Appendix H: Fauna Study
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Avian and Terrestrial Surveys Conducted for the Kea‘au-Pāhoa Road Improvement Project, Puna District, Island of Hawai‘i.

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**Introduction**

The State of Hawai‘i, Department of Transportation (HDOT) is proposing to construct various improvements along approximately 15.3 kilometers (9.5 miles) of the Kea‘au-Pāhoa Road (State Route 130), from the terminus of the existing four-lane Kea‘au Bypass to its intersection with Pāhoa-Kapoho Road (Figure 1). The project is located in the Puna District, Island of Hawai‘i.

The project purpose is to improve highway safety, increase roadway capacity, and modernize State Route 130 between Kea‘au and Pāhoa. Currently, the Kea‘au-Pāhoa Road is heavily congested during its peak hours of operation. The study area is only a quarter built-out, but it is expected that over the next 20-30 years, population will double, exacerbating an already-congested situation if improvements are not made. Safety for both motorists and non-motorists is a paramount concern, as the roadway serves motor vehicles, the county’s Hele-On bus routes, bicyclists, and pedestrians. Vehicle conflict points, at the intersections and numerous driveways, contribute to an accident rate much higher than the statewide average.

This report summarizes the findings of the avian and mammalian surveys that were conducted on the project site between July 9, and July 13, 2009 as part of the environmental disclosure process. The primary purpose of the surveys was to determine if there were any 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 the immediate vicinity of the proposed right-of-way. 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, 2009).


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 15.
Figure 1 – Kea‘au-Pāhoa Road Improvement Project Location Map
**General Project and Site Description**

The approximately 15.30 kilometers (9.5-mile) long right-of-way runs from the southern end of Kea‘au, through the communities of Hawaiian Paradise Park, Orchidland, ‘Ainaloa, Keonepoko Homesteads, Nānāwale Homesteads and Pāhoa (Figure 1). HDOT is currently studying three alternatives that would improve the roadway with a combination of different cross-sections (six lanes, four lanes, and two lanes) along various segments of the corridor.

The project runs from an approximate elevation of 94 meters (308-feet) above sea level (ASL) at the southern terminus of the Kea‘au Bypass, south to the intersection of State Route 130 and Pāhoa-Kapoho Road at an approximate elevation of 204 meters (670-feet) ASL. The terrain within the project site is composed of a mix of ‘a‘ā and pāhoehoe lava flows, disgorged from Kilauea Volcano between 300 and 6000 years ago (Wolfe and Morris 1996).

The habitat present along the roadway corridor is a mix of cleared subdivision and farm lots (Figure 2), with large areas of a mixed Lowland Wet ʻōhiʻa / ʻuluhe (Metrosideros / Dicranopteris) fern forest (Figure 3 & 4), and at the southern terminus fairly dense secondary alien forest with some very large Moluccan albizia (*Paraserianthes falcataria*) trees close to the existing roadway (Figure 5).
Figure 3 – Typical low stature ʻōhia forest with mixed alien understory

Figure 4 – ʻuluhe / ʻōhia forest
Figure 5 – Albizia stand at the southern end of the project, just north of the intersection of State Route 130 and the Pāhoa-Kapoho Road

**Avian Survey Methods**

A record was kept of all avian species detected while within the project area. The entire length of the project corridor was walked first from north-to-south, and then, from south-to-north, on opposite sides of the right-of-way. Additionally, 22 eight-minute point counts were sighted along the roadway corridor. Field observations were made using Leitz 10 X 42 binoculars, and by listening for vocalizations. Counts took place between 07:30 a.m. and 10:00 a.m., the peak of daily bird activity. Time not spent counting was used to search the study site for species and habitats that were not detected during count sessions.

