

*et al.* 2000; Mangel and Tier 1994; Pimm *et al.* 1998; Stacey and Taper 1992). We conclude that designation of adequate suitable habitat for 8 to 10 populations as critical habitat is essential to give the species a reasonable likelihood of long-term survival and recovery, based on currently available information.

In summary, the long-term survival and recovery of Hawaiian plant species requires the designation of critical habitat units on one or more of the Hawaiian islands with suitable habitat for 8 to 10 populations of each plant species. Some of this habitat is currently not known to be occupied by these species. To recover the species, it will be necessary to conserve suitable habitat in these unoccupied units, which in turn will allow for the establishment of additional populations through natural recruitment or managed reintroductions. Establishment of these additional populations will increase the likelihood that the species will survive and recover in the face of normal and stochastic events (*e.g.*, hurricanes, fire, and nonnative species introductions) (Mangel and Tier 1994; Pimm *et al.* 1998; Stacey and Taper 1992).

In this rule, we have defined the primary constituent elements based on the general habitat features of the areas from which the plants are reported, such as the type of plant community, the associated native plant species, the physical location (*e.g.*, steep rocky cliffs, talus slopes, stream banks), and elevation. The areas we are designating as critical habitat provide some or all of the habitat components essential for the conservation of the 83 plant species.

Our approach to delineating critical habitat units was applied in the following manner:

1. Critical habitat was proposed and will be designated on an island by island basis for ease of understanding for landowners and the public, for ease of conducting the public hearing process, and for ease of conducting public outreach. In Hawaii, landowners and the public are most interested and affected by issues centered on the island on which they reside.

2. We focused on designating units representative of the known current and historical geographic and elevational range of each species; and

3. We designated critical habitat units to allow for expansion of existing wild populations and reestablishment of wild populations within the historic range, as recommended by the recovery plans for each species.

The proposed critical habitat units were delineated by creating rough units for each species by screen digitizing polygons (map units) using ArcView

(Environmental Systems Research Institute, Inc.), a computer GIS program. We created polygons by overlaying current and historic plant location points onto digital topographic maps of each of the islands.

We then evaluated the resulting shape files (delineating historic elevational range and potential, suitable habitat). We refined elevation ranges, and we avoided land areas identified as not suitable for a particular species (*i.e.*, not containing the primary constituent elements). We then considered the resulting shape files for each species to define all suitable habitat on the island, including occupied and unoccupied habitat.

We further evaluated these shape files of suitable habitat. We used several factors to delineate the proposed critical habitat units from these land areas. We reviewed the recovery objectives as described above and in recovery plans for each of the species to determine if the number of populations and population size requirements needed for conservation would be available within the suitable habitat units identified as containing the appropriate primary constituent elements for each species. If more than the area needed for the number of recovery populations was identified as potentially suitable, only those areas within the least disturbed suitable habitat were designated as proposed critical habitat. A population for this purpose is defined as a discrete aggregation of individuals located a sufficient distance from a neighboring aggregation such that the two are not affected by the same small-scale events and are not believed to be consistently cross-pollinated. In the absence of more specific information indicating the appropriate distance to assure limited cross-pollination, we are using a distance of 1,000 m (3,280 ft) based on our review of current literature on gene flow (Barret and Kohn 1991; Fenster and Dudash 1994; Havens 1998; Schierup and Christiansen 1996). We further refined the resulting critical habitat units by using satellite imagery and parcel data to eliminate areas that did not contain the appropriate vegetation or associated native plant species, as well as features such as cultivated agriculture fields, housing developments, and other areas that are unlikely to contribute to the conservation of one or more of the 83 plant species for which critical habitat was proposed on January 28, 2002. We used geographic features (ridge lines, valleys, streams, coastlines, etc.) or manmade features (roads or obvious land use) that created an obvious

boundary for a unit as unit area boundaries.

Following publication of the proposed critical habitat rules, some of which were revised, for 255 Hawaiian plants (67 FR 3940, 67 FR 9806, 67 FR 15856, 67 FR 16492, 67 FR 34522, 67 FR 36968, 67 FR 37108), we re-evaluated proposed critical habitat, State-wide, for each species using the recovery guidelines (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) to determine if we had inadvertently proposed for designation too much or too little habitat to meet the essential recovery goals of 8 to 10 populations per species distributed among the islands of the species' known historic range (HINHP Database 2000, 2001; Wagner *et al.* 1990, 1999). Based on comments and information we received during the comment periods, we assessed the proposed critical habitat in order to ascertain which areas contained the highest quality habitat and had the highest likelihood of conserving the species. We ranked areas of the proposed critical habitat by the quality of the primary constituent elements (*i.e.*, intact native plant communities, predominance of associated native plants versus nonnative plants), potential as a conservation area (*i.e.*, whether the land is zoned conservation and; whether the landowner is already participating in plant conservation or recovery actions), and current or expected management of known threats (*e.g.*, ungulate control; weed control; nonnative insect, slug, and snail control). We ranked as most essential areas that contain high quality primary constituent elements, are zoned for conservation, and have on-going or expected threat abatement actions. This ranking process also included determining which habitats were representative of the historic geographical and ecological distributions of the species (see "Primary Constituent Elements"). Areas that are zoned for conservation or have been identified as a State Forest Reserve, NAR, Wildlife Preserve, State Park, or are managed for conservation by a private landowner have a high likelihood of providing conservation benefit to the species and are therefore more essential than other comparable habitat outside of those types of areas. Of these most essential areas, we selected adequate area for our recovery goals of 8 to 10 populations distributed