Best Practices for Climate-Resilient Active Seabird Restoration

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List of Abbreviations:
CCP – Comprehensive Conservation Plan
ESA – Endangered Species Act
INRMP – Integrated Natural Resources Management Plan
IPCC – Intergovernmental Panel on Climate Change
IUCN – International Union for Conservation of Nature
MBTA – Migratory Bird Treaty Act
NISC - National Invasive Species Council
NEPA – National Environmental Policy Act
NPS – National Park Service
PRC – Pacific Rim Conservation
SD – Standard deviation
SMA – Special Management Area
USFWS – U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

Seabirds are one of the most threatened bird groups in the world and have been the focus of a great deal of conservation management (Dias et al. 2019). Some seabirds have responded well to management actions and have increased in number or recolonized locations from which they had been extirpated (Spatz et al. 2023). However, in some cases more direct actions may be needed to restore or augment seabird populations. Translocation and social attraction are the two primary methods that can be used to actively "jump start" seabird restoration by deliberately moving or luring a target species to a restoration site (Spatz et al. 2023, VanderWerf et al. 2023).

Climate change is affecting marine systems worldwide and is expected to have severe effects on many seabirds and the ecosystems on which they depend (Sydeman et al. 2021). As seabirds are increasingly threatened by climate change, there will be a corresponding increase in the need to undertake active management actions to prevent species extinctions and facilitate population recovery, and, in some cases, allow assisted migration to increase climate resiliency.

The methods for conducting social attraction and translocation have been reviewed and several references are available about the recommended best practices for translocation (Jones and Kress 2012, VanderWerf et al. 2023). Nevertheless, it would be beneficial to compile information from these sources into a single location, and, more specifically, to explain how various factors that can affect outcomes apply to different groups of seabirds or particular species. The recent development of a comprehensive Seabird Restoration Database (Spatz et al. 2023) has made it more feasible to systematically examine the methods and results of previous projects and draw conclusions about which aspects and techniques are likely to affect the outcome and make recommendations.

Obtaining all the permits and completing the environmental compliance documents can be one of the most daunting tasks associated with planning and implementation of an active restoration project. The permits and compliance documents required for a given project will depend on multiple aspects of the project, including the species involved, its status in the relevant jurisdictions, the landowner and status of the source and release sites, and the environment and biotic composition of the source and release sites.

This document has three purposes: 1) summarize previous active seabird restoration efforts and identify common factors that have affected outcomes; 2) synthesize the methods and results to produce a set of best practice recommendations for planning and implementing a seabird active restoration project with different seabird groups, and 3) describe the regulatory requirements that may apply to a seabird active restoration project under different circumstances. Collectively, these evidence-based best-practices and regulatory explanations are intended to improve the performance of this management approach and make it more accessible to practitioners, thereby "mainstreaming" the process and maximizing the benefit to seabirds.

There were 851 documented active restoration events involving social attraction and translocation in 551 locations targeting 138 seabird species between 1954 – 2021 (Spatz et al. 2023). There were 19 events that explicitly cited climate change as the primary reason for active restoration and an additional 116 events that cited it as a secondary reason. Social attraction alone was used in 802 events, translocation alone in 49 events, and 52 events employed both social attraction and translocation. Social attraction events averaged 4 years in duration, translocation events averaged 3 years in duration, and events combining social attraction and translocation averaged 12 years in duration.

Ninety-seven percent of the 851 events were successfully implemented. Reasons for failure in implementation included suboptimal habitat or insufficient predator control, ineffective deployment of social attraction equipment, or lack of survival of translocated chicks. The success rate of events was high; visitation by the target species occurred in 80% of events and breeding occurred in 76%. Success varied among taxonomic groups and increased with project duration but was not affected by latitude nor whether implementation occurred on an island versus continent. Charadriiformes (terns, gulls, and auks) had the highest and quickest breeding response rates, primarily with social attraction, and with better outcomes on artificial habitats. Success rates also were high for Procellariformes (albatrosses, petrels, shearwaters, and storm-petrels), especially when both social attraction and translocation methods were used together and over multiple years, but they took longer to begin breeding (five years on average), consistent with their delayed onset of breeding. Project duration was the most important determinant of project success; projects that were implemented for a longer time were more likely to show a response by the target species.

Implementing an active seabird restoration project is a complex process involving many steps. This document breaks down the process into discrete and (hopefully) manageable pieces and describes how to accomplish the following steps:

- Identifying a project purpose/target species
- Obtaining sufficient funding
- Selecting a restoration method (social attraction or translocation)
- Selecting a restoration site
- Selecting a source site (for translocation only)
- Obtaining permits and completing other compliance documents
- Outreach, community engagement, and social acceptance
- Preparing the site
- Implementing the proposed restoration action
- Monitoring results and measuring success toward milestones and long-term goals

The permits required for a seabird restoration project can be grouped into three categories: 1) those related to working with the target species; 2) those related to working at a particular site or transporting birds to or from a particular site; and 3) those related to compliance with the National Environmental Policy Act (NEPA). This report includes an interactive, color-coded spreadsheet (Appendix 1) that uses information about a project entered by the user to indicate which permits are needed in different situations and for different species.

It is also important to consider the social implications and consequences of conducting a seabird restoration project, and these aspects should be considered early during the planning process, not after the project has been planned and is ready to be implemented.

1. INTRODUCTION

Seabirds are one of the most threatened bird groups in the world and have been the focus of a great deal of conservation management (Croxall et al. 2012, Dias et al. 2019). Some seabirds have responded well to management actions such as removal of invasive predators from islands or restoration of nesting habitat and have increased in number or recolonized locations from which they had been extirpated (Jones et al. 2016). However, seabird recolonization or recovery following management actions such as predator removal or habitat restoration is not guaranteed, particularly in species with high natal philopatry and where they have been extirpated for multiple generations (Buxton et al. 2014, Kawakami and Horikoshi 2021). In such cases, more direct actions may be needed to restore or augment a seabird population. Translocation and social attraction are methods that can be used to “jump start” recovery or reduce recovery times by deliberately moving or luring a target species to a restoration site (IUCN/SSC 2013), particularly on islands where threats have been managed (reviewed in Spatz et al. 2023, VanderWerf et al. 2023).

Climate change is affecting marine and terrestrial systems worldwide, with perturbations expected to intensify in the coming decades (Hoegh-Guldberg and Bruno 2010, Bruno et al. 2018, Gagne et al. 2018). The expected impacts of climate change on seabirds and the ecosystems on which they depend are driven, in large part, by oceanographic responses to changing atmospheric conditions (Grémillet and Boulinier 2009, Sydeman et al. 2012, 2021). Robust results from nearly all global climate models used by the Intergovernmental Panel for Climate Change in its 6th Assessment Report (IPCC 2019, Zhai et al. 2021) include: (1) warming of the atmosphere and the oceans leading to increased oceanic stratification, (2) pole-ward shifts of the westerly winds at mid latitudes, (3) sea level rise; and (4) a reduction in ocean pH. The predicted decline in ocean pH will cause acidification that is expected to affect coral reefs in tropical ecosystems by accelerating the erosion of coral structures, and other factors mentioned will alter currents, increase marine heat waves, and result changes in availability of prey for some species.

The recent development of a comprehensive Seabird Restoration Database has made it more feasible to systematically examine the methods and results of previous projects and draw conclusions about which aspects and techniques are likely to affect the outcome (Spatz et al. 2023). There already has been an increase in the number of active seabird restoration projects over time (Jones and Kress 2012, Zhou et al. 2017, Spatz et al. 2023), and as seabirds are increasingly threatened by climate change, there will be a corresponding increase in the need to undertake active management actions to prevent species extinctions and facilitate population recovery, and, in some cases, allow assisted migration to increase climate resiliency (Karasov-Olson et al. 2021).

The methods for conducting social attraction and translocation have been reviewed (VanderWerf et al. 2023), and several references are available about the recommended best practices for translocation (Gummer 2013, IUCN 2013, Jacobs et al. 2020). Nevertheless, it would be beneficial to compile information from these sources into a single location, and, more specifically, to explain how various factors that can affect outcomes apply to different groups of seabirds or particular species. Despite the abundance of information, what to do and how to do it in specific situations is not always readily available.

Obtaining all the permits and completing the environmental compliance documents can be one of the most daunting tasks associated with planning and implementation of an active restoration project, and this can be an impediment to getting a project off the ground. The permits and compliance documents required for a given project will depend on multiple aspects of the project, including the species involved, its status in the relevant jurisdictions, the landowner and status of the source and release sites, and the environment and biotic composition of the source and release sites. A comprehensive description of the permits and compliance documents needed in various circumstances would help to make this process clearer and more accessible to prospective conservation practitioners.

This document has three purposes: 1) summarize previous active restoration efforts aimed at seabirds and identify common factors that have affected outcomes; 2) synthesize the previous methods and results to produce a set of best practice recommendations for planning and implementing a seabird active restoration project with different seabird groups; and 3) describe the regulatory requirements that may apply to a seabird active restoration project under different circumstances. Collectively, these evidence-based best-practices and regulatory explanations are intended to improve the performance of this management approach and make it more accessible to practitioners, thereby “mainstreaming” the process and maximizing the benefit to seabirds.

