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A Survey of Botanical, Avian and Terrestrial  
Mammalian Species for the Waikoloa Highlands  
Subdivision Project, South Kohala District,  
Island of Hawai'i.

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## ***Introduction***

The Vitoil Corporation is seeking a State Land Use Boundary Amendment from Agricultural to Rural, so as to be able to develop a residential subdivision consisting of 400+ lots, in two phases, on approximately 700-acres of land identified as TMK (3) 6-8-002:0016 and 6-8-003:032 located adjacent to the existing Waikoloa Village in the South Kohala District, Island of Hawaii (Figure 1).

This report summarizes the findings of the botanical, avian and mammalian surveys that were conducted on the subject property to determine the potential effects of the proposed development on biological resources present on the site, and within the general project area.

The primary purpose of the survey was to determine if there were any botanical, avian or mammalian species currently listed as endangered, threatened, or proposed for listing under either the federal or the State of Hawai'i's endangered species programs on, or within in the immediate vicinity of the site. Federal and State of Hawai'i listed species status follows species identified in the following referenced documents (Division of Land and Natural Resources (DLNR) 1998, Federal Register 2005, U. S. Fish & Wildlife Service (USFWS) 2005, 2006). Fieldwork was conducted on May 11, through the 13, 2006.

Avian phylogenetic order and nomenclature follows *The American Ornithologists' Union Check-list of North American Birds 7<sup>th</sup> Edition* (American Ornithologists' Union 1998), and the 42<sup>nd</sup> through the 46<sup>th</sup> supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986). Plant names follow *Hawai'i's ferns and fern allies* (Palmer, 2003) for ferns, *Manual of the Flowering Plants of Hawai'i* (Wagner et al. 1990, 1999) for native and naturalized flowering plants, and *A Tropical Garden Flora* (Staples and Herbst, 2005) for ornamental plants. Place names follow *Place Names of Hawaii* (Pukui et al. 1976).

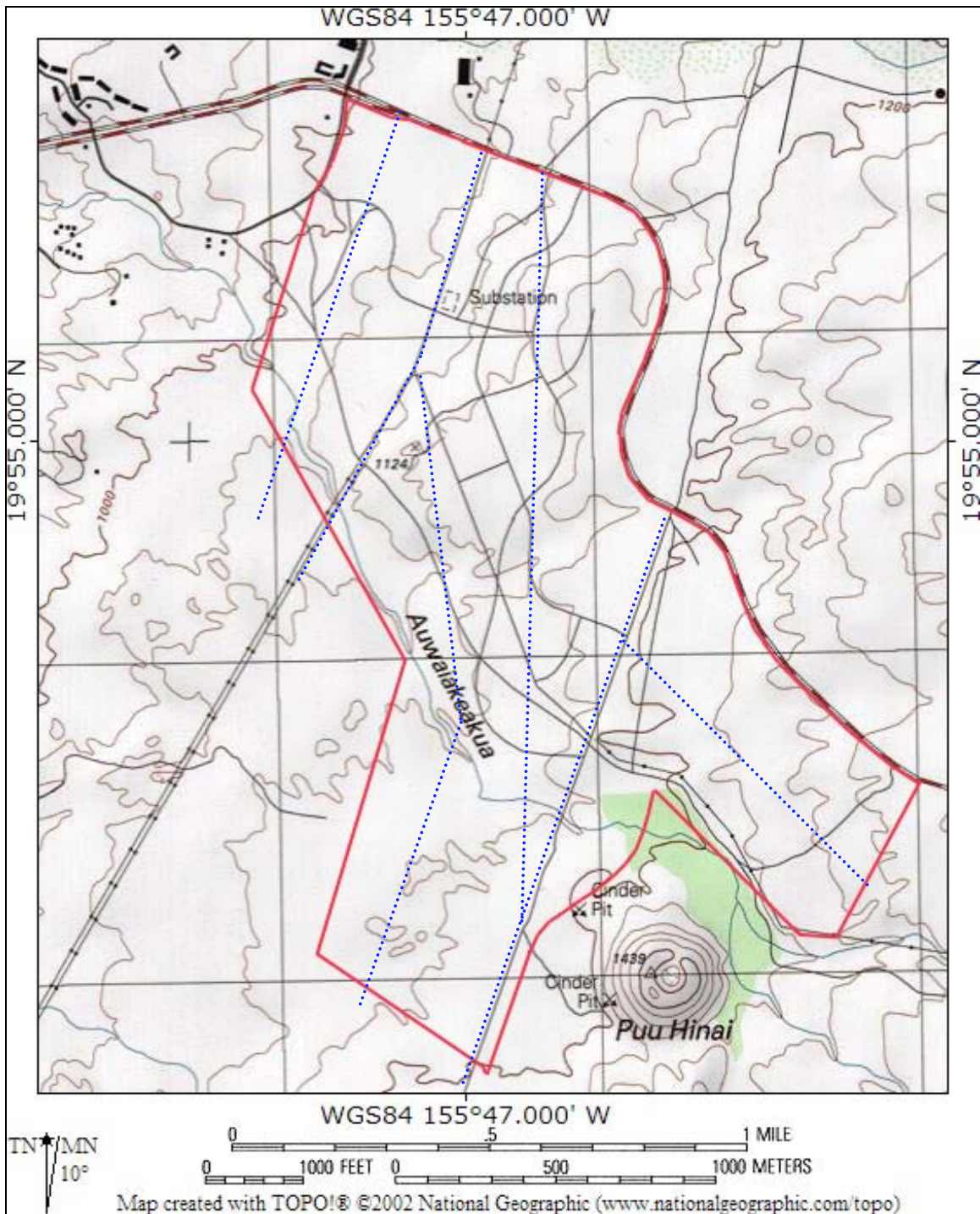
Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text on Page 19.

## ***General Site and Project Description***

The approximately 700-acre site is bound to the north by Waikoloa Road, to the west by Paniolo Avenue and to the south and east by undeveloped grassland. There is a large active quarry on Pu'u Hina'i, a scoria cinder cone dating to the Pleistocene Age which is located immediately southeast of the proposed development (Figure 1).

