

EVIDENCE OF NEWELL'S SHEARWATER BREEDING IN PUNA DISTRICT, HAWAII

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Abstract.—Nocturnal surveys using auditory cues and night-vision equipment were conducted during the seabird breeding season in 1993 to determine use of inland areas in the Puna District, Hawaii by Newell's Shearwater (*Puffinus auricularis newelli*). Two hundred sixty Newell's Shearwater auditory or visual detections were made during 275 survey hours from 23 Jul. 1993–20 Sep. 1993. Mean detection rates were 1.26 birds/h at Puulena Crater ($n = 160$ Newell's Shearwater detections), 1.05 birds/h at Heihei ahulu ($n = 99$) and 0.04 birds/h at Puu Kaliu ($n = 2$). Vocalizing peaked between 50 and 90 min after sunset and 4 h before sunrise. Although night-vision equipment was used on most of the seabird surveys, only 4% of seabirds were detected visually. Two road-killed birds collected in Puna in June 1993, and four burrows located in Puulena Crater after the 1994 breeding season, provided additional evidence of breeding.

EVIDENCIA DE QUE *PUFFINUS AURICULARIS NEWELLI* ESTA ANIDANDO EN HAWAII

Sinopsis.—Durante la época reproductiva de 1993 se trabajó de noche, utilizando equipo auditivo especializado y de visión nocturna, para determinar si el pampero *Puffinus auricularis newelli* se estaba reproduciendo en el distrito Puna de Hawaii. Del 23 de julio al 20 de septiembre se llegaron a hacer 260 detecciones auditivas o visuales en 275 h de estudio. La tasa de detección fue de 1.26 pamperos/h en el cráter Puulena ($n = 160$ detecciones), 1.05 pamperos/h en Heihei ahulu ($n = 90$) y 0.04 pamperos/h en Puu Kaliu ($n = 2$). El pico de las vocalizaciones ocurrió entre 50 y 90 minutos después de la puesta del sol y cuatro horas antes del amanecer. Tan sólo el 4% de las aves fueron observadas utilizando el equipo especializado. Dos aves muertas por colisiones y coleccionadas en junio de 1993 en Puna y cuatro madrigueras localizadas en el cráter Puulena, luego de la época reproductiva de 1994, proveen evidencia adicional de que las aves se están reproduciendo en la localidad.

The Newell's Shearwater, or 'A' o, *Puffinus auricularis newelli*, is a threatened procellariid (US Fish and Wildlife Service 1992) known to breed on the Islands of Kauai and Hawaii, and suspected to breed on the other main Hawaiian Islands (Pratt et al. 1987). Newell's Shearwater was thought to be extinct after 1894, but in 1954 a specimen was collected on Oahu (King and Gould 1967) and a breeding colony was found on Kauai in 1967 (Sincock and Swedberg 1969).

During the April–November breeding season, adults and subadults forage offshore for fish, plankton, and squid (Harrison 1990). Parents feed young after sunset and return to sea before dawn (Ainley and Podolsky 1993, Day and Cooper 1995). Newell's typically nest colonially in sloped terrain between 150–700 m elevation (US Fish and Wildlife Service 1983); they dig burrows in areas dominated by uluhe fern (*Dicranopteris linearis*). The current nesting range is probably much more restricted than it was historically, due to increased predation pressure and land use changes

(Banko 1980). The breeding biology of Newell's is discussed in more detail by Harrison (1990), Ainley and Podolsky (1993), and Ainley et al. (in press).

Degradation or loss of habitat caused by the invasion of exotic vegetation, cinder mining, and urbanization has rendered many former colony sites unsuitable for nesting (US Fish and Wildlife Service 1983). Such habitat degradation also exposes ground-nesting seabirds to a higher level of predation by introduced, feral, and domestic animals (US Fish and Wildlife Service 1983). Cats (*Felis catus*) and mongooses (*Herpestes auripunctatus*) take advantage of fragmented habitats by hunting along forest edges and trails (Ehrlich et al. 1992). Introduced Barn Owls (*Tyto alba*) prey on many native birds (Byrd and Telfer 1980, Snetsinger et al. 1994), and were observed hunting in Newell's colony sites (Reynolds et al. 1994) and predating nestling seabirds (Ainley et al. 1995).

Bright lights are known to cause fledglings and some adult birds to become disoriented while flying to or from the ocean and nest sites. Hawaiian seabird mortality due to fall out and collisions with utility structures is well documented (Ainley et al. 1995, Day and Cooper 1995, Reed et al. 1985, Telfer et al. 1987). Many birds die of injuries received in the collision, are struck by automobiles, or are killed by feral or domestic animals. On Kauai, approximately 1500 fledging Newell's Shearwaters are recovered annually by the Save Our Shearwater Program (Telfer 1979, 1992; Telfer et al. 1987).

