ʻAKIKIKI FIVE-YEAR RECOVERY WORK PLAN 2010-2015
Kauai Forest Bird Working Group

PURPOSE. The long-term recovery goals, delisting criteria, recovery strategy, and a comprehensive list of recovery tasks for the ʻAkikiki are provided in the Final Revised Recovery Plan for Hawaiian Forest Birds, which covers 21 species (USFWS 2006). The ʻAkikiki was included as a candidate for listing in this recovery plan, although it has since been listed as endangered, and presumably updates will be forthcoming. The purpose of this work plan is to identify recovery objectives for the ʻAkikiki that can be realized within five years, and to succinctly describe the actions needed to reach these short-term objectives. Identification of recovery objectives and actions will facilitate the efficient use of limited recovery resources and provide milestones that can be used to evaluate progress.

SPECIES SUMMARY. The ʻAkikiki or Kauaʻi Creeper (*Oreomystis bairdi*) is a small (12 - 17 g) insectivorous honeycreeper endemic to the island of Kauaʻi. It is dark gray to olive gray on the head, back, sides and flanks, and off-white on the throat, breast, belly, and undertail coverts (Pratt *et al.* 1987, Foster *et al.* 2000, Pratt 2005). The bill is short, slightly decurved, and pale pink. Males and females are similar. Juveniles resemble adults, but have white spectacles around the eyes. The song is a short, descending trill. Males and females give a soft "whit" contact call (Pratt *et al.* 1987, Foster *et al.* 2000). They are usually found in pairs, family groups, or small flocks (8 – 12 individuals); during the non-breeding season ʻAkikiki join mixed species foraging flocks.

ʻAkikiki are found in mesic and wet native montane forests dominated by ʻōhiʻa (*Metrosideros polymorpha*), koa (*Acacia koa*), ʻōlapa (*Cheirodendron trigynum*), lapalapa (*C. platyphyllum*), ʻōhia hʻa (*Syzygium sandwicensis*), kāwaʻu (*Ilex anomala*), and kōlea (*Myrsine lessertiana*), with a diverse understory of native plants including ʻōhelo (*Vaccinium calycinum*), and kanawao (*Broussaisia arguta*). ʻAkikiki forage on trunks, branches, and twigs of live and dead trees, primarily ʻōhiʻa and koa and occasionally in subcanopy shrubs (Foster *et al.* 2000). They feed on insects, insect larvae, and other arthropods taken from bark, crevices, dead wood, and epiphytes by gleaning, probing, and rarely by excavation (Foster *et al.* 2000, VanderWerf and Roberts 2008).

The nesting season of the ʻAkikiki extends primarily from March - June (Foster *et al.* 2000), but recent information indicates nesting may occur from January to July in at least some years (VanderWerf and Roberts 2008). Few ʻAkikiki nests have been found, but all have been located in the crowns of ʻōhiʻa trees 4 - 12.5 m above ground and were composed of moss, small pieces of bark, bits of lichen, and fine plant fibers (Eddinger 1972, Foster *et al.* 2000, VanderWerf and Roberts 2008). Both sexes help build the nest and feed the nestlings, but incubation has only been observed by the female; males feed females during nest construction, incubation, and brooding (Eddinger 1972, Foster *et al.* 2000, VanderWerf and Roberts 2008). There is no information about nest success, reproductive rates, survival of adults or juveniles, or movements (Foster *et al.* 2000, USFWS 2006). A long period of parental dependency makes double brooding unlikely. The ʻAkikiki is one of the least known extant Hawaiian passerines.