The project site gently slopes from east to west, from an elevation of ~ 1,340-feet above mean sea level (MSL), at the northeastern terminus of the project, adjacent to Waikoloa

**Figure 1 Waikoloa Highlands Subdivision Project Site and Wildlife Transects:**  
Site is Outlined in (Red) – Transects in Dotted (Blue)



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Road, down to ~ 1,000-foot MSL at the western edge of the property along Auwaiakeakua Gulch, which transects the site from southeast to northwest along the southern edge of the property (United States Geological Survey 1997). The terrain is composed of a mix of 'a'ā and pāhoehoe lava flows, the bulk of which were disgorged from Mauna Kea between 65,000 and 250,000 years ago during the Pleistocene Age, this in turn is overlain on the southern portion of the site below Auwaiakeakua Gulch, with newer flows deposited between 14,000 and 65,000 years ago (Wolfe and Morris 1996).

### ***Mammalian Survey Methods***

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or 'ōpe'ape'a as it is known locally, all terrestrial mammals currently found on the Island of Hawai'i are alien species. Most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all vertebrate species observed and heard within the project area. Visual and electronic scans, using a Broadband AnaBat II<sup>®</sup> ultrasonic bat detector, were made for bats during crepuscular periods on the evening of May 13, 2006.

### ***Mammalian Survey Results***

A total of eight mammalian species were detected during the course of this survey. A lone European house mouse (*Mus domesticus*) was seen crossing a four-wheel drive road adjacent to the Hawaiian Electric Light Companies substation located east of the Waikoloa Post office. Several dogs (*Canis f. familiaris*) were heard barking from within the Waikoloa Stables, located just north of the project site. One small Indian mongoose (*Herpestes a. auropunctatus*) was seen walking down the Pu'u Hīna'i Quarry access road. A litter of cats (*Felis catus*) were heard within Waiakeakua Gulch, west of the quarry. Several herds of goats (*Capra h. hircus*) were seen within the project site on all three days that we were on the property. Additionally, scat, tracks, and sign of dog, cat, horse (*Equus c. caballus*), pig (*Sus s. scrofa*), goat, and sheep (*Ovis aries*) were encountered at numerous locations within the study site. All mammals recorded are considered to be alien to the Hawaiian Islands. Hawai'i's sole endemic terrestrial mammalian species, the endangered Hawaiian hoary bat, was not detected during the course of this survey.

### ***Avian Survey Methods***

Twenty-one avian count stations were sited along linear transects within the project site (Figure 1). Count stations were placed at approximately 300-meter intervals equally spaced along these transects. Six-minute point counts were made at each of the 21-count stations. Each station was counted once. Field observations were made with the aid of Leitz 10 X 42 binoculars and by listening for vocalizations. Counts were concentrated between 07:00 a.m. and 11:00 a.m., the peak of daily bird activity. An additional two hours were spent within the project area on the evenings of May 13, 2006, and on the

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morning of February 13, 2006, in an attempt to detect nocturnally flying seabirds overflying the project area. Time not spent counting was used to search the remainder of the project site for species and habitats that were not detected during count sessions.

### ***Avian Survey Results***

A total of 115 individual birds of nine different species, representing seven separate families, were recorded during station counts (Table 1). All nine species detected are alien to the Hawaiian Islands.

Avian diversity and densities were extremely low. Three species, Black Francolin (*Francolinus francolinus*), Sky Lark (*Alauda arvensis*), and African Silverbill (*Lonchura cantans*), accounted for more than 90% of the total number of birds recorded during station counts. The most common avian species recorded was Black Francolin, which accounted for 38% of the total number of individual birds recorded. A remarkably low number of five individual birds were recorded per station count.

### ***Botanical Survey Methods***

Botanical resources in the project area were investigated by conducting wandering “transects” over the terrain and noting species as they were encountered. Surveys were conducted on May 11-12, 2006. Photographs were taken and, in some cases, specimens collected, to verify field identifications. As the survey progressed, a total of 72-waypoints (intermittent position locations) were entered into a hand-held GPS unit (Garmin *etrex* “Vista”®). These 72-points were later downloaded into a computer-mapping program (TOPO! ®) and a map produced showing the general route of the survey (Figure 2; waypoints shown as blue diamonds with red centers). Because only waypoints of the botanists were recorded, the actual ground covered during the survey was more extensive, in addition to the fact that the actual route taken by the botanist was more convoluted than shown. This survey was conducted following a relatively wet period on Hawai’i. Consequently, most of the plants encountered (including annuals) were growing well and were in flower and/or fruiting, making positive identifications relatively easy.

A plant checklist (Table 2) was compiled from the observations, with entries arranged alphabetically under family names. Included in the list are scientific name, common name, and status (whether native or not-native) of each species. In addition to identifying the plants present within the study site, qualitative estimates of plant abundance were made. These are coded in the table as explained in the Legend to Table 2 and apply to observations made during the present survey. For some species, a two-level system of abundance is used: the letter-number codes indicating species that have a limited distribution (e.g., found in only one small area of the property), but where present occur in numbers exceeding just a few individuals. For example, an abundance rating of “R” indicates a plant encountered only one to several times during the entire survey. A “R1”

indicates a plant encountered in just one or two places, but with several individuals present in that place.

