



HAWAIIAN PETRELS NEAR THE HALEAKALĀ OBSERVATORIES: A REPORT TO K. C. ENVIRONMENTAL, CO. INC. FOR PREPARATION OF A LONG-RANGE DEVELOPMENT PLAN

INTRODUCTION

The University of Hawaii, Institute For Astronomy is preparing a long-range development plan for an 18-acre site on Haleakalā, Maui. This site, known as the Haleakalā Observatories, is adjacent to Haleakalā National Park (HNP). K.C. Environmental Co., Inc., a private environmental consulting firm, is preparing pre-planning studies for the University and requests assistance from Haleakalā NP. Of particular interest is an assessment of endangered Hawaiian Petrel populations.

Hawaiian Petrels (*Pterodroma sandwichensis*), also known by the Hawaiian name 'Ua'u, is Hawaii's only seabird that is federally listed as Endangered. About 85% of the world's known population nests on Mt. Haleakalā, Maui, near the summit. Most of the population is within National Park boundaries (Fig. 1, Haleakalā NP, unpubl. data). About 55 burrows are within $\frac{1}{2}$ mile (400 meters) of the Haleakalā Observatories but outside National Park boundaries (Fig. 2, Haleakalā NP, unpubl. data). These are considered part of the "Haleakalā population." HNP biologists have been conducting regular monitoring and searches of 'Ua'u nests since 1988.

'Ua'u are at the Haleakalā colony from February through November each year. The birds make their nests in burrows and use the same burrow year after year. Not all burrows are occupied. Regular monitoring include monthly checks of whether or not burrows are occupied, and which nests successfully fledge young birds.

The 'Ua'u fly at night. They fly from the ocean to the Haleakalā colony just before sunset, and leave the colony for the ocean just before sunrise. These birds fly up the slopes of Mt. Haleakalā, some passing near the Haleakalā Observatories (Haleakalā NP, unpubl. data).

There are several known causes of unnatural 'Ua'u mortality (Simons 1985, Natividad Hodges and Nagata 2001, Simons and Natividad Hodges 1999). Alien mammals such as feral cats, mongooses, rats, and dogs prey upon 'Ua'u and their eggs. Feral ungulates such as goats and Axis deer cave in burrows and cause nest abandonment. 'Ua'u collide into unfamiliar objects such as buildings, fences, telephone poles and lines (Natividad Hodges 1994). Haleakalā NP data show that there has been one reported instance of an 'Ua'u flying into a building at the Haleakalā Observatories.

Human-made lights confuse flying 'Ua'u. These birds are thought to navigate by stars. The birds, especially fledglings, become confused by human-made lights that imitate stars, circle around the lights, become tired, and fall to the ground. Once on the ground they are hit by cars or attacked by alien mammals (Haleakalā NP, unpubl. data.)

To reduce unnatural causes of mortality Haleakalā NP maintains predator control and feral animal control programs. Haleakalā NP also conducts a public education program to inform Maui residents of the possibility of 'Ua'u falling to the ground after become confused by bright lights.

This study examines results from the 2002 and 2003 'Ua'u nesting season and other information. The information gathered is used to provide suggests for conservation of 'Ua'u near the Haleakalā Observatories.

METHODS

Comparing Nests Near the Haleakalā Observatories vs. Away From the Observatories
There are approximately 55 burrows within $\frac{1}{2}$ mile (400 meters) of the Haleakalā Observatories. In 2002 and 2003, 18 randomly selected burrows were monitored for burrow activity and

fledging success. These randomly selected burrows were compared with burrows found within Haleakalā National Park boundaries, along the west rim of Haleakalā Crater. 128 and 99 randomly selected burrows were monitored in 2002 and 2003, respectively. Burrow activity and nesting success were compared using chi-square and Fisher Exact Tests for comparing two proportions (Zar 1984).