2. SUMMARY OF PREVIOUS ACTIVE SEABIRD RESTORATION EFFORTS

2.1. Description of Previous Efforts. There were 851 documented active restoration events involving social attraction and translocation in 551 locations targeting 138 seabird species between 1954 – 2021 (Spatz et al. 2023)**.** The number of active restoration projects increased over time, reaching a peak in the late 2010s (Figure 1). Data collection for the Seabird Restoration Database ended in 2022, and the apparent decline in recent years could be caused by a publishing lag, could indicate that the easiest and most obvious projects have already been attempted, or could be a short-term effect of the Covid-19 pandemic on project initiations (Spatz et al. 2023). Of the 138 species involved, 43 (31%) were considered globally threatened by the IUCN (categorized by IUCN as critically endangered, endangered, or vulnerable). Those 43 species represented only 39% of the 111 seabird species categorized as threatened by the IUCN (BirdLife International 2023), indicating the majority of threatened seabirds have not been the subject of active restoration. Furthermore, only 139 of the 851 events (16%) focused on these threatened species; the disparity indicates that the species in greatest need of conservation efforts have been under-represented.

There were 19 events that explicitly cited climate change as the primary reason for active restoration implementation and an additional 116 events that cited it as a secondary reason, along with habitat loss, invasive species, and human-wildlife conflicts.

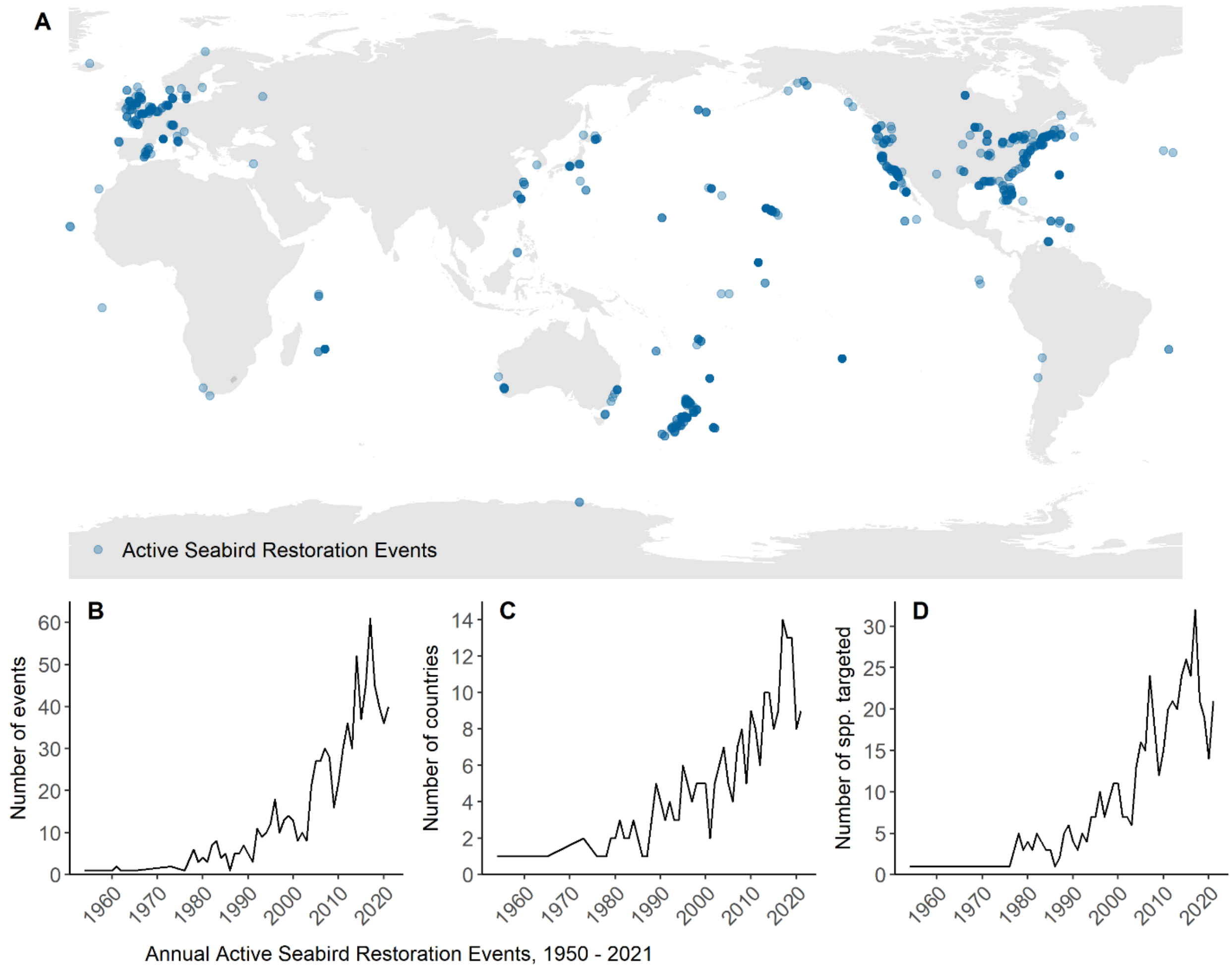

Figure 2. Global active seabird restoration events, 1954 to 2021. (A) Restoration sites where each dot is an event; darker dots indicate more events at a site (sensitive data excluded). (B–D) Annual trends in the number of events, number of countries implementing events, and number of seabird species targeted, respectively. From Spatz et al. (2023).

Social attraction alone has been used more often (802 events) than translocation alone (49 events), and an additional 52 events employed both social attraction and translocation (Spatz et al. 2023). Social attraction stimuli were primarily decoys (563 events, 75%) or audio playbacks (551 events, 63%), which were commonly used together (40% of events). Other stimuli included sounds or decoys of congeners (30 events), mirrors (20 events), and scent (24 events). Translocations involved chicks (74 events, 71%), eggs (11, 11%), adults (5, 6%), or a combination of age classes (7, 6%). Social attraction events averaged 4 years in duration (SD = 5, maximum = 41 years). Translocation events averaged 3 years in duration (SD = 6, maximum = 33 years). Events combining social attraction and translocation averaged 12 years (SD = 8, maximum = 30, median = 8), in which translocation stopped at year 4 on average and social attraction continued longer. A median of 103 individuals were translocated per event (range = 5–954, excluding an outlier in which over 2000 chicks were translocated; Spatz et al. 2023).

The 551 restoration sites were in 36 countries, including 12 territories plus Antarctica, with 357 sites (63%) on islands and 194 (37%) on continental areas (Spatz et al. 2023). Six countries (including territories) accounted for 80% of all restoration events: United States (40%), New Zealand (15%), United Kingdom (10%), Mexico (6%), Canada (5%), and France (5%). New Zealand implemented the most translocations (36%) and the United States implemented the most social attractions (40%). In terms of land ownership, 395 sites (71%) were federal, state, provincial, or regional government land, and 96 (17%) were on private land (remaining land ownership was mixed or unknown). Artificial habitat (e.g., rafts, boats, rooftops, levees) made up 189 restoration sites (34%). Threat management at the restoration site primarily targeted invasive and problematic native animals (58% of sites).

2.2. General Outcomes. Ninety-seven percent of events (496 of 510 events evaluated) were considered successfully implemented, including 394 that achieved full implementation and 102 events that achieved partial implementation (Spatz et al. 2023). Reasons for failure in implementation included suboptimal habitat or insufficient predator control, ineffective deployment of social attraction equipment, or lack of survival of translocated chicks. It is worth noting that 341 of the 851 total projects could not be evaluated because they did not report even basic information that would have indicated whether the project was implemented effectively.

Of the events that provided sufficient information to assess the outcomes, visitation by the target species occurred in 80% of events and breeding occurred in 76%. Continued breeding (>1 year) occurred in 82% of events that could be assessed for long-term outcomes (Spatz et al. 2023). On average, seabirds visited within 0.9 years of implementation and were breeding within 2.0 years (SD = 3.2 years). However, this response timing varied significantly among seabird families (Figure 2). On average, larids (gulls and terns) took 0.2 years to visit (SD = 0.7) and 0.6 years to breed (SD = 1.3), while procellariforms (albatrosses, petrels, and relatives) took 2.8 years to visit (SD = 3.5) and 5.3 years to breed (SD = 3.8).

2.3. Factors associated with positive outcomes. Success of active seabird restoration varied among taxonomic groups and increased slightly with project duration but was not affected by latitude nor whether implementation occurred on an island versus continent. Charadriiformes (terns, gulls, and auks) had the highest and quickest breeding response rates, primarily with social attraction, and with better outcomes on artificial habitats (Spatz et al. 2023). The colonial behavior, low natal philopatry, and short generation times of Charadriiformes, particularly gulls and terns, likely helped them to colonize new sites quickly, including those in artificial habitats.