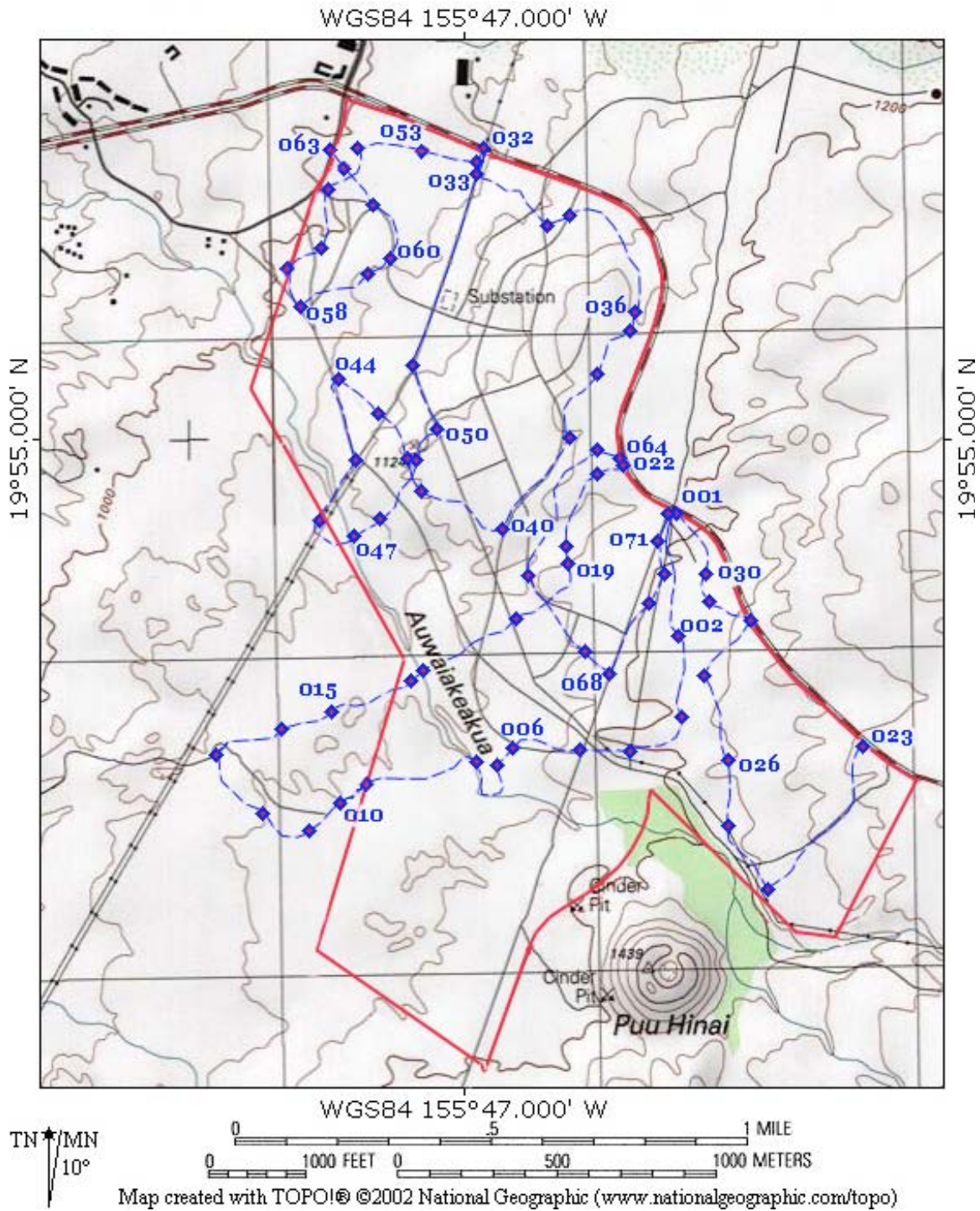
<b>Table 1 Avian Species Detected, Waikoloa Highlands Subdivision Site</b>			
Common Name	Scientific Name	ST	RA
GALLIFORMES			
PHASIANIDAE – Pheasants & Partridges			
Phasianinae – Pheasants & Allies			
Gray Francolin	<i>Francolinus pondicerianus</i>	A	0.05
Black Francolin	<i>Francolinus francolinus</i>	A	2.01
COLUMBIFORMES			
COLUMBIDAE – Pigeons & Doves			
Zebra Dove	<i>Geopelia striata</i>	A	0.10
Mourning Dove	<i>Zenaida macroura</i>	A	0.10
PASSERIFORMES			
ALAUDIDAE – Larks			
Sky Lark	<i>Alauda arvensis</i>	A	1.62
ZOSTEROPIDAE – White-Eyes			
Japanese White-eye	<i>Zosterops japonicus</i>	A	0.05
MIMIDAE – Mockingbirds & Thrushes			
Northern Mockingbird	<i>Mimus polyglottos</i>	A	0.10
STURNIDAE – Starlings			
<i>Table 1 (continued)</i>			
Common Myna	<i>Acridotheres tristis</i>	A	0.14
ESTRILDIDAE - Estrildid Finches			
Estrildinae - Estrildine Finches			
African Silverbill	<i>Lonchura cantans</i>	A	1.24

**KEY TO TABLE 1**

- ST** Status  
**A** Alien Species  
**RA** Relative Abundance: Number of birds detected divided by the number of count stations (21)



**Figure 2 Waikoloa Highlands Subdivision Project Botanical Survey Transects:**  
 Site is Outlined in (Red) – Botanical Survey Routes in (Blue)