**Avian Survey Results**

During the course of the avian survey a total of 461 individual birds of 15 different species representing eight families were recorded (Table 1). One of the species recorded, Hawai‘i Amakihi (*Hemignathus virens*) is endemic to the Island of Hawai‘i. The remaining 14 species recorded are considered to be alien to the Hawaiian Islands. No species currently listed as threatened, endangered or proposed for listing under either the Federal or State of Hawaii endangered species statutes was detected during the course of this survey.
Avian diversity and densities were relatively low, due in no small part by the level of disturbance that the extremely busy Kea‘au-Pāhoa Road represents. Two of the species recorded Japanese White-eye (Zosterops japonicus), and House Finch (Carpodacus mexicanus) accounted for slightly less than 61 percent of the total number of birds recorded. Japanese White-eye was the most frequently detected avian species during the course of this survey. No additional species were detected as incidental observations while transiting the site.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>ST</th>
<th>RA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GALLIFORMES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phasianidae - Pheasants &amp; Partridges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Junglefowl</td>
<td>Gallus gallus</td>
<td>D</td>
<td>0.73</td>
</tr>
<tr>
<td>Ring-necked Pheasant</td>
<td>Phasianus colchicus</td>
<td>A</td>
<td>0.05</td>
</tr>
<tr>
<td>Common Peafowl</td>
<td>Pavo cristatus</td>
<td>A</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>COLUMBIFORMES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Columbidae - Pigeons &amp; Doves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock Pigeon</td>
<td>Columba livia</td>
<td></td>
<td>0.14</td>
</tr>
<tr>
<td>Spotted Dove</td>
<td>Streptopelia chinensis</td>
<td></td>
<td>1.05</td>
</tr>
<tr>
<td>Zebra Dove</td>
<td>Geopelia striata</td>
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<td>0.91</td>
</tr>
<tr>
<td><strong>PASSERIFORMES</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Timaliidae - Babblers</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hwamei</td>
<td>Garrulax canorus</td>
<td>A</td>
<td>1.77</td>
</tr>
<tr>
<td>Red-billed Leiothrix</td>
<td>Leiothrix lutea</td>
<td>A</td>
<td>0.41</td>
</tr>
<tr>
<td>Japanese White-eye</td>
<td>Zosterops japonicus</td>
<td>A</td>
<td>9.86</td>
</tr>
<tr>
<td>Common Myna</td>
<td>Acridotheres tristis</td>
<td>A</td>
<td>0.55</td>
</tr>
<tr>
<td>Northern Cardinal</td>
<td>Cardinalis cardinalis</td>
<td>A</td>
<td>1.68</td>
</tr>
<tr>
<td></td>
<td>Fringillidae - Fringilline and Cardueline Finches &amp; Allies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>House Finch</td>
<td>Carpodacus mexicanus</td>
<td>A</td>
<td>2.86</td>
</tr>
<tr>
<td>Yellow-fronted Canary</td>
<td>Serinus mozambicus</td>
<td>A</td>
<td>0.14</td>
</tr>
<tr>
<td>Hawai‘i Amakihi</td>
<td>Drepanidinae - Hawaiian Honeycreepers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hemignathus virens</td>
<td>E</td>
<td>0.18</td>
</tr>
<tr>
<td>Nutmeg Mannikin</td>
<td>Lonchura punctulata</td>
<td>A</td>
<td>0.41</td>
</tr>
</tbody>
</table>
**Key to table 1**

<table>
<thead>
<tr>
<th>ST</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Domesticated – Not known to be established in the wild on the Island of Hawai‘i</td>
</tr>
<tr>
<td>A</td>
<td>Alien – Introduced to the Hawaiian Islands by humans</td>
</tr>
<tr>
<td>E</td>
<td>Endemic – Native and unique to the Island of Hawai‘i</td>
</tr>
</tbody>
</table>

| RA | Relative Abundance – Number of birds detected divided by the number of count stations (22) |

**Mammalian Survey Methods**

All observations of mammalian species were of an incidental nature. With the exception of the endangered Hawaiian hoary bat (*Lasius 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, and 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 study area.