On the island of Hawaii, no information exists on the current distribution of Newell's Shearwater. Objectives of this study were to determine the presence and distribution of the species in the Puna District, Hawaii, to locate breeding colonies, and to document colony attendance patterns.

MATERIALS AND METHODS

Selected sites in the district of Puna on the eastern (windward) side of Hawaii, were monitored from 28 Jul.–21 Oct. 1993 (19°22'N, 155°11'W; Fig. 1). Observers began surveys at sunset until 2130 h and from 0400 h until sunrise. Continuous sunset-to-sunrise surveys were also conducted periodically. One observer per study site identified species and number of detections at potential colony sites and bright light sources. Each Newell's vocalization, which consists of a call series, was counted as a separate detection. Night-vision goggles (US Army model AN/PVS-5A) were used to help detect seabirds entering colony areas. We recorded the compass bearings of each seabird detection, as well as current weather and moon phase. We minimized disturbance to potentially nesting birds by not cutting trails, restricting the use of bright lights, and keeping quiet.

Burrow searches were conducted 14 Dec. 1994. With a support team, we rappelled into Puulena Crater in areas where Newell's Shearwaters had been heard during the breeding season. We searched areas within 1–2 m of two 45-m ropes placed 80-m apart on the SW crater wall. Puulena Crater, with a rim elevation of 189 m, is a volcanic pit crater, approximately 90-m deep with walls sloping to 78°. Vegetation on the crater walls

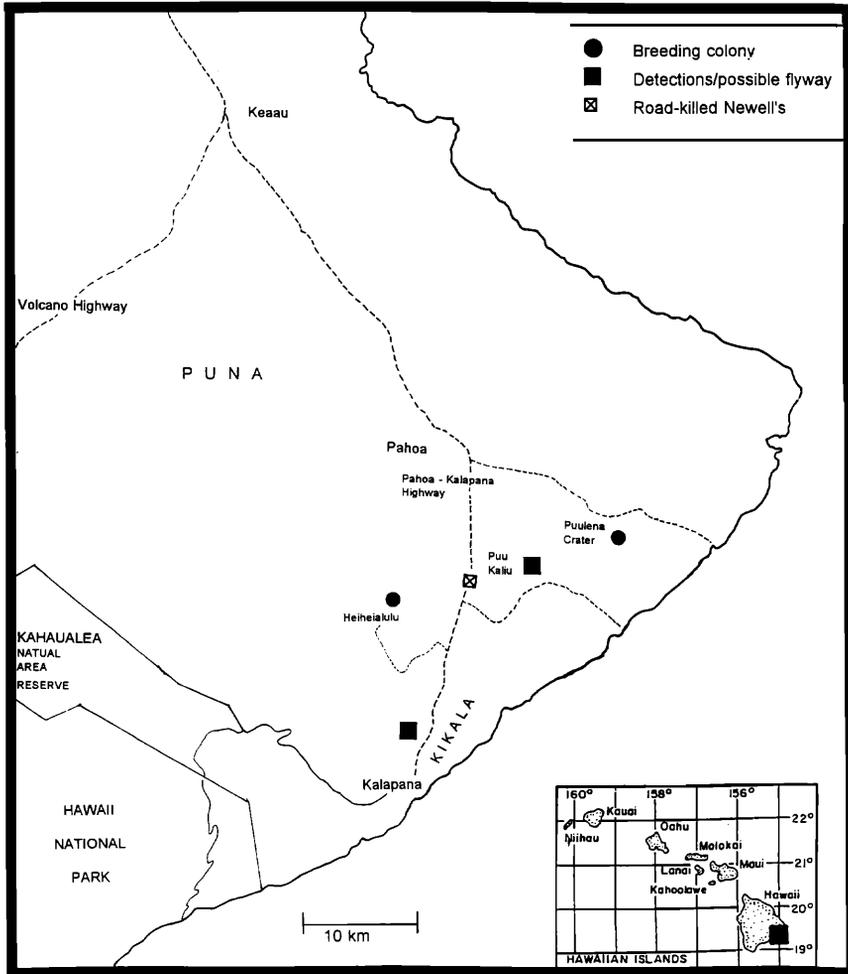


FIGURE 1. Locations of Newell's Shearwater detections in the Puna district, Hawaii, 1993.

is predominantly uluhe with an open canopy consisting of hala (*Pandanus tectorius*) and ohia (*Metrosideros polymorpha*) trees. Some sheer areas were not vegetated.

