

*Mariscus pennatiformis*, *Pritchardia remota*, *Schiedea verticillata*, and *Sesbania tomentosa* is described in the "Background" section of this final rule.

All areas designated as critical habitat are within the historical range or have been identified in the recovery plans for these species as sites for conservation of one or more of the five 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 five 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., *Pritchardia remota* mesic coastal forest), associated native plant species, locale information (e.g., steep rocky cliffs, talus slopes, gulches), 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 Plant Taxa** section above, constitute the primary constituent elements for these species in the NWHI.

#### *D. Criteria Used To Identify Critical Habitat*

The Service considered a number of factors in the selection and proposal of specific boundaries for critical habitat. For each, the overall recovery strategy outlined in the 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 or within areas identified in the recovery plans for conservation of the species, and (4) research on species biology and ecology (Service 1998d, 1999). 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 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., a population viability analysis) to identify the optimal number, size, and location of critical habitat units needed 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). At this time, and consistent with the listing of these species and their recovery plans, the best available information leads us to conclude 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. We used the same information, along with the opinions of scientists familiar with these species, to identify potentially suitable habitat within the known historic range of each species.

The recovery goals stated in the recovery plans for these species include the following: Establishment of 8 to 10 populations with a minimum of 300 mature, reproducing individuals per population for *Mariscus pennatiformis* and *Sesbania tomentosa* distributed among the islands of each species known historic range (Service 1999). For purposes of this discussion, a population, as defined in the recovery plan 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 which contains a minimum of 300 mature, reproducing individuals for these short-lived perennial species (Service 1999).

Within the five species at issue, there are three exceptions to this general recovery goal of 8 to 10 populations for species that are believed to be very narrowly distributed. The recovery goals for *Amaranthus brownii*, *Pritchardia remota*, and *Schiedea verticillata* include one to three additional colonies of each species on an island other than Nihoa (Service 1998d). In the case of *Pritchardia remota*, Laysan Island should be considered, since a palm that may have been this species formerly occurred there. For *Amaranthus brownii* and *Schiedea verticillata*, Necker Island should be considered since it is adjacent to Nihoa, has similar habitat, and is protected as a U.S. Fish and Wildlife Service refuge (Service 1998d). Should establishment of one to three colonies of any or all of these taxa on an island other than Nihoa occur, delisting may

be considered when they have reached a minimum of 100 mature individuals per colony for *Pritchardia remota*, a minimum of 300 mature individuals per colony for *Schiedea verticillata*, and a minimum of 500 mature individuals for *Amaranthus brownii*. Each colony should be stable or increasing for a minimum of five consecutive years. If the establishment of additional colonies on an island other than Nihoa proves infeasible for these taxa, they may be considered recovered if five colonies of each species reach the population targets described above (Service 1998d). The critical habitat designations reflect these exceptions for these species.

By adopting these specific recovery objectives, 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 of extinction and be adaptable to environmental change through evolution and migration.

Many aspects of species life history are considered to determine guidelines for species' interim stability and recovery, including longevity, breeding system, growth form, fecundity, ramet (a plant that is an independent member of a clone) production, survivorship, seed longevity, environmental variation, and successional stage of the habitat. Hawaiian species are generally poorly studied, and the only one of these characteristics that can be uniformly determined for all Hawaiian plant