Nest monitoring methods described by Simons (1985) and Natividad Hodges (1994) were used. Burrows were monitored to determine if a nest was "active." "Active" nests were monitored to determine fledging success, i. e. if "active" nests showed signs of fledging chicks. Burrows were monitored at least once a month from February through October to determine burrow activity. Burrows were monitored every two weeks from October through December to determine fledging success. Criteria described by Natividad Hodges (1994) were used to determine "active" nests and nests that fledged chicks.

Mortality

The 'Ua'u entire colony was inventoried for 'Ua'u carcasses and eggs. Observatory employees agreed to report any dead 'Ua'u to the National Park Service or the Fish and Wildlife Service.

Determining Threats to 'Ua'u Near the Haleakalā Observatories

Past information on known causes of 'Ua'u mortality is available from 1960. This information, combined with information collected in 2002 and 2003 are used to determine threats to the 'Ua'u population near the Haleakalā observatories.

RESULTS

Comparing Nests Near the Haleakalā Observatories vs. Away From the Observatories

In 2002 and 2003, there was no significant difference burrow activity and fledging success between burrows near the Haleakalā Observatories and those away from the Observatories.

In 2002, 10 (56%) of 18 burrows showed signs of activity near the Observatories (Table 1). Eighty-five (66%) of 128 burrows away from the observatories showed signs of activity. Five (50%) of the 10 active burrows showed signs of fledging chicks near the Observatories. Thirty-six (42%) of 85 active burrows away from the observatories showed signs of fledging chicks. There was no significant difference in burrow activity (Z -test $0.10 < p < 0.20$; $\chi^2 = 0.3639$) and fledging success (Z -test $p > 0.50$; $\chi^2 = 0.6442$)

Table 1. 2002 results of burrows monitored near and away from the Haleakalā Observatories

	Total Surveyed	Number Active (%)	Number Fledged (%)
NEAR	18	10 (56%)	5 (50%)
AWAY	128	85 (67%)	36 (43%)

In 2003, 12 (67%) of 18 burrows showed signs of activity near the Observatories. Seventy-two (66%) of 99 burrows away from the observatories showed signs of activity. Four (33%) of the 12 active burrows showed signs of fledging chicks near the Observatories. Thirty-one (43%) of 72 active burrows away from the observatories showed signs of fledging chicks. There was no significant difference in burrow activity (Z -test $p > 0.50$; $\chi^2 = 0.5991$) and fledging success (Z -test $p > 0.50$; $\chi^2 = 0.5270$)

Table 2. 2003 results of burrows monitored near and away from the Haleakalā Observatories

	Total Surveyed	Number Active (%)	Number Fledged (%)
NEAR	18	12 (67%)	4 (33%)
AWAY	128	72 (66%)	31 (43%)

Mortalities

There were two egg mortalities in 2002 from burrows away from the Observatories. In 2003, there was two eggs mortalities; one near the Observatories and one away from Observatories. All eggs were infertile. There were no signs of predation. There were no bird mortalities in 2002 and 2003.

Threats to 'Ua'u Near the Haleakalā Observatories

Known causes of 'Ua'u mortality from 1994 to 2003 include nest collapse by feral ungulates, predation by native owls and introduced predators, roadkills, collision into unnatural objects such as buildings, utility poles, fences, lights and vehicles, and disturbance from road resurfacing activity (Natividad Hodges and Nagata 2002, Haleakalā unpubl. data).

DISCUSSION

The lack of significant difference in burrow activity and nesting success between sites near the Haleakalā Observatories and those away from the Observatories suggest that current activities at the Haleakalā Observatories do not have negative effects on nesting 'Ua'u. Construction activity for a new telescope started in September 2001 when ground excavation by heavy equipment was conducted. The building construction was complete by September 2002. This activity appeared to have no negative impact on nesting 'Ua'u. The lack of negative effect may be due to the fact heavy equipment was used during the end of the 'Ua'u nesting season and continued through the months when 'Ua'u were absent from the Haleakalā colony.