**Table 2. Flora Listing, Waikoloa Highlands Subdivision Site**

<i>Species listed by family</i>	<i>Common name</i>	<i>Status</i>	<i>Abundance</i>	<i>Notes</i>
<b>FERNS AND FERN ALLIES</b>				
<b>PTERIDACEAE</b>				
<i>Pellaea ternifolia</i> (Cav.) Link	<i>kalamoho lau li'i</i>	<b>Ind.</b>	R1	(1)
<i>Pteris hillebrandii</i> Copel.	---	<b>End.</b>	R1	(1)
<b>FLOWERING PLANTS</b>				
<b>DICOTYLEDONES</b>				
<b>AMARANTHACEAE</b>				
<i>Amaranthus spinosus</i> L.	spiny amaranth	Nat.	R	(1)
<b>ANACARDIACEAE</b>				
<i>Schinus molle</i> Raddi	California pepper tree	Orn.	R	
<b>ASCLEPIADACEAE</b>				
<i>Calotropis gigantea</i> (L.) W. T. Aiton	crown flower	Orn.	R	
<b>ASTERACEAE (COMPOSITAE)</b>				
<i>Ageratum conyzoides</i> L.	<i>maile honohono</i>	Nat.	O3	
<i>Conyza bonariensis</i> (L.) Cronq.	hairy horseweed	Nat.	U	
<i>Galinsoga</i> cf. <i>parviflora</i> Cav.	---	Nat.	U2	(1)
<i>Emilia fosbergii</i> Nicolson	<i>pualele</i>	Nat.	O	
<i>Pseudognaphalium</i> sp.	---	???	U	
<i>Senecio madagascariensis</i> Poir.	---	Nat.	C	
<i>Sonchus oleraceus</i> L.	sow thistle	Nat.	R	
<i>Verbesina enceliodes</i> (Cav.) Benth. & Hook.	golden crown-beard	Nat.	U2	(1)
<i>Xanthium strumarium</i> L.	<i>kikiana</i> , cockleburr	Nat.	R	(1)
<i>Zinnia peruviana</i> (L.) L.	Peruvian zinnia	Nat.	R	
Indet. sp. resembling <i>Hypochoeris glabra</i>	---	Nat.	R	(1)
<b>BRASSICACEAE</b>				
<i>Lepidium</i> sp.	---	Nat.	R	(3)
<b>CARYOPHYLLACEAE</b>				
<i>Petrorhagia velutina</i> (Guss.) P. Ball & Heyw.	childing pink	Nat.	O	
<b>CHENOPODIACEAE</b>				
<i>Atriplex semibaccata</i> R. Br.	Australian saltbush	Nat.	R	
<i>Chenopodium carinatum</i> R.Br.	---	Nat.	R	
<i>Chenopodium oahuense</i> (Meyen) Aellen.	<i>`aheahea</i>	<b>End.</b>	O2	
<b>CONVOLVULACEAE</b>				
<i>Ipomoea indica</i> (J. Burm.) Merr.	<i>koali'awa</i>	<b>Ind.</b>	U	
<i>Jacquemontia ovalifolia</i> (Choisy) H. Hallier	<i>pa'u-o-Hi'iaka</i>	<b>Ind.</b>	U2	
<b>CUCURBITACEAE</b>				
<i>Momordica charantia</i> L.	balsam pear	Nat.	R	

Table 2 (continued).

<b>Species listed by family</b>	<b>Common name</b>	<b>Status</b>	<b>Abundance</b>	<b>Notes</b>
<b>EUPHORBIACEAE</b>				
<i>Chamaesyce hirta</i> (L.) Millsp.	garden spurge	Nat.	R3	
<i>Chamaesyce hypericifolia</i> (L.) Millsp.	graceful spurge	Nat.	R	
<i>Euphorbia lactea</i> Haworth	mottled-candlestick tree	Orn.	R	
<i>Ricinus communis</i> L.	castor bean	Nat.	U2	
<b>FABACEAE</b>				
<i>Chamaecrista nictitans</i> (L.) Moench	partridge pea	Nat.	C	
<i>Crotalaria incana</i> L.	fuzzy rattlepod	Nat.	C	
<i>Crotalaria pallida</i> Aiton	smooth rattlepod	Nat.	U	
<i>Leucaena leucocephala</i> (Lam.) deWit	<i>koa haole</i>	Nat.	A	
<i>Erythrina sandwicensis</i> Degener	<i>wiliwili</i>	<b>End.</b>	R	
<i>Indigofera suffruticosa</i> Mill.	indigo	Nat.	C3	
<i>Macroptilium lathyroides</i> (L.) Urb.	cow pea	Nat.	R	
<i>Medicago lupulina</i> L.	black medic	Nat.	U2	
<i>Prosopis pallida</i> (Humb. & Bonpl. ex Willd.) Kunth	<i>kiawe</i>	Nat.	O2	
<b>LAMIACEAE</b>				
<i>Ocimum basilicum</i> L. var. <i>thyrsiflorum</i> (L.) Benth.	Thai basil	Orn.	R	(2)
<b>MALVACEAE</b>				
<i>Malva parviflora</i> L.	cheese weed	Nat.	R	(1)
<i>Sida ciliaris</i> L.	---	Nat.	R	
<i>Sida fallax</i> Walp.	<i>`ilima</i>	<b>Ind.</b>	A	
<i>Sida rhombifolia</i> L.	---	Nat.	R	(2)
<b>MOLLUGINACEAE</b>				
<i>Mollugo cerviana</i> (L.) Ser.	threadstem carpetweed	Nat.	C	
<b>PORTULACACEAE</b>				
<i>Portulaca pilosa</i> L.	---	Nat.	R	
<b>SAPINDACEAE</b>				
<i>Dodonaea viscosa</i> Jacq.	<i>'a'ali'i</i>	<b>Ind.</b>	O2	
<b>SOLANACEAE</b>				
<i>Nicotiana glauca</i> R.C. Graham	tree tobacco	Nat.	O3	
<i>Solanum americanum</i> Mill.	<i>popolo</i>	<b>Ind.</b>	R	
<b>STERCULIACEAE</b>				
<i>Waltheria indica</i> L.	<i>`uhaloa</i>	<b>Ind.</b>	A	
<b>THYMELAEACEAE</b>				
<i>Wikstroemia pulcherrima</i> Skottsdb.	<i>'akia</i>	<b>End.</b>	U3	
<b>VERBENACEAE</b>				
<i>Verbena litoralis</i> Kunth	<i>owi</i>	Nat.	R	(1)

Table 2 (continued).

<i>Species listed by family</i>	<i>Common name</i>	<i>Status</i>	<i>Abundance</i>	<i>Notes</i>
<b>MONOCOTYLEDONES</b>				
POACEAE				
<i>Cenchrus ciliaris</i> L.	buffelgrass	Nat.	AA	
<i>Eleusine indica</i> (L.) Gaertn.	beach wiregrass	Nat.	U	(2)
<i>Eragrostis variabilis</i> (Gaud.) Steud.	<i>kawelu</i>	<b>End.</b>	AA	
<i>Melinis repens</i> (Willd.) Zizka	Natal redtop	Nat.	U	
<i>Panicum maximum</i> Jacq.	Guinea grass	Nat.	U3	
<i>Pennisetum setaceum</i> (Forssk.) Choiv.	fountain grass	Nat.	AA	
<i>Setaria gracilis</i> Kunth	yellow foxtail	Nat.	U3	(1)
Indet. grass	small three-awn	???	R2	

