

State of Hawai`i  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
Division of Forestry and Wildlife  
Honolulu, Hawai`i 96813

November 18, 2011

Chairperson and Members  
Natural Area Reserves System Commission  
State of Hawai`i  
Honolulu, Hawai`i

NARS Commission Members:

**SUBJECT: REQUESTING APPROVAL TO PLACE TWO SMALL PREDATOR FENCES WITHIN A PORTION OF KAHAKULOA SECTION, WEST MAUI NATURAL AREA RESERVE, MAUI ISLAND.**

BACKGROUND:

First Wind was granted permission to, and constructed a wind farm on West Maui. As part of their on-going operations, they have agreed to conduct studies to mitigate any effects the presence of windmills may place on sea birds, in particular. They now wish to expand their operations, and have been conducting field surveys to locate other possible nesting colonies specifically of endangered Newell's shearwaters (`a`o) and Hawaiian petrels (`ua`u).

STAFF ANALYSIS:

Surveys have become focused on the Makamaka`ole Stream drainage with its steep, fern-shrouded cliffs. The area overhead is a fly way for these birds. The area is difficult for human access; when ground surveys were conducted, only old burrows and a few feathers were encountered; however when traps were set, it became obvious that mongoose in particular were killing any birds that tried to land and nest. Since the development of the predator fence at Ka`ena Point Natural Area Reserve, there have been similar fences developed for more forested areas that do not have as large a construction footprint. First wind biologists as well as others believe that building two small predator-proof fences in the area will provide a safe place for these endangered sea birds to nest. Access to the lower area is via road, so transport of materials and crew can be more readily staged than with helicopters. There is a gated community below the Forest Reserve and Natural Area Reserve; community members appear to be very supportive of this proposed project.

RECOMMENDATION:

That the NARS Commission recommends approval to install two small predator fences within

Kahakuloa Section, West Maui Natural Area Reserve, Maui; and further recommends that this be approved by the Board of Land and Natural Resources or its authorized representative; subject to also obtaining any necessary permits from the Land Division, Office of Coastal and Conservation Lands, or others as deemed necessary.

Respectfully submitted,



Betsy Harrison Gagné, NARSC Executive Secretary  
Natural Area Reserves System Commission

Attachment: NARS Special Use Permit Application  
Summary Report of Newell's Shearwater Survey and Botanical Survey,  
Kahakuloa Section, West Maui Natural Area Reserve, Maui.

Department of Land and Natural Resources  
Division of Forestry and Wildlife

1151 Punchbowl St., Room 325

Honolulu, HI 96813

(808) 587-0063, (808) 587-0064 (Fax)

Application for NARS Special Use Permit



Application Date: November 8, 2011

The following activities are prohibited in a Natural Area Reserve (NAR), unless allowed by Special Use Permit granted under HAR § 13-209-5. Please check **ALL** that apply to your proposed activity:

- remove, injure, or kill **any form** of plant or animal life, except game mammals and birds hunted according to department rules\*
- introduce **any form** of plant or animal life\*
- remove, damage, or disturb any geological or paleontological features or substances\*
- remove, damage or disturb any historic or prehistoric remains\*
- engage in **any** construction or improvement\*
- engage in any camping activity; **this is a possibility and would require NARS coordination**
- establish a temporary or permanent residence
- start or maintain a fire
- litter, or to deposit refuse or any other substance
- operate any motorized or non-motorized land vehicle or air conveyance in any area (including roads and trails) not designated for its use
- operate any motorized water vehicle of any shape or form in freshwater environments or marine waters, except as otherwise provided by the Department's boating rules
- enter into, place any vessel or material on, or otherwise disturb a lake or pond
- engage in commercial activities
- have or possess the following tools, equipments or implements: fishing gear or devices (in Ahihi-Kinau NAR), cutting or harvesting gear (in any NAR), and hunting gear or tools (except as permitted by the hunting rules of the department)
- hike, conduct nature study or conduct any activity **with a group larger than 10**
- presence in an area closed pursuant to HAR § 13-209-4.5 or after visiting hours established by § 13-209-4.6
- anchor any motorized or non-motorized water vehicle in the marine waters of Ahihi-Kinau NAR.

**\*May require additional State or Federal permits. Applicants are responsible for identifying and securing all approvals that may be required.**

**\*\* The NARS rules and recent rule amendments can be viewed on-line at <http://www.state.hi.us/dlnr/dofaw/rules/Chap209.pdf> and <http://www.state.hi.us/dlnr/dofaw/Final%20approved%20NARS%20amendments.pdf>**

## **Applicant Contact Information**

Name: **Gregory C. Spencer, Senior Wildlife Biologist**  
**First Wind, Environmental Affairs**  
**Kaheawa Wind Power, LLC**

### **Title of Proposed Activity:**

**Kahakuloa-Makamaka'ole Hawaiian petrel and Newell's shearwater predator free breeding enclosures – West Maui Natural Area Reserve.**

Primary contact person for this permit application: **Gregory Spencer**

Mailing Address: **56 Honuhula Street, Kihei, Hawaii 96753**

Phone: **(808) 298-5097**

Fax:

Email: **gspencer@firstwind.com**

## **Supporting Information**

Please provide the following information about your proposed activity that requires a special-use permit (“proposed special-use”). Failure to provide responses to the following questions may result in your application being returned for incompleteness.

- What is the period of time for which the permit is requested (e.g., the date of a proposed single event or an ongoing research project from when to when)?

**January 1, 2012 – December 31, 2017**

*\* Please note: research permits are limited to one year in length, except where waived for permits to other governmental agencies where the board determines the waiver to be in the best interest of the State. Proposals for multi-year projects are advised of the need to apply for a new permit EACH year.*

- List the individual Natural Area Reserve(s) involved:

### **Kahakuloa Section, West Maui Natural Area Reserve**

- Attach a map that illustrates where in the Natural Area Reserve(s) you propose to conduct your special-use: **Please see attached map and figures**

There is one (1) specific site we are proposing for Special Use:

The site occurs in the vicinity of Makamaka'ole Stream and borders the northeastern edge of the West Maui Natural Area Reserve, Kahakuloa Section. Along this boundary the two separate units also extends into the West Maui Forest Reserve and a small portion of an adjacent leased section (Nobriga Ranch).

- Provide a description of the proposed special use.

Kaheawa Wind Power, LLC (KWP) operates a 30MW wind energy facility on Maui. The site is located on a 200 acre parcel of State of Hawaii Conservation District land on leeward West Maui along an elevation gradient between 1500 – 3300 ft. In accordance with the project's Habitat Conservation Plan (HCP), KWP is seeking opportunities on Maui to provide mitigation that result in a cumulative net ecological benefit for Newell's shearwaters and Hawaiian petrels. The conservation initiatives we are developing to facilitate mitigation for seabirds are long-term in nature due to several factors including the longevity of these species and the time it takes for birds to reach maturity and begin successfully breeding. The description below offers what experts in the recovery and conservation of Hawaiian petrels and Newell's shearwaters agree is necessary to enhance the breeding success and survival of these species in the West Maui ecosystem.

Most evident on the island of Kauai, breeding populations of Newell's Shearwater have sharply declined in recent years and the results of population modeling suggest this decline may continue if management options are not identified and implemented that can be used to stabilize populations and aid in recovery. Hawaiian petrels are known to breed on Maui, Lanai, Kauai, and Hawaii. In May, 2007 during nocturnal field surveys to learn where petrels and shearwaters were breeding in West Maui, KWP biologists documented an area occupied by Hawaiian petrels at Makamaka'ole Stream adjacent to the Kahakuloa Natural Area Reserve (NAR). Petrels were observed calling overhead and displaying flight patterns consistent with a nearby breeding colony, and since that discovery we have directed considerable attention to developing this site as a management area. We have frequently heard Newell's Shearwaters vocalizing in transit through Makamaka'ole Valley, presumably enroute to nesting and/or staging sites further inland, possibly in the upper reaches of Kahakuloa NAR.

Within the context of this proposed special use, we are proposing to attract prospecting and first-time breeding petrels and shearwaters to artificial nest sites in an effort to promote survival and breeding success. The most fundamental element of the project consists of constructing and maintaining 2 separate 4-5 acre predator-free fenced enclosures. Predators will be eradicated and maintained following completion of the fence construction and each respective enclosure will contain an estimated 50-100 artificial petrel and shearwater nesting burrows, accompanied by enclosure-specific petrel and shearwater social attraction media. The fenced areas have been selected based on the presence and proximity of petrels and shearwaters at this site during the breeding season, feasibility of construction, and availability of good quality attraction habitat. A botanical assessment completed in both the proposed fence enclosure areas on September 24, 2011 (Starr Environmental) includes a list of the plant species identified and did not include any threatened or endangered species, candidate species, or species of particular conservation concern. As described above, the project is expected to be long-term and, if successful, may span several years or even decades. Should the project be terminated or otherwise determined no longer practical or warranted, the fence and artificial nesting burrow materials would be removed and the disturbed areas would be rejuvenated and/or restored in accordance with recommendations and guidance provided by the NARS.

## **Fence Construction**

Construction of the fenced enclosures is intended to be low-impact and will proceed according to guidelines and protocols established in collaboration with the NARS and Division of Forestry and Wildlife (DOFAW). Because there is expected to be a significant amount of building materials transported to the site during this phase of the project, we are asking that helicopter support be approved for this purpose. Careful evaluation of off-load and possible landing sites will be done in coordination with Maui NARS and other experts to ensure efficiency and low impact to surrounding habitat. The fence building team will consist of a project leader, foreman, and a team of 4-5 local sub-contractors with extensive experience building conservation fences in Hawaii. Pre-installation survey work will enable the fenceline to be marked and a roughly 3-4 meter-wide area will need to be cleared of vegetation in alignment with the fenceline to enable construction and appropriate skirting. The clearing will be done manually and with small power equipment where feasible. Installation of the 2 fenced enclosures is expected to take 6-8 weeks. Native vegetation will be used to fill in the cleared areas to the extent canopy growth does not enable predator access. All materials and supplies will be inspected and treated as necessary prior to transport and delivery to the project site to prevent introduction of unwanted alien weeds or pest species.

## **Predator Eradication and Control**

We are proposing to establish a grid of modified conibear-style traps that target both mongoose and cats within the enclosures once construction is complete. These traps will be baited and deployed in a manner that would discourage non-target species (e.g. seabirds) and will be checked frequently to evaluate capture success and rates. We also propose to eliminate rats inside the enclosures using a combination of traps and toxin stations containing Diphacinone. Gnaw sticks and tracking tunnels, as well as catch rate will determine when the enclosures are pest free. The objective is to remove all mongoose, feral cats, and most rats from the enclosures by April, 2012, prior to activating the social attraction component of the project. Barn owls are considered a significant predator and left unmanaged might impart undesirable impact upon prospecting birds attracted to the site. Therefore, we will implement a Barn owl control initiative that will include lethal measures but will rely on trapping and humane removal.