POPULATION STATUS. The ʻAkikiki was considered common at all elevations in native forests in the late 1800s (Perkins 1903), and was locally abundant on and near the Alakaʻi Plateau in the early 1960s (Richardson and Bowles 1964). In 1968 - 1973, the ʻAkikiki was estimated to number 6,832 ± 966 birds, and the range was thought to encompass 88 km^2 ranging in elevation from 600 to 1,600 m (USFWS 1983). In 1981, the number of ʻAkikiki estimated to occur in a 25 km^2 area of the southeastern Alakaʻi was 1,650 ± 450 (Scott *et al.* 1986). In 1968 - 1973, the estimated ʻAkikiki population in this same area was 2,300 ± 700 birds (USFWS 1983). Surveys in March - April 2000 indicated that the ʻAkikiki population had decreased to 1,472 ± 680 birds and that the species had disappeared from much of the periphery of its range (Foster *et al.* 2004).

Recent population estimates of the ʻAkikiki have been variable. Estimates from 2005 and 2007 surveys were 1,364 ± 401 and 1,312 ± 530, respectively (Hawaii Division of Forestry and Wildlife and USGS, unpubl. data). Based on surveys conducted in April and May 2008 the population was estimated at 3,924 ± 756 (Hawaii Division of Forestry and Wildlife and USGS, unpubl. data). This number should be viewed with caution as it has been difficult to accurately estimate the abundance of this species. The number of detections during surveys has always been limited which results in large confidence intervals around estimates. Density estimates for ʻAkikiki have fluctuated more than any other Kauaʻi bird, and it is difficult to ascertain whether these fluctuations are real or the result of sampling error. The geographic range occupied by the ʻAkikiki has declined from 88 km^2 in 1970 to 40 km^2 in 2008 (Fig 1).

MANAGEMENT / PROTECTION TO DATE. After a long period as a candidate species under the Endangered Species Act, the ʻAkikiki was listed as endangered in March 2010. The species has not been the focus of any long-term study or management actions; most life history data is based on anecdotal observations. The first focused studies of this species will begin in 2011. Weed control is being conducted by The Nature Conservancy and Kōkeʻe Resource Conservation Program. The Kauaʻi Watershed Alliance is currently (2010) constructing a fence to protect the southeastern Alakaʻi Wilderness Preserve from ungulates and fencing in the Hono O Nā Pali Natural Area Reserve (NAR) is currently being planned. Extensive pre and post fence construction forest bird surveys and vegetation data collection will document the benefits of the southeastern Alakaʻi fence. Captive propagation of the ʻAkikiki has not been attempted, although the Hawaii Creeper has been successfully bred in captivity by the Zoological Society of San Diego (ZSSD).

PRIMARY THREATS. Non-native disease appears to limit the distribution of many native Hawaiian forest birds, including the ʻAkikiki (van Riper *et al.* 1986, Atkinson *et al.* 1995, Atkinson and LaPointe 2009), and global climate change may exacerbate this threat by increasing the elevation at which regular transmission of avian malaria and avian pox virus occurs (Reiter 1998, Benning *et al.* 2002, Harvell *et al.* 2002, Hay *et al.* 2002). Currently, there are no forested areas on Kauaʻi where the mean ambient temperature prevents the seasonal incursion of malaria, meaning mosquitoes and malaria can survive across all parts of the island, at least periodically (Benning *et al.* 2002). Benning *et al.* (2002) used GIS simulation to show that an increase in temperature of 2°C, which is a conservative figure based on recent data (IPCC 2007), would result in an 85% decrease in the area on Kauaʻi where malaria transmission currently is only periodic. Without translocation to higher islands or the development of disease resistance, the loss of such a large proportion of suitable habitat would likely result in extinction of the ʻAkikiki (Pounds *et al.* 1999, Still *et al.* 1999). Temperature data on Kauaʻi have not been examined, but disease prevalence on Kauaʻi has increased over the last 10 years. Although based on a small sample, the prevalence of malaria in ʻAkikiki increased from zero between 1994-1997 to 40% between 2007-2009 (Atkinson and Utzurrum 2010). In addition, most of the species' decline has occurred at lower elevations on the edge of its range (Foster *et al.* 2004), suggesting that disease has contributed to these losses (however, see below).