The National Park Service conducted construction activities for a new restroom facility near the House of the Sun Visitor Center. Excavation of ground materials using heavy equipment began in November 2002. This construction project ended in September 2003. This project also appeared to have no negative impact on nesting 'Ua'u. Burrows near the construction site were monitored and compared with burrows away from the site. There was no significant difference in burrow activity (Z test $p > 0.50$; $\chi^2 = 0.8735$) and fledging success (Z test $p > 0.50$; $\chi^2 = 0.9039$). The lack of negative effect on nesting 'Ua'u may be due to the fact that ground excavation occurred during months when 'Ua'u were absent from the Haleakalā colony. Only building construction occurred during the months when 'Ua'u were at the colony.

Previous data (HNP, unpubl. data) suggests that continued use of heavy equipment used near 'Ua'u has negative effects on 'Ua'u fledging success. The exact component of heavy equipment use that affects nesting 'Ua'u is unknown. Several factors could contribute to negative fledging success. These include any combination of excessive noise, exhaust, dust, and ground vibrations from heavy equipment or mitigations measures used to lessen impacts from heavy equipment.

The nests that are near the Observatories are somewhat protected from predators. The National Park Service regularly maintains predator control traps near the area. The traps in the National Park are protecting those 'Ua'u that nest near the Observatories (Natividad Hodges and Nagata 2001).

The egg mortalities that occurred in 2002 and 2003 were from adult birds abandoning eggs. Reasons for egg abandonment may be because adults knowingly abandon infertile eggs or that the adults are young, inexperienced nesters that do not lay or care for eggs appropriately. The fact that all the abandoned eggs were infertile suggests there were no unusual events or disturbances to cause egg abandonment.

The most common objects that 'Ua'u collide into are fences and utility lines and poles. 'Ua'u probably collide into unnatural objects because of the limited visibility of these objects. 'Ua'u fly at night in erratic patterns at high speeds when at the Haleakalā colony (pers. obs.). Fences, utility lines and poles may be difficult for 'Ua'u to see when flying at the colony.

There are no known instances of 'Ua'u becoming confused by human-made lights near the Observatories or within HNP. However, if "grounding" occur at the Haleakalā colony, 'Ua'u may not have enough energy to fly to their feeding grounds at the ocean.

SUGGESTIONS FOR LONG-RANGE PLANNING

Based on the information in this report and previous data, the following are suggested for 'Ua'u conservation and long-range planning at the Haleakalā Observatories.

- 1) Continue positive communication with HNP biologists. Observatory staff is already in positive communications with HNP biologists. HNP biologists consider all the 'Ua'u burrows near the summit of Haleakalā as one population, even if the nests are outside Park boundaries. Biologists regularly monitor 'Ua'u nests around the Observatories each year. Biologists also conduct predator control trapping near the Observatories. Updated information on 'Ua'u and threats are available from these biologists. The Haleakalā Observatories should continue to notify HNP of any 'Ua'u mortalities and special projects in the area.
- 2) Obtain current maps of locations of 'Ua'u burrows as needed to make decisions and statements concerning 'Ua'u conservation. HNP biologists are continuously finding and mapping new 'Ua'u burrows. These maps are available to the Haleakalā Observatories for planning purposes upon request.
- 3) Use of heavy equipment for construction should be restricted to months when 'Ua'u are absent from the colony to avoid possible disturbance to nesting 'Ua'u.
- 4) New utility lines should be underground, if possible, to avoid 'Ua'u mortality from colliding into these objects. Routes for utilities lines should be surveyed to determine if 'Ua'u burrows exist near or around these routes.
- 5) Construction of fences should be avoided, if possible, to avoid 'Ua'u mortality from colliding into fences. If fence construction is necessary, the use of barbed wire should be avoided. The fence around HNP boundary have caused 'Ua'u mortalities. Specifically, 'Ua'u were caught on the barbed wire placed at the top of the fences. Once the barbed wire was removed, mortalities decreased to near zero. The fences benefit the 'Ua'u population by keeping large feral animals out of the Park and allowing for habitat and population recovery (Natividad Hodges and Nagata 2001).
- 6) To avoid attracting 'Ua'u, lighting should not be the same color as stars. Other colors, such as red, blue, or orange or similar colors, should be considered
- 7) Drive cautiously while traveling through the Park to avoid hitting and killing 'Ua'u and the endangered Nēnē (Hawaiian Goose) that also travel on Park roads. 'Ua'u and Nēnē have been hit by cars traveling through the Park. Most road kills occurred in the dark (HNP unpubl. data).
- 8) Contain all trash, especially food items, to avoid attracting predators such as rats, cats and mongooses.
- 9) Keep Observatory staff informed of conservation issues at HNP. This will help HNP in our efforts to conserve our native resources. Information sheets on Haleakalā's resources are available from the Endangered Species Management project (ESM). ESM staff can be available to provide informational talks to Observatory employees.