## **Social Attraction and Artificial Burrows**

The social attraction and placement of artificial burrows are closely related elements of the project. The playback system will broadcast recorded calling and vocalizations of each species from a custom MP3 or equivalent digital player via a sound system and 2-4 external weather-resistant speakers per enclosure. The system will be run on a solar-powered 12-volt battery power source. Burrows will be excavated and installed to approximate the average burrow configuration known for each species (roughly 15 cm diameter entrance, 2 meter passage, and nest box partially installed into the substrate) and will be placed in a proportionally higher density adjacent to the speaker systems due to the likelihood birds will be attracted to the source of social stimuli. Each burrow will be equipped with a removable cover that will enable inspection of the nest chamber (box) by observers without reaching into the burrow passage. Custom-fabricated petrel and shearwater decoys may be used to simulate adult birds resting or staging near burrow entrances. The primary portions of each enclosure that are being considered for social attraction are dominated by pasture grasses fringed by native shrub species. Therefore,

to enhance the visibility of burrow sites and decoys we propose to maintain these pasture grass-dominated areas in a “semi-groomed” condition (by hand and using weed-trimmers) to maximize access for prospecting birds. There will be no use of weed-trimmers or other power tools during the breeding season when birds could be occupying nest sites during the day. The sound system will be broadcast daily from dusk until dawn from mid-April through December when birds are present and accessible to the social attraction area.

## **Monitoring**

Monitoring activities will be necessary to document project success. In addition, there will be the need to monitor the fence and repair worn materials or segments of the enclosures. Few large trees are present in the area which should reduce damage due to fallen material. A trapping buffer to suppress predator densities outside the enclosure will be monitored to detect changes or increases that might be a concern should breaches in the enclosures be observed. Barn owl trapping and surveillance activities will also consume the attention of monitors and may be modified if results indicate densities have been temporarily depressed in the vicinity of the project area. The social attraction system will be inspected and maintained as necessary throughout the breeding season. Nesting burrows will be monitored frequently to evaluate visitation by seabirds and once occupancy is established and birds are visiting the site regularly, monitoring will entail documenting critical life history processes and events (e.g. occupancy, breeding attempts, egg laying, hatching, fledging success, and survival). During the breeding season (March-December) 2-3 biologists/technicians are expected to visit the site daily to perform regular biological and operational monitoring activities associated with the project.

In consultation with the Hawaii Division of Forestry and Wildlife (DOFAW), US Fish and Wildlife Service (USFWS), and the Endangered Species Recovery Committee (ESRC), First Wind has agreed to continue investigating other sites in West Maui, including Upper Kahakuloa (as described under an existing SUP), to determine whether accessible Newell’s Shearwater breeding colonies may be present, and whether future management actions to protect any of these colonies are feasible and warranted. However, we anticipate submitting a separate Special Use Permit Application or, request an extension for that work.

*The description should be detailed enough so that those reviewing your application understand what you propose to do and the scope of your proposal. Please include a description of the planned method of transportation to and within the Natural Area Reserve. For research proposals, please explain your objectives, your methods, and why the proposed special-use is necessary to your research. If part of your graduate studies, please include the name and affiliation of your major professor. Also, if you are seeking permission to remove or introduce any form of plant or animal life, please list all species involved and note which are threatened, endangered, or candidate species. In addition, for the collection of any specimens, please note type of specimen (species and parts collected, if less than entire species), quantities, storage methods, and ultimate disposition. If other people than you will participate in the proposed special-use, please note how many people, and whether they are volunteers, research assistants, or paying customers. Failure to provide sufficient information may result in your application being returned for additional information or rejected. Please feel free to attach additional sheets as necessary.*

- Please answer the following questions about your proposed special use:
  - **Can your proposed special use be conducted elsewhere? If not, why not?**

We do not believe the special use we are proposing can be performed elsewhere at this time. KWP has dedicated considerable effort at learning more about where birds that visit Makamaka'ole may be nesting and have included systematic audio-visual point counts from standard count stations, multiple radar surveys, and extensive nesting burrow searches. The point counts and radar surveys confirmed significant Hawaiian petrel activity and visitation along with regular passage of Newell's shearwaters over the site. The burrow searches resulted in the identification of one unoccupied burrow with Hawaiian petrel remains discovered nearby and two old, disused burrows. In July 2011 a canine team from Ecoworks Global, based in New Zealand, was brought in with two specially trained detector dogs and handlers to help find Hawaiian petrel burrows at Makamaka'ole. After a very comprehensive search effort the team identified three old, disused burrows (the same burrows discovered in 2010) and additional Hawaiian petrel remains that were estimated to be several months old. We have concluded that Makamaka'ole probably represents an historic nesting site, but that few or no active nest sites presently remain. Several razorback ridge areas contain what resemble typical petrel nesting habitat with optional landing and take-off aspects. Hawaiian petrels continue to congregate in the airspace above Makamaka'ole Valley even though no active burrows were found during the 2011 Ecoworks survey.

We believe the Makamaka'ole area represents an important staging and courtship area where the prevailing wind is forced up a 350 ft (107 m) vertical rock wall, creating strong updrafts ideal for courtship flight. Several other petrel species appear to do a considerable amount of aerial courting (i.e., Grey-faced petrels, New Zealand, Juan Fernandez petrels, Chile) and is comparable to behavior observed at Haleakala and Lana'ihale, adjacent to petrel breeding sites. There are likely to be other declining Hawaiian petrel colonies elsewhere in the Makamaka'ole – Kahakuloa watershed, probably several thousand feet in elevation (as confirmed by audio detections at these elevations) and very difficult to access, manage or protect sufficiently. Evidence suggests some juvenile birds probably land at Makamaka'ole and begin to excavate burrows. However, due to their vulnerability on the ground, these birds are likely killed by mongoose or feral cat in a short time as they search for cavities and/or establish suitable nesting sites. For example, a total of 12 mongoose were trapped in two traps during 14 trap days in July 2011. This is a catch rate substantially higher in comparison to areas in New Zealand known to contain dense habitation by mustelids and other pest vertebrates – at levels known to significantly limit seabird productivity. Coupled with evidence of the only active nest site in the area containing remains of Hawaiian petrel suggest chances of a bird surviving even a short period of time on the ground at Makamaka'ole is extremely low. Based on the densities of mongoose we observed at Makamaka'ole it is unlikely that predator control alone is going to be enough to protect nesting Hawaiian petrels and/or Newell's shearwaters and is probably not adequate in most portions of the species' range.

Using methods to shift the colony from these remote, exceedingly difficult to manage areas to sites where threats to nesting seabirds can be minimized or even eliminated is an important element of this project that is expected to promote the protection and survival capacity of Hawaiian petrels and Newell's shearwaters attracted to the site. Given the presence of Hawaiian

petrels and Newell's shearwaters in the vicinity of the proposed project area, this places the project at a desirable starting point for attracting prospecting birds to potential nesting sites.

The terrain at Makamaka'ole is steep, making options for fenced enclosures to exclude predators and promote nesting success for petrels and shearwaters difficult. After multiple years of review we have selected an area that is set back slightly from the "core activity area" (see Kaheawa Wind Power 2010) where we believe fence construction is feasible and will meet the criteria necessary for project success. The topography here is less severe with broader slope faces and fewer natural drainage issues.

- **Is your proposed special-use consistent with the purpose and objectives of the Natural Area Reserve System (the purpose and objective of the NARS is to protect in perpetuity specific land and water areas which support communities, as relatively unmodified as possible, of the natural flora and fauna of Hawaii)? If so, how?**

Because the NARS considers the long term benefits of preserving and perpetuating the ecological integrity of native resources within the NARS, we believe the actions proposed here will benefit the conservation and recovery of Hawaiian petrels and Newell's shearwaters in West Maui and be complimentary to that mission. The proposed work will strive to maintain and perpetuate the land and water resources that nourish the community by maintaining a minimal impact during fence construction and all aspects of monitoring associated project management.

- **Is your proposed special-use consistent with the management plan developed for the individual Reserve(s) (*Management plans are available for review at [www.dofaw.net/nars](http://www.dofaw.net/nars) or by contacting the NARS office*)?**

We believe this proposed special-use is consistent with the management plan developed for Kahakuloa NAR and indeed the NARS overall. Neither species are presently well-described within the context of the West Maui NAR management plan. This proposed special use may be considered complimentary to the Kahakuloa NAR management plan in the sense that it endeavors to apply the results of scientific research data gathering and conservation principles toward the implementation of a management plan intended to promote survival and reproductive success of both seabird species in an otherwise unmanaged portion of the NAR. Furthermore, if successful, the site may contribute to the overall health of the ecosystem including adjacent watersheds.

- **Does your proposed special-use provide a benefit (direct or indirect) to the Natural Area Reserves System or to the individual Reserve(s) or both? (*For research, please note whether any studies have previously been made similar to the one proposed and how you will convey your research findings to the Department*).**

Based on the NARS management plan (1988), discussions with Maui NARS personnel, the recovery goals for Hawaiian petrel and Newell's shearwater as stated in the Recovery Plans (1983), Interim Action Plans for both species (USFWS 1993, Newell's Shearwater Working Group, 2006), and the Hawaii Comprehensive Wildlife Conservation Plan (Mitchell et. al. 2005) we believe the proposed special use will provide a tangible conservation benefit to the NARS and particularly the West Maui NAR, Kahakuloa Section. This proposed special-use is intended to promote important conservation advancements for both species and aid their recovery potential in the West Maui ecosystem. If successful, this project will highlight the valuable cooperation between First Wind, the NARS, DOFAW, and USFWS and has the potential to also promote public outreach and education.

- **Will the proposed special-use damage or threaten to damage the integrity or condition of the natural, geological, or cultural resources in the individual Natural Area Reserve(s) and adjacent area or region? If so, how? If not, why not?**

First Wind biologists will take all practical measures and follow all prescribed protocols and procedures requested by Maui NARS staff to minimize the risk of any significant damage to the integrity or condition of the natural, geological, or cultural resources within or adjacent to the proposed special use area in Kahakuloa NAR and the surrounding region. We recognize and acknowledge there will be some impact imparted on landscape during the construction of the fenced enclosures and installation of artificial burrows. The area disturbed during the fence construction should gradually recover while monitors will take actions to control the ingress of unwanted weeds. We look to the guidance of Maui NARS experts and others consulted for their knowledge concerning sensitive native resources and ways to minimize impacts in the proposed special use area. First Wind biologists are already coordinating with Maui NARS and DOFAW on the scope of the project and expect significant input and guidance in the final micro-siting and survey work that will precede fence construction.

- **Does the proposed special-use comply with the provisions and guidelines contained in HRS Chapter 205A, entitled 'Coastal Zone Management,' where applicable?**

This proposed special use would be in compliance with these provisions and guidelines. The proposed special use does entail some physical alteration of the natural environment, however these alterations will be carried out in a manner that avoids and minimizes unnecessary impacts that might be construed as being in conflict with any of the provisions and guidelines, as described for coastal zones and in general in HRS Chapter 205A.

- **Have you (the applicant) previously received a NARS Special Use Permit? If so, did you comply with the conditions of any previously approved permit (including providing a final report as requested?)**

Yes. We received a Special Use Permit on July 30, 2007 and again on July 25, 2011 for the West Maui Natural Area Reserve, Kahakuloa Section. A short report describing our 2011 activities and findings is being submitted in November, 2011.

- **Do you (the applicant) have any other current NARS special-use permits? If so, please list and state whether you are currently in compliance with the conditions of those permits.**

The applicant is presently in possession of a Special Use Permit, effective July 25 – December 31, 2011 (West Maui NAR, Kahakuloa Section).