### Legend to Table 2

STATUS = distributional status for the Hawaiian Islands:	
<b>end.</b> =	endemic; native to Hawaii and found naturally nowhere else.
<b>ind.</b> =	indigenous; native to Hawaii, but not unique to the Hawaiian Islands.
<b>nat.</b> =	naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.
<b>orn.</b> =	exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).
<b>pol.</b> =	Polynesian introduction before 1778.
ABUNDANCE = occurrence ratings for plants by area:	
R - Rare	seen in only one or perhaps two locations.
U - Uncommon-	seen at most in several locations
O - Occasional	seen with some regularity
C - Common	observed numerous times during the survey
A - Abundant	found in large numbers; may be locally dominant.
AA - Very abundant	abundant and dominant; defining vegetation type.
Numbers following an occurrence rating indicate clusters within the survey area. The ratings above provide an estimate of the likelihood of encountering a species within the specified survey area; numbers modify this where abundance, where encountered, tends to be greater than the occurrence rating:	
1 -	several plants present
2 -	many plants present
3 -	locally abundant
NOTES:	(1) - Seen only along the bottom of Auwaiakeakua Gulch (riparian) or a tributary stream
	(2) - Seen only along the highway shoulder area
	(3) - Plants lacking important diagnostic characters (e.g., no flowers or fruit)

## ***Botanical Survey Results***

The flora in the project area is listed above in Table 2. The site is nearly completely covered with grassland and the terrain becomes increasingly stony to the south of Auwaiakeakua Gulch (Figure 3). An exception is the riparian zone along Auwaiakeakua Stream beside Pu'u Hīna'i, where an open *kiawe* forest with grassland understory is present on moderately thick soil and alluvial bed deposits of sand and gravel. In the deeper soils all along the gulch bottom several different grasses predominate in large patches, with buffelgrass (*Cenchrus ciliaris*) and yellow foxtail (*Setaria gracilis*) most

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conspicuous (Figure 4). Note in Table 2, that a number of mostly weedy species were observed on the property only along the bottom of the gulch, reflecting germination of seeds encouraged by the recent wet season flows.

*Figure 3. View towards Pu‘u Hīna‘i*



The above figure illustrates the predominance of open grassland within the site with the exception of the bottom of Auwaiakeakua Gulch where *kiawe* trees form an open forest. Elsewhere, three species of grasses form extensive monotypic stands or are variously intermixed: *kāwelu* grass (*Eragrostis variabilis*), buffelgrass, and fountain grass (*Pennisetum setaceum*). The later two are non-natives that are extremely abundant on undeveloped lowlands of West Hawai‘i. Figure 4 illustrates a portion of Auwaiakeakua Gulch which is characterized by deep soil with a dense growth of non-native grasses.

The Kāwelu Grassland forms a nearly monospecific grass stand over a wide area near the center of the property, but is mixed with other grasses towards the margins and heavily invaded by these non-native grasses wherever roadways have been cut through the *kāwelu* stand. Several shrubs are associated with the Kāwelu Grassland: ‘*ilima* (*Sida fallax*), ‘*a‘ali‘i* (*Dodonaea viscosa*), and *koa haole* (*Leucaena leucocephala*) (Figure 5). Buffelgrass predominates in most other areas, although fountain grass is increasingly dominant on the very stony pāhoehoe flow south of Auwaiakeakua Gulch.

Shrub species that are common to abundant on the property include fuzzy rattlepod (*Crotalaria incana*), indigo (*Indigofera suffruticosa*; especially in the area of pahoehoe lava flow), and *koa haole*. A small cluster of perhaps three dozen native ‘*akia* (*Wikstroemia pulcherrima*) occurs east of the quarry entrance road not far in from Waikoloa Road. ‘*Uhaloa* (*Waltheria indica*) is ubiquitous over the area, whereas tree



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tobacco (*Nicotiana glauca*) is more common over the *pāhoehoe* flow on the south. 'Āheahea, (*Chenopodium oahuense*), another native shrub, is limited in its distribution in the survey area to the northwest corner nearest Waikoloa Village.

**Figure 4. Auwaiakeakua Gulch Characterized by Deep Soil and Alien Grasses**



**Figure 5. Kāwelu Grassland and Low Stature Shrubs: 'ilima and koa haole.**



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The *kiawe* is the most abundant tree species on the property, but is sparse outside of the riparian zone in the vicinity of Pu‘u Hīna‘i (Figure 3). A very few and widely scattered native *wiliwili* (*Erythrina sandwicensis*) trees are present within the site.

## ***Discussion***

### ***Mammalian Resources***

The findings of the mammalian survey are consistent with at least one other faunal survey conducted on lands immediately adjacent to the subject property (David 1999), as well as with other surveys conducted within similar habitat in the South Kohala District within the recent past (David 1996, 2000a, 2000b, 2002, 2004, 2005a, 2005b, 2006a).

Although not detected during the course of this survey, it is likely that Hawaiian hoary bats over-fly the site occasionally, as they have been recorded hawking for insects over at least one water feature within the Waikoloa Golf Course, and in as skeletal remains within a cave system found south of Pu‘u Hīna‘i (David 2006b).

Unlike nocturnally flying seabirds, which often collide with man-made structures, bats are uniquely adapted to avoid collision with most obstacles, man-made or natural. They navigate and locate their prey primarily by using ultrasonic echolocation, which is sensitive enough to allow them to locate and capture small volant insects at night.

Very little research into the life cycle, distribution, or population estimates of this species, has been conducted; and much of what has been studied, were small, disconnected, or anecdotal studies as opposed to coherent controlled experiments. Fundamental research into this species distribution and life cycle has just begun (Bonaccorso et al. 2005).

Although we only recorded one rodent, a European house mouse, it is likely that the other three naturalized rodents present in Hawai‘i, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), and possibly Polynesian rats (*Rattus exulans hawaiiensis*) utilize resources found within the project site.

### ***Avian Resources***

Avian diversity and densities were in keeping with the habitat present within the project area. The findings of the avian survey are consistent with at least one other faunal survey conducted on lands immediately adjacent to the subject property (David 1999), as well as with other surveys conducted within similar habitat in the South Kohala District within the recent past (David 1996, 2000a, 2000b, 2002, 2004, 2005a, 2005b, 2006a).

