identified in specific sections of text, and a thematic label is added to any respondent quotes that are associated with that concept. The coding process is iterative and hierarchical, wherein broader codes are used initially to segment and label interview themes. The data are then further segmented into more specific themes under these broader labels. In some cases, initially identified themes are divided under a new label that better represents the range of views for that theme or are consolidated under a single label. For this study, all interviews were coded by using R (R core team 2021) and the software package RQDA for qualitative data analysis.

To initiate the coding process, a series of a priori thematic codes were developed prior to analyzing the interview transcripts based on the literature that determined the main topics used in the interviews including broad input from USGS and USFWS partners (fig. 1). To further segment these broad themes, a follow up generative step was conducted by the team of authors to develop additional emergent codes that were not included in the literature-derived a priori codes. To develop these emergent codes, three interviews (in other words, 10 percent of the dataset) were selected that represented a range of views identified in the study. These interviews were independently coded by the team of authors by using the a priori codes and any others that emerged that were needed to clarify the respondents meaning. Following detailed discussion among the team, the suggested emergent codes from each researcher were combined, parsed, and incorporated into the final codebook. The final and agreed upon codebook was then used by a single researcher to code all interviews (table 1).

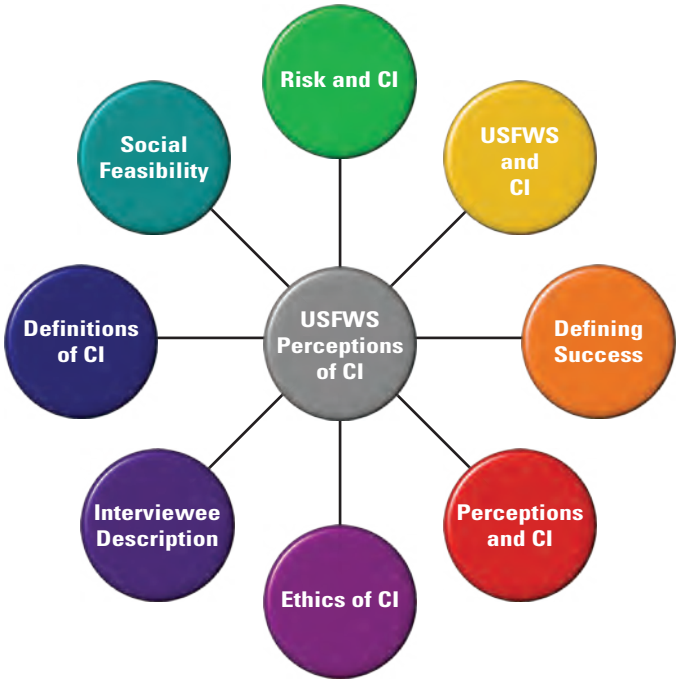

Figure 1. Priori thematic codes identified and used in the initial analysis of U.S. Fish and Wildlife Service (USFWS) participant interviews centered on conservation introduction (CI) as an ecological management strategy. Detailed descriptions of what each theme represents is provided in table 1.

Table 1. Primary codebook assembled for terms used in analyzing semistructured interviews with U.S. Fish and Wildlife Service personnel.

[USFWS, U.S. Fish and Wildlife Service; CI; conservation introduction; IUCN SSC, International Union for Conservation of Nature Species Survival Commission; ESA, Endangered Species Act; NEPA, National Environmental Protection Act]

Code	Subcode	Description
Interviewee description	Role in USFWS	Participant description of their professional background and their duties within the USFWS
	Experience with CI	Participants experience with CI or other translocation efforts
Definition of CI	Participant definition	Comments on IUCN SSC (2013) definition for CI and potential alternatives in terminology
	No movement outside native range	Comments specific to movement of species outside indigenous range or ranges in general
	Baseline assumptions	Baseline assumptions for CI that the participant believed were relevant
Perceptions of CI	Perceptions, general	General perceptions and views related to CI
	Benefits of CI	Perceptions that refer to specific benefits of CI
	Legal and policy frameworks	Perceptions that refer to legal and policy frameworks (for example, ESA or NEPA) related to CI
	Species- vs. ecosystem-centric	Perceptions that set up an explicit contrast between preserving a species or an ecosystem/habitat
	Endangered species-related	Perceptions of CI that are specifically related to endangered species
	Climate change and CI	Perceptions of how CI relates to climate change
	Barriers	Perceptions of barriers to conducting CI
	Prerequisites and criteria	Perceptions or views that comment on specific prerequisites or criteria that should be met before conducting CI
	Caveats	Caveats or qualifiers related to specific perceptions of CI
Risk and CI	Risk, general	General perceived risks of conducting CI
	Risk of no action	Risks associated with taking no action or waiting too long to conduct CI
	Risk to source population	Risks to the source population of species being translocated
	Risk to recipient ecosystem	Risks to the recipient ecosystem where species are being translocated
	Socioeconomic risks	Social or economic risks that would result from conducting CI
	Tradeoffs	Comparisons of tradeoffs and risks
	Uncertainty and confidence	Risks associated with uncertainty, and level of confidence in predicted outcomes associated with CI
	High-profile species	Risks associated with high profile species
Social feasibility		General perceptions or views that relate to the social feasibility of conducting CI
Defining Success	Success, general	General perceptions of markers for success when conducting CI
	Hybridization	Implications of hybridization on success when conducting CI
	Short-term	Views on the markers for short-term success
	Long-term	Views on the markers long-term success
Ethics of CI	Ethics, general	General perceptions of the ethics and morals associated with conducting CI
	Obligations/stewardship	Comments on the obligations for preservation or stewardship of species or ecosystems related to CI
CI within USFWS	Internal Barriers	Barriers to conducting CI specific to operating within the USFWS
	USFWS Culture and CI	General perceptions of USFWS agency-wide culture that relate to CI
	Suggestions for change	Specific suggestions for change within the USFWS related to conducting CI
	Things working well	Suggestions for things that should not change within the USFWS related to CI
	Unaware/uncommon	Perceptions of CI being uncommon or of USFWS personnel being unaware of it