**Mammalian Survey Results**

Eight mammalian species were detected during the course of this survey (Table 1). Two Roof rats (*Rattus r rattus*) were seen dead on the road, and several European house mice (*Mus musculus domesticus*) were seen at several locations along the right-of-way. Several small Indian mongooses (*Herpestes a. auropunctatus*) were seen within the project corridor, as were several cats (*Felis catus*). Several horses (*Equus c. caballus*) were seen outside the right-of-way in pastures along the corridor. Track, sign and scat of pigs (*Sus s. scrofa*), was encountered in numerous locations within the study site.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>Det/Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RODENTIA - Gnawers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muridae - Old World Rats &amp; Mice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof rat</td>
<td><em>Rattus r. rattus</em></td>
<td>V</td>
</tr>
<tr>
<td>European house mouse</td>
<td><em>Mus musculus domesticus</em></td>
<td>V</td>
</tr>
<tr>
<td><strong>CARNIVORA- Flesh Eaters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canidae - Wolves, Jackals &amp; Allies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic dog</td>
<td><em>Canis f. familiaris</em></td>
<td>V, A, Si</td>
</tr>
<tr>
<td>Small Indian mongoose</td>
<td><em>Herpestes a. auropunctatus</em></td>
<td>V, Si,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Felidae- Cats</td>
</tr>
<tr>
<td>House cat</td>
<td><em>Felis catus</em></td>
<td>V</td>
</tr>
<tr>
<td>Common name</td>
<td>Scientific name</td>
<td>Det/Type</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Domestic horse</td>
<td><em>Equus c. caballus</em></td>
<td>V</td>
</tr>
</tbody>
</table>

**Key To Table 2**

<table>
<thead>
<tr>
<th>Det/Type</th>
<th>Detection type</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Visual – animals that were seen</td>
</tr>
<tr>
<td>A</td>
<td>Audio – animals that were detected by sound</td>
</tr>
<tr>
<td>Si</td>
<td>Sign – animals that were detected by seeing tracks, scat and other sign</td>
</tr>
</tbody>
</table>

**Discussion**

A one-time short duration field survey that are typically performed for environmental disclosure documents, are by their very nature, snapshots in time. The data that is generated by these surveys is augmented and put into a broader perspective by comparing the data generated to previous surveys and the experience of the investigator (In the authors case, one who has been conducting such surveys in Hawai‘i and the tropical Pacific and Asia for over 30 years). Species of particular interest not detected during a short-term survey that are likely to be present on a seasonal basis are addressed in the discussion section, which follows.

**Avian Resources**

The relatively low diversity and densities of avian species detected during the course of this survey was in keeping with the results of at least three other survey conducted on lands located close to the study site (David, 1992, 2004, 2005). In addition this is a direct result of the disturbance caused by the very heavy traffic transiting the Kea‘au-Pāhoa Road, especially during the early morning hours, when birds are most active.

All but one of the 15 avian species detected during the course of this survey are considered to be alien to the Hawaiian Islands. The lone native species recorded, Hawai‘i ‘Amakihi is the second most commonly encountered endemic avian species still extant on the island. This species is not listed as an endangered species under either federal or State of Hawai‘i endangered species statutes. The other 14 avian species detected during this survey are all considered to be alien to the Hawaiian Islands.
**Migratory Shorebirds.** Although not detected during the course of the field surveys, it is almost a certainty that two migratory indigenous shorebird species, Pacific Golden-Plover (*Pluvialis fulva*), and Ruddy Turnstone (*Arenaria interpres*), use resources within the general project area on a seasonal basis. Both of these shorebird species nest in the high Arctic during the late spring and summer months, returning to their wintering grounds in Hawaii, Japan, Okinawa, Polynesia, Micronesia, Melanesia, New Zealand, Australia, Indonesia, Philippines, southern China, southeast Asia, Bangladesh, Nepal, India, Sri Lanka, Pakistan, Iran, Bahrain, and northeast and southern Africa (Johnson and Conners 1996). Wintering birds usually leave Hawai‘i for their trip back to the Arctic in late April or the very early part of May, and return to their wintering grounds in late July. Some individuals overwinter in Hawai‘i, and thus are present all year. There is little suitable habitat within the proposed right-of-way suitable for these or other shorebird species.

**Hawaiian Hawk.** Although not detected during this survey it is probable that the endangered Hawaiian Hawk uses resources within the general project area on a seasonal basis. Hawaiian Hawks are currently found in nearly all habitats on the island that still have some large tree components. They are regularly seen foraging in the South Hilo and Puna areas. Hawk densities are highest in mature, native species dominated forests, with grassy under-stories. This habitat, with high amounts of forest edge, supports large populations of game birds and the four species of introduced rodents known from the island (two of which were detected during the course of this survey), all of which are prey items for the hawk. Additionally, this type of habitat also provides numerous perches and nesting sites suitable for this species (Klavitter 2000).