A total of nine avian species were detected during the course of this survey (Table 1). All nine species are alien to the Hawaiian Islands. Between late July and the end of April it is likely that one indigenous migratory species, Pacific Golden-Plover (*Pluvialis fulva*) use resources within the project site. This species is a commonly encountered migratory shorebird, which nests in the high Arctic during the summer months, but returns to



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Hawai‘i and the Tropical Pacific to spend the winters. Additionally, it is probable that the endemic Hawaiian sub-species of the nearly cosmopolitan Short-eared Owl (*Asio flammeus sandwichensis*) uses resources within the general project area, as this species has been regularly documented within the South Kohala grasslands (David 2002, 2005a, 2005b, 2005c, 2006b).

Although not detected during this survey, it is possible that small numbers of the endangered endemic Hawaiian Petrel (*Pterodroma sandwichensis*), and the threatened Newell’s Shearwater (*Puffinus auricularis newelli*), over-fly the project area between the months of May and November (Banko 1980a, 1980b, Harrison 1990, Day et al. 2003a). Recent surveys using ornithological radar have recorded both species flying inland from Kawaihae (Day et al. 2003a)

Hawaiian Petrels were formerly common on the Island of Hawai‘i (Wilson and Evans 1890–1899). This pelagic seabird reportedly nested in large numbers on the slopes of Mauna Loa and in the saddle area between Mauna Loa and Mauna Kea (Henshaw 1902), as well as at the mid-to-high elevations of Mount Hualālai. It has, within recent historic times, been reduced to relict breeding colonies located at high elevations on Mauna Loa and, possibly, Mount Hualālai (Banko 1980a, Banko et al. 2001, Cooper and David 1995, Cooper et al. 1995, Day et al. 2003a, Harrison 1990, Simons and Hodges 1998). The United States Fish & Wildlife Service listed Hawaiian Petrels as an endangered species in 1967 and by the State of Hawai‘i in 1973 (Federal Register 1967, DLNR 1998)

Newell’s Shearwaters were formerly common on the Island of Hawai‘i (Wilson and Evans 1890–1899). This species breeds on Kaua‘i, Hawai‘i, and Moloka‘i. Newell’s Shearwater populations have dropped precipitously since the 1880s (Banko 1980b, Day et al., 2003b). This pelagic species nests high in the mountains in burrows excavated under thick vegetation, especially *uluhe* (*Dicranopteris linearis*) fern. Newell’s Shearwater was listed as a threatened species by the USFWS in 1975 and by the State of Hawai‘i in 1973 (Federal Register 1975, DLNR 1998).

The primary cause of mortality in both Hawaiian Petrels and Newell’s Shearwaters is thought to be predation by alien mammalian species at the nesting colonies (USFWS 1983, Simons and Hodges 1998, Ainley et al. 2001). Collision with man-made structures is considered to be the second most significant cause of mortality of these seabird species in Hawai‘i. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley 1961, Telfer 1979, Sincock 1981, Reed et al. 1985, Telfer et al. 1987, Cooper and Day 1998, Podolsky et al. 1998, Ainley et al. 2001). There is no suitable nesting habitat within or close to the project area for either of these pelagic seabird species.

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### ***Botanical Resources***

The flora of the project area is comprised mostly of lichens on exposed rock surfaces and flowering plants. Over much of the area, alien plant species predominate. A total of 58-species of plants including two species of ferns, were observed during the plant survey (Table 2). The dry climate and well-drained soils are not conducive to supporting most fern species found in Hawai‘i, and the two species observed occurred in small numbers on exposed rock areas in a normally dry wash. However, both species (*Pelaea ternifolia* and *Pteris hillebrandii*) are natives, the latter is an endemic.

Of the 56-species of flowering plants listed in the table, ten (10 or 17.9%) are known to have been present in the Hawaiian Islands prior to the arrival of James Cook in 1778. Of these 10, four are endemic, and the remaining six are indigenous species. If we consider the abundance estimates for these native species, several are very abundant in the project area: notably *kāwelu* (*Eragrostis variabilis*) and *‘ilima* (*Sida fallax*). Both were most abundant in the central part of the property.

Although the property is mostly covered by non-native grasslands, and these grasslands are best developed along the low areas of Auwaiakeakua gulch, a native Kāwelu Grassland occupies the more central part of the property roughly between the highway (Waikoloa Road) and the gulch and the quarry entrance road and the powerline road. Close to the highway and close to the gulch, non-native grasses dominate, and within the *kāwelu* stand, non-native grasses dominate all areas of previous grading, as has occurred for access roads and fire suppression. This distribution suggests that a *kāwelu* grassland is capable of excluding the prolific non-native grasses—such as buffleggrass and fountain grass that now dominate the landscape of West Hawai‘i—until a disturbance and then non-natives invade and are effective at preventing reestablishment of *kāwelu*.

### ***Potential Impacts to Protected Species***

#### ***Hawaiian Hoary Bat***

As previously discussed, it is likely that Hawaiian hoary bats over-fly the general project area on a seasonal basis. There is no suitable vegetation on the site for bats to roost in, so it is unlikely that the clearing of the current vegetation, and the development of a subdivision on this property will result in deleterious impacts to this species. The planting of trees and ornamental vegetation following development may increase the presence of prey items for this insectivorous bat, and thus may in fact enhance foraging resources for this species in the area.

#### ***Hawaiian Petrel and Newell’s Shearwater***

The principal potential impact that the development of the proposed Waikoloa Highlands Subdivision poses to Hawaiian Petrels and Newell’s Shearwaters is the increased threat that birds will be downed after becoming disoriented by street lights associated with the new development.

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### ***Botanical Resources***

No plant species currently listed as endangered, threatened, or proposed for listing under either the federal or the State of Hawai‘i’s endangered species programs were recorded within or close to the proposed project site.

### ***Conclusions***

It is not expected that the development of the proposed Waikoloa Highlands Subdivision will result in deleterious impacts to native avian or mammalian resources present within the South Kohala District. There will be adverse impacts to the native plant assemblages present within the site.