2.3. Participant Characteristics

Most participants included in this study were identified by a convenience sample collected by using a voluntary questionnaire that was administered by email by the USFWS. Seventy-nine USFWS employees responded to the prescreening questionnaire. We used those responses to select and contact 30 individuals by following three strata (geographic region of work, position within USFWS, and program of work within USFWS) identified as important by partners within the USFWS. Seven more potential participants were also contacted to fill in underrepresented strata within the participant group. Of those 37 invitations, we were unable to reach three people, one refused to participate in the study, and three others were not interviewed because saturation of topics had been reached. As such, we completed a total of 30 interviews.

Obtaining a representative sample proved challenging, with the largest portion of participants coming from the Ecological Services program (table 2). The next most represented programs were Fisheries and Refuges, with the rest of the sample representing Science Applications, Migratory Birds, Wildlife Conservation, and Cultural Resources. Based on comments from partners in the USFWS, we deemed this a representative sample based on the composition of personnel in target regions. For example, all participants from the Fisheries program were based in the Pacific Northwest, because few Fisheries personnel operate in Hawaii and the Pacific Islands.

Table 2. Frequency of participant inclusion during interviews conducted to discern beliefs about conservation introduction efforts among personnel of the U.S. Fish and Wildlife Service.

[Region refers to the two Department of Interior (DOI), U.S. Fish and Wildlife Service (USFWS) regions included in the study; position refers to the type of position within the USFWS, and program refers to the USFWS program the participant operates within according to their DOI profile; USFWR, U.S. Wildlife and Sport Fish Restoration]

Participant characteristics	Levels	Frequency (number and [percent of total])
Region	Pacific Northwest (region 9)	15 (50)
	Hawaii and Pacific Islands (region 12)	9 (30)
	Both	6 (20)
Position	Direct interaction role	16 (53)
	Administrative or coordination role	14 (47)
Program	Ecological Services	12 (40)
	Fisheries	5 (17)
	Refuges	6 (20)
	Science Applications	3 (10)
	USFWR, Migratory Birds	2 (7)
	Wildlife Conservation	1 (3)
	Cultural Resources	1 (3)

Among the participants, all but six said that they had previous experience with CI or other types of translocation efforts. The experience ranged across actively capturing and moving species, supervising the planning and execution of a translocation effort, and assisting in the regulatory and permitting requirements. Of the participants who had experience with translocation efforts, 11 said that at least one of the efforts fit the IUCN SSC (2013) definition for CI. Most participants who suggested they had experience with CI referred to projects that were still in the planning stages and were occurring in USFWS region 12.

Six participants commented on translocation efforts that fell under a reintroduction classification rather than an introduction, specifically referencing species that had been or were believed (based on paleontological evidence) to have been extirpated from an area . Among these participants, there was some confusion about whether or not something qualified as an introduction.

3. Considerations for Developing a Decision Framework

One of the objectives for this study was to investigate and obtain baseline knowledge needed to develop a decision framework for CI. Some participants commented specifically on the need for a decision framework and consistent guidance on how and when CI should be used within the USFWS. For example, participant 6 in region 9 states:

> "I think that one way to encourage conservation introductions would be to come up with a plan, an action plan, a conservation plan that really would outline steps, phases, project design features, protections, conditions that would be followed for when a project were to occur."

Other participants suggested a framework that would encourage communication and collaboration between USFWS programs. A participant in region 9 agreed, stating that communication of what CI entails and why it needs to be done across programs will be important.

Over the course of conducting the interviews, a consistent set of themes arose around how and when CI should be used in the USFWS. Most participants we interviewed were not against the USFWS conducting CI and felt that it was a necessary tool to preserve at-risk species and ecosystems. When asked how they felt CI was generally viewed within the USFWS, most participants believed it was viewed positively but offered caveats (table 3). A minority of participants believed it was viewed as necessary and important or that USFWS personnel were unaware of the approach (table 3). This breakdown was indicative of how many participants seemed to maintain a cautious and risk-averse view of CI while still recognizing that it may be necessary and effective in certain situations.

Table 3. Frequency of participant responses relating to beliefs about how conservation introduction is viewed agency-wide within the U.S. Fish and Wildlife Service.

["Region" refers to the two Department of Interior, U.S. Fish and Wildlife Service regions that were included in the study]

Belief	Region 9	Region 12	Both
Necessary and important	3	1	1
Positive but with cautious	6	6	3
Skeptical and risk-averse	0	0	1
Unaware or considered uncommon	4	0	2

Key finding:

Participants tended to have a positive but cautious view of CI and often focused on potential uncertainty or risk.

Similarly, most participants felt CI was an ethical management practice in most situations (table 4). Others felt it was only ethical in specific situations, and a small minority of participants felt it was unethical in most situations (table 4). It is important to note that, given its qualitative design, the intention of this study is not to draw agency-wide conclusions about how CI is viewed within the USFWS. That said, among the participants in this sample, the majority of participants hold positive views for CI and suggested in interviews that they believe CI is not viewed negatively within the USFWS at large.

