

species. Second, we are not able to precisely identify, map, and designate the underground corridors that would provide this connectivity.

Therefore, this final critical habitat designation is based on what we are at this time able to identify as essential to the conservation of these two species: multiple cave systems (*i.e.*, eight caves occupied by one or both species, six unknown occupied caves, their associated mesocaverns, and three areas containing higher quality habitat likely to contain one or more occupied caves) known to be occupied or that have relatively higher quality habitat and most likely to be occupied, and that are located in a wide distributional pattern within the basin. As discussed below, this approach of multiple populations that are distributed throughout the basin provides the best protections against extinction of the species due to catastrophic events as well as the highest likelihood of long-term conservation of these species.

In determining critical habitat for these species, we started with lands within the region containing geologic and soil characters similar or identical to those of known, occupied, accessible caves. This area includes the Waikomo-Kalihi-Koloa soil association (Foote *et al.* 1972) where it overlays the Koloa Volcanic Series flows (MacDonald *et al.* 1960). In addition, karst outcrops of calcified marine deposits are part of the same geologic deposits that contain the cave at Mahulepu that is occupied by the Kauai cave amphipod. Solution pockets and voids are abundant in this rock type and, like the cave at Mahulepu, lay on top of old, lava-tube-bearing pahoehoe flows.

Within these areas, we designated sites where either the Kauai cave amphipod or the Kauai cave wolf spider have been verified as occurring. We set out the following buffers to capture the adjacent mesocaverns where the animals are likely to spend the majority of their time as previously discussed in this rule. In cases where development was not complete, whenever possible, a 61 meter (200 ft) buffer was included around caves. Information provided during the comment period showed that a previous archeological and biological cave survey was done (Hammatt *et al.*, 1978) that recommended a 30 meter (100 ft) buffer be placed around known caves. We believe that these buffers are essential to the conservation of the species because they reduce the vulnerability of the species to diseases and other catastrophic events by providing habitat that is most likely occupied, area for local intracave dispersal, as well as refugia from effects

from disturbance that may take place in and around identified caves. We did not feel that with the additional known activities that may be occurring in the Koloa Basin, a 100 ft. buffer would be adequate to protect against impacts from adjacent development. Dr. Howarth's information on what he believed was a necessary buffer to maintain the existence of the species in a given area assisted us in refining what we believe to be an adequate buffer. In cases where development around the cave has been completed, a 30 meter (100 ft) buffer around caves was included. A smaller buffer zone was used for these areas which include habitat most likely occupied and allow for local intracave dispersal. Because all development and ground disturbance has already occurred in these areas, less refugia is needed and therefore a smaller buffer area was needed.

For those areas where surveys showed they were highly likely to contain suitable habitat and the animals were likely to occur, we designated the entire area to be sure we would capture any caves and the surrounding mesocaverns. The addition of these areas is essential to the conservation of the species because they create a widely distributed pattern of protected areas across the best habitat throughout the Koloa basin. This wide distribution protects the species from a single catastrophic event and therefore is essential to the conservation of both species.

Because a recovery plan has not been completed for either of these species, in making this determination, we looked to areas where the Kauai cave wolf spider and the Kauai cave amphipod have been verified and also included those areas that are highly likely to contain these animals. We looked for a distribution across geologically suitable habitat and conferred with the recognized expert on the necessary distribution of caves within the Koloa area to maintain both species (Dr. F. Howarth, pers. comm., 2002). This approach is consistent with the recovery outline for the Kauai cave wolf spider and the Kauai cave amphipod. If, after critical habitat for the Kauai cave wolf spider and the Kauai cave amphipod is designated, a final approved recovery plan for these animals calls for a different approach to the conservation of the Kauai cave wolf spider and the Kauai cave amphipod, we will consider amending the critical habitat designation.

#### Primary Constituent Elements

In accordance with section 3(5)(A)(i) of the Act and regulations at 50 CFR 424.12 in determining which areas to propose as critical habitat, we are

required to consider those physical and biological features essential to the species' conservation that may require special management considerations and protection. Such features are termed primary constituent elements, and include but are not limited to: Space for individual and population growth and for normal behavior; food, water, air, minerals and other nutritional or physiological requirements; cover or shelter; and habitats that are protected from disturbance and represent the historic geographical and ecological distributions of the species.

The habitat requirements of the Kauai cave wolf spider and Kauai cave amphipod may differ slightly, as the wolf spider can feed on other arthropods that become trapped in caves or reside in caves facultatively. However, as observed elsewhere in Hawaii, the presence of a healthy, intact cave ecosystem, which includes roots or other sources of naturally occurring detritus and an associated detritivore or herbivore fauna, contains larger numbers of healthy troglobitic predators (A. Asquith, pers. comm., 2001). While native, troglobitic predators, detritivores, and herbivores may be present in caves lacking naturally occurring plant biomass, this situation represents an unhealthy cave ecosystem. Native troglobitic assemblages occurring in "sterile" caves (those lacking roots or other sources of active nutrient input) probably represent declining populations that will be extirpated as the existing plant biomass is consumed unless efforts are made to enhance conditions.

As with most troglobites, both the Kauai cave wolf spider and Kauai cave amphipod require dark or stagnant air zone habitats in caves. These zones typically have atmospheres with humidity at saturation levels (greater or equal to 100 percent), which is necessary to prevent desiccation and death of the troglobites.

A sustainable food base, such as the roots of living perennial plants or other sources of detritus, is necessary to support a breeding population and for the long-term survival of the Kauai cave amphipod and other herbivorous or detritivorous troglobites. In turn, healthy populations of herbivores or detritivores will help ensure that co-evolved predators, such as the Kauai cave wolf spider, will also persist as viable populations.

There is little information on what, if any, species of food plants are preferred by the Kauai cave amphipod. Since the amphipod is regarded as a detritivore, there may be little or no food specialization by these animals.