### ***Recommendations***

If streetlights are installed in conjunction with the various new roads planned for this new subdivision, it is recommended that lights be shielded to reduce the potential for interactions of nocturnally flying Hawaiian Petrels and Newell’s Shearwaters with external lights and man-made structures (Reed et al. 1985, Telfer et al. 1987). This mitigation would serve the dual purpose of minimizing the threat of disorientation and downing of Hawaiian Petrels and Newell’s Shearwaters, while at the same time complying with the Hawaii County Code § 14 – 50 *et seq.* which requires the shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

Use of plants indigenous to the area is encouraged for landscaping of public areas following development. The ‘*akia* found here (*Wikstroemia pulcherrima*) is an especially attractive plant that has potential to be a signature plant for the development. *Wiliwili* trees, increasingly rare in the Waikoloa area, are likewise deserving of consideration for wider planting in the area. Native plantings would have a distinct advantage over more typical landscape schemes of not requiring irrigation once the plants become established.

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***Glossary:***

'A 'ā – Clinker lava formed by slow moving lava flows

Alien – Introduced to Hawai'i by humans

Crepuscular – Twilight hours

Endangered – Listed and protected under the Endangered Species Act of 1973, as amended as an endangered species.

Endemic – Native and unique to the Hawaiian Islands

Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally

Nocturnal – Night-time, after dark

*Pāhoehoe* – Sheet lava formed by relatively fast moving lava flows

Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young

Threatened – Listed and protected under the ESA as a threatened species

Volant – Flying, capable of flight, as in flying insect

DLNR – Hawaii State Department of Land & Natural resources.

MSL – Mean Sea Level

TMK – Tax Map Key

USGS – United States Geological Survey

USFWS – United States Fish & Wildlife Service

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**Literature Cited:**

- Ainley, D. G, R. Podolsky, L. Deforest, G. Spencer, and N. Nur. 2001. The Status and Population Trends of the Newell's Shearwater on Kaua'i: Insights from Modeling, *In: Scott, J. M, S. Conant, and C. Van Riper III (editors) Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna*. Studies in Avian Biology No. 22.: Cooper's Ornithological Society, Allen Press, Lawrence, Kansas. (Pg. 108-123)
- American Ornithologist's Union. 1998. *Check-list of North American Birds*. 7th edition. AOU. Washington D.C. 829pp.
- \_\_\_\_\_. 2000. Forty-second supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 117:847-858.
- Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2002. Forty-third supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 119:897-906.
- \_\_\_\_\_. 2003 Forty-fourth supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 120:923-931.
- \_\_\_\_\_. 2004 Forty-fifth supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 121:985-995.
- \_\_\_\_\_. 2005 Forty-sixth supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 122:1031-1031.
- Banko, W. E. 1980a. Population Histories- Species Accounts Seabirds: Hawaiian Dark-rumped Petrel ('Ua'u). Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Department of Botany, Technical Report #5B.
- \_\_\_\_\_. 1980b. Population Histories- Species Accounts Seabirds: Newell's Shearwater ('A'o). Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Department of Botany, Technical Report #5A.
- Banko, P. C., R. E. David, J. D. Jacobi, and W. E. Banko. 2001. Conservation Status and Recovery Strategies for Endemic Hawaiian Birds, *In: Scott, J. M, S. Conant, and C. Van Riper III (editors) Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna*. Studies in Avian Biology No. 22. Cooper's Ornithological Society, Allen Press, Lawrence, Kansas (Pg. 359-376).
- Bonaccorso, F. J., C. M. Todd and, A. C. Miles. 2005. Interim Report on Research to Hawaiian Bat Research Consortium for The Hawaiian Hoary Bat, Ope'ape'a, *Lasiurus cinereus semotus*. 1 September 2004 to 31 August 2005
- Cooper, B. A. and R. E. David. 1995. Radar and Visual Surveys of Seabirds in the HELCO SSP Unit 71, Puna, Hawaii, During July 1995. Prepared for R. M. Towill Corporation & Hawaii Electric Light Co.

- 
- Cooper, B.A., R.E. David, and R.J. Blaha. 1995. Radar and Visual Surveys of Endangered Seabirds and Bats in the Pohakuloa Training Area, Hawai‘i, During Summer 1995. Prepared for R.M. Towill Corporation and the U.S. Army Corps of Engineers, Pacific Division (POD).
- Cooper, B. A and R. H. Day. 1998. Summer Behavior and Mortality of Dark-rumped Petrels and Newells’ Shearwaters at Power Lines on Kauai. *Colonial Waterbirds*, 21 (1): 11-19.
- David, R. E. 1996. Ornithological and Mammalian Surveys of the Waikalooa Maneuver Area, Waimea, Island of Hawai‘i, Hawaii. Prepared for: Wil Chee Planning and the U.S. Army Corps of Engineers, Pacific Ocean Division . 32 pp.
- \_\_\_\_\_. 1999. A Survey of Terrestrial Vertebrate Species Associated with the Waikoloa Maneuver Area, Phase II: Waikoloa Village and Surrounding Areas, Island of Hawai‘i, Hawai‘i. Prepared for: Edward K. Noda & Associates and the U.S. Army Corps of Engineers, Pacific Ocean Division.
- \_\_\_\_\_. 2000a. Waimea Trails and Greenways Avian and Mammalian Surveys. Prepared for: AECOS Consultants, and Gerald Park Consulting.
- \_\_\_\_\_. 2000b. A Survey of Terrestrial Vertebrate Species Associated with the Ordnance Avoidance and Environmental Survey of the Former Nansay Hawaii Lands at Ouli, DERP-FUDS Site No. H09H1004301 and Puako, DERP-FUDS Site No. H09H1004302, South Kohala, Hawai‘i. Prepared for: Donaldson Enterprises, Inc. and the U.S. Army Corps of Engineers, Pacific Ocean Division .
- \_\_\_\_\_. 2002. A Survey of Avian and Terrestrial Mammalian Species for the Saddle Road Extension Project : Queen Ka‘ahumanu Highway to Mamalahoa Highway South Kohala & North Kona Districts, Hawai‘i. Prepared for: Okahara & Associates, and Hawai‘i Department of Transportation, Highways Division.
- \_\_\_\_\_. 2004. A Survey of Terrestrial Vertebrate Species Associated with the Ordnance Avoidance and Environmental Survey of Sector 15 of the former Waikoloa Maneuver Area, Phase III. South Kohala and Hamakua Districts, Island of Hawai‘i. Prepared for: Donaldson Enterprises Inc. & the U.S. Army Corps of Engineers, Pacific Ocean Division.
- \_\_\_\_\_. 2005a. A Survey of Avian and Terrestrial Mammalian Species for the Waimea Bypass Highway: Hawai‘i: Belt Road, Mud Lane to Parker Ranch Racetrack, South Kohala District, Island of Hawai‘i. Prepared for: Akinaka & Associates, Inc and State of Hawai‘i Department of Transportation, Highways Division (HDOT).
- \_\_\_\_\_. 2005b. A Survey of Avian and Terrestrial Mammalian Species, on the Proposed Kanu o Ka‘Āina Learning ‘Ohana Site, South Kohala District, Island of Hawai‘i. Prepared for: Kanu o Ka‘Āina Learning ‘Ohana.
- \_\_\_\_\_. 2006. A Survey of Avian and Terrestrial Mammalian Species for the Māmalahoa Highway to Kawaihae Road Connector Project, South Kohala District, Island of Hawai‘i. Prepared for Belt Collins Hawaii, Inc. and the County of Hawai‘i, Department of Transportation.
-