The Hawaiian Hawk, or ‘io, is the only extant *falconiforme* in Hawai‘i. It is currently endemic to the Island of Hawai‘i. Sub-fossil remains indicate that it was also formerly found on Moloka‘i and Kaua‘i (Olson & James 1997). Several incidental unconfirmed sightings of this species exist from Kaua‘i (Dole 1879, Beaglehole, 1967) and Maui (Banko 1980c). This species was first mentioned in the western literature by Cook and King in 1784 and was scientifically described by Peale in 1848 from a specimen collected in Kealakekua (Medway 1981, Peale 1848).

Current population estimates based on John Klavitter’s research extrapolates that there are currently 1,450 Hawaiian Hawks living in the wild. That number is, in his estimation, equal to or higher than the number present in pre-contact times (Klavitter 2000). The Hawaiian Hawk breeding season starts in late March, chicks hatch in May, and begin to fledge in July (Griffin et al. 1998). Although hawks use resources in most forest habitats they usually nest in ‘ōhi‘a trees (*Metrosideros polymorpha*). Of 112 nests found during the 1998 and 1999 nesting seasons, 82 percent of the nests were located in ‘ōhi‘a trees (Klavitter 2000). There are no appropriate nesting trees present on the project site for this species. The USFWS published a proposed rule to delist the Hawaiian Hawk in the *Federal Register* on August 6, 2008. The proposal is still open (*Federal Register* 2008).

**Hawaiian Petrel and Newell’s Shearwaters.** It is probable that small numbers of the endangered endemic Hawaiian Petrel (*Pterodroma sandwichensis*), or ua‘u, and the threatened Newell’s Shearwater (*Puffinus auricularis newelli*), or ‘a‘o, over-fly the project area between the months of May and November, as ornithological radar studies conducted in the Pāhoa, Hawaiian Beaches, and Paradise Park in 2001, 2002 and 2003 recorded small numbers of birds flying...
inland (Day and Cooper 2003). There is no suitable nesting habitat within or close to the proposed project site for either of these pelagic seabird species.

Hawaiian Petrels were once 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. 2003, Harrison 1990, Hue et al. 2001, Simons and Hodges 1998).

Newell’s Shearwaters, another pelagic seabird species 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 in extremely small numbers. Newell’s Shearwater populations have dropped precipitously since the 1880s (Banko 1980b, Day et al., 2003b). This species nests high in the mountains in burrows excavated under thick vegetation, especially uluhe (Dicranopteris linearis) fern.

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 (U.S. Fish & Wildlife Service 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).

Mammalian Resources

The findings of the mammalian survey are in keeping with the habitat present on the site, and keeping with the results of at least three other survey conducted on lands located close to the study site (David, 1992, 2004, 2005).

Hawaiian hoary bat. Although, no Hawaiian hoary bats were detected during the course of this survey, it is probable that bats do occasionally use resources within the general project area. Hawaiian hoary bats are regularly seen in the general project area on a seasonal basis (Jacobs 1994, David 2009). Unlike nocturnally flying seabirds, which sometimes 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.

Recent research on this species has shown that the species is present on the Island of Hawai‘i on a seasonal basis in almost all areas on the Island where dense vegetation and tree cover is present. The research also indicates that the bat is a human commensal species often associated with tree
farms and other agricultural efforts, they are also attracted to outdoor lights which attract volant insects on which this species forages (Bonaccorso et al. 2004, 2007).

Although only two of the established alien muridae known from the Island were detected during the course of this survey it is probable that the other two established species, Norway rat (Rattus norvegicus), and Polynesian rat (Rattus exulans hawaiiensis), also use resources within the project corridor on a seasonal basis, as they too are human commensal species.

