CHAPTER 5

RESTORATION DEFINED

INTRODUCTION

In the following chapter we describe the various definitions of restoration and rehabilitation, and discuss the categories of activities considered by the U.S. government as being part of restoration (restoration, rehabilitation, replacement, enhancement, and acquisition of the equivalent resources). We also outline what we believe to be the most appropriate ecological units (e.g., colony, population, metapopulation) on which to conduct restoration and describe the potential time frames restoration might require.

DEFINITIONS

There is confusion in the literature over the definitions of restoration and rehabilitation. This confusion stems in part from regulations governing damage assessment and "restoration" activities in the United States, in which the definitions used are slightly different from those in the ecological literature (cf. National Research Council 1992). Below we discuss restoration and rehabilitation, and define them for the purpose of this report.

Restoration

The Society for Ecological Restoration defines restoration as "the process of altering a site intentionally to establish a defined, indigenous, historic system. The goal of this process is to emulate the structure, functioning, diversity, and dynamics of the specified ecosystem." A similar goal was suggested by Simberloff (1990:40), who proposed that restoration would be successful "if it produces a system whose structure and function cannot be shown to be outside the bounds generated by normal dynamic processes and ecosystems."

In the United States since 1987, restoration of seabird populations injured[4] by oil spills has been guided by the Natural Resource Damage Assessment (NRDA) regulations (43 CFR Part 11) of the Department of Interior. These regulations were enacted as a requirement of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA)and applied to natural resource injuries resulting from spills of oil and hazardous substances, generally including injuries resulting from the *Exxon Valdez* oil spill.

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[4] Injury can be defined in reference to individual organisms, populations, or any other higher-order ecological unit. A resource (e.g., individual, population, species) is injured when it has been detrimentally affected. For example, an individual bird is injured when it becomes oiled. In this case, an extreme injury would be death. A population is injured when some aspect of its demographics, abundance, distribution, or genetic variance is altered. An extreme injury here would be local extinction.

The National Oceanic and Atmospheric Administration has recently released Natural Resource Damage Assessment regulations (see *Federal Register* Vol. 61, No. 4, January 5, 1996) under the Oil Pollution Act of 1990 that replace the Department of Interior regulations for natural resource injuries that result from oil spills (NOAA 1996). The Department of Interior regulations are still applicable to natural resource injuries resulting from spills of other toxic substances. Both sets of regulations recommend approaches for use by natural resource trustees in assessing and quantifying injuries, estimating associated damages, and selecting restoration alternatives. The definition of restoration is essentially the same in both the Department of Interior and NOAA regulations (NOAA 1996:505):

> Restoration means any action (or alternative), or combination of actions (or alternatives), to restore, rehabilitate, replace, or acquire the equivalent of injured natural resources and services. Restoration includes: (1) primary restoration, which is any action, including natural recovery, that returns injured natural resources and services to baseline; and (2) compensatory restoration, which is any action taken to compensate for interim losses of natural resources and services that occur from the date of the incident until recovery.

In other words, the regulatory definition of restoration is broad, using "restoration" as a general term for restoration, rehabilitation, replacement, and acquisition of the equivalent of the injured natural resources and the services they provide. Trustees are given considerable flexibility to select appropriate restoration alternatives from the four restoration categories, depending on the location of the spill, the nature and extent of the injuries, the species involved, and the amount of trust funds available. Thus, direct restoration of an extirpated colony may be selected as the most appropriate way to deal with seabird injuries at one location, whereas another technique (e.g., removal of exotic predators or herbivores from an island to enhance nest success) may be selected as most appropriate to restore the same seabird species under a different set of circumstances at another spill location.

The Trustee Council adopted a definition of restoration that is essentially the same as the NOAA/Department of Interior definition, except that it makes reference to "pre-spill condition" (Trustee Council 1994a, 1994b) rather than baseline (see below). However, while replacement and acquisition are not defined in the NOAA rule, the Trustee Council (1994b:4) uses these terms synonymously, and explicitly defines them as "compensation for an injured, lost or destroyed resource by substituting another resource that provides the same or substantially similar services as the injured resource."