The habitat of the ʻAkikiki has been, and continues to be, negatively affected by invasive alien plants that displace native plants used for foraging and nesting, and by feral ungulates, particularly feral pigs (*Sus scrofa*) and goats (*Capra hircus*) (Lepson and Pratt 1997, Foster *et al.* 2004). ʻAkikiki depend on areas of intact native forest for foraging and nesting. Feral ungulates negatively affect native forest by browsing, causing soil erosion, disrupting regeneration, spreading of invasive alien plant seeds, facilitating the invasion of alien plants, and creating breeding habitat for mosquitoes (Scott *et al.* 2001, USFWS 2006), and degradation of forest habitat has likely played a role in the range contraction of the ʻAkikiki. Most declines have occurred at the edge of the species' range (Foster *et al.* 2004), where disturbance and the effects of ungulates and invasive alien plants are most severe. Habitat degradation by non-native plants and feral ungulates is likely to continue damaging forest structure and integrity.

Introduced predators are one of the most serious threats to Hawaiian forest birds, particularly during nesting (Atkinson 1977, Scott *et al.* 1986, VanderWerf and Smith 2002). The nesting biology of the ʻAkikiki has been little studied, but black rats (*Rattus rattus*), Polynesian rats (*R. exulans*), Norway rats (*R. norvegicus*), and feral cats (*Felis catus*) are present on the Alakaʻi Plateau and are potential predators on roosting or incubating adults, nests, and young. Predation, probably by black rats, was the greatest cause of nest failure in the Puaiohi or Small Kauaʻi Thrush (*Myadestes palmeri*), occurring at 38% of nests (Tweed *et al.* 2006). Two species of owls, the native Pueo (*Asio flammeus sandwichensis*) and the introduced Barn Owl (*Tyto alba*) also occur on Kauaʻi and are known to prey on forest birds (Snetsinger *et al.* 1994). Feral cats also are present on the Alakaʻi Plateau.

Major hurricanes struck Kauaʻi in 1983 and 1992 and significantly affected native habitats by destroying native habitat, creating gaps into which alien plants could expand, and spreading invasive plants. Large numbers of dead trees killed by hurricane Iniki in 1992 are still visible in several areas where ʻAkikiki have declined in abundance or disappeared. Habitat damage by the hurricane was more severe at higher elevations on the western slope of Waiʻaleʻale (E. VanderWerf pers. obs.), and ʻAkikiki have not been found in this area recently.

A number of other factors are likely contributing to the decline of this species. The effects of non-native arthropod predators and competitors are completely unknown. Threats or stressors may interact with each other and increase their negative impact on ʻAkikiki. For example, birds experiencing malarial symptoms may be more susceptible to predation. Finally, single island endemics like the ʻAkikiki are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a single population by random demographic fluctuations and localized catastrophes such as hurricanes, fires, and disease outbreaks (Wiley and Wunderle 1994), and potentially genetic issues (Keller and Waller 2002, although see Brodie 2007). As populations and ranges of island birds decline due to other threats, the extinction risk from catastrophic events also increases.

RECOVERY STRATEGY. Given the lack of data on this species, initiating studies to collect basic life history is critical. In addition to this, several tools can potentially be used to manage ʻAkikiki populations, including captive propagation and release, which may include the breeding of disease resistant individuals; controlling predators, which may facilitate the evolution of disease resistance (Kilpatrick 2006); controlling alien plants; fencing and ungulate eradication; and translocating the species to other islands. All may be important components of a long-term recovery strategy for ʻAkikiki, but knowing which tool is most effective will allow more efficient short-term use of limited conservation resources. Collecting life history and assessing threats will contribute to making these determinations.

Interim Recovery Objectives 2010-2015. In order to meet the long-term recovery goals for the ʻAkikiki, the following interim goals were developed:

- Collect demographic data necessary to conduct PVAs.
- Conduct a threat assessment to determine what factors most strongly influence abundance and distribution.
- Continue monitoring population status and trends.
    - Develop new monitoring methods as needed.
- Determine habitat preferences.
- Investigate management tools for stabilizing / increasing the ʻAkikiki population (e.g., predator control, habitat restoration).
- Develop a captive breeding work-plan that outlines different methods (i.e., rear-and-release) and how these methods would dovetail with other recovery actions.
- Investigate feasibility of translocating birds to protected areas on higher Hawaiian Islands (e.g., Maui, Hawai'i Island).