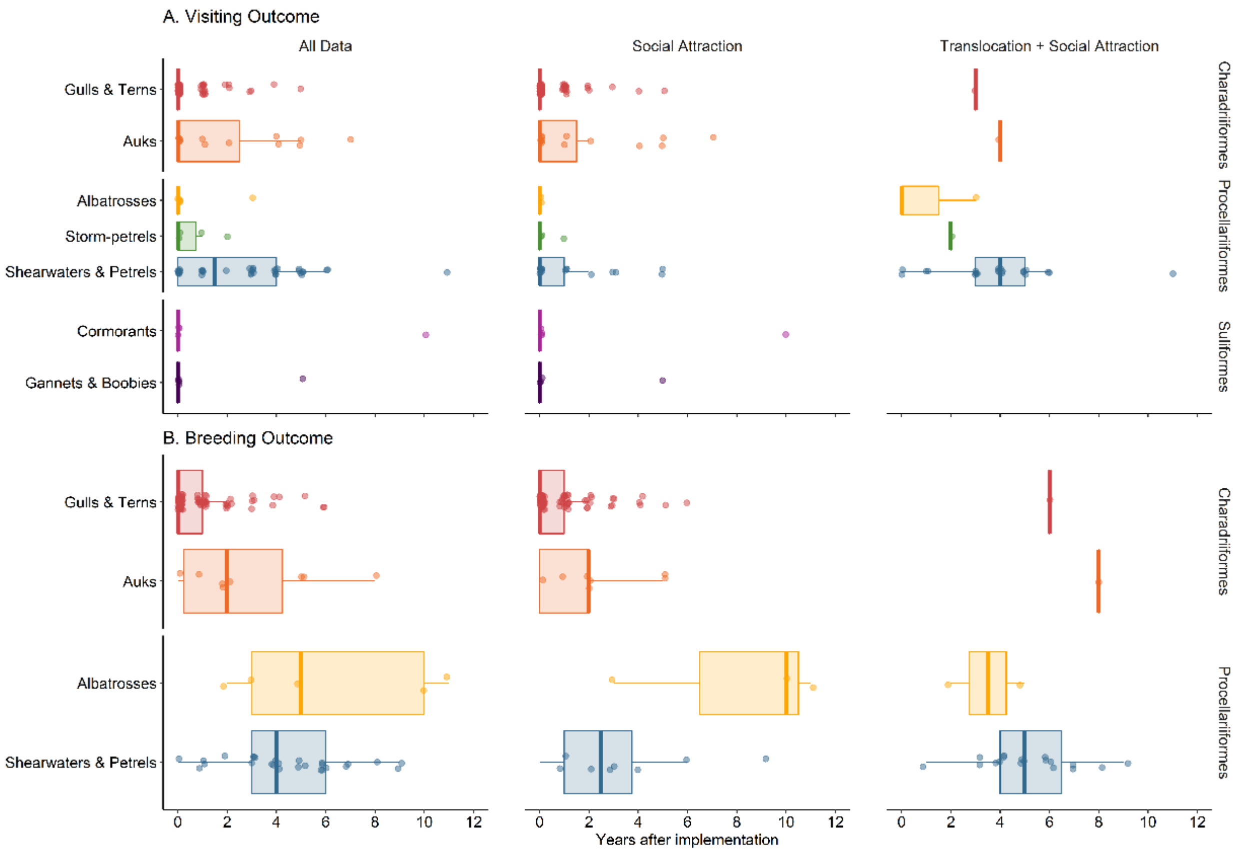

Figure 3. Timing of response to active restoration in different seabird families. Boxplots display median values and interquartile ranges. Families with < 5 records were removed from analysis. A) Time until first visitation. (B) Time until first breeding. Each point represents one event, darker points represent more events at that time. From Spatz et al. 2023.

Figures 3 and 4 show response rates by different seabird taxa and by method. For example, success rates were high for Procellariformes (Figure 3), especially when both social attraction and translocation were used together (Figure 4) and over multiple years). Procellariiformes, which includes families with the largest and smallest seabird species (albatross and storm-petrels), had variable responses to active restoration, likely driven by differences in life-history along with abundance and threat status. The distance of existing colonies to restoration sites likely influenced the probability of visitation by prospecting birds and restoration outcome. Species in the Procellariidae took longer to begin breeding (five years on average), consistent with their delayed onset of breeding (2–8 years; Schreiber and Burger 2002).

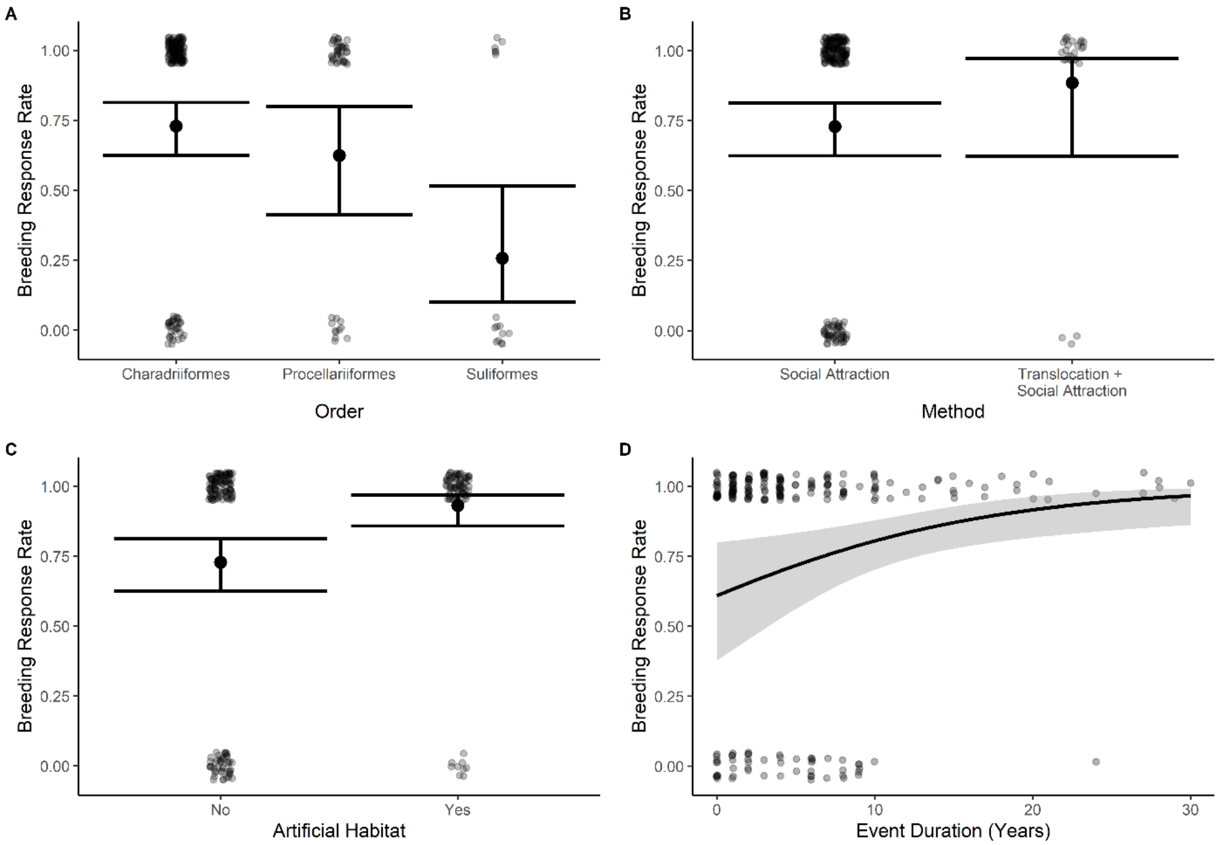

Figure 4. Factors affecting seabird breeding response rate to active restoration, based on analysis of 230 events. Shaded points represent the observed binomial breeding response for each factor (breeding or not breeding), with darker areas indicating more events. Whisker-plots in plots A – C are mean and 95% confidence intervals and indicate the likelihood of restoration success or failure for the various factors. In plot D, the black line is the logistic regression curve; the shaded area is the 95% confidence interval, showing the relationship between response rate and length of implementation duration in years. From Spatz et al. 2023.

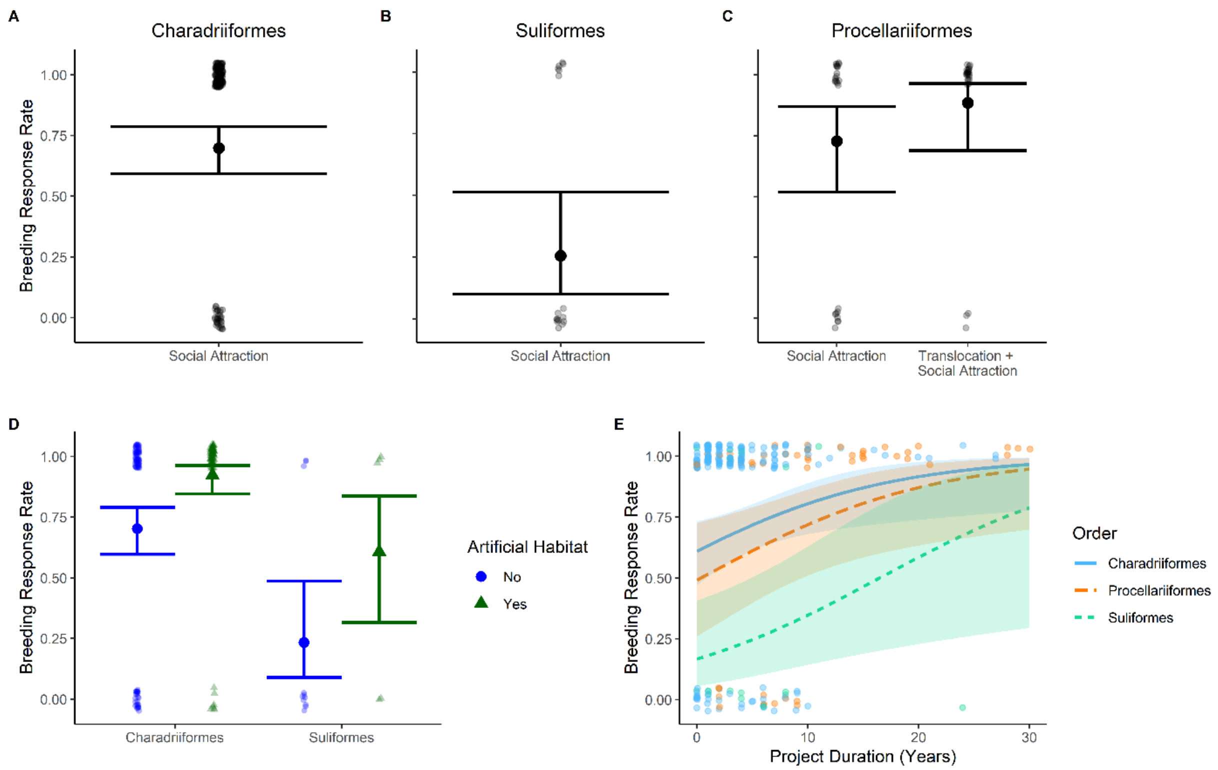

Figure 5. Factors affecting rate of seabird breeding in response to active restoration, based on analysis of 230 events. Groups were excluded if there were <5 records (e.g., translocations in Charadriiformes and Suliformes). Shaded points represent the observed binomial response (breeding or not breeding), with darker areas indicating more events. Whisker-plots in panels A – D are mean and 95% confidence intervals and indicate the likelihood of restoration success or failure for the various factors. In plot E, each line displays the logistic regression curve by seabird order; the shaded area is the 95% confidence interval, showing the relationship between response rate and length of implementation duration in years. From Spatz et al. 2023.