For the purpose of this report, we define restoration as any action taken directly or indirectly to manipulate a system for the repair or recovery of injured populations, colonies, or communities. *We emphasize that restoration is an action taken by humans; the natural recovery of an injured resource without some form of human input is not here regarded as restoration.* That is, restoration is something that people do for seabirds, not what seabirds do for themselves.

Rehabilitation

Atkinson (1994) defines rehabilitation as the removal of the affecting or disturbing agent, without the direct manipulation of any population demographic factor. Conducted by itself, rehabilitation promotes natural regeneration (recovery). In other words, if the population decline at a seabird colony was the result of an oil spill or gillnet activity near that colony, rehabilitation would involve the removal of the oil or gillnets. Likewise, according to this definition, if seabird populations have declined at a colony as the result of predation from exotic predators, the removal of these predators would constitute rehabilitation. If, following removal of the predators, the colonies eventually returned to a baseline or "predisturbance" condition, the system would have recovered. Namely, the system was restored through a process of natural recovery aided by rehabilitation. However, if colonies of the original species did not return despite removal of predators, and no further action was taken, the system would not have recovered and restoration would not have progressed beyond rehabilitation. In other words, rehabilitation may constitute an incomplete form of restoration if natural recovery does not occur.

The U.S. agencies dealing with oil spills generally view rehabilitation as the procedure by which injured individuals animals are treated, nursed back to health, and released into the population. This process involves retrieving live oiled animals (in particular, seabirds) and then washing them, feeding them, and, if necessary, conducting medical procedures on them. Although these activities may seem very different from removing exotic predators from islands, they can be viewed as a different stage in a similar process. With the removal of oil, the focus is on the individual animal, whereas in the ecological definition the focus is on a group of animals such as a seabird colony, population, or community. The ecological effects of the two kinds of rehabilitation may be identical. Just as the removal of a predator may not by itself restore all of the original extirpated species, the removal of oil residues from individual birds is unlikely to restore the original population; many oiled birds will not be recovered, and others may die during or soon after rehabilitation attempts (see Chapter 9f).

If the intent of restoration is to repair an injured population, then removing oil and treating individual animals (rehabilitation) may be a first step toward that repair or recovery (see Chapter 9f for comments about this method). Likewise, removing exotic predators from islands is also an activity that can repair an injured system. In this report, we generally do not distinguish rehabilitation of individuals from that of populations since both can contribute to the process of restoration; however, our discussion of rehabilitation in Chapter 9f does concern only the rehabilitation of individuals (i.e., the rescue and cleaning of oiled birds).

Baseline

The goal of restoration is to return a population (or colony, metapopulation, etc.) to a predetermined level that existed before a defined disturbance event. In Chapter 6 we discuss restoration goals and define the point at which restoration is no longer needed (i.e., recovery). However, it is important to outline here what is meant by baseline.

The concept of baseline is an important part of U.S. Natural Resource Damage Assessment regulations. Baseline refers to the condition of natural resources and services that would have existed had the spill not occurred. Implicit in this concept is an understanding that biotic and abiotic factors can cause the carrying capacity of environments to change with time, so that restoration of populations to prespill numbers may not always be feasible or appropriate (see Chapter 12). Restoration of ecosystem function is always considered appropriate, and trustees are encouraged to use their best judgment and knowledge of local ecological processes and trends to select feasible restoration alternatives and criteria for evaluating project success (e.g., Trustee Council 1994b:35).

The Trustee Council also emphasized an ecosystem approach in conducting restoration activities. In fact, Mission Statements 1 and 2 note that "[r]estoration should contribute to a healthy, productive and biologically diverse ecosystem within the spill area . . . [and] restoration will take an ecosystem approach to better understand what factors control the populations of injured resources" (Trustee Council 1994b:12).

WHAT IS RESTORED?

Restoration of Populations

Mitigation of population declines of seabirds that forage over vast distances must inevitably be site based; there is little chance of restoring the marine systems that provide resources to seabirds, except on a very limited spatial scale. Indeed, the kind of management undertaken will depend in large part on the biology of the birds (see Chapter 3). For example, species with mobile colonies (such as some gulls and terns) may require only *rehabilitation* of destroyed nest sites to provide the full range of locations available to the identified metapopulation. Even if the rehabilitated sites are then recolonized rapidly, there is no guarantee that the birds will remain indefinitely if their distribution is a reflection of the quality and location of a shifting food resource, rather than availability of nest sites. However, where food resources are more stable, such as in estuarine environments along the California coast, protection of least tern nests from human disturbance and predation has enabled colonies to recover and persist for many years (i.e., rehabilitation in the form of removing the human and predator disturbance).