- **Is the proposed special-use expected to have an environmental impact on the Natural Area Reserve(s) or the surrounding area? If, so please elaborate. If not, why not? Please include discussion of any off-trail work, such as mist-netting, setting of traps, removal of vegetation, etc. and any measures planned to mitigate any short and long-term damage.**

The construction of the fenced enclosures is expected to have a short-term impact on the environment. However, appropriate measures to ensure ground disturbance remains within necessary limits will be implemented during the installation process. These will help reduce secondary disturbance and impact adjacent to the fenced area. The installation of artificial burrows will require manual excavation, placement of structures, and rejuvenation of the immediate surface substrate. Although some excavation of surface substrate will be required to accommodate the artificial burrows, these structures are not expected to result in an unacceptable level of impact to the environment. The setting and maintenance of traps used in the predator eradication process are not expected to represent an adverse impact.

- **Citations**

Kaheawa Wind Power, 2010. Assessing the feasibility of implementing seabird mitigation at Makamaka'ole, West Maui. Prepared for Hawaii Department of Land and Natural Resources and U.S. Fish and Wildlife Service (August 2010).

- **Please attach a check for \$50 made out to the *Department of Land and Natural Resources*. If you would like to be considered for a fee waiver, please check here and explain in the space below why the proposed special-use is in the public interest or benefits the State. If the waiver is granted, the \$50 check will be returned.**
- **For research proposals, please list any local collaborators or contacts (if any).**

First Wind Energy, LLC

Dave Cowan, VP Environmental Affairs (207) 712-8271  
Mitch Craig, Senior Wildlife Biologist (808) 633-3723  
3 TBD

State of Hawaii, Division of Forestry and Wildlife

Scott Fretz, Wildlife Program Manager (808) 587-4187

Sandee Hufana, Conservation Initiatives Coordinator (808) 587-4171  
Fern Duvall, Wildlife Biologist (808) 873-3502  
Jay Penniman, Wildlife Biologist (808) 280-4114

SWCA, Environmental Consultants

Ling Ong, Wildlife Biologist (808) 548-7922  
Jaap Eijzenga, Wildlife Ecologist (808) 548-7922

Pacific Rim Conservation

Eric Vanderwerf  
Lindsay Young  
Andrew Titmus  
Mike Lohr

**All permits will have the following standard conditions, pursuant to HAR § 13-209-5. Additional conditions may apply.**

- 1) The permittee shall adhere to the specifications given in the permit application
- 2) Disturbance of vegetation and wildlife shall be avoided as much as possible
- 3) Precautions shall be taken to prevent introductions of plants or animals not naturally present in the area. The permittee is responsible for making sure that participants' clothing, equipment, and vehicles are free of seeds or dirt to lessen the chance of introducing any non-native plants or soil animals. Should an infestation develop attributable to the permittee, the permittee is responsible for eradication by methods specified by the department
- 4) Once approved, the permit is not transferable
- 5) Once approved, the permit does not exempt the permittee from complying with any other applicable rule or statute
- 6) The State of Hawaii shall be released and held harmless from any and all liability for injuries or death, or damage or loss of property however occurring during any activity related to the permit

I certify that the information contained in this application is true and correct.

Gregory C. Spencer  
November 8, 2011

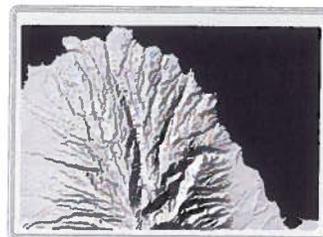
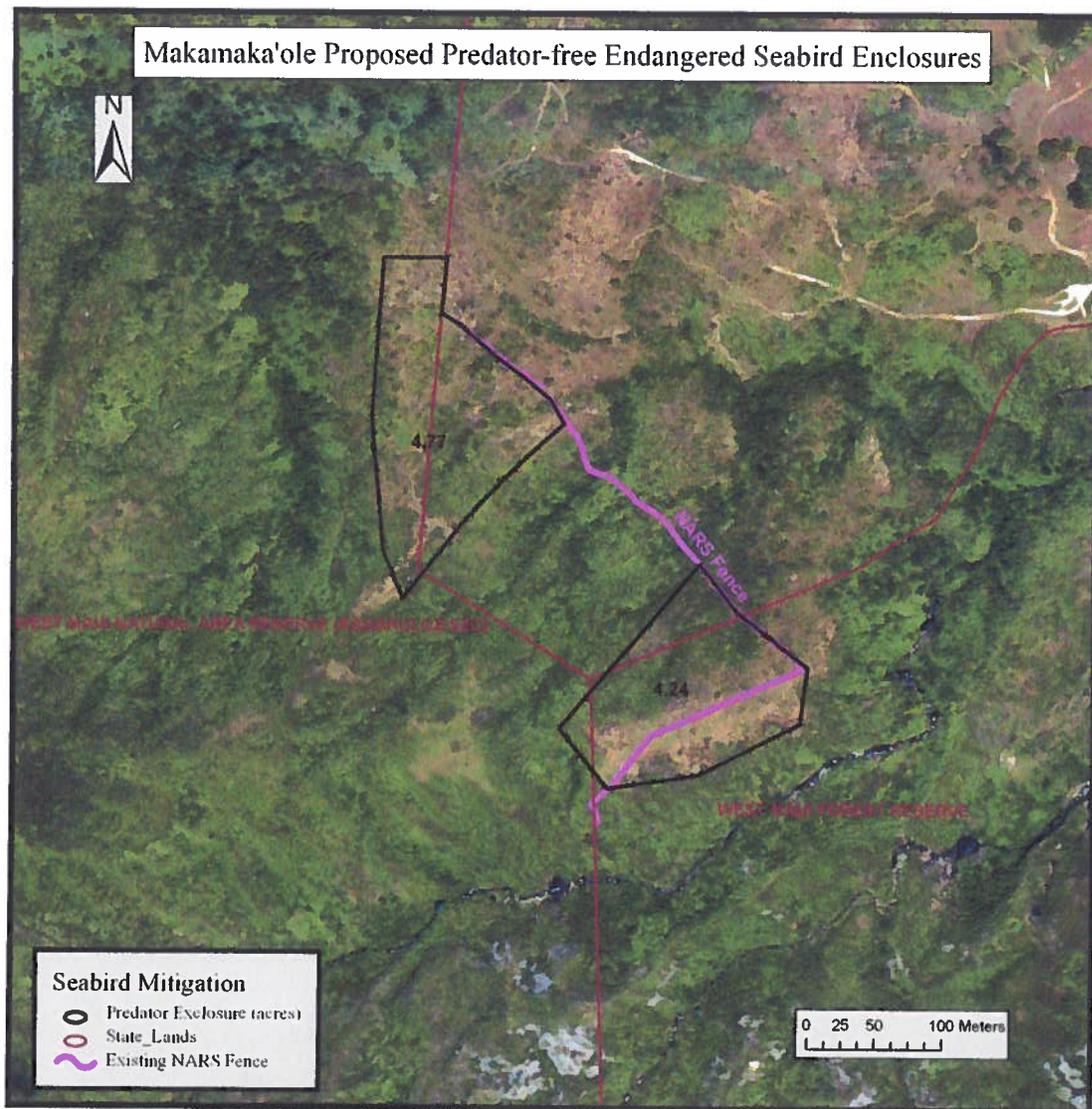


---

Applicant's Signature

*If approved, copies of the permit will be provided to:*

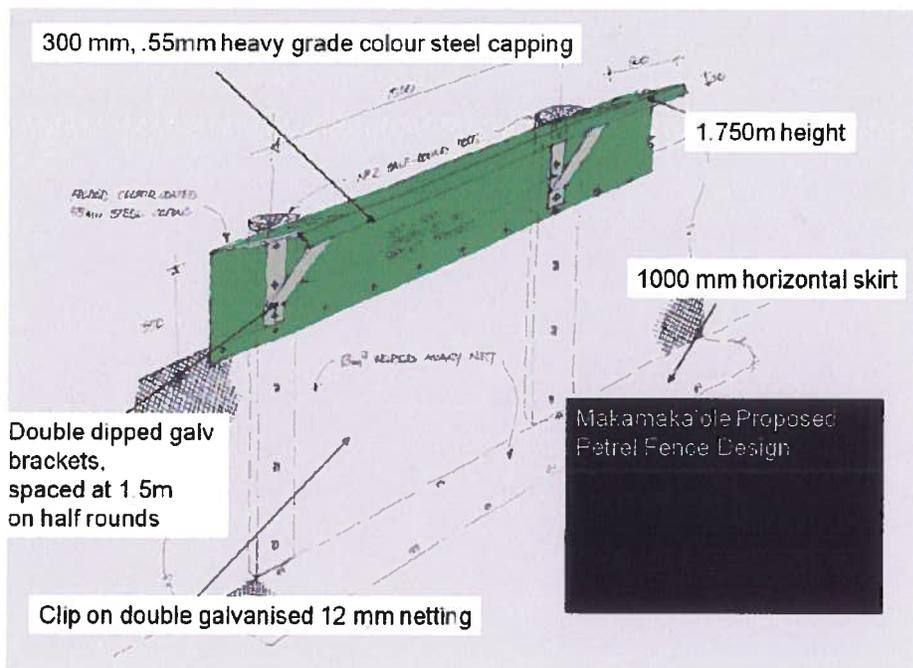
- Applicant
- NARS Commission Executive Secretary
- NARS Branch staff
- DLNR-DOCARE



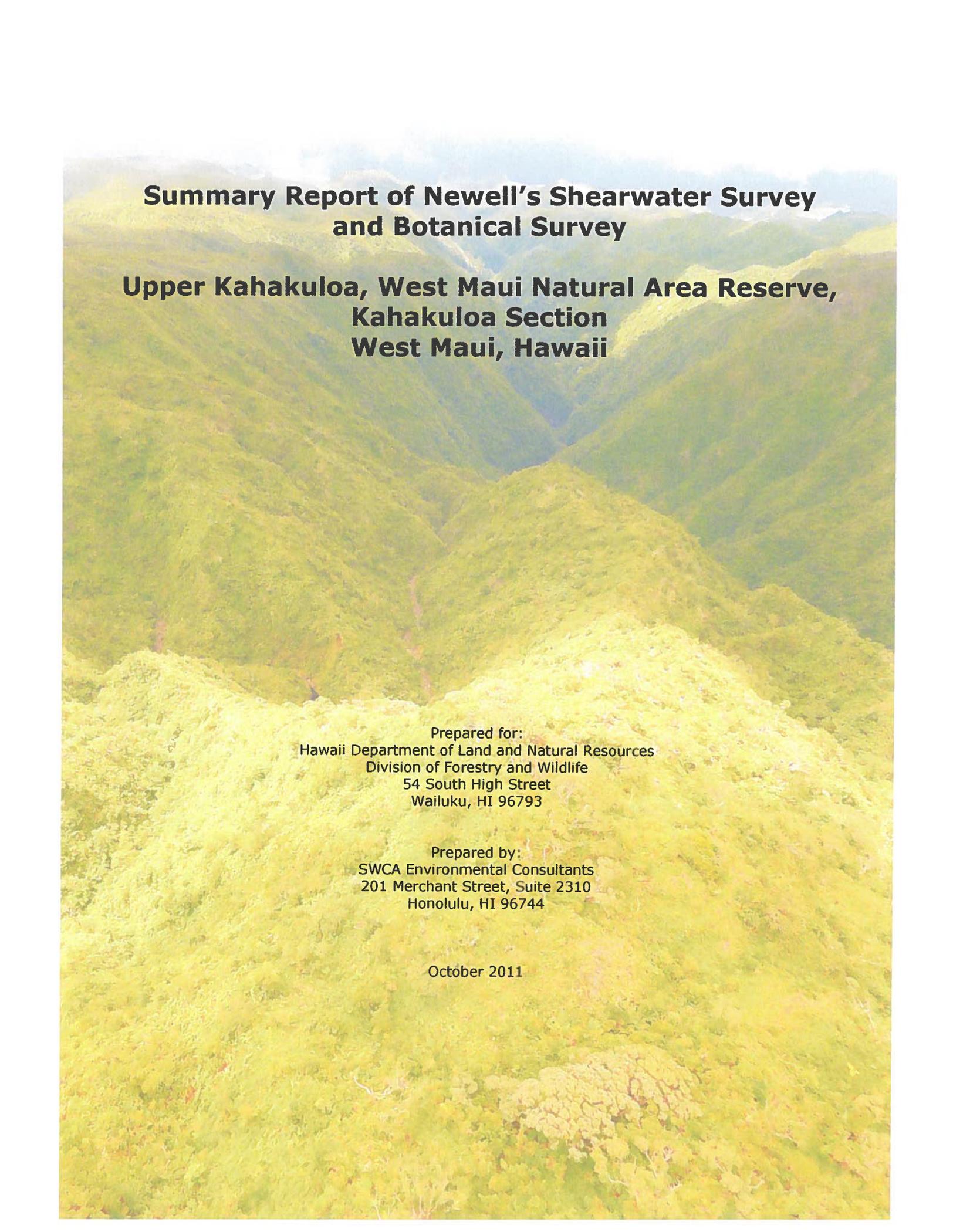
Map showing the locations and configuration of 2 proposed predator-free enclosures to protect and enhance breeding success of Hawaiian petrels and Newell's shearwaters at Kahakuloa-Makamaka'ole, West Maui.