Project duration was the most important determinant of project success; projects that were implemented for a longer time were more likely to show a response by the target species (Figure 4). Furthermore, to determine the success of a project, the project duration must exceed the age at first breeding of the target species. For seabirds with long generation times, like albatrosses and petrels, the recommended duration of implementation (2-4 years, see next section) combined with the required follow-up monitoring (5-6 years) could be a decade. This result provides managers with a tangible a-priori timeframe in which to plan, apply for funding, and expect outcomes. While long-term projects can be difficult to finance, success is more likely when partnerships exist among government, non-profit, and local communities. These practices also provide opportunities for public engagement, which promotes awareness, local stewardship, and project support.

3. RECOMMENDED BEST PRACTICES FOR ACTIVE SEABIRD RESTORATION

Implementing an active seabird restoration project is a complex process involving many steps. Getting a project started, especially those involving translocation, can seem overwhelming. These recommendations are intended to break down the process into discrete and (hopefully) manageable pieces and to describe the best methods for accomplishing each step. The primary tasks involved in initiating a seabird restoration project are listed below, followed by a brief description of each. Some steps are related and must be undertaken simultaneously, not necessarily in the order listed below. For example, the restoration method may depend on the restoration site chosen, and the amount of funding needed will depend on what site preparation is needed at the restoration site and whether social attraction or translocation will be used.

- Identifying a project purpose/target species
- Obtaining sufficient funding
- Selecting a restoration method (social attraction or translocation)
- Selecting a restoration site
- Selecting a source site (for translocation only)
- Obtaining permits and completing other compliance documents
- Outreach, community engagement, and social acceptance
- Preparing the site
- Implementing the proposed restoration action
- Monitoring results and measuring success toward milestones and long-term goals

3.1. Identifying a project purpose and target species. In many cases, the purpose of a project is conservation of a particular species, sometimes called the target species, and this is known at the outset because a conservation need has been identified or there is a desire to restore the species at a location from which it has been extirpated or establish it in a new location. Another common purpose of seabird restoration is ecological restoration, such as to restore nutrient input that has been lost (Benkwitt et al. 2019, Spatz et al. 2023). In such cases there may be several potentially suitable target species to choose from, and the most appropriate choice may depend on aspects of their biology, characteristics of the site, and available funding. Another scenario is deciding which seabird species can or should be restored to a location that has been made suitable for seabirds, such as through removal or predators or creation of nesting habitat. If the goal is species conservation, one approach would be to attempt restoring species that are most in need of conservation efforts. For the U.S. Tropical Pacific, Young and VanderWerf (2023) prioritized species by conservation need and also prioritized sites where the highest priority species could be restored. For the California Current, a similar process was performed by Young et al. 2024 as part of this project.

3.2. Obtaining sufficient funding. Funding is needed to plan and implement a seabird restoration project. The amount of funding required will vary depending on many aspects of the project, including the target species, the location, the method(s) used, the expected duration, the extent of outreach and community engagement needed, and whether environmental compliance documents are needed. Much of the work is "front-loaded," meaning it must be accomplished toward the beginning of the project, even before the actual restoration action begins. Ideally, sufficient funding should be obtained at the outset to carry out the entire project throughout its anticipated duration. The recommended duration over which the project should be implemented can vary, but in general at least two years are recommended for social attraction and two to four years for translocation (see section 3.3 below). Funding should also be secured to monitor outcomes after the actual implementation is over, and the duration of monitoring should be comparable to the age at first breeding of the target species. For species with long generation, such as albatrosses and petrels, the project thus could span up to 10 years. Obtaining sufficient funds to get a project off the ground thus can be difficult. However, in practice it may be possible to obtain sufficient funding for just one or two years, and to seek additional funding once the project has begun. If early results are promising this can help with obtaining additional funding.

3.3. Selecting a Restoration Method. There are two methods for actively restoring or creating seabird breeding colonies: social attraction and translocation. Social attraction uses visual, auditory, or olfactory lures to attract seabirds to a site (Jones and Kress 2012, VanderWerf et al. 2023). Translocation involves deliberately moving birds from one location to another, with the expectation that they will eventually return to the new site and breed (Deguchi et al. 2012, Jacobs et al. 2020, VanderWerf et al. 2023).

The question of which method is more likely to be successful depends on multiple factors, including the breeding biology of the target species, the location and characteristics of the restoration site, and proximity to the nearest existing colony (Jones and Kress 2012, Buxton et al. 2014, VanderWerf et al. 2019, VanderWerf et al. 2023).

Knowledge of the target species' ecology and breeding biology is fundamental to selecting a restoration method. The biological factor most important in selecting a restoration method is whether the target species exhibits natal philopatry (also called site fidelity), which is how likely birds are to return as adults to the site where they were hatched or raised (Greenwood 1980, Antaky et al. 2020). Seabirds vary in their degree of natal philopatry, the age at which they imprint on their natal location, and in the cues they use to recognize their natal location (Coulson 2016, Antaky et al. 2021). Translocation is unlikely to work in species with low natal philopatry because birds that are moved to a new location may not return to nest there as adults. Procellariiform seabirds (albatrosses, shearwaters, petrels, and storm-petrels) have generally high natal philopatry, with moderate philopatry in Suliformes (boobies and gannets) and alcids (auks; Kress and Nettleship 1988, Antaky et al. 2021). In contrast, gulls, terns, and cormorants have weaker philopatry and may visit multiple breeding locations prior to nesting, and readily nest at new sites where they find suitable habitat (Roby et al. 2002, Coulson 2016).

Another important factor to consider when choosing between social attraction and translocation is whether the target species exhibits post-fledging parental care. If parents continue to feed their offspring after they fledge from the nest and the fledglings are dependent on this parental care for survival, then translocation of chicks will not be effective because the young birds are likely to starve after fledging. This limitation does not apply to translocation of eggs that are placed with foster parents that hatch the eggs and raise the chicks. Seabirds with post-fledging parental care include most gulls, terns, and some alcids, such as murres and murrelets (Burger 1980, Coulson 2016).

3.3.1. Social attraction. Social attraction alone is more likely to be effective in colonial species with weak natal philopatry and that require post-fledging parental care, and where existing colonies of the target species are close enough that birds are likely to fly near the site. Social attraction is only effective over short distances; birds must be able to see, hear, or smell the attractants. Although seabirds may sometimes interact or even court with a decoy or mirror, they may know there is no other bird present. The key is to encourage birds to remain longer, until others of their species arrive, after which the first birds that visit may become more attractive to later arrivals than the artificial devices.

One advantage of social attraction is that it is less expensive and labor intensive than translocation. Once attraction systems are deployed, they can operate independently with little labor required. Well-chosen sites can provide early success with both surface and burrow nesting species (Sawyer and Fogle 2013). On the other hand, in species with strong natal philopatry or that have no nearby colonies, social attraction may take many years to achieve success and sometimes will not succeed at all (Kappes and Jones 2014).

One approach is to attempt social attraction first, and then doing translocation only if social attraction is not successful. It may be possible to start colonies without the need for translocation, which would provide considerable cost savings and lower risk. This approach may be appropriate in situations where translocation would be logistically difficult, if limited funding is available, if it would be difficult to obtain permits to work with birds directly because of the risk of mortality during translocation, or there is a lack of infrastructure to care for translocated birds at the release site.

Once social attraction is selected as the restoration method, the main decisions involved are: 1) what type(s) of lure to use; 2) how many lures are needed; and 3) how and when the lures should be deployed. Regardless of which type of lure is used, it is desirable to deploy them in a conspicuous location where they will be easily detected by prospecting birds, such as a headland, hill, or cliff edge. Decoys that are hidden from view are less likely to be seen and thus will be less effective. Similarly, speakers should not be obstructed by vegetation or objects that would limit sound transmission. Prospecting birds often land close to the attractant, so decoys, speakers, and other lures should be strategically placed near any artificial structures intended for them, such as nest boxes or platforms, and not near fences or other obstacles that could pose a collision hazard.

Visual attractants include decoys and mirrors and are used primarily for diurnal species, though they may be useful for nocturnal species too. Seabird decoys have been made from a variety of materials, including plastic, fiberglass, wood, clay, plaster, papier-mâché, polystyrene, and foam. For more details on decoys designs, see VanderWerf et al. (2023). Mirrors may be less expensive than decoys and have the advantage of providing a moving stimulus, but mirrors are fragile and may be difficult to secure and the image is only visible to the target individual at a certain angle. Mirrors were important in the success of social attraction projects for terns and puffins in Maine, and for Common Murres in California (Kress 1997, Parker et al. 2007).

Audio playback is the primary method for attracting nocturnal seabirds that return to nesting areas at night (Miskelly et al. 2009, Young et al. 2018, VanderWerf et al. 2019), though audio playbacks can also be important for species that return in daylight in conjunction with decoys. For example, Kress (1983) found that Arctic and Common Terns (*Sterna hirundo* and *S. paradisea*) did not nest at a restoration site with decoys until audio playbacks were added and were played continuously. Likewise, Arnold et al. (2011) demonstrated that Common Terns only nested in experimental plots with a combination of decoys and sound.