Rehabilitation of nesting sites for highly philopatric species may not always be sufficient. For these species, a concerted *restoration* program may be required. For example, in the period between their introduction in 1890 and eradication in 1964, feral house cats devastated the burrowing seabird assemblage on Cuvier Island off New Zealand. In the 30 years following removal of the cats (rehabilitation), two species returned unaided: sooty shearwaters and grey-faced petrels. But common diving petrels, little shearwaters, fluttering shearwaters, and Pycroft's petrel, although abundant on some islands nearby, have not returned naturally (Bellingham *et al.* 1981). The re-establishment of species with moderate levels of philopatry may require the development of innovative translocation or social facilitation methods (e.g., Kress 1983, Podolsky 1990, Bell 1994; see also Chapter 9). As a further complication, the site-

specific reproductive behavior of highly philopatric species could be reflected in genetically distinctive populations.

Consequently, depending on the kind of disturbance faced by seabird populations and the biology of the birds, we may need to consider restoration of individual colonies as demes (genetic isolates), restoration of geographic range, and rehabilitation of metapopulations. For some metapopulations, the solution may be site-specific rehabilitation, but other populations may require intensive manipulation (restoration)

Restoration of Habitats

The restoration of islands for seabirds is a recent concept. The most comprehensive restoration project to date anywhere involves revegetation and the re-establishment of three species of birds (including cahow), marine turtles, and a land snail on the 6-hectare Nonsuch Island in Bermuda (Wingate 1985). This is not a large pool of experience from which to extrapolate the large-scale effects of oil spills. However, there are situations in which oil spills may so drastically affect terrestrial environments that significant habitat restoration could be required. If an incident like the *Braer* spill off the Shetland Islands, United Kingdom, in 1993 (Ritchie and O'Sullivan 1994) were repeated during extreme weather off seabird islands in New Zealand, for instance, wind-driven petroleum products could have a devastating effect on vegetation, poison the soils, and thereby destroy large areas used by burrowing seabirds (P. Irving, pers. com.).

Restoration of Communities and Ecosystems

Fortunately, there have not yet been any catastrophic oil spills combined with extreme weather around the seabird islands of New Zealand. However, because of the keystone role of seabirds in coastal and island ecosystems, even minor disturbance events may have long-term effects on some components of terrestrial ecosystems (see Chapter 13). For example, scurvy grasses (cresses: *Lepidium* spp.) are coastal plants that may be extremely abundant around seabird colonies. If seabird numbers are reduced, the soil chemistry changes and the scurvy grasses may disappear (Norton *et al.* 1997). An oil spill with an apparent population effect on seabirds could thus have successional effects on plant communities. In such circumstances the focus may need to be shifted from rehabilitation of a seabird population capable of only slow natural recovery to an accelerated restoration campaign designed to overcome the community effects of low bird numbers.

RESTORATION TIME SCALES

Given all the potential effects on seabird populations, the time scales required to complete their restoration will be equally varied. However, an overriding consideration is the potential productivity of the species involved. Species with high dispersal rates can show rates of population increase that exceed 20% per annum (see Nur and Ainley 1992: Chapter 12). These

may be the least likely candidates for restoration because the probability of natural recovery may be high. It is more likely that restoration will be required for species with low dispersal rates and low probability of natural recovery; many such species have rates of population increase of less than 5% per annum. Furthermore, some of these species remain at sea for five years or more after fledging. Therefore, if techniques are used that involve translocation of nearly fledged chicks (e.g., Bell 1994), no returns can be expected until several years after commencement of the program. Even if first-year breeders do return to the translocation site, because of their low productivity many years of monitoring will be required before we can be sure that a self-sustaining population is established. Consequently, the recovery of dense colonies of some seabirds following restoration may take many decades.