Table 4. Frequency of participant responses relating beliefs about whether conservation introduction is an ethical practice for the U.S. Fish and Wildlife Service to use.

[Region refers to the two Department of Interior, U.S. Fish and Wildlife Service regions included in the study]

Belief	Region 9	Region 12	Both
Ethical in most situations	9	3	2
Ethical in certain situations	6	3	4
Unethical in most situations	2	1	0

Participants who maintained a risk-averse view of CI tended to be concerned about the severe consequences of potential operational mistakes. Although the IUCN SSC (2013) guidance addresses these concerns, when developing a decision framework, it will be important to address these concerns explicitly. Participants made it clear that in some of these cases, they believe CI should only be used if other mitigation methods have been tried or there is evidence that alternatives are unlikely to be successful. For example, participant 1 in region 9 explains:

> "I'd want to make sure that I exhausted all of the mitigation measures of those threats. Translocation is not necessarily a last resort, but in some cases it is. We want to make sure we're doing everything we can to abate the threat."

Some participants believe that the justifiability is case-specific and that there should be an evidential requirement to prove that it is appropriate. For example, participant 5 in region 9 states:

> "Yeah. I would say, as a big picture answer, our assumption should be that we start with the baseline that it's probably inappropriate. Only after we have accumulated a lot of evidence and have a lot of confidence do we even start talking about its appropriateness."

Furthermore, some participants emphasized that it is imperative for adequate time and effort to be taken to fully describe potential impacts to the source population of the species, the recipient ecosystem, and any species that may be affected. For example, participant 20 in region 12 states:

> "I think it would be inappropriate if a thorough evaluation of the impacts, particularly to the receiving ecosystem * * *if that process isn't thorough enough."

Key recommendation:

Explicitly describing the appropriate criteria for assessing a CI effort will be an important aspect of any decision framework.

The cautious approach we identified among some participants was in direct opposition to others who believe that being too cautious will limit the success of CI projects in the future. For example, participant 16 in region 12 points out how important moving quickly will be, stating:

> "I think there's two sides to it. I think that there are people that are proactive, and the idea is to assist these species and to say, okay, before things get bad, let's be proactive * * * I err on the side of being proactive and not waiting till the last possible minute"

To implement a successful decision framework, it will be imperative to address how CI efforts are being assessed and what actions should be taken to prevent unexpected consequences. These discussions should incorporate strategies laid out in existing frameworks and explicitly state how the USFWS should use them to limit risk.

When participants were asked about any changes that they believe will need to happen if CI is to be more widely applied, four participants commented that the USFWS should

not go it alone and that there needs to be more emphasis on public-private partnerships. For example, participant 2 in region 12 states:

> "I talked about community input. That's one part. Political power and financial [power] is really, really important. We don't have the money to do a lot of these translocations. We don't have, sometimes, the political power, so * * * Public-private partnerships are important, and there are some policies, I think, in our agency that allow that."

Other participants agreed, referencing how important public-private partnerships are to the success of any conservation action. Participant 14 in region 12 suggests that the partnerships are more important than the introduction or reintroduction efforts themselves to determine success.

Key finding:

Some participants tended to be more risk-averse and suggested that stringent planning and data collection are necessary prior to conducting CI.

4. Perceptions of Conservation Introduction

This section explores the range of perceptions and views that USFWS participant personnel expressed about CI as a management technique and any implications they perceived regarding its use within the USFWS.

4.1. Perceptions of International Union for the Conservation of Nature's Species Survival Commission Proposed Terms

In this section, we investigate how USFWS personnel use and interpret the terms for management actions that are associated with translocating species outside their current range for the purpose of conservation. As previously discussed, CI and its corresponding terms and definitions as proposed in IUCN SSC (2013) are only a few of the terms that are broadly used inside and outside of the USFWS to describe these types of translocation efforts. For this study, we drew from the IUCN SSC guidelines and their proposed terminology to ask participants to comment on them or suggest alternatives. So that every participant was able to comment from the same minimum baseline of information, an informational paragraph was provided to each respondent that defined the IUCN SSC proposed terms that are listed under CI. This paragraph was read during the interview, as follows:

> "The IUCN conservation guidelines describe a management action called conservation introduction, and it describes it as existing in two different forms. The first form is called assisted colonization, and that is the intentional movement and release of an organism outside its indigenous range to avoid extinction of populations of that focal species. That's one form of CI. Then, the second form is called ecological replacement, and that is the intentional movement and release of an organism outside its indigenous range, but to perform a specific ecological function rather than to preserve it and keep it from going extinct. Those two fall under the conservation introduction term and are distinct from conservation translocation, which is the movement and release of species within their indigenous range, not outside of their indigenous range."

Among the participants we interviewed, there was substantial support for adopting the IUCN SSC (2013) guidance on terminology and definitions. Most suggested they were already aware of this guidance and were already incorporating the definitions into their current work. Indeed, half of all participants we interviewed stated explicitly that they agreed with the guidance on terminology for CI and felt that the USFWS should adopt it (table 5). Among the other half of the participants, most were neutral towards the terminology and neither opposed nor explicitly agreed with the USFWS adopting those specific terms. In some cases, the participants did not have a specific preference, while others referenced issues with ambiguity regarding the terminology. Only 2 participants did not believe the definitions were adequate or that the USFWS should not adopt them (table 5). Thus, most study participants supported adopting the ICUN SSC (2013) guidelines and terminology within the USFWS and relying on them to develop a decision-support framework for CI.