Olfactory attractants have been used occasionally to attract nocturnal Procellariiforms, which have a good sense of smell, usually by placing nesting material from active nests inside artificial burrows at a restoration site, and in in combination with audio playbacks. This method seems promising, but more research is needed to verify its efficacy, and if material from active nests is used as the olfactory attractant there is a risk of moving parasites or pathogens along with the nest material (VanderWerf et al. 2023).

3.3.2. Translocation. Translocation is necessary more often in species with strong natal philopatry, including all Procellariiform seabirds, and in cases where there are no nearby colonies and thus a lower chance of visitation by prospecting birds (Jones and Kress 2012, Buxton et al. 2014). Translocation is unlikely to succeed in species with low natal philopatry and in species that require post-fledging parental care, including gulls, terns, and some alcids. Social attraction is often done in conjunction with translocation; the social attraction cues simulate the environment of a seabird colony for the developing chicks and attract returning individuals from previous years of the project.

Most translocation projects have involved chicks, and it is crucial that the chicks be moved before they have imprinted on their natal site. Translocation of adults or fledged juveniles is generally not effective because such individuals have already imprinted on the location they view as “home” and are likely to return there instead of the restoration site (Fisher 1971, VanderWerf et al. 2023). In situations where suitable foster nests are available, egg translocation can be a good option that avoids the need to feed chicks by hand and relies on the foster parents to do most of the work. Translocation of eggs and placement in foster nests was done with Laysan Albatrosses (*Phoebastria immutabilis*) in Hawaii (VanderWerf et al. 2019, 2024) and with Black-footed Albatrosses (*P. nigripes*) on Guadalupe Island, Mexico (VanderWerf et al. 2023).

3.3.3. Recommendations for taxonomic groups. The following subsections provide recommendations for different seabird taxonomic groups.

Larids (Gulls and Terns). Social attraction is generally the only viable option for creating a colony of gulls or terns because they have low site fidelity and often have some degree of post-fledging parental care. Translocation is unlikely to be effective because: 1) young birds may require parental care after fledging, which cannot be provided in translocations that involve chicks; and 2) the returning adults may choose to breed at a different location than the release site. Social attraction has been used frequently with gulls and terns and has been effective in several species (Spatz et al. 2023), including Arctic and Common Terns (*Sterna hirundo* and *S. paradisea*; Kress 1983), Caspian Terns (*Hydroprogne caspia*; Roby et al. 2002), and Chinese Crested Terns (*Thalasseus bernsteini*; Lu et al. 2020). In most cases both visual (decoys or mirrors) and audio attractants were used (Spatz et al. 2023).

Alcids or Auks (Puffins, Murres, Murrelets, Auklets). Both social attraction and translocation can be effective for alcids, depending on the species. One of the earliest and most famous examples of seabird restoration is that of the Atlantic Puffin (*Fratercula arctica*) in Maine, which used a combination of social attraction and translocation, both of which proved to be important in the eventual success of the project (Kress 1997, Kress and Jackson 2016; see project puffin.org). However, some alcids, such as murres and murrelets, have an extended period of post-fledging parental care, which means translocating chicks and raising them by hand would not be effective for those species, and social attraction would be the only option.

Sulids (Boobies and Gannets). Sulids have a moderate rate of natal philopatry (Antaky et al. 2021) and do not have post-fledging parental care, so in theory translocation could be effective, but there have been no translocation attempts with boobies or gannets to confirm this (Spatz et al. 2023). Social attraction has been used 19 times with gannet species, but only three times for boobies (Spatz et al. Seabird Restoration Database). Social attraction has been effective for Australasian Gannets in New Zealand (Sawyer and Fogle 2013) but was less effective for Red-footed Boobies in Hawaii (PRC unpubl. data). Further attempts at social attraction and translocation of sulids would help establish which techniques are effective, but there is a risk that neither technique may be effective.

Tropicbirds. There have been only seven active restoration projects focused on tropicbirds, five involving social attraction and two that used translocation, but none reported any information about breeding outcomes, or it was too soon for the outcome to be assessed, so the efficacy of both methods in these species is not known (Spatz et al. Seabird Restoration Database). Tropicbirds have high natal philopatry (Schreiber and Schreiber 2020), so translocation can be expected to be effective, but there have been no attempts to demonstrate that it is. Red-tailed Tropicbirds have a conspicuous aerial courtship display and loud courtship calls that often involve groups of birds, which would seem to make them good candidates for social attraction too, but again there have been no efforts to confirm this. Because translocation is more costly and labor intensive and there is uncertainty about whether it would be effective, in locations where existing colonies are nearby and there is a reasonable chance that prospecting birds might visit, it would be worth attempting social attraction first before committing the resources required for translocation.

Procellariforms or "tubenoses" (Albatrosses, Petrels, Shearwaters, Storm-petrels, and Diving Petrels). Social attraction and translocation are both viable options for creating a breeding colony of Procellariform seabirds because they have high natal philopatry and many species are colonial and are attracted to colonies. Which method is more likely to succeed depends on the proximity of existing breeding colonies to the restoration site and how likely birds are to encounter the restoration site during their usual movements. Sites that are far from existing colonies or that not close to usual flight paths or not visible from the ocean are unlikely to be visited, and thus unlikely to be colonized despite the presence of attraction devices such as decoys and sound playbacks equipment. However, because social attraction is usually less costly and labor intensive, it may be worth trying social attraction for at least one or two years before attempting a translocation.

For albatrosses, social attraction usually involves decoys and sound playbacks because they are primarily diurnal and nest on the surface (Deguchi et al. 2017, VanderWerf et al. 2019). Decoys in a courtship posture may be more effective than those in a resting posture (Podolsky 1990). Albatrosses develop natal site recognition early during development, sometime between 1 and 5 months of age (Fisher 1971). Establishing albatross breeding colonies at new locations using translocation therefore requires moving chicks prior to this imprinting age and then raising them at the new site (Deguchi et al. 2012, 2017, VanderWerf et al. 2019). Moving chicks at a few weeks of age also allows them time to imprint on their own species and to be inoculated with the gut micro-biome by their parents (VanderWerf e al. 2019, Góngora et al. 2021).

For petrels and shearwaters that are active at the nesting colony primarily at night and nest underground, social attraction typically has involved primarily sound playbacks because it is thought that decoys would not be that visible. However, the importance of decoys to burrowing procellariforms has not been adequately investigated. Use of olfactory attractants, such as nest material from an active nest collected elsewhere, has been used for several species (Spatz et al. Seabird Restoration Database 2021). Burrowing petrels and shearwaters are thought to imprint when they first emerge above ground, which often occurs at night, and likely involves several environmental cues, including the constellation of stars and the earth's magnetic field (Warham 1990, Wynn et al. 2020). Although some studies suggest imprinting may begin while chicks are still in the burrow (Serventy et al. 1989), most burrowing seabirds can be moved later in development, just before they emerge for the first time (Miskelly et al. 2009).

3.4. Restoration site selection. A variety of biological, logistical, and social factors must be considered when selecting a site for seabird restoration. Prior to initiating a project, conservation practitioners are obligated to ensure that a proposed seabird restoration site is safe and under a land management regime consistent with resource conservation, ideally one that provides protection in perpetuity and with a management plan in place. Several existing references describe the various factors that can affect the success of a project (Jacobs et al. 2020, VanderWerf et al. 2023). Below is a list of factors, followed by a more general discussion of each.

Criteria to Consider when Selecting a Seabird Restoration Site:

- Ownership and management authority.
- Geography.
- Physical characteristics: terrain, habitat, and substrate.
- Presence and management of predators and harmful invasive species.
- Logistics and accessibility.
- Distance to source colonies and other restoration sites.
- Presence of potential hazards or threats.
- Potential conflicts with other uses and activities.

- Potential disturbance to other natural resources.

Ownership and Management. Obviously, permission must be obtained from the landowner or manager before the project can begin. In the case of land owned by the Federal, State, or local governments, this likely will involve a permit of some sort, which is described in more detail in the section below on permitting. If the site is privately or community owned, the owner may require at least a waiver to be signed, and it is advisable to create a memorandum of understanding or some other document that specifies the conditions for access, activities to be conducted, disposition and ownership of any equipment or infrastructure built or brought to the site, and conduct of project personnel while on the property. It is preferable for the site to be designated for long-term conservation use, and ideally to have a management plan in place that spells out the management goals, hopefully including seabird restoration.

Geography. A seabird restoration site must be geographically suitable for the target species with respect to the following characteristics: size; sufficient elevation to preclude periodic inundation from storm waves; adequate access to the ocean; favorable prevailing wind direction and speed; and reasonable distance to foraging grounds. These characteristics are difficult, if not impossible, to change, so they must be considered carefully before a project begins. Larger sites are generally preferable because they eventually could support a larger population of the target species and there is less chance of birds settling outside the managed area where threats are higher. Additional factors to consider with regard to climate change mitigation in particular include: 1) whether changes in water or air temperature are anticipated to alter any of the previous factors, particularly food availability and distance to foraging grounds; 2) if increases in sea level rise or storm surge could result in increased inundation risk; and 3) if changes in rainfall or other weather patterns are anticipated to result in adverse effects to the nesting area and habitat, such as increased erosion of soil used for burrowing or changes in abundance or structure of vegetation used for nesting. Proximity to foraging areas and abundance of prey also should be considered, although information about prey often is sparse.

In general, islands and atolls where the majority of the land is < 5m above sea level are not suitable seabird restoration sites because they are at risk of inundation, and the goal is to move birds to higher sites (Nunn et al. 2016, Young and VanderWerf 2023). However, such sites could be considered as temporary "stepping-stone" colony locations in a longer project involving multiple sites. Establishment of colonies in such stepping-stone locations can provide another asset that enables more options.