If these objectives are accomplished in the next five years, then interim recovery objectives will be identified to continue to guide progress toward recovery. If these objectives are not accomplished in five years, the reasons for delays will be identified and rectified. If the current strategy is deemed ineffective, then a new strategy will be developed.

Five-year Recovery Actions (2010-2015). In order to realize the recovery objectives described above, the following actions are necessary:

- Complete surveys in areas not surveyed or under-surveyed areas (DOFAW, KFBRP).
    - Hono O Na Pali NAR
    - Northeastern Alaka'i
- Develop captive propagation and translocation thresholds, time tables, budgets, and plans. Plans should identify thresholds for initiating different phases of a captive breeding program (e.g., developing protocols, developing a captive flock) (ZSSD).
- Determine food availability and preferences (KFBRP, CSU).
- Determine productivity and nest site selection by following nests (KFBRP, CSU).
    - Experiment with protecting nests using flashing or collars.
- Determine survival and dispersal of adults and juveniles, by mist-netting, banding, and resighting (KFBRP, CSU).
    - Collect and screen blood samples for disease.
    - Monitor survival and reproduction of individuals with and without malaria.
- Use habitat imagery and biological data to model 'Akikiki habitat (KFBRP).
- Assess any response in density attributable to habitat recovery related to the East Alaka'i fence (KFBRP).
- Model 'Akikiki population trends using density, occupancy, or demography (as funding allows) under various management scenarios (KFBRP, CSU).
- Develop a translocation document (KFBRP, ZSSD).

REFERENCES

Atkinson, C.T. and R.B. Utzurrum. 2010. Changes in prevalence of avian malaria on the Alakai'i Plateau, Kaua'i. Hawai'i, 1997-2007, Hawai'i Cooperative Studies Unit Technical ReportHCSU-017. University of Hawai'i, Hilo.

Atkinson, C. T., and D. A. Lapointe. 2009. Ecology and pathogenicity of avian malaria pox. In Conservation biology of Hawaiian forest birds: implications for island avifauna (T. K. Pratt, C. T. Atkinson, P. C. Banko, J. D. Jacobi, and B. L. Woodworth, eds.). Yale University Press, London.

Atkinson, C. T., K. L. Woods, R. J. Dusek, L. Sileo, and W. M. Iko. 1995. Wildlife disease and conservation in Hawaii: Pathogenicity of avian malaria (*Plasmodium relictum*) in experimentally infected Iiwi (*Vestiaria coccinea*). *Parasitology* 111:S59-S69.

Atkinson, I. A. E. 1977. A reassessment of factors, particularly *Rattus rattus* L., that influenced the decline of endemic forest birds in the Hawaiian Islands. Pacific Science 31:109-133.

Benning, T. L., D. LaPointe, C. T. Atkinson, and P. M. Vitousek. 2002. Interactions of climate change with biological invasions and land use in the Hawaiian Islands: modeling the fate of endemic birds using a geographic information system. Proceedings of the National Academy of Science 99:14246-14249.

Brodie, E. D. 2007. Population size is not genetic quality. Animal Conservation 10:288-290.

Eddinger, C. R. 1972. Discovery of the nest of the Kauai Creeper. Auk 89:673-674.

Foster, J. T., J. M. Scott, and P. W. Sykes, Jr. 2000. Akikiki (*Oreomystis bairdi*). The Birds of North America (A. Poole and F. Gill, eds.). Number 552. The Birds of North America Inc., Philadelphia, Pennsylvania.

Foster, J. T., E. J. Tweed, R. J. Camp, B. L. Woodworth, C. D. Adler, and T. Telfer. 2004. Long-term population changes of native and introduced birds in the Alakai Swamp, Kauai. Conservation Biology 18:716-725.