Photo of the proposed management area; the arrows denote grassy sections that represent prime locations for the installation of artificial burrows and audio playback systems.



Fence design features for Hawaiian petrel and Newell's shearwater predator-free enclosures at the Kahakuloa-Makamaka'ole project site.



**Summary Report of Newell's Shearwater Survey  
and Botanical Survey**

**Upper Kahakuloa, West Maui Natural Area Reserve,  
Kahakuloa Section  
West Maui, Hawaii**

Prepared for:  
Hawaii Department of Land and Natural Resources  
Division of Forestry and Wildlife  
54 South High Street  
Wailuku, HI 96793

Prepared by:  
SWCA Environmental Consultants  
201 Merchant Street, Suite 2310  
Honolulu, HI 96744

October 2011

*This page intentionally left blank*

## Contents

Background .....	1
Introduction.....	1
Methods .....	2
Results of Seabird Survey.....	2
Results of Botanical Survey.....	2
Conclusions .....	3
References Cited .....	5
Appendix 1: Botanical report.....	7

## Figures

Figure 1: Kahakuloa Newell's shearwater survey map. ....	4
--	---

## Appendices

Appendix 1: Botanical Survey Report.

## Background

Based on data collected in the 1990's the population of Newell's shearwater was estimated to be approximately 84,000 breeding and non breeding birds, with a possible range of 57,000 to 115,000 birds (Ainley et al. 1997). Radar studies on Kaua'i showed a 63% decrease in detections of shearwaters between 1993 and 2001 (Day et al. 2003). More recently, Holmes (Planning Solutions et al. 2010) suggest a 75% population decrease between 1993 and 2008, based on radar surveys and Save Our Shearwater (SOS) data. This puts the 2008 total population estimate on the order of 21,000 birds. The largest breeding population of Newell's shearwater occurs on Kaua'i (Telfer et al. 1987; Day and Cooper 1995, Ainley et al. 1995, 1997; Day et al. 2003a). Breeding also occurs on Hawai'i Island (Reynolds and Richotte 1997; Reynolds et al. 1997; Day et al. 2003) and almost certainly occurs on Moloka'i (Pratt 1988; Day and Cooper 2002). Recent radar studies suggest the species may also nest on O'ahu in small numbers (Day and Cooper 2008). On Maui, radar studies and visual and auditory surveys conducted over the past decade suggest that one or more small breeding colonies are present, but no colony estimates are available. Cooper and Day (2003) estimate 51 Newell's shearwaters flying inland in West Maui, and 89 Newell's shearwaters flying inland on East Maui. However, these numbers are based on the use of timing of radar targets to determine if a target is a Hawaiian Petrel or a Newell's shearwater. It has become evident that timing of movement may not be a valid criterion for discriminating shearwaters from petrels (Brian Cooper pers. com., David Ainley pers. com.). No Newell's shearwaters were visually observed during this study (Cooper and Day 2003). No Newell's shearwater burrow has been identified on the island of Maui, but based on the presence of calling birds at upper Kahakuloa Valley in West Maui (Greg Spencer pers. com.) and reports of ground calling at Kipahulu (Cathleen Bailey pers. com.) and Kōlōlau Gap (Wood and Bily 2007), a few small breeding colonies may be present.

The Hawaiian petrel was once abundant on all main Hawaiian Islands except Ni'ihau (Mitchell et al. 2005). The population was most recently estimated to be approximately 20,000, with 4,000 to 5,000 breeding pairs (Mitchell et al. 2005). Today, Hawaiian petrels continue to breed in high-elevation colonies on Maui, Hawai'i, Kaua'i and Lāna'i (Richardson and Woodside 1954; Simons and Hodges 1998; Telfer et al. 1987). Radar studies conducted in 2002 also suggest that breeding may occur on Moloka'i (Day and Cooper 2002). It is believed that breeding no longer occurs on O'ahu (Harrison 1990). Mount Haleakalā, which defines East Maui, supports the largest known nesting colony of Hawaiian petrels (USFWS 2005; Hodges and Nagata 2001). Approximately 1,000 known nests are within the crater of the dormant shield volcano, with the highest concentration on the western rim between 2,400 and 3,055 m elevation. The highest densities of nests (15-30 burrows per hectare) occur within Haleakalā National Park. Predator trapping is conducted year-round to reduce predation pressure on these burrows. Lower densities of nesting burrows occur elsewhere in the crater and beyond the park boundaries, but these are currently not actively managed (Hodges and Nagata 2001).

## Introduction

A multi-night survey in 2007 along the Eke Trail revealed the presence of a potential nesting site within the upper Kahakuloa section of the West Maui Natural Area Reserve, with an estimated 20-30 birds calling and exhibiting attendance. This survey aimed to further elucidate the presence of Newell's shearwaters in this area at this time, in an effort to identify potential breeding sites where predator management or other protection measures may be implemented in the future. This survey was preceded by three aerial reconnaissance flight with Bill Evanson to identify point count stations, landing zones, and the path connecting them. These surveys took place on 6/17, 6/24, and 7/1. Following these reconnaissance flights we attempted to land for a botanical survey as part of the permit requirements on 7/6 and 7/15 and for an overnight botanical and Newell's shearwater survey on 8/11, before the successful trip on 9/1-9/2.

## Methods

The team consisted of Jaap Eijzenga (SWCA), Greg Spencer (First Wind), and Ken Wood (NTBG). We were dropped off around 12:30 pm on Thursday September 1 by Windward Aviation. We were picked up on Friday September 2 at 7:00am. Conditions were extremely challenging for a successful drop off, with low clouds and moderately strong winds. The landing zone at which the pilot was eventually able to drop us off was approximately 100 meters south (uphill) of the planned landing zone (figure 1). However, the length of area to traverse between the landing zone and AV1 was approximately the same as planned.

After we were dropped off Ken Wood conducted a botanical survey, described in more detail in appendix 1), of the path between the Landing Zone and the point count stations. We walked from the Landing Zone to the first point count stations (AV1), from there on to AV2, and finally AV3. Greg Spencer was dropped off at AV1, Jaap Eijzenga was stationed at AV2, and Ken Wood was at AV3. Ken Wood performed a walk-through botanical survey of the area surrounding the point count stations and the Landing Zone. On the morning before pickup we walked along the same track back to the Landing Zone.

The purpose of the botanical survey was to assure that the access and activities associated with the Newell's shearwater surveys would not result in impact to rare or listed plant species. We recorded all vascular plant species found within each survey plot. Each plot was given an estimated 9 m radius around each point count station, totaling a 250 m<sup>2</sup> circular plot

We conducted audio and visual (using night vision goggles) point counts from 19:00h to 22:00h, and again from 04:00h to 06:00h. Sunset was at 18:43h, and sunrise was at 06:10h. New moon was on August 28; moonrise was at 09:57h, and moonset was at 21:31, and although the moon was partially obscured by clouds, light was visible throughout the count sessions.

Movement around the area was kept to a minimum, and overnight camps were limited to bivy style camps with minimal impacts.

## Results of Seabird Survey

Weather conditions at the site were fair. The cloud ceiling hovered below 3000 feet, obscuring the valley and ridges for most of the duration of the survey. Morning conditions on September 2 were clearer. The wind from the north east was variable, averaging 6 mph, with regular gusts of 11 mph. It did not rain during the surveys.

We heard only one single Newell's shearwater call from a bird transiting Kahakuloa Valley to the east of the point count stations. The bird was detected from AV2 at 19:32h. No other seabirds were heard during the survey.

## Results of Botanical Survey

The survey plots included 31 taxa of plants, consisting of 19 endemic, 7 indigenous, and 5 weedy naturalized species. The botanical communities in the general region are situated along wind swept ridges and moderately steep slopes that suddenly become very steep and drop into the deeply dissected headwater drainages of Honokohau and Kahakuloa. This region is scattered with occasional open bog communities dominated by stunted trees (<1 m) of *Metrosideros polymorpha* and the sedge *Machaerina angustifolia*, although our plots did not occur within any of these bogs. Adjacent to bogs occur low canopy *Metrosideros polymorpha* (ca. 3-5 m tall) wet forest and other native genera of trees such as *Broussaisia*, *Cheirodendron*, *Clermontia*, *Coprosma*, *Dubautia*, *Ilex*, *Melicope*, *Myrsine*, and *Psychotria*. Numerous dead standing *Metrosideros* were observed in and around our survey plots. Riparian *Metrosideros* wet forest communities occur along banks of drainages. For a full report and species list see Appendix 1.

We found no rare or listed species in the survey area. As much as possible, we located our bivy camps in areas dominated by non-native species; therefore impacts to native species were kept to an absolute minimum.

## Conclusions

We were able to confirm the presence of transiting Newell's shearwaters in the areas, however, only a single Newell's shearwater was heard during the survey, and no other seabird species were detected.

The 2007 surveys from Eke trail indicated the presence of a breeding site within the NAR. We were unable to confirm the presence a potential breeding site, but the timing of the survey may have precluded detection of breeding activity. Call rates at breeding sites and of transiting birds are highest in June and July, decline in August, and are significantly lower after August based on survey work on Kauai. (N. Holmes, pers. com.).

Newell's shearwaters are undergoing a significant population decline as birds are under threat by habitat degradation, introduced predators, most notably mongoose, cats, rats, and barn owls, and mortality related to artificial light attraction and collisions with power lines ( Ainley et al. 1995, Ainley et al 1997, Day et al. 2003, Mitchell et al. 2005, Planning solutions 2009). Recent population modeling suggest that small remnant Newell's shearwater colonies, where present on Maui, may be undergoing a population decline similar to what has been described on Kauai. It is therefore possible that the possible breeding site at upper Kahakuloa may have further declined since 2007, and may be scattered, making it more difficult to detect.