Physical Characteristics: topography, habitat, and substrate. The physical characteristics of a site can determine whether it is suitable for a species in several ways. Topography of a restoration site can affect the ease of take of landing. Some seabirds, like terns and gulls, can take off directly from the ground and can nest on flat ground, but other species, such as albatrosses and some petrels and boobies, frigatebirds, and alcids, cannot generate enough lift immediately and require, or at least prefer, a slope, cliff, or runway to take off. Some species will nest only in open areas without vegetation where predators cannot hide (Roby et al. 2002). For burrowing species, the substrate must be soft enough to allow excavation of a burrow and not too rocky or compacted to prevent digging. For crevice nesting species, there must be sufficient rocky crevices available of the appropriate size. For species that prefer to nest in trees of other vegetation, such as some boobies and frigatebirds, there must be a sufficient amount and distribution of such vegetation. Habitat management can be done to make the site suitable, such as invasive plant control, soil scarification, outplanting, or installation of artificial structures such as burrows or nest platforms, but it is preferable if the desired habitat conditions already exist (Kress et al. 2008, Libois et al. 2012, Suzuki et al. 2015).

Presence and management of predators and other harmful invasive species. Few seabird species can persist in the presence of non-native predators; this is the reason many seabirds nest on predator-free islands (Spatz et al. 2014, Dias et al. 2019). It is therefore preferable for the restoration site to be free of predators and other invasive species harmful to the target species. If no suitable predator-free sites are available, then the predation risk must be managed somehow, and there are several options for accomplishing this. The best option that can provide the highest level of protection is constructing a predator exclusion fence and removing all predators from within the fence before the birds are attracted or brought to the site (Saunders 2001, Burns et al 2012; Dickman 2012, Young and VanderWerf 2024). If it is not feasible to build a predator exclusion fence because of the terrain or substrate, or there is insufficient funding, then predators must be removed by trapping, hunting, or some other means to create an "island" where predation risk is managed to a tolerable degree (Saunders 2001, Innes et al. 2024). The predator removal program must be capable of reducing predator abundance to an extent that allows reproduction and persistence of the target seabird species, and this must be done in perpetuity (Armstrong et al. 2006).

Non-native mammals are usually the most serious predators on seabirds, but non-native birds and native birds also can be important predators on seabirds and their presence and potential need for management also should be considered. In Hawaii, Barn Owls are a serious predator on seabirds nesting in montane and coastal habitats and control efforts have been needed to reduce impacts on seabird populations (Raine et al. 2019, 2020). In the California Channel Islands, the presence of Bald Eagles (*Haliaeetus leucocephalus*) and Common Ravens (*Corvus corax*), which are native to the region, were considered in selecting a possible restoration site for albatrosses (VanderWerf et al. 2023).

Other invasive species to consider include ants, such as the yellow crazy ant (*Anoplolepis gracilipes*) and big-headed ant (*Pheidole megacephala*), which are not predators on seabirds but are known to cause injury and severe annoyance to nesting seabirds and can render a site unusable for seabirds (Plentovich et al. 2009, Kroplidowski 2014, Misso and West 2014, Plentovich et al. 2018).

Logistics and Accessibility. Seabird restoration is more feasible and may be more likely to succeed in locations where access is reliable and easy. However, some locations may be suitable or desirable for seabird restoration in part because of their relative inaccessibility. Seabird restoration can be done in locations where logistics and accessibility are difficult, but careful planning and preparation are needed in such cases to ensure the safety of the birds and personnel involved in the project. First, there must be safe access to transport people, equipment, and birds to the site. If translocated chicks require extended care, then there must be housing or a camp site for people, hygienic facilities to store and prepare food and clean equipment, and reliable access to replenish food, water, and other supplies. If reliability of access is uncertain, then infrastructure must be present to allow storage of food, water, and essential supplies to ensure the safety of personnel and birds for an extended period. Social attraction is more feasible in sites with limited accessibility because fewer visits are needed and no long-term presence is necessary. Once social attraction equipment is det up it can operate independently for extended periods, though period visits are advisable to ensure the system is working properly.

Distance to source colonies and other restoration sites. This criterion is relevant to both social attraction and translocation, for somewhat different reasons. For translocations, it is desirable to move eggs or chicks from as close as possible to minimize the transport time and duration that chicks are out of the nest, when they are at risk from heat stress, dehydration, and weight loss (VanderWerf et al. 2023). However, the speed of different modes of transport (plane, boat, car, walking) should be considered together with the distance. A more distant location that is accessible by a faster mode of transport may be preferable to a closer location that has more difficult transport options.

For social attraction, it is desirable to select a restoration site that is close to source colonies, but not too close, and that is also not too close to any other restoration sites. Buxton et al. (2014) found that the most influential variable affecting success of seabird restoration on islands around New Zealand was distance to a source population, with few cases of recolonization in which the nearest source population was >25 km away. Conversely, sites that are too close to a large existing colony may struggle to compete for prospecting birds because the larger colony is more attractive due to the noise, odor, and abundance of potential mates (Deguchi et al. 2017). Attempting to attract the same species to too many sites in a limited area may decrease the chance of success at each site because they will compete with each other for the same limited pool of prospecting birds. In New Zealand, the recommended distance between two social attraction sites is 100 km (Gummer and Cotter 2014, Buxton et al. 2016). Projects wishing to undertake social attraction should consult with other landowners and stakeholders nearby to ensure that their project does not overlap with any existing or planned social attraction, and to ensure that any spillover of excess birds onto neighboring properties will not create human-wildlife conflicts.

Presence of potential hazards or threats. Potential hazards such as artificial lights, utility lines, communication towers, wind turbines, and busy roads could cause mortality of released or socially attracted birds, and the presence of such hazards should be considered in selecting a release site. Some seabirds, particularly petrels and shearwaters that move between montane nesting areas and the ocean, are susceptible to collisions with towers and utility lines (Travers et al. 2023, Raine et al. 2024). Similarly, many seabirds are susceptible to collisions with wind turbines at sea and on land, and even the presence of wind turbines can make an area less suitable or attractive for foraging (Croll et al. 2022).

Potential for conflict with other uses, activities, and natural resources. (e.g. local fishing, aircraft operations, lights, antennae, etc.). Use of a site for seabird restoration potentially could conflict with other native plant or animal species, or other land uses and activities. For example, albatrosses are attracted to airfields in some locations because the flat, open ground and windy conditions make it easier for them to take off and land, and this can cause them to become a collision hazard with aircraft. This scenario has occurred at the Pacific Missile Range Facility on Kauai since the 1980s, where they pose a bird-aircraft collision hazard (BASH), and the U.S. Navy has a management program to decrease this risk, which includes reducing the number of albatross present at the facility (Anders et al. 2009). In assessing the feasibility for restoration of albatrosses to the Channel Islands in California, the presence of airfields and potential for conflict with that use was considered (VanderWerf et al. 2024). Similarly, the potential effects of albatrosses on an endangered plant, endangered Santa Barbara Island live-forever (*Dudleya traskiae*), also was considered in ranking sites.

3.5. Source site selection (for translocation)

Several factors should be considered when selecting a site from which to remove seabirds for translocation to a restoration site, which are listed below, followed by a discussion of each.

Criteria to Consider when Selecting a Source Site in Translocation:

- Ownership and management authority
- Population size, trend, and impact of removal.
- Infrastructure and logistics
- Genetic population structure
- Rescue opportunity
- Disturbance to target species and other resources
- Biosecurity and dispersal of invasive species, parasites, and pathogens

Ownership and management authority. As with selecting a restoration site, capturing and removing birds or their eggs for translocation will require permission of the landowner to access the property and carry out the specified activities. This is true of government-owned lands and private lands.

Population size, trend, and impact of removal. One goal of most translocations is to reduce any negative effects on the source population and the species as a whole, and in general the impact of removing birds for translocation will be lower at sites with a larger population (Bain and French 2009, Verdon et al. 2021). If there is information about the population trend at individual sites, this would be useful for assessing the potential impacts of removing birds for translocation. Populations that are stable, increasing, or have high reproduction would be more able to withstand removal of birds for translocation. In declining populations, removal for translocation could accelerate the decline and lead to extirpation. Even a large population could be negatively impacted by removal of birds for translocation if it is already declining.

Infrastructure and logistics. A variety of logistical factors could make it easier or harder to obtain individuals for translation, including such things as vehicle access, facilities for storing equipment and temporarily housing or caring for birds, or constructing such facilities if needed, and transport time. It is desirable to minimize the transport time and duration that chicks are out of the nest, when they are at risk from heat stress, dehydration, and weight loss. For example, during translocations of the Short-tailed Albatross from Torishima to Mukojima, chicks were transported by helicopter instead of by ship because of the shorter transport time despite the higher cost (Deguchi et al. 2012). Similarly, Black-footed Albatrosses (*Phoebastria nigripes*) and Bonin Petrels (*Pterodroma hypoleuca*) initially were collected from Tern Island and transported by ship to Oahu, a trip of 2.5 days, but this approach was discontinued after the first year in favor of moving chicks from Midway by plane, a trip of just a few hours, because the longer trip resulted in too much stress for the chicks (Pacific Rim Conservation, unpubl. data).

Genetic population structure. In selecting a source site, and also the translocation cohort, the genetic population structure of the species should be considered. The importance of genetics in translocations is discussed in detail by Dwyer et al. (2021) and Capel et al. (2022). First, the number of birds translocated should be large enough to adequately represent the existing genetic diversity. In general sites with larger populations are likely to have greater genetic diversity and will make it more feasible to collect the prescribed number of individuals. Second, if there is genetic structure among populations or colonies of a species, this should be considered, though it is not always clear whether to select birds from one site or multiple sites. Seabirds with high natal philopatry may evolve genetically distinct, locally adapted populations because of limited dispersal among colonies, which could warrant management as distinct population segments, such as in the Hawaiian Petrel (*Pterodroma. sandwichensis*; Welch et al. 2012). On the other hand, if preserving the existing genetic structure and differences among colonies is not desired, and the goal is to maximize genetic diversity in the founders of a new colony, then it would be preferable to collect birds from more than one site. If cohorts are taken from the same location in more than one year, an effort should be made to collect eggs or chicks from different pairs, or from different nest sites if the identity of individual birds is not known, to minimize the chance that siblings are taken in successive years.