References

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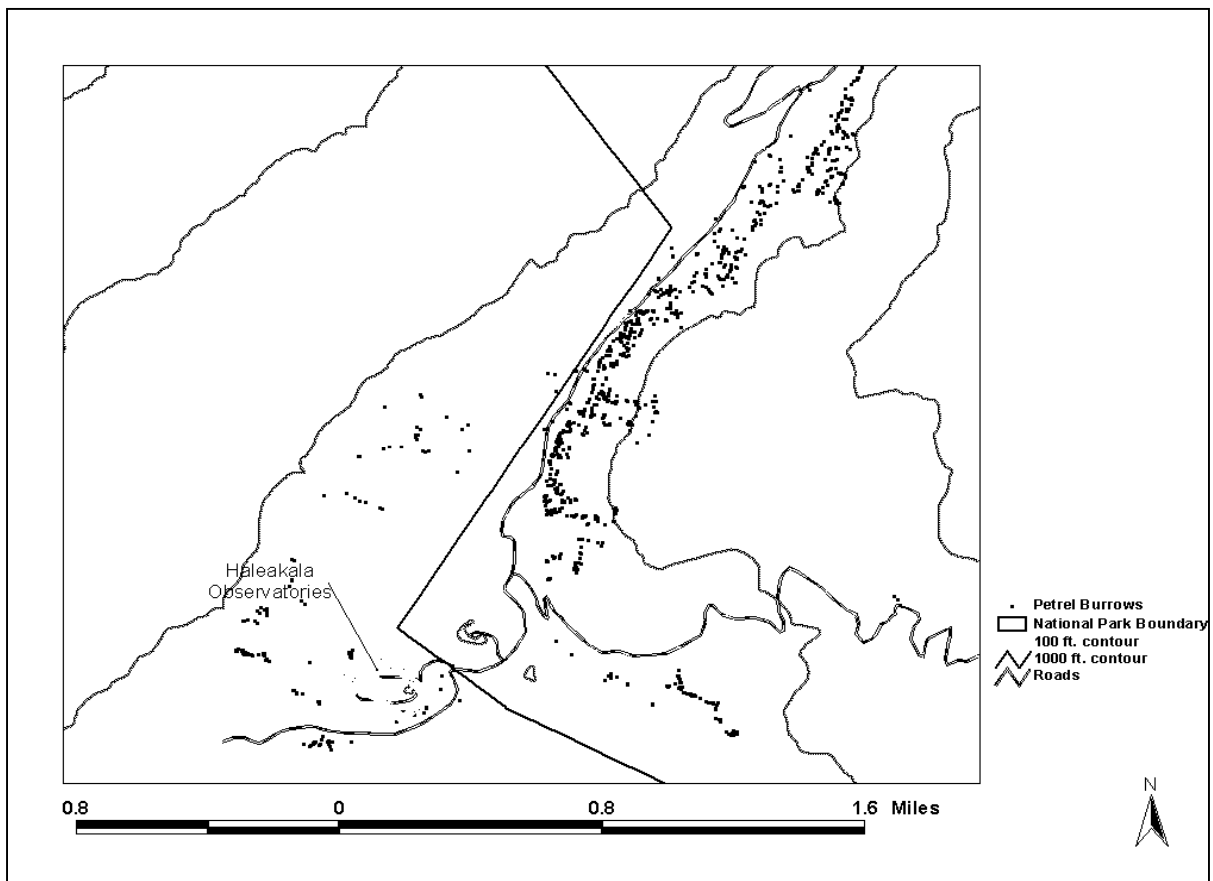