Further surveys are recommended to confirm the fate of the Newell's shearwaters at upper Kahakuloa.

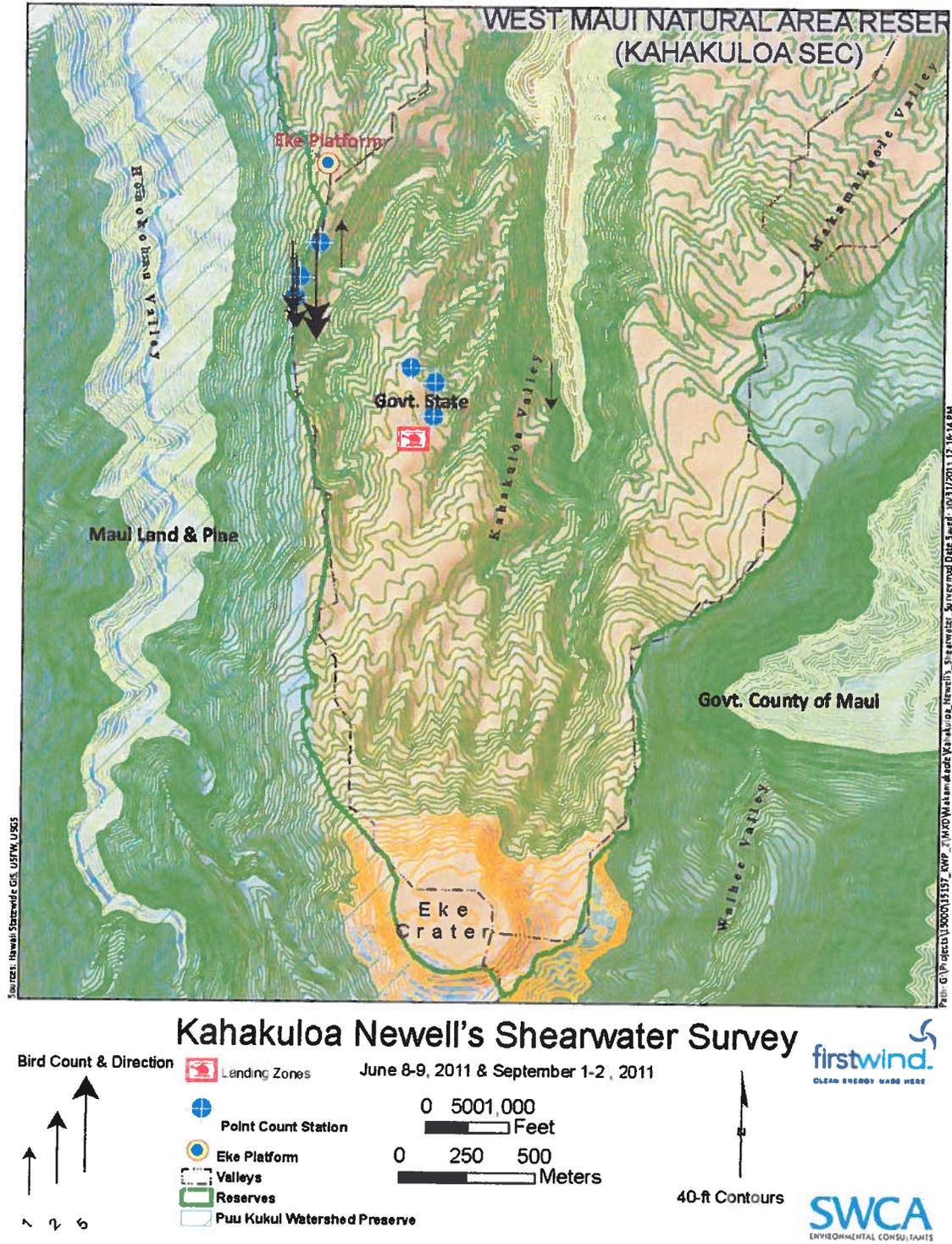


Figure 1: Kahakuloa Newell's shearwater survey map.

## References Cited

- Ainley, D.G., L. DeForest, N. Nur, R. Podolsky, G. Spencer, and T.C. Telfer. 1995. Status of the threatened Newell's Shearwater on Kaua'i: Will the population soon be endangered?
- Ainley, D.G., T.C. Telfer, and M.H. Reynolds. 1997. Townsend's and Newell's Shearwater (*Puffinus auricularis*). In *The Birds of North America*, No. 297, edited by A. Poole and F. Gill. The Birds of North America, Inc., Philadelphia, PA.
- Cooper, B.A., and R.H. Day. 2003. Movement of Hawaiian Petrels to inland breeding sites on Maui Island, Hawai'i. *Waterbirds* 26:62-71.
- Day, R.H., and B.A. Cooper. 1995. Patterns of movement of Dark-rumped Petrels and Newell's Shearwaters on Kaua'i. *The Condor* 97:1011-1027
- Day, R.H., and B.A. Cooper . 2002. Petrel and shearwater surveys near Kalaupapa, Molokai Island, June, 2002. Final report to the National Park Service, Hawaii National Park. ABR, Inc., Fairbanks, Alaska.
- Day, R.H., B.A. Cooper, and T.C. Telfer. 2003. Decline of Townsend's (Newell's) Shearwaters (*Puffinus auricularis newelli*) on Kaua'i, Hawai'i. *The Auk* 120:669-679.
- Harrison, C. 1990. *Seabirds of Hawaii: Natural History and Conservation*. Ithaca: Cornell University Press.
- Hodges, C.S.N., and R.J. Nagata. 2001. Effects of Predator Control on the Survival and Breeding Success of the Endangered Hawaiian Dark-rumped Petrel. *Studies in Avian Biology* 22: 308-318.
- Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. Hawaii's Comprehensive Wildlife Conservation Strategy. State Department of Land and Natural Resources. Honolulu, HI. Accessed August 29, 2011.  
<http://www.state.hi.us/dlnr/dofaw/cwcs/index.html>
- Pratt, T.K. 1988. Recent observations, March-May 1988. *'Elepaio* 48:65-66.
- Planning Solutions, 2009. Public Review Draft Short-term seabird habitat conservation plan Kauai Island Utility Cooperative (KIUC).
- Reynolds, M.H., B.A. Cooper, and R.H. Day. 1997. Radar study of seabirds and bats on windward Hawai'i. *Pacific Science* 51:97-106.
- Reynolds, M.H., and G.L. Ritchotte. 1997. Evidence of Newell's Shearwater Breeding in Puna District, Hawaii. *Journal of Field Ornithology* 68(10):26-32.
- Richardson, F., and D.H. Woodside. 1954. Rediscovery of the nesting of the Dark-rumped Petrel in the Hawaiian Islands. *The Condor* 56: 323-327.
- Simons, T.R., and C.N. Hodges. 1998. Dark-rumped Petrel (*Pterodroma phaeopygia*). In *The Birds of North America*, No. 345, edited by A. Poole and F. Gill. The Birds of North America, Inc., Philadelphia, PA
- Telfer, T.C., J.L. Sincovec, G.V. Byrd, and J.R. Reed. 1987. Attraction of Hawaiian seabirds to lights: conservation efforts and effects of moon phase. *Wildlife Society Bulletin* 15: 406-413.

Upper Kahakuloa Flora and Newell's Shearwater Survey  
September 1-2, 2011

USFWS. 2005. Regional Seabird Conservation Plan, Pacific Region. U.S. Fish and Wildlife Service, Migratory Birds and Habitat Programs, Pacific Region, Portland, OR.

Wood, K. R., and P. Bily. 2008. Vegetation description of a nesting site for Newell's shearwater (*Puffinus auricularis newelli*), Piinaau Stream, East Maui, Hawaii. *Elepaio* 68 (8): 63-68.

## **Appendix 1: Botanical report**

**SUMMARY REPORT OF BOTANICAL RESEARCH  
KAHAKULOA NATURAL AREA RESERVE  
WEST MAUI, HAWAII  
September 2011**

**Botanical report prepared for  
The Department of Land & Natural Resources / Division of Forestry and Wildlife**

**K. R. WOOD**  
NATIONAL TROPICAL BOTANICAL GARDEN  
3530 PAPALINA RD, KALAHEO, KAUA'I, HAWAII 96741 [kwood@ntbg.org](mailto:kwood@ntbg.org)

**INTRODUCTION.**

On September 1-2, 2011 Kenneth R. Wood (NTBG), along with Jaap Eijzenga (SWCA Environmental Consultants) and Greg Spenser (First Wind, Environmental Affairs), conducted a biological survey within the Kahakuloa Natural Area Reserve (NAR), West Maui, Hawaii. This survey was mainly conducted to insure that no rare and/or endangered plants would be disturbed by human activities around three pre-chosen seabird survey points (to be referred to as AV-1, AV-2, & AV-3). The author found no rare and/or endangered plant taxa within these seabird survey plots. A separate report is being prepared for the seabird observation portion of this research.

Besides presenting all plant taxa found within the three seabird survey points (Table 1), I have also prepared an updated checklist of vascular plant taxa currently known to occur within the Kahakuloa NAR (Table 2).

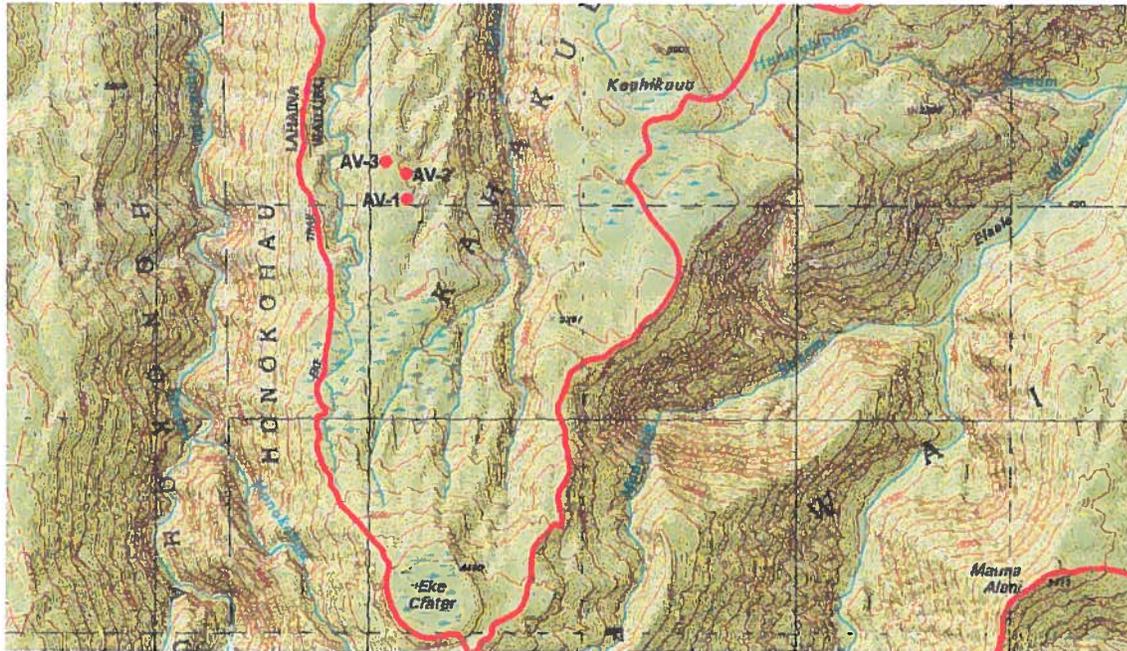
**SURVEY OF PLOTS AV-1, AV-2, & AV-3**

On 1 September 2011 we accessed Kahakuloa Natural Area Reserve by helicopter and conducted a botanical inventory of survey plots AV-1, AV-2 & AV-3. We recorded all vascular plant species found within each survey plot. Each plot was given an estimated 9 m radius, totaling a 250 m<sup>2</sup> circular plot (Table 1). Coordinates for survey plots are as follows (NAD 83 Zone 4): **AV-1** = 0752179-2317024; **AV-2** = 0752173-2317147; **AV-3** = 0752076-2317199.