Key finding:

The majority of participants did not oppose the USFWS adopting the IUCN SSC (2013) guidelines into a decision-support framework associated with CI in future policy.

Despite the lack of significant opposition to the USFWS adopting the IUCN SSC (2013) terminology guidelines, it is important to understand the points of ambiguity identified by some of the study participants because with any decision-support framework, it is imperative for the terminology to be clear and generalizable to many different situations. Ambiguity in the terms and definitions that underly a framework is especially concerning because it can lead to different interpretations in where and when the framework should be applied, how it should be applied, and who should be using it.

Key finding:

Some USFWS personnel indicate that the IUCN SSC (2013) guidance is too ambiguous to allow for distinctions between reintroductions and introductions and is not clear about parameters of evidence that are appropriate in determining that distinction.

When asked about the IUCN SSC guidance on CI terms and definitions, a minority of participants suggested that they believed the definitions are too ambiguous. The guidance states that to be considered a CI, the species must be moved outside its indigenous range and that the indigenous range of a species is the known or inferred distribution as described in historical records or indicated by physical evidence of the species' occurrence. Some participants we interviewed suggested that they are confused about how to employ the definition of "indigenous range" to their purposes within the USFWS. Regardless of their preference for the term "indigenous range" over alternate terms (for example, "historical" or "native" range), these study participants are not the only ones to question its applicability and lack of clarity (Seddon, 2010; Dalrymple and Moehrenschlager, 2013).

Even if concerns about the applicability of the term "indigenous range" constitute only a minority view, they require further examination. At the root of these concerns is that the current guidance allows the designation of an indigenous range to be too broadly defined. The evidentiary parameters for the determination are currently set at any historical or physical evidence of a species occurring in a given area, but skeptical participants raised questions about how these parameters would be sufficient to distinguish between introductions and reintroductions of a species. More specifically, they questioned how and whether or not the time frames during which a species occurred in an area would be considered; what types of evidence should qualify to confirm occurrence of a species in an area; and what distinctions should be drawn between species and subspecies. These questions indicate that the current definition for indigenous range leaves substantial leeway to inappropriately classify a translocation effort as a reintroduction rather than CI. It seems, therefore, that this definition is too ambiguous for some of our study participants, and that this ambiguity could result in opposition to future CI or reintroduction efforts.

Key recommendation:

Ambiguity within the distinctions between introductions and reintroductions should be addressed by the decision-support framework to prevent misunderstandings and unnecessary opposition to future projects.

When developing a decision-support framework, it is imperative for all individuals who have a stake in executing the framework to be operating from the same basic assumptions. Given the perceived ambiguity we identified among USFWS personnel regarding the term "indigenous range" and the term's implications for defining CI, it will be imperative for any decision-support framework to be clear about its terminology and how the definitions will be employed.

Table 5. Frequency of participant responses relating to beliefs regarding the definitions of "conservation introduction" provided in IUCN SSC (2013).

[Region refers to the two Department of Interior, U.S. Fish and Wildlife Service regions included in the study: IUCN SSC, International Union for the Conservation of Nature's Species Survival Commission]

Belief	Region 9	Region 12	Both
Prefer to use IUCN SSC definitions	9	3	3
Neutral	5	4	3
Prefer alternate terms and definitions	2	0	0

4.2. Perceived Barriers Associated With Conservation Introduction

Barriers are factors that may impede the implementation of a CI effort and limit successful outcomes. Participants described potential barriers that covered a wide range of themes, including issues of funding; social acceptance and support; regulatory or legal barriers; access (or lack thereof) to appropriate information necessary to alleviate risk and avoid unintended consequences, and a range of biological circumstances. Table 6 includes a comprehensive list of the themes and subthemes related to these potential barriers, along with descriptions of how each is expressed by participants and with a contextual quote that is representative of the theme.

Key finding:

The ability to obtain funding through traditional sources and for the entire duration of a CI or reintroduction project is a commonly referenced potential barrier.

In discussions of funding as a potential barrier to conducting CI, there were three main subthemes (table 6). The first was a general awareness that funding is limited and difficult to obtain when seeking to preserve at-risk species or ecosystems. Many of these participants suggested that although funding may be obtained, the magnitude is not likely to be sufficient to execute CI effectively. To some participants,

the potential barrier of insufficient funding connects closely with issues of social acceptance and support, because they reason that having such support will be necessary to offset the limitations of funding that is typically available through more traditional means. Insufficient social support also imposes additional difficulty in gaining long term partnerships with other groups who can assist USFWS's CI efforts. An additional subtheme that these participants identify derives from inconsistencies in funding longevity. Even though funding may be available to start a CI project, the relatively long time horizon required for such projects makes planning and executing them difficult because typical funding cycles are shorter.

The theme regarding potential barriers associated with obtaining reliable information that is necessary to effectively plan a CI project is split into two distinct subthemes (table 6). Participants raising these concerns all recognized the difficulties inherent in obtaining reliable information to ameliorate risk and avoid the potential unintended ecological consequences they perceive to be associated with CI. For these participants, it seems that information-access barriers are rooted in what they perceive to be a larger context of uncertainty inherent in CI projects. For such reasons, these participants imply that they are or would be more comfortable with reintroductions. Relatedly, the perceived ambiguity in defining an indigenous range was again referenced in the context of information barriers, with a minority of participants identifying that the difficulty of obtaining sufficient historical or paleontological records is important to distinguish introductions from reintroductions. For some participants, there is the perception that the USFWS may not have the capacity to obtain or interpret information that would define a translocation as a reintroduction rather than an introduction. Historical examples of relocating certain species (for example, zebra mussels, brown trout, and mosquitos) were cited to illustrate their perception that the ramification of species being moved may be impossible to predict.