**Potential Impacts to Protected Species**

**Hawaiian Hawk**
The principal potential impact that the development of the proposed Kea’au-Pāhoa Road improvement project poses to Hawaiian Hawks is if during the clearing and grubbing phases of the project an active Hawaiian Hawk nest is disturbed. With that said, there is very little suitable hawk nesting habitat within the proposed right-of-way, with the exception of the last 500-meters (1640-feet) of right-of-way on the southern terminus of the project where the Kea’au-Pāhoa Road meets the Pāhoa-Kapoho Road. There are large exotic trees along this section that potentially could be used by hawks as nest trees (Figure 5). Additionally, individual foraging hawks potentially could be temporarily disturbed by construction activity. Such potential disturbance to foraging Hawaiian Hawks is not likely to be significant, as there are miles and miles of suitable foraging habitat surrounding the length of the project corridor.

**Hawaiian Petrel and Newell’s Shearwater**
The principal potential threat that the development and operation of the proposed project poses to Hawaiian Petrels and Newell’s Shearwaters are associated with birds potentially being downed after becoming disoriented by lights associated with night time construction, and following build-out by street lights that may be required for public safety. With that said it should be borne in mind that multi-year ornithological radar studies conducted in the general project area have detected extremely small passage rates of these species through the area (Day and Cooper 2003).

**Hawaiian Hoary Bat**
The principal potential impact that the development of the proposed project poses to bats is during the clearing and grubbing phases of construction as vegetation is removed. The removal of vegetation within the project corridor may temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season female carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared, additionally adult female bats sometimes leave their pups in the roost tree while they themselves forage, very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between April 15 and August 15, the period in which bats are potentially at risk from vegetation clearing.
Conclusions

The modification of the current habitat within the proposed right-of-way is not expected to result in significant impacts to any avian or mammalian species currently listed as threatened, endangered or proposed for listing under either the Federal, or State of Hawai‘i endangered species programs. Additionally, there will be no appreciable difference in impacts associated with any of the build alternatives currently under consideration. This opinion is based on the fact that relatively simple minimization measures can be implemented to reduce the potential for deleterious impacts to occur as a direct result of this action on the four listed species that are known to occur in the project area.

Recommendations

To minimize the potential that clearing and grubbing activity might disturb nesting Hawaiian Hawks it is recommended that an audio playback nesting survey be conducted for hawks along the last kilometer of the proposed roadway corridor on the southern terminus of the project if clearing will occur during the Hawaiian Hawk nesting period. Typically such surveys are conducted in the month of January.

To reduce the potential for interactions between nocturnally flying Hawaiian Petrels and Newell’s Shearwaters with external lights and man-made structures, it is recommended that if during the construction phase of the project, nighttime construction activity becomes necessary that all lights associated with the construction activities should be shielded and or directed at the ground.

Following build-out it is recommended that any streetlights that may be required for public safety reasons along the new road be shielded (Reed et al. 1985, Telfer et al. 1987). This minimization measure 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.

It is recommended that to minimize potential impacts to Hawaiian hoary bats, woody vegetation taller than 4.6 meters (15-feet) high not be cleared between April 15 and August 15 each year.
Glossary

‘a‘ā – Clinker lava formed by slow moving lava flows
Alien - Introduced to Hawai‘i by humans.
Commensal – Animals that share humans’ food and lodgings, such as rats and mice.
Diurnal – Daytime.
Endangered – Listed and protected under the ESA as an endangered species.
Endemic – Native and unique to the Hawaiian Islands.
*Falconiforme* – Diurnal birds of prey – 271 species worldwide.
Indigenous - Native to the Hawaiian Islands, but also found elsewhere naturally.
*Mauka* – Upslope, towards the mountains.
*Muridae* – Rodents, including rats, mice and voles, one of the most diverse family of mammals.
Naturalized – A plant or animal that has become established in an area that it is not indigenous to
Nocturnal – Nighttime, after dark.
pāhoehoe – Sheet lava formed by relatively fast moving lava flows
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Sign – Biological term referring tracks, scat, rubbing, odor, marks, nests, and other signs created
by animals by which their presence may be detected
Threatened - Listed and protected under the ESA as a threatened species.
Volant – Flying, capable of flight - as in flying insect.

ASL – Above mean sea level.
DLNR – State of Hawai‘i, Department of Land and Natural Resources
HDOT – Hawai‘i Department of Transportation
USFWS – U.S. Fish & Wildlife Service
Literature Cited


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