Rescue opportunity. If there are sites where the target species is not safe or is not expected to persist in the long-term because of unmanageable predation or declining habitat quality, or where their presence causes conflict or is incompatible with some other use, birds can be "rescued" from such populations and used for translocation. This scenario could occur with seabirds as a result of inundation of colonies by sea level rise and storm surge associated with climate change, or at locations where birds are subject to predation by invasive species that cannot be effectively managed. There are several examples from Hawaii in which birds were collected from locations where they were at risk or caused conflict. On Midway Atoll, Black-footed Albatross eggs and chicks were removed from areas where nests were being washed away by high waves and had a low probability of survival, and moved to create new breeding colonies at James Campbell NWR on Oahu, and Guadalupe Island, Mexico (VanderWerf et al. 2019). In the Laysan Albatross (*Phoebastria immutabilis*), eggs have been removed from the Pacific Missile Range Facility on Kauai, where they pose a collision hazard with aircraft, and placed in foster nests elsewhere on Kauai to augment existing colonies and on Oahu to create a new colony (VanderWerf et al. 2019, 2024).

Biosecurity and dispersal of invasive species, parasites, and pathogens. The activities and transport of equipment associated with social attraction and translocation could accidentally result in the introduction of invasive alien species. All precautions should be taken to avoid this, including thorough cleaning and inspection of all materials and dedicated clothing and equipment that would be used only on the specified island or site.

Similarly, seabirds moved among sites could carry parasites or diseases that could spread to other bird species at the site. In previous albatross translocations, the chicks were treated with an external insecticide designed specifically for birds and an internal antibiotic to kill parasites (VanderWerf et al. 2019), and this would greatly reduce the risk. If eggs were moved, the risk would be lower because the eggshell itself is a barrier to parasites and most pathogens. Eggs chosen for translocation should be clean and free of dirt and bird feces; if necessary they can be wiped with a damp cloth but should not be washed because doing so could cause pathogens to pass through the shell into the egg.

3.6. Preparing the Restoration Site. Ideally, the site selected for restoration should already have substrate and vegetation structure preferred by the target species and be free of non-native predators. If there are predators at the restoration site that could prey on seabirds, they should be excluded with a fence or removed with trapping; these actions must start well in advance of the arrival of birds to ensure their safety. If there are plants that create collision hazards, block sunlight for solar panels, or block the wind and cause over-heating, they should be removed or pruned if possible. For burrow-nesting species, artificial burrows should be installed to accommodate translocated chicks and to provide suitable nesting sites for prospecting adults. In warmer climates, the internal temperature of the artificial burrows should be monitored after they are installed but before birds arrive to ensure they do not get too hot inside (above about 102 degrees F). If they are too hot, a shade lid can be installed on top of them, or they can be buried further underground. In areas that receive heavy rainfall, burrows should be placed on a slope to facilitate drainage and prevent flooding of the burrow chamber and monitored during heavy rains prior to seabird occupancy. Layers of gravel and then sand, soil, or sawdust can be placed on the bottom of the burrow to promote drainage and provide a suitable substrate. If trail cameras will be used to monitor released or socially attracted birds, they should be deployed shortly before the project begins and tested to ensure they function properly and are located appropriately with respect to sunlight and any objects that could obscure their field of view or move in the wind and trigger excessive unwanted photos.

3.7. Implementing the Proposed Restoration Action. Ideally a restoration plan will have been written during the planning stages of the project, and this should be followed to the maximum extent practicable. Deviations from the plan should be considered carefully and based on adequate justification. For social attraction, the equipment should require little maintenance, but periodic checks should be scheduled to ensure everything is working properly and has not been moved or damaged by wind, rain, or animals. For translocations, the chicks should be weighed, measured, and fed according to the prescribed schedule, usually every day when they are younger and less frequently as they grow. On days when they are not fed they should still be checked visually unless doing so would cause excessive disturbance. The specific care protocols will vary among seabird species and should be based on previous translocation projects with the same or similar species; many examples can be found in Gummer et al. (2013) and VanderWerf et al. (2023).

3.8. Monitoring Results and Measuring Success toward Milestones and Long-Term Goals

The ultimate goal of a seabird restoration project is to establish a self-sustaining population at the release site, and accomplishing that goal is the long-term measure of success. However, seabird restoration is a long-term process and the final goal may not be attained for several years. It can be important to define interim goals and short-term milestones that can be used at various stages to help assess whether the project is on track and likely to succeed eventually. The metrics listed below are useful for measuring success at each stage of a project, starting with metrics that are relevant during the early stages and ending with metrics that apply to later stages of successful projects.

- Survival rate during collection and transport (translocation only)
- Survival to fledging (translocation only)
- Time to first visitation (or time to first return for translocations)
- Number of individuals visiting
- Duration of visits (assuming birds are banded and can be individually identified)
- Sources from which birds are attracted (social attraction only)
- Time to first breeding
- Number of breeding pairs
- Breeding success rate

The importance of different metrics may change over the course of a project. For example, at the beginning of a project it may be desirable to count every visit and measure the duration of each visit as a way of measuring whether visitation is increasing. Once breeding starts, the number of visits may be less important, and the number of breeding pairs may become the most important metric. It may be important to record information separately for each sex, or in different time periods, such as months, to examine response patterns. It can be useful to set targets for each metric, but these may vary among species, locations, and techniques. If target values are desired for certain metrics, examining the literature for the results of previous project with the same or similar species can provide useful guidance. For metrics involving survival and reproduction, a target value no lower than the natural rate is often a reasonable starting point (VanderWerf et al. 2019). If target(s) are not met at certain stages of the project, it could be an indication that something is wrong and efforts should be made to determine the cause(s) any make any possible corrections.

4. PERMITTING AND ENVIRONMENTAL COMPLIANCE PATHWAYS

Projects involving seabird social attraction and translocation usually require an array of permits from federal, state, and sometimes local government agencies, and from the landowner or manager. Obtaining all the permits and other environmental compliance documents required for a seabird restoration project can be one of the most daunting and confusing aspects of the project. This section is intended to provide an overview of which permits are likely to be needed in various situations based on experience with previous projects. However, the laws, policies, and administrative rules that govern actions like seabird restoration are variable, depending on location, jurisdiction, and the species in question, and these regulations may change over time. These guidelines should not be regarded as the final word on what is legally required; practitioners interested in starting a seabird restoration project are strongly encourage to consult with the relevant government agencies early in the project design process to avoid any surprises on both sides. The permits required for a project will depend on:

1. The species being targeted, particularly whether it is listed under the U.S. Endangered Species Act (ESA).
2. The technique being used - social attraction or translocation.
3. Ownership of the restoration site.
4. Ownership of the source site (for translocations).
5. Whether the restoration site is within the species known historical breeding range, or if the project is an assisted colonization.
6. Whether the birds will be moved across international, state, or territory boundaries.
7. Whether potential environmental impacts of the action have been assessed previously or are covered under another document.

The permits required for a seabird restoration project can be grouped into three categories: 1) those related to working with the target bird species; 2) those related to working at a particular site or transporting birds to or from a particular site; and 3) those related to compliance with the National Environmental Policy Act (NEPA).

4.1. Species Permits. Permits will be required at both the federal and state levels. At the federal level, permits may be required under two important pieces of legislation, the Endangered Species Act (ESA) and the Migratory Bird Treaty Act (MBTA). Essentially all bird species native to the US, including all seabirds, are protected under the MBTA. For a list of species protected under the MBTA, visit: https://www.ecfr.gov/current/title-50/chapter-I/subchapter-B/part-10/subpart-B/section-10.13. Working with any species on the MBTA list will require a MBTA permit from the U.S. Fish and Wildlife Service (USFWS) Division of Migratory Birds. This permit is required for all translocations, and may be required for social attraction, at the discretion of the USFWS, because attempting to attract birds to an unsafe location could be viewed as leading to violation of the MBTA. For information about applying for a USFWS MBTA permit, visit: https://www.fws.gov/program/migratory-bird-permits.

If the target species is listed under the ESA, an additional permit, called a species recovery permit, is required under section 10 of the ESA. For a list of species protected under the ESA, visit: https://www.fws.gov/program/endangered-species/species. For more information about recovery permits, visit: https://www.fws.gov/library/collections/permits-native-endangered-and-threatened-species. Working with ESA listed species can be more complicated because of the additional protections involved (Sansilvestri et al. 2015). For translocation projects, the recovery permit must cover collection and transport of chicks (or eggs) and feeding and other forms of care of chicks at the restoration site. For social attraction projects, the recovery permit must at least allow broadcast of recorded vocalizations, and also could include banding and nest checking if those activities are planned.

If the restoration site is outside the target species known historical range (i.e., an assisted colonization), it may be advisable to conduct additional outreach about the project, as described below in the section on social considerations and communication. Extensive information about assisted colonizations, including an interactive worksheet designed to help assess risks, is available in Karasov-Olson et al. (2021a,b). To help relieve actual or perceived risks associated with assisted colonizations, it could be advantageous to officially designate the released birds as an "experimental population" under section 10j of the ESA to reduce the potential for conflicts that might result from the action (50 CFR §17.81[a]). For more information about 10j experimental populations, visit:
https://www.fws.gov/sites/default/files/documents/ESA-section10(j)-fact-sheet.pdf

If birds will be banded as part of the project, which is strongly recommended, then a banding permit will be required from the U.S. Geological Survey Bird Banding Lab. For translocations, banding birds is essential to be able to identify individuals and determine if and when they return. For social attraction, banding is not essential but is useful for helping to identify individual birds. A master bird banding permit is only given to individuals who can demonstrate extensive experience banding birds. It may also be possible to collaborate with someone who already has a banding permit, such as a State or Federal biologist, or a researcher with a local university. For information about the bird banding permits, visit:
https://www.usgs.gov/labs/bird-banding-laboratory.