Key finding:

Some participants are concerned with additional uncertainty associated with CI, including how it can be differentiated from reintroductions and how to identify additional information necessary to reduce the risk of unintended consequences.

Regulatory and legal barriers make up another theme that is also cited by participants in the study (table 6). When discussing regulatory barriers, participants most often referenced the difficulty of operating across geopolitical boundaries, especially when it is necessary to move species across them. For example, participant 6, operating in region 9, points out how difficult it is to obtain appropriate permits across multiple jurisdictions. (Note: as part of our methodology, we separated legal barriers from regulatory barriers because legal barriers tend to be more associated with statutory compliance, avoiding litigation, or understanding the limitations relegated by statutory laws.) For example, two of the participants who operate in both regions commented on the lack of clarity in what is required if a species in consideration for CI falls under the Endangered Species Act or related laws. Some participants perceive the need to avoid litigation to be directly connected to other success barriers, like social acceptance or obtaining sufficient prerequisite information. To make this point, participant 6, in region 9 points out the need for well formulated and clear management plans, stating:

> "Think of a risk and an issue and then create a management plan, so to say, or a plan to be consistent for all projects in the future. That's one way that we work because that helps us avoid litigation. It helps us protect the species."

Key recommendation:

Seek input from partnering organizations and stakeholders before or during the development of a decision-support framework. This could include a follow up survey or qualitative workshop that seeks input beyond the USFWS.

Potential barriers within the theme of social support and acceptance is by far the most frequently suggested one, with 18 participants highlighting it (table 6). These participants perceive a distinction being drawn between support from the public, the scientific community, and political partners. Among our participants, potential barriers associated with public support are often related to anticipated perceptions among local community members who are interested in either the source population or the recipient ecosystem. For example, one participant (operating in both regions) comments that they believe CI might go against current perceptions within the general public about the importance of native species They believe that a generalized feeling of ethical responsibility for native species has developed and that it may be difficult to overcome this sentiment among the public or other stakeholders who have internalized that ethic, even in legitimate CI efforts. Some study participants even perceive that ignoring this public perception could be used by resistant community members as an example of governmental overreach.

Among study participants, potential barriers associated with the scientific community are generally based on a perception that CI is controversial and that experts could oppose the USFWS moving species outside their indigenous range. Relatedly, there is a consequential perception that it could be difficult to maintain support from USFWS partners holding similar views. These participants feel that cooperation and logistical support from other agencies that manage species and land is necessary for any effort to be successful.

Table 6. Participant responses identifying a wide range of perceived barriers that they believe will need to be overcome in any conservation introduction effort.

[References to perceived barriers are aggregated under a series of themes and subthemes that represent a general consensus. Descriptions of the barriers discussed, and representative quotes are provided for nuanced context. Direct quotes are reproduced from coded transcripts of the interviews and have not been altered for grammar, mechanics, or style in order to preserve the speech patterns of each participant. Region refers to the two Department of Interior, U.S. Fish and Wildlife Service regions included in the study; CI, conservation introduction; p, participant, r, region; BR, both regions]

Subtheme	Description	Participant quote
	Funding	
Funding amount	Difficulty gathering funds to conduct CI that is appropriate to the scale of the problem being addressed	"I guess part of my big question is where do we find the money for these types of things, but I guess it's a separate issue? This is really more about attitudes. I guess money is part of attitudes" (p21, r9).
Funding consistency	Recognition that funds may be available initially but not long-term	"We have to make a commitment for a 10-year project, and we may only know our budget for the next year and a half. These are all the preplanning components that take thought and careful work * * *" (p3, r9).
Non-Federal partnerships	Ties closely to social-support theme and recognizes that support may be required from partners and stakeholders initially and long-term.	"* * * how do you get [buy-in from] your peers. It's not just peers within the agency. It's the agency's peers as well. How do you get the Audubon Society and Sierra Clubs of this world to buy off on some of these things * * *" (p5, r9).
	Information	
Prerequisite information	Difficulty obtaining information required to predict likelihood of success, potential risks, and undesirable outcomes.	"I think the biggest one is what I just mentioned, just a lack of information—being able to come up with a full picture of the ecological consequences of something like that. I think that would always be the biggest barrier in my mind to doing something like that" (p29, r9).
Uncertainty	Unrealistic to trust there is capacity to understand and predict potential risks and unexpected outcomes	"When you introduce them into that habitat, there's no telling if they're going to react the same way as [if they were in] their normal habitat or if there are factors that you don't understand that may still affect them" (p1, r12).
	Logistics	
Safe capture and transport	Difficulty of safely capturing and moving species that are already at-risk	"* * *sometimes technological and logistical considerations. That was a big deal with the millerbird translocation, for sure. Moving a bunch of little insectivorous birds 650 miles by sea and keeping them alive for three days in a boat." (Participant 24, R12)
Genetic viability	Genetic viability of the focal species and preventing genetic bottleneck effects among the translocated species or the remaining source population	"Is it something [in other words, a species population] that there's actually enough left to make this work? Like, if you have 100 individuals left, is there enough genetic diversity there? If you have 50 individuals left is there really enough genetic diversity there to make it worthwhile" (p11, r9)?
	Governance	
Regulatory	Obtaining appropriate permits for operating across political boundaries (for example, international, state, local, and private)	"* * * just getting the permits to do [it], and just ensuring that you've gone through appropriate quarantine before releasing an animal, having quarantine facilities available where you can do that. There's a ton of infrastructure that you need to build up to make these things happen" (p7, BR)
Legal	Compliance with applicable statutory or judicial laws; potential for litigation	"Yeah, because all it takes is—and then given the uncertainties, you're gonna have to make sure that you document very well what you do and have good reasons, and you go through the process very well, so that you can stand litigation" (p5, r9).

