

neowawraea, *Geranium arboreum*, *Geranium multiflorum*, *Gouania vitifolia*, *Hedyotis coriacea*, *Hedyotis mannii*, *Hesperomannia arbuscula*, *Hibiscus brackenridgei*, *Ischaemum byrnone*, *Isodendron pyrifolium*, *Kanaloa kahoolawensis*, *Lipochaeta kamolensis*, *Lysimachia lydgatei*, *Mariscus pennatifolius*, *Melicope adscendens*, *Melicope balloui*, *Melicope knudsenii*, *Melicope mucronulata*, *Melicope ovalis*, *Neraudia sericea*, *Nototrichium humile*, *Peucedanum sandwicense*, *Phlegmariurus mannii*, *Phyllostegia mannii*, *Phyllostegia mollis*, *Plantago princeps*, *Platanthera holochila*, *Pteris lidgatei*, *Remya maiensis*, *Sanicula purpurea*, *Schiedea haleakalensis*, *Sesbania tomentosa*, *Spermolepis hawaiiensis*, *Tetramolopium capillare*, *Tetramolopium remyi*, *Vigna owahuensis*, and *Zanthoxylum hawaiiense* is described in the "Background" section of this final rule.

We are unable to identify these features for *Adenophorus periens*, *Clermontia peleana*, *Delissea undulata*, *Phyllostegia parviflora*, *Schiedea hookeri*, *Schiedea nuttallii*, *Solanum incompletum*, and *Tetramolopium arenarium*, which no longer occur on the islands of Maui and Kahoolawe, because information on the physical and biological features (*i.e.*, the primary constituent elements) that are considered essential to the conservation of these eight species on Maui and Kahoolawe is not known. Therefore, we are not designating critical habitat for these species on Maui. We are able to identify these features for *Hesperomannia arborescens*, but we are not designating critical habitat for this species on Maui for the reasons given in the "Analysis of Impacts Under Section 4(b)(2): Other Impacts" section.

All areas designated as critical habitat are within the historical range of the 60 species at issue and contain one or more of the physical or biological features (primary constituent elements) essential for the conservation of the species.

As described in the discussions for each of the 60 species for which we are designating critical habitat, we are defining the primary constituent elements on the basis of the habitat features of the areas from which the plant species are reported, as described by the type of plant community (*e.g.*, mesic *Metrosideros polymorpha* forest), associated native plant species, locale information (*e.g.*, steep rocky cliffs, talus slopes, gulches, stream banks), and elevation. The habitat features provide the ecological components required by the plant. The type of plant community and associated native plant species

indicate specific microclimate (localized climatic) conditions, retention and availability of water in the soil, soil microorganism community, and nutrient cycling and availability. The locale indicates information on soil type, elevation, rainfall regime, and temperature. Elevation indicates information on daily and seasonal temperature and sun intensity. Therefore, the descriptions of the physical elements of the locations of each of these species, including habitat type, plant communities associated with the species, location, and elevation, as described in the "Supplementary Information: Discussion of the Plant Taxa" section above, constitute the primary constituent elements for these species on the islands of Maui and Kahoolawe.

Criteria Used To Identify Critical Habitat

The lack of detailed scientific data on the life history of these plant species makes it impossible for us to develop a robust quantitative model (*e.g.*, population viability analysis (National Research Council 1995)) to identify the optimal number, size, and location of critical habitat units to achieve recovery (Beissinger and Westphal 1998; Burgman *et al.* 2001; Ginzburg *et al.* 1990; Karieva and Wennergren 1995; Menges 1990; Murphy *et al.* 1990; Taylor 1995). However, based on the best information available at this time, including information on which the listing of these species was based, as well as their recovery plans, we have concluded that the current size and distribution of the extant populations are not sufficient to expect a reasonable probability of long-term survival and recovery of these plant species.

For each of these species, the overall recovery strategy outlined in the approved recovery plans includes: (1) Stabilization of existing wild populations; (2) protection and management of habitat; (3) enhancement of existing small populations and reestablishment of new populations within historic range; and (4) research on species biology and ecology (Service 1995a, 1995b, 1996a, 1996b, 1997, 1998a, 1998b, 1999, 2001). Thus, the long-term recovery of these species is dependent upon the protection of existing population sites and potentially suitable unoccupied habitat within their historic range.

The overall recovery goal stated in the recovery plans for each of these species includes the establishment of 8 to 10 populations with a minimum of 100 mature, reproducing individuals per population for long-lived perennials,

300 mature, reproducing individuals per population for short-lived perennials, and 500 mature, reproducing individuals per population for annuals. (There is one specific exception to this general recovery goal of 8 to 10 populations for species that are believed to be very narrowly distributed on a single island. The recovery goal for *Argyroxiphium sandwicense* ssp. *macrocephalum* is one population of more than 50,000 individuals, and the critical habitat designations reflect this exception for this species.)

To be considered recovered, the populations of a multi-island species should be distributed among the islands of its known historic range (Service 1995a, 1995b, 1996a, 1996b, 1997, 1998a, 1998b, 1999, 2001). A population, for the purposes of this discussion and as defined in the recovery plans for these species, is a unit in which the individuals could be regularly cross-pollinated and influenced by the same small-scale events (such as landslides), and that contains a minimum of 100, 300, or 500 mature, reproducing individuals, depending on whether the species is a long-lived perennial, short-lived perennial, or annual.

By adopting the specific recovery objectives enumerated above, the adverse effects of genetic inbreeding and random environmental events and catastrophes, such as landslides, hurricanes, or tsunamis, which could destroy a large percentage of a species at any one time, may be reduced (Menges 1990; Podolsky 2001). These recovery objectives were initially developed by the HPPRCC and are found in all of the recovery plans for these species. While they are expected to be further refined as more information on the population biology of each species becomes available, the justification for these objectives is found in the current conservation biology literature addressing the conservation of rare and endangered plants and animals (Beissinger and Westphal 1998; Burgman *et al.* 2001; Falk *et al.* 1996; Ginzburg *et al.* 1990; Hendrix and Kyhl 2000; Karieva and Wennergren 1995; Luijten *et al.* 2000; Meffe and Carroll 1996; Menges 1990; Murphy *et al.* 1990; Podolsky 2001; Quintana-Ascencio and Menges 1996; Taylor 1995; Tear *et al.* 1995; Wolf and Harrison 2001). The overall goal of recovery in the short-term is a successful population that can carry on basic life history processes, such as establishment, reproduction, and dispersal, at a level where the probability of extinction is low. In the long-term, the species and its populations should be at a reduced risk