All native species are also protected under state laws, and undertaking an active seabird restoration project therefore also will require a permit from the appropriate state agency. As with federal permits, such a permit would be required for all translocations, and possibly for social attraction, at the discretion of the state agency. The name of the relevant agency may vary from state to state, but all states have an agency concerned with protection of native species and that issues permits for projects that involve native species.

4.2. Site-specific (Landowner and Transport) Permits. Permits are required to conduct activities at the restoration site and, for translocations, at the source site, and in some cases for moving birds across international, state or territorial boundaries. If the project will occur on a national wildlife refuge, a Special Use Permit will be required from that particular refuge and should be applied for directly from that refuge. Similarly, if the project will occur in a national park, a research permit or some other type of permit will be required from that particular park. If the project will occur on State land, some form of permit will be required from the State agency that manages the land, and this may vary among states and among types of state land in question.

If birds or their eggs are moved from one state to another, an import permit may be required from the state into which the birds are moved, and an export permit may be required from the state in which the birds are being removed. Whether import and export permits are required may vary among states. In Hawaii and California, at least, an import permit is required to import virtually all wildlife, including all seabirds, from another state or territory, and the birds must be inspected on arrival and undergo a quarantine before they can be released. The length and location of the quarantine are at the discretion of the state department of agriculture.

If birds or their eggs are imported into the United States from another country or a US territory, or exported from the US or a territory, permits are required from both the USFWS Division of Migratory Birds office and the USFWS Division of Law Enforcement. They are separate permits and each involves a separate application. It is possible that a single MBTA permit from the USFWS can cover import, transport, and temporary possession of birds for raising them until fledging at the release site. However, MBTA permits usually are issued by regional USFWS offices, and if the import location is in a different region than the release site it may be necessary to apply for MBTA permits from more than one regional jurisdiction within the USFWS. Applications for import and export permits from the USFWS Office of Law Enforcement must be completed and submitted at: https://www.fws.gov/eLicense/ and requires creating an account. The USFWS LOE maintains a list of designated locations at which wildlife can be legally imported and exported in the US; if there is a need to import or export from a different location that is not on the approved list, it is possible to apply for a Designated Port Exception Permit at the same website.

Import and export of birds or their eggs into or from the USA also requires an inspection and health certificate signed by a certified veterinarian and subsequently endorsed by the US Department of Agriculture Animal and Plant Health Inspection Service using their Veterinary Export Health Certification System (VEHCS). For information about health certificates required by USDA, visit: https://vehcs-training.aphis.usda.gov/VEHCSHelp/index.html .

In addition to permits related to a specific site, some states have designated special management areas (SMAs) in which, regardless of land ownership, certain types of actions require an additional level of environmental review and permitting. Special Management Areas often exist in coastal zones, watersheds, cultural areas, and other areas considered to be especially sensitive for some reason. Seabird projects are often affected by such designations because they occur in coastal areas that are regarded as especially sensitive. Whether an SMA permit is required may depend on the activities involved in the project. Construction activities, such as building a predator exclusion fence or some other infrastructure, is likely to require a special management area permit, but temporary placement of social attraction equipment or periodic visits to care for birds may not require a permit. It is wise to determine at the beginning if the restoration site lies within any type of special management area and whether the proposed activities would trigger the additional protections provided by such designations.

Finally, some federal lands are designated as Wilderness Areas, where there are restrictions on use of motorized vehicles, most forms of construction, and certain other activities. If the proposed project will occur in a Wilderness Area there may be limitations on some activities, and obtaining an exemption from the restrictions would be difficult, and perhaps inappropriate. Activity on formally designated wilderness areas is coordinated by the National Wilderness Preservation System. Wilderness areas are managed by four federal land management agencies: the National Park Service, the U.S. Forest Service, the U.S. Fish and Wildlife Service, and the Bureau of Land Management. For example, information about Wildlands managed by the National Park Service, visit:
https://www.nps.gov/subjects/wilderness/index.htm

4.3. Environmental Compliance (NEPA). Some seabird restoration projects may also have to complete documents to satisfy requirements of the National Environmental Protection Act (NEPA). If NEPA compliance is required it can be in one of two forms: an Environmental Assessment (EA); or an Environmental Impact Statement (EIS), which is more detailed. In general, NEPA compliance may be required if there is a federal nexus to the project (i.e., federal funding is being used or the project is being conducted on federal lands), or if the target species is listed under the ESA. NEPA review may not be necessary if it has already been completed for some other management document for the site that includes species restoration actions. Examples of such documents are Integrated natural Resource Management Plans (INRMPs) for military installations and Comprehensive Conservation Plans (CCPs) for national wildlife refuges. It is best if the management plan specifically mentions social attraction or translocation, but even if it does not, those actions may be considered part of overall restoration or recovery, at the discretion of the USFWS.

Other Federal regulations that may affect translocations 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 conservation introductions meant to reduce the risk of species invasion (ISAC, 2017). While these are less common when dealing with seabirds due to ambiguity over whether their pelagic range contributes to them being an "exotic species", and the fact that they do not forage on land and are thus at reduced risk for becoming "invasive", the regulations should still be consulted on a case-by-case basis.

To help illustrate which permits are required under different circumstances, this report includes an interactive, color-coded spreadsheet that uses information about a project entered by the user to indicate which permits are needed. This spreadsheet is available as Appendix 1. Below are two examples in which information was entered about hypothetical seabird restoration projects. The first example involves translocation of Black-footed Albatrosses from Midway Atoll National Wildlife Refuge to Channel Islands National Park in California. The second example involves social attraction of California Least Terns (*Sternula antillarum browni*) at a national wildlife refuge in California.

Table 1. Permits that would be required to translocate Black-footed Albatrosses from Midway Atoll National Wildlife Refuge to Channel Islands National Park in California. Cells highlighted in yellow are not relevant to the project.

Action type	Condition	USFWS recovery permit	USFWS MBTA permit	State species permit	Bird banding permit	Site permit	State import+ export permit	State SMA permit
Translocation	ESA listed?	no						
	MBTA protected?		yes					
	State protected?			yes				
	Source site ownership					federal		
	Birds moved between states?						yes	
Social Attraction	ESA listed?							
	MBTA protected?							
	State protected?							
Both	Birds to be banded?				yes			
Both	Restoration site ownership					federal		
Both	Restor. site located in SMA?							yes

color	meaning
(red)	Federal permit required
(orange)	Federal permit may be required; consult USFWS
(blue)	State permit required
(green)	State permit may be required; consult state wildlife agency or dept. of agriculture

Table 2. Permits that would be required for social attraction of California Least Terns at a national wildlife refuge in California. Cells highlighted in yellow are not relevant to the project.

Action type	Condition	USFWS recovery permit	USFWS MBTA permit	State species permit	Bird banding permit	Site permit	State import+ export permit	State SMA permit
Translocation	ESA listed?							
	MBTA protected?							
	State protected?							
	Source site ownership							
	Birds moved between states?							
Social Attraction	ESA listed?	yes						
	MBTA protected?		yes					
	State protected?			yes				
Both	Birds to be banded?				yes			
Both	Restoration site ownership					state		
Both	Restor. site located in SMA?							yes

color	meaning
(red)	Federal permit required
(orange)	Federal permit may be required; consult USFWS
(blue)	State permit required
(green)	State permit may be required; consult state wildlife agency or dept. of agriculture

5. SOCIAL CONSIDERATIONS, COMMUNITY SUPPORT, AND COMMUNICATION

When conducting a seabird restoration project, it is important to consider the social implications and consequences of the action, and these aspects should be considered early during the planning process, not after the project has been planned. If the local community or stakeholders do not support the action, or feel they have not been adequately involved, there is more chance that there will be legal challenges to implementation, lack of support, and greater potential for vandalism and hunting of the birds for sport or food. Public outreach and community engagement will be necessary in advance of any restoration efforts, particularly for translocations. Social considerations are important to the success of conservation introductions and include legal, policy, economic, and cultural considerations. In particular, it is important to engage with indigenous cultural practitioners and conservation stakeholders. It may be beneficial to undertake a feasibility assessment of the proposed restoration action.

Several guiding documents have been produced recently that contain a wealth of information about social and community issues related to translocations (Karasov-Olson et al. 2021a,b, USFWS 2024). Some issues covered by these documents are focused primarily on assisted colonization, or translocations outside the target species known historical range, but the information provided and questions asked are worth considering in all seabird restoration projects. Specific questions that a feasibility assessment should address include, but are not limited to (taken from USFWS 2024):

- Are human communities near the potential release and source areas, relevant government agencies, non-government organizations, and informal interest groups aware of the identified conservation problem? What forms of engagement and outreach are needed to raise awareness of the problem and increase understanding of public and partner perspectives on possible responses?
- Are there established mechanisms for communication, engagement and problem-solving between interested parties, affected groups and decision makers?
- What contingencies are needed to prepare for a conservation introduction not going as planned (e.g., exit strategy)? How feasible will implementation of these plans be?
- What cultural opportunities and impacts need to be assessed?
- What economic opportunities or impacts need to be considered?
- Are there sufficient human and financial resources to accomplish the conservation introduction, including post-release monitoring and management?

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