Table 6. Participant responses identifying a wide range of perceived barriers that they believe will need to be overcome in any conservation introduction effort.—Continued

[References to perceived barriers are aggregated under a series of themes and subthemes that represent a general consensus. Descriptions of the barriers discussed, and representative quotes are provided for nuanced context. Direct quotes are reproduced from coded transcripts of the interviews and have not been altered for grammar, mechanics, or style in order to preserve the speech patterns of each participant. Region refers to the two Department of Interior, U.S. Fish and Wildlife Service regions included in the study; CI, conservation introduction; p, participant, r, region; BR, both regions]

Subtheme	Description	Participant quote
	Social support	
Political support	Obtaining support and partnerships from other agencies and institutions that are necessary for success	"Again, just based on my experiences with just conservation translocations, establishing a species that had been extricated from a state and just the pushback from neighboring land owners and the political capital that it would take to pass that through * * *I think there's going to be regulatory hurdles, but there's also, depending on where you're doing it and what the species is, you might have that community barrier as well, community perception barrier" (p14, r12)
Support of public	Difficulty obtaining support from public that are local to source population and recipient ecosystem	"Another barrier, which is more political, might be the social perception from either the place they're being taken from or the place that they're being brought to" (p21, r9)
Support of scientific community	Difficulty obtaining support from scientific community and peers in natural resource management	"* * *in our agencies * * *you need to look to your peers for support. Cause if you don't get support from your peers, things get really tough, right or wrong. Because sometimes the majority of our peers are not necessarily right, not necessarily fully informed. That's a big challenge, okay" (p5, r9)
Perceived government overreach	Highly interventional management techniques, like CI, can result in a perception of government overreach or waste of public funds—atypical to what the public is used to.	"* * *there's nothing that raises people's hackles like conservation introductions, particularly when you start talking about the megafauna * * * They become the vehicle by which people have concerns about overreach of the Federal government * * *" (p3, r9)
Economic impacts	Negative economic impacts on locals (for example, limit of economic opportunity and impacts to previously viable opportunity)	"Local community and private landowner barriers: particularly, in most areas where we consider doing these things are in areas where landmasses exist to and resources exist to perpetuate a population of a species which oftentimes lies in direct relationship with public lands or water, which lies in direct conflict or perceived conflict with tax bases at local and individual scales * ** (pp4, r9)
Non-native implications	Difficulty obtaining support for CI due to perceived implications for being in opposition of a historical push to emphasize native species in conservation and ecosystem restoration.	"We spend so much of our effort trying to manage non-native species, the perception that you're introducing a non-native to a novel environment purposefully for conservation will, there'll be people who oppose it on the risk factor" (p8, BR)

4.3. Risks and Tradeoffs for Conducting Conservation Introduction

Risks are factors that may lead to undesirable outcomes after a CI effort has been implemented. We analyzed how participants assess the risks of CI and which risks they emphasize. When participants were asked to discuss the risks they perceive, the most common answers were associated with the recipient ecosystems and the potential impacts of moving a species outside its indigenous range (table 7). Another set of similar risks includes proceeding within a context of too much uncertainty or while lacking sufficient confidence in the potential outcomes. A minority of participants are more concerned about socioeconomic risks and risks to the source population of the translocated species (table 7). A few participants commented on the risk of waiting too long to attempt CI and the potential for missed opportunities to save at-risk species and ecosystems.

Key finding:

Potential risks to the recipient ecosystem and the perceived lack of knowledge or understanding in identifying potential problems are themes that are substantially linked among participants.

Among participants who are concerned about risks to the recipient ecosystem, many perceive the risk of a translocated species becoming invasive (table 7). These participants tend to focus on the severity of the consequences of invasion and refer to past examples of conservation-related invasions. These participants are especially concerned with whether or not rare or unique species might exist in the recipient ecosystem. For these participants, it seems important that the USFWS be more risk-averse when rare or unique species, novel habitats, or already at-risk species might be negatively impacted by a CI effort, even at the expense of saving an at-risk species or ecosystem. Some participants attached this perceived risk to certain taxa that might have a higher likelihood to negatively impact the recipient ecosystem (in other words, predators, highly fecund species, or highly mobile species).

Key finding:

Many participants in this study are concerned with perceived risks of unexpected and difficult-to-identify consequences of moving species outside their indigenous range.

The perceived risk of uncertainty is qualified by a perceived inability for the USFWS to accurately identify potential, unknown risks. For these participants, there seems to be a concern that the proper due diligence to identify potential unexpected outcomes cannot or will not be completed in the available time. Furthermore, we identified a key overlap between perceived risks to recipient ecosystems with the risk that the agency will act in the context of too much uncertainty or while lacking sufficient confidence in the outcomes (table 7). That is, half of those participants who are focused on impacts to recipient ecosystems are often also concerned with outcomes of risks that are associated with uncertainty or a lack of confidence.

Key recommendation:

Provide clear guidance and explanations for how potential CI efforts are being assessed and how potential unintended consequences are being identified.