As previously mentioned, this survey was mainly conducted to insure that no rare and/or endangered plants would be disturbed by human activities around three pre-chosen seabird survey points. All plant taxa found within the three seabird survey points are presented below in Table 1. **No rare plant taxa were observed in plots.** AV-1, AV-2, & AV-3 are located ca. 100 m distance from each other and were chosen by State of Hawaii DLNR NARS staff along with staff from SWCA and First Wind during previous helicopter reconnaissance flights (Map 1).

The region of survey lies just to the north of Eke crater and east of Honokohau (ca. 3000-3050 ft elev.), where several relatively flat zones could be accessed for seabird monitoring. The botanical communities in the general region are situated along wind swept ridges and moderately steep slopes that suddenly become very steep and drop into the deeply dissected headwater drainages of Honokohau and Kahakuloa. This region is scattered with occasional open bog communities dominated by stunted trees (<1 m) of *Metrosideros polymorpha* and the sedge *Machaerina angustifolia*, although our plots did not occur within any of these bogs. Adjacent to bogs occur low canopy *Metrosideros polymorpha* (ca. 3-5 m tall) wet forest and other native genera of trees such as *Broussaisia*, *Cheirodendron*, *Clermontia*, *Coprosma*, *Dubautia*, *Ilex*, *Melicope*, *Myrsine*, and *Psychotria*. Numerous dead standing *Metrosideros* were observed in and around our survey plots. Riparian *Metrosideros* wet forest communities occur along banks of drainages.

Survey plots included 31 taxa of plants, namely 19 endemic, 7 indigenous, and 5 weedy naturalized species (see Table 1)



**Map 1.** Location of three seabird survey plots, Kahakuloa Natural Area Reserve, West Maui, Hawai`i: AV-1 = 0752179-2317024; AV-2 = 0752173-2317147; AV-3 = 0752076-2317199.

**TABLE 1**

**Checklist of Vascular Plant Taxa found within Survey Plots AV-1, AV-2, & AV-3  
Kahakuloa Natural Area Reserve (NAR), West Maui, Hawai`i  
September 2011**

Note: Checklist alphabetical by genus. Symbols: end=Endemic Species; ind=Indigenous; nat=Naturalized. Flowering plants follow Wagner et al. 1999; pteridophytes follow Palmer 2003.

FAMILY	GENUS	SPECIES	STATUS	AV-1	AV-2	AV-3
Polypodiaceae	Adenophorus	hymenophylloides (Kaulf.) Hook. & Grev.	end		AV-2	
Poaceae	Andropogon	virginicus L.	nat		AV-2	AV-3
Hydrangeaceae	Broussaisia	arguta Gaudich.	end	AV-1		AV-3
Apiaceae	Centella	asiatica (L.) Urb.	nat		AV-2	
Araliaceae	Cheirodendron	trigynum (Gaudich.) A.Heller	end	AV-1	AV-2	AV-3
Cibotiaceae	Cibotium	glaucum (Sm.) Hook. & Arn.	end	AV-1		AV-3
Cibotiaceae	Cibotium	menziesii Hook.	end		AV-2	

FAMILY	GENUS	SPECIES	STATUS	AV-1	AV-2	AV-3
Campanulaceae	Clermontia	micrantha (Hillebr.) Rock	end	AV-1		
Gleicheniaceae	Dicranopteris	linearis (Burm.f.) Underw.	ind		AV-2	AV-3
Gleicheniaceae	Diplopterygium	pinnatum (Kunze) Nakai	ind	AV-1		
Asteraceae	Dubautia	laxa Hook. & Arn.	end	AV-1	AV-2	AV-3
Elaphoglossaceae	Elaphoglossum	crassifolium (Gaudich.) W.R.Anderson & Crosby	end	AV-1	AV-2	
Pandanaceae	Freycinetia	arborea Gaudich.	ind	AV-1	AV-2	
Hymenophyllaceae	Hymenophyllum	lanceolatum Hook. & Arn.	end		AV-2	
Aquifoliaceae	Ilex	anomala Hook. & Arn.	Ind		AV-2	
Juncaceae	Juncus	planifolius R.Br.	nat		AV-2	
Lycopodiaceae	Lycopodiella	cernua (L.) Pic.Serm.	ind	AV-1		AV-3
Cyperaceae	Machaerina	angustifolia (Gaudich.) T.Koyama	ind	AV-1	AV-2	AV-3
Rutaceae	Melicope	clusiifolia (A.Gray) T.G.Hartley & B.C.Stone	end	AV-1	AV-2	
Myrtaceae	Metrosideros	polymorpha Gaudich.	end	AV-1	AV-2	AV-3
Myrtaceae	Metrosideros	polymorpha Gaudich. var. glaberrima (H.Lév.) H.St.John	end	AV-1	AV-2	AV-3
Myrtaceae	Metrosideros	polymorpha Gaudich. var. incana (H.Lév.) H.St.John	end	AV-1		AV-3
Primulaceae	Myrsine	lessertiana A.DC.	end		AV-2	
Primulaceae	Myrsine	sandwicensis A.DC.	end		AV-2	AV-3
Poaceae	Paspalum	conjugatum P.J.Bergius	nat		AV-2	AV-3
Rubiaceae	Psychotria	mariniana (Cham. & Schltdl.) Fosberg	end	AV-1		
Cyperaceae	Pycrus	polystachyos (Rottb.) P. Beauv.	ind		AV-2	
Blechnaceae	Sadleria	pallida Hook. & Arn.	end	AV-1		
Smilacaceae	Smilax	melastomifolia Sm.	end	AV-1		

FAMILY	GENUS	SPECIES	STATUS	AV-1	AV-2	AV-3
Melastomataceae	Tibouchina	herbacea (DC.) Cogn.	nat	AV-1	AV-2	AV-3
Ericaceae	Vaccinium	dentatum Sm.	end	AV-1	AV-2	AV-3

**KAHAKULOA NATURAL AREA RESERVE (NAR) FLORA SUMMARY:**

The following Kahakuloa flora checklist (Table 2) is contributed by the author as there was no updated checklist for Kahakuloa NAR available to botanists since DLNR's management plan of 1989. This updated checklist is the combination of several sources, namely, a) NTBG field research conducted by the author on the following dates: 3 Feb 1992; 5 May 94; 30 Apr 96; 28 Aug 1996; 21–22 Mar 97; 1-2 Sep 2011; b) data collected from the NTBG herbarium (PTBG); c) confirmed sightings from the West Maui Natural Area Reserve Management Plan prepared by the Department of Land and Natural Resources (DLNR 1989); and d) data from the Hawaii Biodiversity and Mapping Program, Natural Diversity Database (HBMP).

I currently estimate the flora of the Kahakuloa NAR to be composed of some 200 taxa of vascular plants from 69 families. This includes 168 native taxa, 27 non-native naturalized species, and 5 Polynesian introductions. In regard to the 168 native floristic components naturally occurring within the Reserve, we find that 145 are endemic and 23 are considered indigenous. Kahakuloa NAR also has 15 single island endemic (SIE) taxa (see Table 2).

The author recommends that additional biological surveys be conducted within this NAR, as there is a very strong potential to increase the known numbers of endemic species within the NAR, including snails and insects. I would estimate that future surveys will substantially increase our understanding and knowledge of Kahakuloa's endemic flora, considering the diverse range of botanical communities found in the NAR, including Hawaiian continuous perennial stream, Hawaiian montane lake, lowland wet fernland, shrubland and cliff communities, along with its numerous diverse bogs and wet forests. In addition, it is recommended that collections (seeds/propagules) of rare taxa could be made to assist against species extinctions.

TABLE 2

**Checklist of Vascular Plant Taxa found within  
Kahakuloa Natural Area Reserve (NAR), West Maui, Hawai`i  
September 2011**

**K. R. Wood / National Tropical Botanical Garden (NTBG)**

Note: Checklist alphabetical by genus. Symbols: C=Candidate for Listing; E=Endangered; end=Endemic Species; EX=Extinct; H=Historical & no longer present; ind=Indigenous; nat=Naturalized; pol=Polynesian Introduction; SIE=Single Island Endemic; SOC=Species of Concern; T=Threatened; V=Vulnerable. Flowering plants follow Wagner et al. 1999; pteridophytes follow Palmer 2003. This checklist represents data collected from the NTBG herbarium (PTBG); DLNR 1989 (portions of the West Maui Natural Area Reserve Management Plan [confirmed sightings only] prepared by the Department of Land and Natural Resources [April 1989]); HBMP 2006 (Hawaii Biodiversity and Mapping Program, Natural Diversity Database); and from the authors field research conducted on the following dates: 3 Feb 1992; 5 May 94; 30 Apr 96; 28 Aug 1996; 21–22 Mar 97; 1–2 Sep 2011.

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
Polypodiaceae	Adenophorus	hymenophylloides (Kaulf.) Hook. & Grev.	end		Wood 3131 (PTBG)
Polypodiaceae	Adenophorus	pinnatifidus Gaudich.	end		DLNR (1989); Wood (obs.)
Polypodiaceae	Adenophorus	tamariscinus (Kaulf.) Hook. & Grev.	end		Wood 3132; DLNR (1989)
Polypodiaceae	Adenophorus	tamariscinus (Kaulf.) Hook. & Grev. var. montanus (Hillebr.) L.E. Bishop	end		Wood 3132, 6065 (PTBG)
Polypodiaceae	Adenophorus	tenellus (Kaulf.) Ranker	end		DLNR (1989); Wood (obs.)
Polypodiaceae	Adenophorus	tripinnatifidus Gaudich.	end		DLNR (1989); (Wood obs.)
Asteraceae	Ageratina	adenophora (Spreng.) R.M.King & H.Rob.	nat		DLNR (1989); Wood (obs.)
Asteraceae	Ageratum	conyzoides L.	nat		DLNR (1989)
Poaceae	Agrostis	sandwicensis Hillebr.	end		Wood 5529, 5532, 5534, 5535,
Euphorbiaceae	Aleurites	moluccana (L.) Willd.	pol		DLNR (1989)
Poaceae	Andropogon	virginicus L.	nat		DLNR (1989); Wood (obs.)
Phyllanthaceae	Antidesma	platyphyllum H.Mann	end		DLNR (1989)
Dryopteridaceae	Arachniodes	insularis W.H.Wagner	end		Wood 5527
Asteraceae	Argyroxiphium	caliginis C.N.Forbes	end, SOC	SIE	DLNR (1989); Wood (obs.)
Asteraceae	Argyroxiphium	grayanum (Hillebr.) O.Deg.	end	SIE	DLNR (1989); Wood (obs.)