Harvell, C. D., C. E. Mitchell, J. R. Ward, S. Altizer, A. P. Dobson, R. S. Ostfield, and M. D. Samuel. 2002. Climate warming and disease risks for terrestrial and marine biota. Science 296: 2158–2162.

Hay, S. I., J. Cox, D. J. Rogers, S. E. Randolph, D. I. Stern, G. D. Shanks, M. F. Myers, and R. W. Snow. 2002. Climate change and the resurgence of malaria in the East African highlands. Nature 415:905–909.

Intergovernmental Panel on Climate Change. 2007. Climate Change 2007: The Physical Science Basis. Cambridge University Press, Cambridge.

Keller, L. F., and D. M. Waller. 2002. Inbreeding effects in wild populations. Trends in Ecology and Evolution 17:708-716.

Kilpatrick, A. M. 2006. Facilitating the evolution of resistance to avian malaria in Hawaiian birds. Biological Conservation 128:475-485.

Perkins, R.C.L. 1903. Vertebrata. Pp. 365-466 *In* Fauna Hawaiiensis. Vol. 1, part IV. (D. Sharp ed.). The University Press, Cambridge.

Pounds, A. J., M. P. Fogden, and J. H. Campbell. 1999. Biological response to climate change on a tropical mountain. Nature 398:611-614.

Pratt, H. D. 2005. The Hawaiian Honeycreepers. Oxford University Press, Oxford.

Reiter, P. 1998. Global warming and vector-borne disease in temperate regions and at high altitudes. Lancet 352:839–840.

Richardson, F. and J. Bowles. 1964. A survey of the birds of Kauai, Hawaii. B. P. Bishop Museum Bulletin 227.

Scott, J. M., S. Conant, and C. van Riper III. 2001. Evolution, ecology, conservation, and management of Hawaiian birds: a vanishing avifauna. Studies in Avian Biology 22:1-428.

Scott, J. M., S. Mountainspring, F. L. Ramsey, and C. B. Kepler. 1986. Forest bird communities of the Hawaiian Islands: their dynamics, ecology, and conservation. Studies in Avian Biology 9:1-431.

Snetsinger, T. J., S. G. Fancy, J. C. Simon, and J. D. Jacobi. 1994. Diets of owls and feral cats in Hawaii. Elepaio 54:47-50.

Still, C. J., P. N. Foster, and S. Schneider. 1999. Simulating the effects of climate change on tropical montane cloud forests. Nature 398:608-610.

Tweed, E. J., J. T. Foster, B. L. Woodworth, W. B. Monahan, J. L. Kellerman, and A. Lieberman. 2006. Breeding biology and success of a reintroduced population of the critically endangered Puaiohi. Auk 123:753-763.

U.S. Fish and Wildlife Service. 1983. Kaua'i forest birds recovery plan. U.S. Fish and Wildlife Service, Portland.

U.S. Fish and Wildlife Service. 2006. Revised recovery plan for Hawaiian forest birds. U.S. Fish and Wildlife Service, Portland.

van Riper, C., III, S. G. van Riper, M. L. Goff, and M. Laird. 1986. The epizootiology and ecological significance of malaria in Hawaiian land birds. Ecological Monographs 56:327-344.

VanderWerf, E. A. 1998. Breeding biology and territoriality of the Hawaii Creeper. Condor 100:541-545.

VanderWerf, E. A., and P. K. Roberts. 2008. Foraging and nesting of the Akikiki or Kauai Creeper (O*reomystis bairdi*). Wilson Journal of Ornithology: 120:195-199.

VanderWerf, E. A., and D. G. Smith. 2002. Effects of alien rodent control on demography of the Oahu Elepaio, an endangered Hawaiian forest bird. Pacific Conservation Biology 8**:**73-81.

Wiley, J. W., and J. M. Wunderle. 1994. The effects of hurricanes on birds, with special reference to Caribbean islands. Bird Conservation International 3: 319-349.