Other participants commenting on both themes seem to be focused on the risk of being wrong about the potential impacts of moving a species outside its indigenous range and about the severe consequences of doing so (table 7). A participant in region 9 suggests that establishing refugia in a closed area or zoo is preferable to CI, because the former carries lower risk and serves the same purpose if the objective is to preserve genetic diversity, and this sentiment is echoed by a minority of other participants. These participants feel that limiting movement of translocated species through enclosures or beginning with a limited number of individuals would allow unexpected outcomes to be recognized while risk is minimized.

Participants who mention socioeconomic risks are most concerned about impacts to local communities and landowners that might result in a loss of social support that many participants deem necessary for success (table 7). For example, a participant in region 12 suggests that landowners often respond negatively to conservation efforts that involve threatened or endangered species and that if an introduction or reintroduction effort does not go well, it can have wide-ranging consequences. Two other participants comment on the impacts to public perception and how stakeholders perceiving some management actions as interventionist can negatively impact relationships with stakeholders.

Participants who comment on risks to the source population are consistent in their belief that impacts to source populations are not acceptable and that assisted colonization is not an appropriate solution if such risks are likely (table 7). For example, a participant in region 9 attributes this risk to waiting too long to conduct an assisted colonization effort. Two other participants also discuss this risk and are specifically concerned about the genetic diversity in the source population, suggesting that any potential CI effort must ensure that the genetic viability of the source population is preserved.

Table 7. Themes related to the perceived risk of conducting conservation introductions, as identified by study participants.

[References to perceived risks are aggregated under a series of themes that represent a general consensus. Descriptions of the risks discussed, and representative quotes are provided for nuanced context. Direct quotes are reproduced from coded transcripts of the interviews and have not been altered for grammar, mechanics, or style to preserve the voice of each participant. Region refers to the two Department of Interior, U.S. Fish and Wildlife Service regions included in the study; CI, conservation introduction; p, participant, r, region; BR, both regions]

Themes	Description	Representative quotes
Risks to recipient ecosystem	Risk of negative impacts (including invasion) to the recipient ecosystem caused by moving translocated species outside their indigenous range.	"If we know it's going to upset the functioning of that ecosystem just to save this other one, no, we're just doubling down on the chaos that we inflicted that created the problem in the first place. * * *The implication to your question or the premise of the question is that we could also send that ecosystem into a tailspin and lose other species. Pretty clearly, the answer is no" (p18, BR).
Risks of uncertainty and lack of confidence	Risk of conducting an introduction in the context of uncertainty or lack of sufficient information about potential unintended outcomes	"Yeah, nature finds a way, you know, and at the organismic level and at the ecological level, their complexity and unpredictability is still so high. The real question to measure is the, what if we're wrong, like create the worst-case scenario and then assess the likelihood of that scenario, potentially being realized. That's what would inform my support or lack of support * * *" (p8, BR).
Risks to source population	Risks of species capture that could result in negative impacts upon source population of an at-risk species	"To me the two risks on that end are making sure that you sort of do your due diligence relative to the donor stock, which at least in the programs that I've been involved with, we have at least tried to * * *" (p28, r9).
Risks of no action	Risks of waiting too long or taking no action that could prevent an at-risk species or ecosystem from being saved	"We have to take some risks. Maybe there are some downsides, but we have to evaluate. If there are downsides, if there are negative consequences for ecosystems, we have to evaluate those in context. If there are negative consequences, maybe, for other species that are hyperabundant and widespread, let's not worry too much about that * * *" (p24, r12).

Participants who commented on the perceived risk associated with taking no action tend to be focused on at-risk species and are concerned about potential extinction (table 7). These participants observe that ecosystems are already compromised due to large-scale impacts like climate change and believe that some risks are acceptable if it means preventing a species from going extinct. These participants recognize that conducting due diligence and being sufficiently confident in expected outcomes are important qualities, but they also suggest that some negative impacts are acceptable and even necessary to preserve at-risk species.

4.4. Defining Success

When asked about judging short-term and long-term success of CI efforts, most participants chose, unprompted, to interpret the question to mean the translocation of species outside their indigenous range to prevent them from going extinct (in other words, assisted colonization) rather than to mean the fulfillment of an important ecological niche (in other words, ecological replacement). This species-centric focus carried throughout most of the interviews, with participants consistently answering from the perspective of preserving at-risk species and preventing extinction, even when the questions were not specific to a particular form of CI. Therefore, the most prevalent view of success in the short term is characterized by the survival of the translocated individuals throughout the translocation process and their persistence to the point of reproduction. Although this view is most prevalent in our study, there are some participants who are more concerned about potential unintended consequences of conducting a CI effort. For example, participant 10 from region 9 suggests that short-term success should be measured commensurate with damage to the source population, stating:

> "A lot of times, when we think about moving species, we mine populations that are already depressed. You have to make sure that you, and this is something I learned a long time ago, and I believe in it wholeheartedly, and that is do no harm at the start, out of the gate."

Another concern, as expressed by participant18 working in both regions, is related to social factors:

> "I would say success in the short term looks like there's no controversy among the human communities affected by this translocation, whether it works or not, that everybody is onboard * * *we have built consensus, and this is the best thing or the right thing to do under the circumstances."

Both of these participants suggest that views of short-term success should highlight the translocation process itself, in contrast to the majority opinion that is more focused on establishment of the species to the point of reproduction so as to prevent extinction.