- 
- David, R. E 2006. Unpublished Field Notes – Island of Hawai‘i: 1985-2006.
- Day, R. H., B. Cooper, and R. J. Blaha. 2003a. Movement Patterns of Hawaiian Petrels and Newell’s Shearwaters on the Island of Hawai‘i. *Pacific Science*, 57, 2:147-159.
- Day, R. H., B. Cooper, and T. C. Telfer. 2003b. Decline of Townsend’s (Newell’s Shearwaters (*Puffinus auricularis newelli*) on Kauai, Hawaii. *The Auk* 120: 669-679.
- Department of Land and Natural Resources. (DLNR). 1998. Indigenous Wildlife, Endangered and Threatened Wildlife and Plants, and Introduced Wild Birds. Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-134-1 through §13-134-10, dated March 02, 1998.
- Federal Register. 2005b. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species That Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions. Federal Register, 70 No. 90 (Wednesday, May 11, 2005): 24870-24934.
- Hadley, T. H. 1961. Shearwater calamity on Kauai. *Elepaio* 21:60.
- Harrison, C. S. 1990. *Seabirds of Hawaii: Natural History and Conservation*. Cornell University Press, Ithica, N.Y. 249 pp.
- Henshaw, H.W. 1902. *Complete list of birds of the Hawaiian Possessions with notes on their habits*. Thrum, Honolulu. 146 pp.
- Jacobs, D. S. 1994. Distribution and Abundance of the Endangered Hawaiian Hoary Bat, *Lasiurus cinereus semotus*, on the Island of Hawai‘i. *Pacific Science*, Vol. 48, No. 2: 193-200.
- Palmer, D. D. 2003. *Hawai‘i’s ferns and fern allies*. University of Hawaii Press, Honolulu. 324 pp.
- Podolsky, R., D.G. Ainley, G. Spencer, L. de Forest, and N. Nur. 1998. “Mortality of Newell’s Shearwaters Caused by Collisions with Urban Structures on Kaua‘i”. *Colonial Waterbirds* 21:20-34.
- Pukui, M. K., S. H. Elbert, and E. T. Mookini. 1976. *Place Names of Hawaii*. University of Hawaii Press. Honolulu, Hawai‘i. 289 pp.
- Reed, J. R., J. L Sincock, and J. P. Hailman 1985. Light Attraction in Endangered Procellariiform Birds: Reduction by Shielding Upward Radiation. *Auk* 102: 377-383.
- Simons, T. R., and C. N. Hodges. 1998. Dark-rumped Petrel (*Pterodroma phaeopygia*). In A. Poole and F. Gill (editors). *The Birds of North America*, No. 345. The Academy of Natural Sciences, Philadelphia, PA. and the American Ornithologists Union, Washington, D.C.

- 
- Sincock, J. L. 1981. Saving the Newell's Shearwater. Pages 76-78 in Proceedings of the Hawaii Forestry and Wildlife Conference, 2-4 October 1980. Department of Land and Natural Resources, State of Hawaii, Honolulu.
- Staples, G. W. and D. R. Herbst. 2005. *A Tropical Garden Flora. Plants Cultivated in the Hawaiian Islands and other Tropical Places*. Bishop Museum, Honolulu. 908 pp.
- Telfer, T. C. 1979. Successful Newell's Shearwater Salvage on Kauai. 'Elepaio 39:71
- Telfer, T. C. , J. L. Sincock, 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.
- Tomich, P.Q. 1986. *Mammals in Hawaii*. Bishop Museum Press. Honolulu, Hawaii. 37 pp.
- U.S. Fish & Wildlife Service (USFWS) 1983. Hawaiian Dark-Rumped Petrel & Newell's Manx Shearwater Recovery Plan. USFWS, Portland, Oregon. February 1983.
- \_\_\_\_\_. 1998. Recovery Plan for the Hawaiian Hoary Bat. U.S. Fish & Wildlife Service, Portland, Oregon.
- \_\_\_\_\_. 2005. Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 (Tuesday, November 1, 2005).
- \_\_\_\_\_. 2006. USFWS Threatened and Endangered Species System (TESS), online at [http://ecos.fws.gov/tess\\_public/StartTESS.do](http://ecos.fws.gov/tess_public/StartTESS.do)
- United States Geological Survey (USGS). 1997. Pu'u Hinai Quadrangle, Hawaii, Hawaii Co. 7.5 minute series (Topographic). Denver, Colorado.
- Wagner, W.L., D.R Herbst, and S.H. Sohmer. 1990. *Manual of the Flowering Plants of Hawai'i*. University of Hawaii Press, Honolulu, Hawaii 1854 pp.
- Wagner, W.L. and D.R. Herbst. 1999. *Supplement to the Manual of the flowering plants of Hawai'i*, pp. 1855-1918. In: Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the flowering plants of Hawai'i. Revised edition. 2 vols. University of Hawaii Press and Bishop Museum Press, Honolulu.
- Wilson, S. B., and A. H. Evans. 1890-1899. *Aves Hawaiiensis: The birds of the Sandwich Islands*. R. H. Porter, London.
- Wolfe, E. W., and J. Morris. 1996. Geological Map of the Island of Hawaii. U.S. Department of the Interior, U.S. Geological Survey.