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
Aspleniaceae	Asplenium	acuminatum Hook. & Arn.	end		DLNR (1989)
Aspleniaceae	Asplenium	contiguum Kaulf.	end		Wood 3134 (PTBG); DLNR (1989)
Aspleniaceae	Asplenium	excisum C.Presl	ind		Wood (obs.)
Aspleniaceae	Asplenium	lobulatum Mett.	ind		Wood 3157 (PTBG); DLNR (1989)
Aspleniaceae	Asplenium	nidus L.	ind		DLNR (1989)
Asteliaceae	Astelia	menziesiana Sm.	end		Wood 5549
Woodsiaceae	Athyrium	microphyllum (Sm.) Alston	end		DLNR (1989); Wood (obs.)
Poaceae	Axonopus	fissifolius (Raddi) Kuhlms.	nat		Wood (obs.)
Asteraceae	Bidens	conjuncta Sherff	end, C	SIE	Wood 6072, 6080, 6091 (PTBG); HBMP
Asteraceae	Bidens	micrantha Gaudich.	end	SIE	Wood 6092 (PTBG)
Blechnaceae	Blechnum	appendiculatum Willd.	nat		DLNR (1989)
Urticaceae	Boehmeria	grandis (Hook. & Arn.) A.Heller	end		DLNR (1989)
Hydrangeaceae	Broussaisia	arguta Gaudich.	end		DLNR (1989); Wood (obs.)
Buddlejaceae	Buddleja	asiatica Lour.	nat		DLNR (1989)
Poaceae	Calamagrostis	expansa (Munro ex Hillebr.) Hitchc.	end, C		Wood 5530; HBMP
Poaceae	Calamagrostis	hillebrandii (Munro ex Hillebr.) Hitchc.	end, C		Wood 5533, 6073 (PTBG); HBMP
Cyperaceae	Carex	alligata Boott	end		DLNR (1989); Wood (obs.)
Cyperaceae	Carex	montis-eeka Hillebr.	end		Wood 6064 (PTBG); DLNR (1989)
Apiaceae	Centella	asiatica (L.) Urb.	nat		DLNR (1989); Wood (obs.)
Araliaceae	Cheirodendron	trigynum (Gaudich.) A.Heller	end		Wood 14772 (PTBG); DLNR (1989)
Cibotiaceae	Cibotium	chamissoi Kaulf.	end		DLNR (1989)

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
Cibotiaceae	Cibotium	glaucum (Sm.) Hook. & Arn.	end		DLNR (1989); Wood (obs.)
Cibotiaceae	Cibotium	menziesii Hook.	end		Wood (obs.)
Campanulaceae	Clermontia	arborescens (H.Mann) Hillebr.	end	SIE	Wood 3156, 6082 (PTBG)
Campanulaceae	Clermontia	grandiflora Gaudich.	end	SIE	Wood 5531, 6077, 14759, 14768 (PTBG); DLNR (1989)
Campanulaceae	Clermontia	micrantha (Hillebr.) Rock	end		Wood 3142 (PTBG); DLNR (1989)
Araceae	Colocasia	esculenta (L.) Schott	pol		DLNR (1989)
Pteridaceae	Coniogramme	pilosa (Brack.) Hieron.	end		Wood (obs.)
Rubiaceae	Coprosma	ochracea W.R.B.Oliv.	end		Wood 14757 (PTBG); DLNR (1989)
Asparagaceae	Cordyline	fruticosa (L.) A.Chev.	pol		DLNR (1989)
Dryopteridaceae	Ctenitis	latifrons (Brack.) Copel.	end		Wood 3158, 5523 (PTBG)
Lythraceae	Cuphea	carthagenensis (Jacq.) J.F.Macbr.	nat		DLNR (1989); Wood (obs.)
Campanulaceae	Cyanea	angustifolia (Cham.) Hillebr.	end		Wood 1604 (PTBG); DLNR (1989)
Campanulaceae	Cyanea	kunthiana Hillebr.	end, C	SIE	Wood 5551, 6088 (PTBG)
Campanulaceae	Cyanea	macrostegia Hillebr.	end	SIE	Wood 3155, 6093 (PTBG)
Thelypteridaceae	Cyclosorus	cyatheoides (Kaulf.) Farw.	end		Wood (obs.)
Thelypteridaceae	Cyclosorus	dentatus (Forssk.) Ching	nat		DLNR (1989)
Thelypteridaceae	Cyclosorus	parasiticus (L.) Farw.	nat		DLNR (1989)
Thelypteridaceae	Cyclosorus	sandwicensis (Brack.) Copel.	end		DLNR (1989); Wood (obs.)
Cyperaceae	Cyperus	haspan L.	nat		DLNR (1989)
Gesneriaceae	Cyrtandra	filipes Hillebr.	end, C		HBMP
Gesneriaceae	Cyrtandra	grayana Hillebr.	end		Wood 3159, 6087 (PTBG); DLNR

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
					(1989)
Gesneriaceae	Cyrtandra	hashimotoi Rock	end	SIE	Wood 3150, 5153, 5158 (PTBG)
Gesneriaceae	Cyrtandra	hawaiensis C.B.Clarke	end		Wood 4148, 6086 (PTBG)
Poaceae	Deschampsia	nubigena Hillebr.	end		DLNR (1989); Wood (obs.)
Poaceae	Dichantherium	cynodon (Reichardt) C.A.Clark & Gould	end		DLNR (1989); Wood (obs.)
Poaceae	Dichantherium	hillebrandianum (Hitcch.) C.A.Clark & Gould	end		DLNR (1989); Wood (obs.)
Poaceae	Dichantherium	isachnoides (Munro ex Hillebr.) C. A. Clark & Gould	end		DLNR (1989); Wood (obs.)
Gleicheniaceae	Dicranopteris	linearis (Burm.f.) Underw.	ind		DLNR (1989); Wood (obs.)
Ebenaceae	Diospyros	sandwicensis (A.DC.) Fosberg	end		Wood (obs.)
Woodsiaceae	Diplazium	arnottii Brack.	end		Wood 5150 (PTBG); DLNR (1989)
Woodsiaceae	Diplazium	sandwichianum (C.Presl) Diels	end		DLNR (1989)
Gleicheniaceae	Diplopterygium	pinnatum (Kunze) Nakai	ind		DLNR (1989); Wood (obs.)
Dryopteridaceae	Dryopteris	crinalis (Hook. & Arn.) C.Chr.	end		Wood 5155 (PTBG)
Dryopteridaceae	Dryopteris	fusco-atra (Hillebr.) W.J.Rob.	end		DLNR (1989); Wood (obs.)
Dryopteridaceae	Dryopteris	glabra (Brack.) Kuntze	end		DLNR (1989); Wood (obs.)
Dryopteridaceae	Dryopteris	rubiginosum (Brack.) H. Mann	end		DLNR (1989); Wood (obs.)
Dryopteridaceae	Dryopteris	sandwicensis (Hook. & Arn.) C.Chr.	end		Wood 5156 (PTBG)
Dryopteridaceae	Dryopteris	subbipinnata W.H.Wagner & Hobdy	end		Wood (obs.)
Dryopteridaceae	Dryopteris	unidentata (Hook. & Arn.) C.Chr. var. paleacea (Hillebr.) Herat ex Fraser-Jenk.	end		Wood 3128 (PTBG); DLNR (1989)
Dryopteridaceae	Dryopteris	wallichiana (Spreng.) Hyl.	ind		DLNR (1989)
Asteraceae	Dubautia	laxa Hook. & Arn.	end		Wood 5548, 14758, 14773 (PTBG);

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
					DLNR (1989)
Asteraceae	Dubautia	plantaginea Gaudich.	end		Wood 6094 (PTBG)
Elaphoglossaceae	Elaphoglossum	crassifolium (Gaudich.) W.R.Anderson & Crosby	end		Wood 1605, 3133 (PTBG); DLNR (1989)
Elaphoglossaceae	Elaphoglossum	paleaceum (Hook. & Grev.) Sledge	ind		DLNR (1989); Wood (obs.)
Elaphoglossaceae	Elaphoglossum	parvisquameum Skotts.	end		Wood 14761, 14771 (PTBG)
Elaphoglossaceae	Elaphoglossum	wawrae (Luer.) C.Ch.	end		DLNR (1989)
Poaceae	Eragrostis	grandis W.F.Hillebr.	end		Wood 3139, 5536 (PTBG); DLNR (1989)
Asteraceae	Erechtites	valerianifolia (Wolf) DC.	nat		DLNR (1989); Wood (obs.)
Theaceae	Eurya	sandwicensis A.Gray	end, SOC		Wood 6081 (PTBG)
Pandanaceae	Freycinetia	arborea Gaudich.	ind		DLNR (1989); Wood (obs.)
Cyperaceae	Gahnia	beecheyi H.Mann	end		DLNR (1989); Wood (obs.)
Rubiaceae	Gardenia	remyi H.Mann	end, C		DLNR (1989); HBMP
Geraniaceae	Geranium	hillebrandii Aedo & Muñoz Garm.	end, C	SIE	Wood 5528
Polypodiaceae	Grammitis	hookeri (Brack.) Copel.	ind		Wood 3135 (PTBG)
Gunneraceae	Gunnera	petaloidea Gaudich.	end		Wood 6083 (PTBG); DLNR (1989)
Pteridaceae	Haplopteris	elongata (Sw.) E.H.Crane	ind		Wood 1603 (PTBG)
Asteraceae	Hesperomannia	arborescens A.Gray	end, E		HBMP
Malvaceae	Hibiscus	kokio Hillebr. ex Wawra	end, SOC		DLNR (1989); HBMP
Lycopodiaceae	Huperzia	erubescens (Brack.) Holub	ind		Wood 3153 (PTBG); DLNR (1989)
Lycopodiaceae	Huperzia	subintegra (Hillebr.) Beitel & W.H.Wagner	end		DLNR (1989)
Hymenophyllaceae	Hymenophyllum	lanceolatum Hook. & Arn.	end		DLNR (1989); Wood (obs.)