When asked about judging long-term success, answers were more varied than were answers about short-term success. Again, many participants are concerned about the continued persistence of the translocated population, while others are more concerned about the establishment of breeding grounds and maintaining an increasing population without imparting negative impacts on the recipient ecosystem. Some participants express that long-term success should focus on aspects of management. Two participants operating in region 12 suggest that long-term success is reliant on establishing a management plan, staying committed to it, and meeting the stated objectives in the plan. For example, participant 10 from region 9 is more concerned about the population no longer requiring continued support from managers:

> "* * *long-term success would be a population that does not need continued support from humans to persist. A lot of times, when we looked at introductions or introducing a population to increase their viability and restore them, I would always push for fixing what caused the population to go away * * *."

This suggestion is a slight departure from many other participants who are more accepting of the potential to create conservation-reliant species, indicates that there is a higher moral obligation to preserve species or novel ecosystems, even if doing so means committing to an indefinite management investment.

Participants were asked about hybridization (in other words, the interbreeding of different species that results in a novel offspring) and how such a possibility impacts their view of success for a CI project. Some participants are definitive in saying that the effort would be a failure if hybridization occurred, but others recognize that there are some situations where hybridization is acceptable. These latter participants suggest that such a judgement should be case-specific and that evaluating potential risks for hybridization is a necessary component of any assessments that occur prior to conducting a CI project. These participants also suggest that any pre-project evaluation should include a consideration of how acceptable hybridization would be in the given context and should plan for actions that should be taken were hybridization to be identified. A small minority of participants express that hybridization would not change their definition of success if it occurred during an otherwise successful project, because human actions are regularly inducing hybridization in other contexts. These participants also point out that some taxa are much more likely to hybridize (in other words, plants and fish) and that it is a normal aspect of species interactions within such taxa, which is a factor that should be accounted for when considering the success of a CI effort.

5. Conclusions

5.1. Considerations for Developing a Decision-Making Framework

Most participants in this study perceive conservation introduction (CI) positively but also recognize the substantial risks associated with moving species outside their indigenous range. A significant number of the participants we interviewed believe that CI is ethical in some or most situations and also believe that agency-wide, the U.S. Fish and Wildlife Service (USFWS) generally views CI positively, albeit with caution. The risks of CI that many participants identify are strongly reflective of a cautious and risk-averse underlying view of CI. Many of these more risk-averse participants are most concerned about the potential negative outcomes that are possible when moving species outside their indigenous range and highlight the need for stringent planning, assessment, and monitoring prior to and during a CI effort.

Key recommendation:

Explicitly describing the appropriate criteria for assessing a CI effort will be an important aspect of any decision-making framework.

5.2. Perceptions of Conservation Introduction Within the U.S. Fish and Wildlife Service

Overall, the USFWS personnel who participated in this study express several key themes related to CI that are consistently commented on among participants. Given the prevalence of these findings among the USFWS personnel in our sample, we identified specific suggestions for topics that will be important to incorporate into a USFWS decision-support framework.

When participants were asked to comment on the IUCN SSC terms and definitions for CI, a few participants expressed specifically negative views. The lack of significant pushback against the IUCN SSC terms and definitions indicates that the USFWS could easily adopt and incorporate this terminology into a formal decision-support framework. One key caveat to that finding is that if the USFWS does choose to incorporate those terms and definitions, it will be important to clearly define the practical use of the term "indigenous range" and to make clear the distinction between an introduction and a reintroduction.

Key recommendation:

Ambiguity within the distinctions between introductions and reintroductions should be addressed by the decision-making framework to prevent misunderstandings and unnecessary opposition to future projects.

There is also substantial agreement that insufficient social acceptance and support could be a major barrier to the planning and execution of CI efforts, with many participants mentioning it. Participants commented on the challenge of obtaining and maintaining support from communities that are local to the source population where species are being captured but also in the recipient ecosystem to which they are being moved. Participants also observed the need to obtain support from other fish and wildlife managing agencies and the scientific community. These participants recognized that, in most cases, the USFWS will need to procure partnerships and encourage joint actions with other fish and wildlife management entities for any CI effort to be successful. Some participants reason that these partnerships could be especially difficult to obtain because incorporation of nonnative species into conservation efforts has been increasingly discouraged among the USFWS's peer agencies and some of these potential partners may, therefore, perceive CI as being antithetical to that approach.

Key recommendation:

Seek input from partnering organizations and stakeholders before or during the development of a decision-making framework. This could include a follow up survey or qualitative workshop that seeks input beyond the USFWS.

There is also substantial agreement among participants about the most concerning risks, with most participants mentioning perceived risks to recipient ecosystems of translocated species. Nearly half of the participants responding as such tied that concern to the uncertainty associated with moving novel species into an ecosystem outside its normal range. It is not surprising that many of the participants would be concerned about risks to the recipient ecosystems, given that this concern is echoed in the scientific literature about CI. Participants in this study are cognizant of difficulty in identifying potential unintended consequences, with many commenting that obtaining the necessary understanding to reduce risk is necessary. Indeed, a small minority of participants were skeptical that it could even be done successfully.

Key recommendation:

Provide clear guidance and explanations for how potential CI efforts are being assessed and how potential unintended consequences are being identified.

When asked what qualifies as short-term and long-term success of CI efforts, most participants framed the responses within the context of assisted colonization, rather than ecological replacement. In the short-term context, most participants are concerned about the establishment of the translocated species and evidence for reproduction in the new area. In the long-term context, many participants are concerned about the establishment of the species and its capacity to reproduce, but there is some disagreement about the acceptability of creating a conservation-reliant species. Although only a minority of participants commented on it, those that did were split in their views, with some suggesting it should be judged on a case-by-case basis.

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