Figure 1. Location of 'Ua'u burrows in relation to Haleakalā Observatories

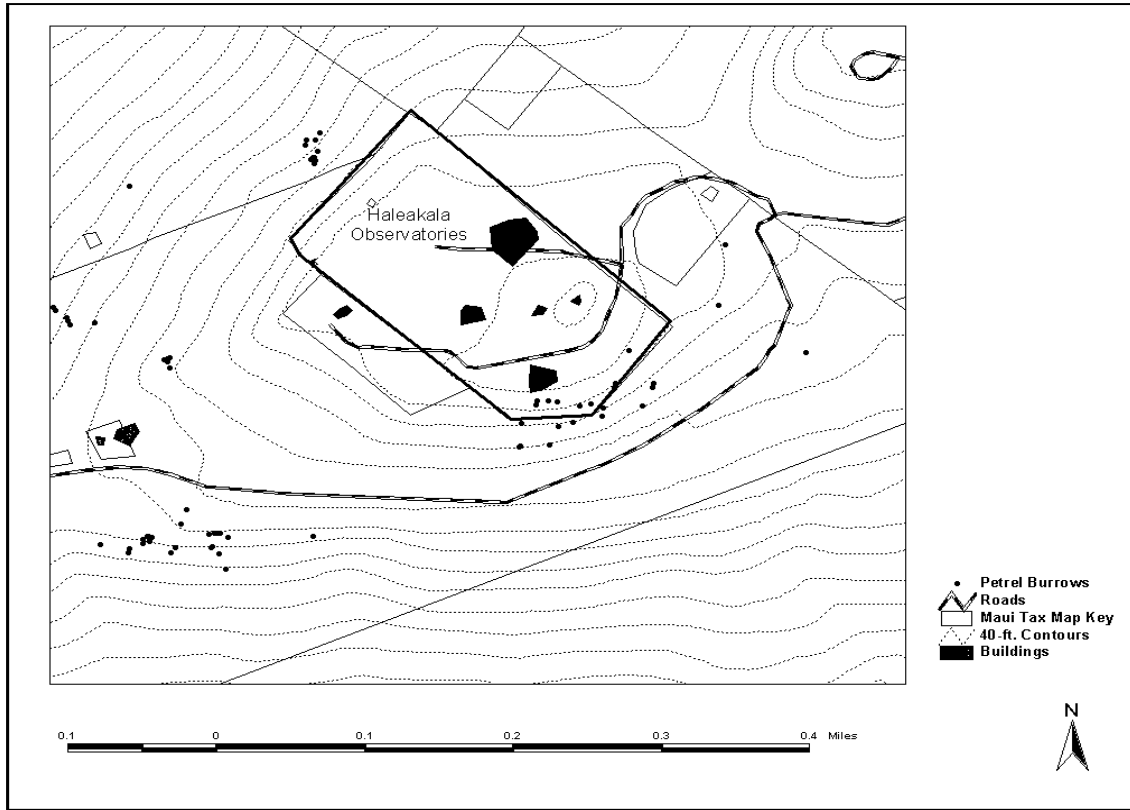


Figure 2. Location of Petrel Burrows in Relation to Haleakalā Observatories