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
Hymenophyllaceae	Hymenophyllum	recurvum Gaudich.	end		DLNR (1989); Wood (obs.)
Asteraceae	Hypochoeris	radicata L.	nat		DLNR (1989); Wood (obs.)
Dennstaedtiaceae	Hypolepis	hawaiiensis Brownsey	end		DLNR (1989); Wood (obs.)
Aquifoliaceae	Ilex	anomala Hook. & Arn.	ind		DLNR (1989); Wood (obs.)
Convolvulaceae	Ipomoea	indica (Burm.f.) Merr.	ind		DLNR (1989)
Poaceae	Isachne	distichophylla Munro ex Hillebr.	end		DLNR (1989)
Isoetaceae	Isoëtes	hawaiiensis W.C.Taylor & W.H.Wagner	end, SOC		Wood 5538; DLNR (1989); HBMP
Joinvilleaceae	Joinvillea	ascendens Gaudich. ex Brongn. & Gris	end, C		Oppenheimer H50016 (PTBG); HBMP
Juncaceae	Juncus	effusus L.	nat		DLNR (1989); Wood (obs.)
Juncaceae	Juncus	planifolius R.Br.	nat		DLNR (1989); Wood (obs.)
Rubiaceae	Kadua	acuminata Cham. & Schltdl.	end		DLNR (1989)
Rubiaceae	Kadua	affinis DC.	end		DLNR (1989); Wood (obs.)
Rubiaceae	Kadua	axillaris (Wawra) W. L. Wagner & Lorence	end		Wood (obs.)
Asteraceae	Keysseria	maviensis (H.Mann) Cabrera	end, SOC		Wood 6067, 6076, 6089 (PTBG); DLNR (1989)
Viscaceae	Korthalsella	cylindrica (Tiegh.) Engl.	end		Wood 14763 (PTBG)
Viscaceae	Korthalsella	remyana Tiegh.	end		Wood (obs.)
Cyperaceae	Kyllinga	brevifolia Rottb. [may be '(Rottb.) Hassk.']	nat		DLNR (1989)
Loganiaceae	Labordia	hedyosmifolia Baill.	end		Wood 3141a, 3145, 14767 (PTBG); DLNR (1989)
Loganiaceae	Labordia	hirtella H.Mann	end		Wood 3143, 6079, 6084 (PTBG)
Epacridaceae	Leptecophylla	tameiameiae (Cham. & Schlecht.) C.M.Weiller	ind		DLNR (1989); Wood (obs.)
Orchidaceae	Liparis	hawaiiensis H.Mann	end, SOC		Wood 14766 (PTBG)

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
Campanulaceae	Lobelia	gloria-montis Rock	end		Wood 6096 (PTBG); DLNR (1989)
Campanulaceae	Lobelia	hypoleuca Hillebr.	end		Wood (obs.)
Juncaceae	Luzula	hawaiiensis Buchenau	end		DLNR (1989)
Lycopodiaceae	Lycopodiella	cernua (L.) Pic.Serm.	ind		DLNR (1989); Wood (obs.)
Cyperaceae	Machaerina	angustifolia (Gaudich.) T.Koyama	ind		DLNR (1989); Wood (obs.)
Rutaceae	Melicope	clusifolia (A.Gray) T.G.Hartley & B.C.Stone	end		DLNR (1989); Wood (obs.)
Rutaceae	Melicope	orbicularis (Hillebr.) T.G.Hartley & B.C.Stone	end	SIE	Wood 14762 (PTBG)
Rutaceae	Melicope	sessilis (H.Lév.)	end		Wood 14769 (PTBG)
Myrtaceae	Metrosideros	polymorpha Gaudich.	end		DLNR (1989); Wood (obs.)
Myrtaceae	Metrosideros	polymorpha Gaudich. var. glaberrima (H.Lév.) H.St.John	end		Wood (obs.)
Myrtaceae	Metrosideros	polymorpha Gaudich. var. incana (H.Lév.) H.St.John	end		Wood 3138 (PTBG)
Myrtaceae	Metrosideros	polymorpha Gaudich. var. pseudorugosa Skottsbr.	end	SIE	Wood (obs.)
Dennstaedtiaceae	Microlepia	strigosa (Thunb.) C.Presl var. mauiensis (W.H.Wagner) D.D.Palmer	end, C		Wood 5526
Primulaceae	Myrsine	lessertiana A.DC.	end		DLNR (1989); Wood (obs.)
Primulaceae	Myrsine	sandwicensis A.DC.	end		Wood 3136 (PTBG)
Primulaceae	Myrsine	vaccinioides W.L.Wagner, D.R.Herbst & Sohmer	end, C	SIE	Wood 5553, 6071 (PTBG); DLNR (1989)
Lomariopsidaceae	Nephrolepis	cordifolia (L.) C.Presl	ind		DLNR (1989); Wood (obs.)
Lomariopsidaceae	Nephrolepis	exaltata (L.) Schott subsp. hawaiiensis W.H.Wagner	end		Wood (obs.)
Lomariopsidaceae	Nephrolepis	multiflora (Roxb.) F.M.Jarrett ex C.V.Morton	nat		DLNR (1989); Wood (obs.)

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
Rubiaceae	Nertera	granadensis (Mutis) Druce	ind		DLNR (1989); Wood (obs.)
Solanaceae	Nothocestrum	longifolium A.Gray	end		Wood 3154 (PTBG)
Apocynaceae	Ochrosia	compta K.Schum	end, SOC		Oppenheimer H100403 (PTBG)
Poaceae	Oplismenus	hirtellus (L.) P.Beauv.	nat		Wood (obs.)
Cyperaceae	Oreobolus	furcatus H.Mann	end		Wood 6074, 6075 (PTBG); DLNR (1989)
Poaceae	Paspalum	conjugatum P.J.Bergius	nat		DLNR (1989); Wood (obs.)
Poaceae	Paspalum	urvillei Steud.	nat		DLNR (1989)
Piperaceae	Peperomia	eekana C.DC.	end		Wood 3152, 6070 (PTBG); DLNR (1989)
Piperaceae	Peperomia	expallescens C.DC.	end		Wood 5151, 5152 (PTBG)
Piperaceae	Peperomia	hirtipetiola C.DC.	end		Wood 3129 (PTBG); DLNR (1989)
Piperaceae	Peperomia	macraeana C.DC.	end		Perlman 10594 (PTBG)
Piperaceae	Peperomia	obovatilimba C.DC.	end		DLNR (1989)
Celastraceae	Perrottetia	sandwicensis A.Gray	end		Wood 3144 (PTBG)
Lamiaceae	Phyllostegia	ambigua (A.Gray) Hillebr.	end		Wood 3137, 5154, 6063 (PTBG)
Lamiaceae	Phyllostegia	glabra (Gaudich.) Benth.	end		Perlman 15762
Piperaceae	Piper	methysticum G.Forst.	pol		DLNR (1989)
Urticaceae	Pipturus	albidus (Hook. & Arn.) A.Gray	end		DLNR (1989); Wood (obs.)
Pittosporaceae	Pittosporum	glabrum Hook. & Arn.	end		DLNR (1989); Wood (obs.)
Plantaginaceae	Plantago	pachyphylla A.Gray	end		Wood 3127, 14764 (PTBG); DLNR (1989)
Polypodiaceae	Polypodium	pellucidum Kaulf.	end		DLNR (1989); Wood (obs.)
Areaceae	Pritchardia	forbesiana Rock	end, SOC	SIE	Wood 3161 (PTBG)

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
Thelypteridaceae	Pseudophegopteris	keraudreniana (Gaudich.) Holtum	end		Wood 5524
Myrtaceae	Psidium	cattleianum Sabine	nat		DLNR (1989); Wood (obs.)
Myrtaceae	Psidium	guajava L.	nat		DLNR (1989)
Psilotaceae	Psilotum	complanatum Sw.	ind		Wood (obs.)
Rubiaceae	Psychotria	kaduana (Cham. & Schltl.) Fosberg	end		Wood 5157 (PTBG)
Rubiaceae	Psychotria	mariniana (Cham. & Schltl.) Fosberg	end		DLNR (1989); Wood (obs.)
Rubiaceae	Psychotria	mauiensis Fosberg	end		DLNR (1989)
Pteridaceae	Pteris	excelsa L.	ind		DLNR (1989)
Pteridaceae	Pteris	irregularis Kaulf.	end		Wood 3146 (PTBG)
Pteridaceae	Pteris	lidgatei (Baker) Christ	end, E		Wood 3149 (PTBG); HBMP
Cyperaceae	Pycreus	polystachyos (Rottb.) P. Beauv.	ind		Wood (obs.)
Cyperaceae	Rhynchospora	chinensis Nees & Meyen subsp. spiciformis (Hillebr.) T.Koyama	ind		DLNR (1989); Wood (obs.)
Rosaceae	Rubus	rosifolius Sm.	nat		DLNR (1989); Wood (obs.)
Poaceae	Sacciolepis	indica (L.) Chase	nat		DLNR (1989); Wood (obs.)
Blechnaceae	Sadleria	cyatheoides Kaulf.	end		DLNR (1989); Wood (obs.)
Blechnaceae	Sadleria	pallida Hook. & Arn.	end		DLNR (1989); Wood (obs.)
Blechnaceae	Sadleria	souleyetiana (Gaudich.) T.Moore	end		Wood (obs.)
Blechnaceae	Sadleria	squarrosa (Gaudich.) T.Moore	end		Wood 3151 (PTBG); DLNR (1989)
Apiaceae	Sanicula	purpurea H.St.John & Hosaka	end, E		Wood 6068 (PTBG)
Goodeniaceae	Scaevola	chamissoniana Gaudich.	end		Wood 5550; DLNR (1989)
Goodeniaceae	Scaevola	hobdyi W.L.Wagner	end, SOC, EX	SIE	HBMP

FAMILY	GENUS	SPECIES	STATUS	SIE	SOURCE / HERBARIUM VOUCHER
Schizaeaceae	Schizaea	robusta Baker	end		DLNR (1989); Wood (obs.)
Selaginellaceae	Selaginella	arbuscula (Kaulf.) Spring	end		DLNR (1989); Wood (obs.)
Selaginellaceae	Selaginella	deflexa Brack.	end		DLNR (1989)
Poaceae	Setaria	parviflora (Poir.) Kerguelen	nat		DLNR (1989); Wood (obs.)
Smilacaceae	Smilax	melastomifolia Sm.	end		DLNR (1989); Wood (obs.)
Lindsaeaceae	Sphenomeris	chinensis (L.) Maxon ex Kramer	ind		DLNR (1989); Wood (obs.)
Lamiaceae	Stenogyne	kamehamehae Wawra	end		DLNR (1989); Wood (obs.)
Gleicheniaceae	Sticherus	owhyhensis (Hook.) Ching	end		DLNR (1989); Wood (obs.)
Myrtaceae	Syzygium	jambos (L.) Alston	nat		DLNR (1989)
Tectariaceae	Tectaria	gaudichaudii (Mett.) Maxon	end		DLNR (1989)
Araliaceae	Tetraplasandra	oahuensis (A.Gray) Harms	end		Wood 3141, 14770 (PTBG); DLNR (1989)
Thelypteridaceae	Thelypteris	globulifera (Brack.) C.F. Reed	end		Wood (obs.)
Melastomataceae	Tibouchina	herbacea (DC.) Cogn.	nat		DLNR (1989); Wood (obs.)
Urticaceae	Touchardia	latifolia Gaudich.	end		DLNR (1989); Wood (obs.)
Ericaceae	Vaccinium	calycinum Sm.	end		DLNR (1989); Wood (obs.)
Ericaceae	Vaccinium	dentatum Sm.	end		Wood (obs.)
Hymenophyllaceae	Vandenboschia	cyrtotheca (Hillebr.) Copel.	end		Wood 3160 (PTBG); DLNR (1989)
Violaceae	Viola	maviensis H.Mann	end		Wood 14760 (PTBG); DLNR (1989)
Thymelaeaceae	Wikstroemia	bicornuta Hillebr.	end, SOC		Wood 3140, 6095, 14765 (PTBG); DLNR (1989)
Thymelaeaceae	Wikstroemia	oahuensis (A.Gray) Rock	end		Wood (obs.)
Zingiberaceae	Zingiber	zerumbet (L.) J.E.Sm.	pol		DLNR (1989)

## LITERATURE CITED

DLNR (1989) West Maui Natural Area Management Plan, Natural Area Reserve System, State of Hawai`i.

HBMP (2006) Hawaii Biodiversity and Mapping Program, Natural Diversity Database, 677 Ala Moana Blvd. Suite 705, Honolulu, Hawai`i 96813.

Palmer, D. D. (2003) *Hawai`i's Ferns and Fern Allies*. University of Hawai`i Press, Honolulu.

Wagner, W. L., Herbst, D. R. & S. H. Sohmer (1999) *Manual of the flowering plants of Hawai`i, revised edition* with supplement by Wagner, W. L. and D. R. Herbst, pp. 1855-1918. Univ. of Hawaii Press, 1919 pp. in 2 volumes. (Bishop Museum Special Publication 97).