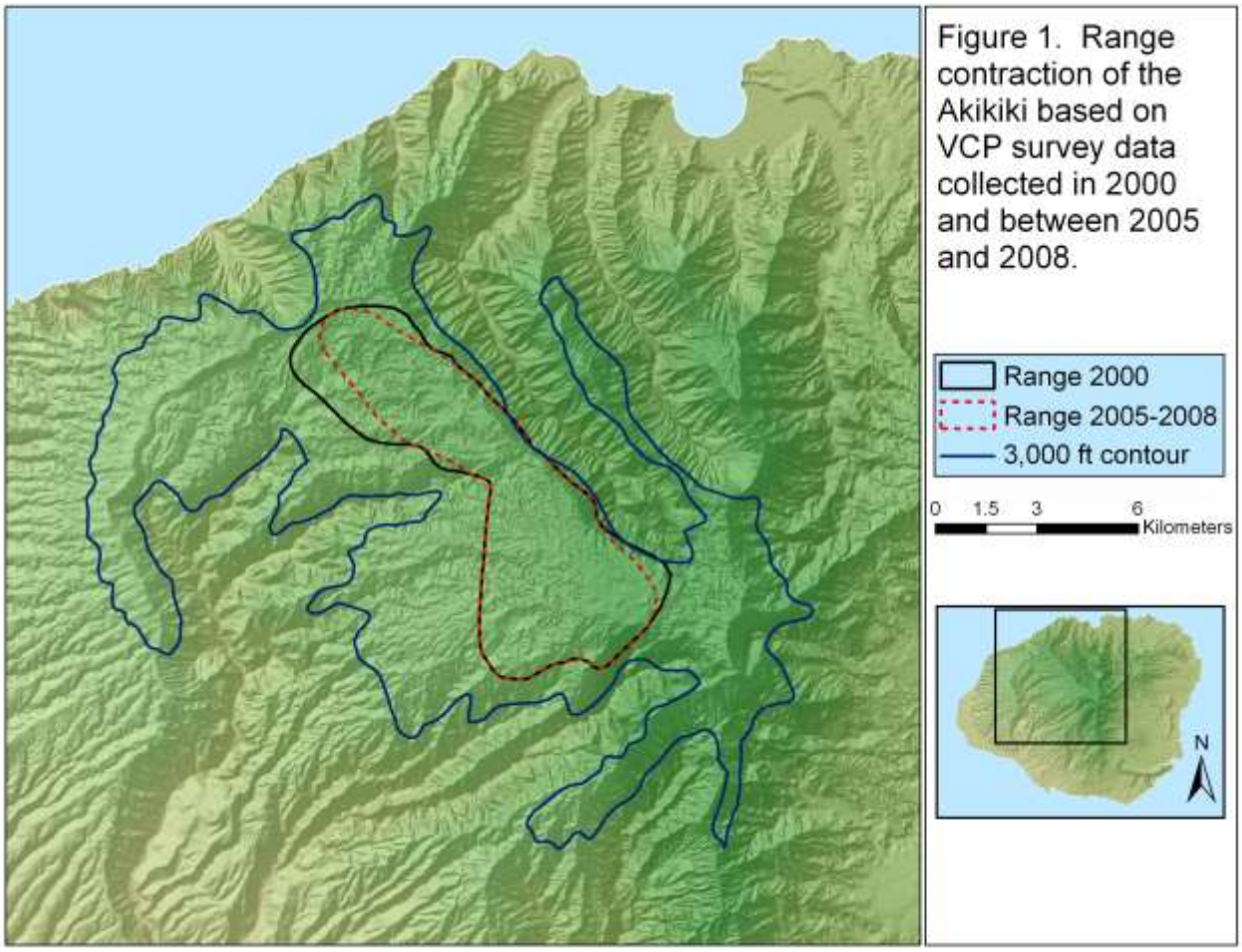

Figure 1. Range contraction of the Akikiki based on VCP survey data collected in 2000 and between 2005 and 2008.