RESULTS

Our surveys confirmed the presence of the Newell's Shearwater in the Puna District at three locations surveyed (Fig. 1). Repeated activity was identified at two sites believed to be active nesting colonies (hereafter called colony sites). Newell's Shearwaters were heard from 23 Jul.–10

TABLE 1. Summary of Newell's Shearwater detections during 275 survey hours in the Puna District, Hawaii, 1993.

Location	Survey dates with Newell's detections	Number of detections ^a	Detections/h
Heiheiahulu	19 August	32	11.64
	23 August	20	6.15
	26 August	2 visual	0.67
	31 August	15 (1 visual)	4.29
	1 September	3	1.53
	2 September	1	0.29
	8 September	2	0.34
	9 September	2	1.00
	10 September	3	0.95
	16 September	4	1.18
	20 September	6 (1 visual)	1.69
		Total = 99	Mean = 1.05
Puulena Crater	23 July	13	14.18
	28 July	7 (6 visual)	3.23
	29 July	2 (1 visual)	1.00
	9 August	5	3.16
	10 August	7	1.00
	25 August	2	0.35
	26 August	19	71.25
	9 September	89	23.52
	10 September	16	14.77
		Total = 160	Mean = 1.26
Puu Kaliu	1 September	2	0.67
			Mean = 0.04

^a Each call series was recorded as an individual detection.

Sept. 1993 at Puulena Crater and at Heiheiahulu (elevation 330 m) from 19 Aug.–20 Sept. 1993 with 260 detections during 275 survey hours. Mean detection rates were 1.26 birds/h at Puulena Crater, 1.05 birds/h at Heiheiahulu and 0.04 birds/h at Puu Kaliu (elevation 305 m). There were 160 detections at Puulena and 99 at Heiheiahulu. The low numbers detected at Puu Kaliu may be due to surveys conducted late in the breeding season starting on 31 Aug. 1993 (Table 1). Follow-up surveys conducted on 1 and 3 Jun. 1994 discovered additional Newell's Shearwaters at Puu Kaliu and south of Puu Kaliu (M. Reynolds, unpubl. data).

Newell's were identified primarily by vocalizations; only 4% were detected visually (Table 1). Road-kills and auditory detections made prior to our surveys suggested flight corridors to nesting areas (Fig. 1), below Puu Kaliu Crater and above Kikala near the water tank on the Paho-Kalapana Highway (L. Katahira, Hawaii Volcanoes National Park, pers. comm.). Two Newell's Shearwater carcasses were collected on the Paho-Kalapana Highway in June 1993; the cause of death, severe trauma, was determined by necropsy (C. Atkinson, Hawaii Field Station, pers. comm.).

Most Newell's were detected 50–90 min after sunset (Fig. 2). Morning detections peaked 4 h before sunrise (Fig. 3). Mean detection rates were

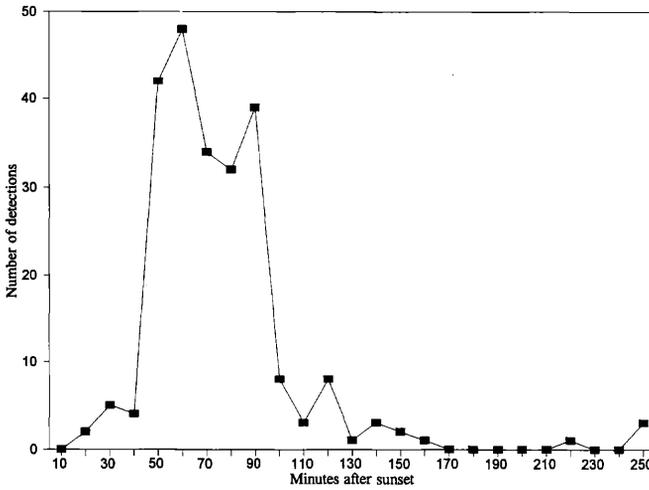


FIGURE 2. Newell's Shearwater evening activity patterns from vocalizations heard between July and October, 1993.

0.34 birds/h during the morning and 1.15 birds per/h during the evening. Detections dropped steadily as the breeding season progressed. Monthly mean detection rates were 3.4 birds/h in July, 3.2 birds/h in August, 1.0 birds/h in September and 0 birds in October 1993.

Four inactive burrows were located at Puulena Crater on 16 Dec. 1994. Burrows were found from 10–50 m below the crater's rim.

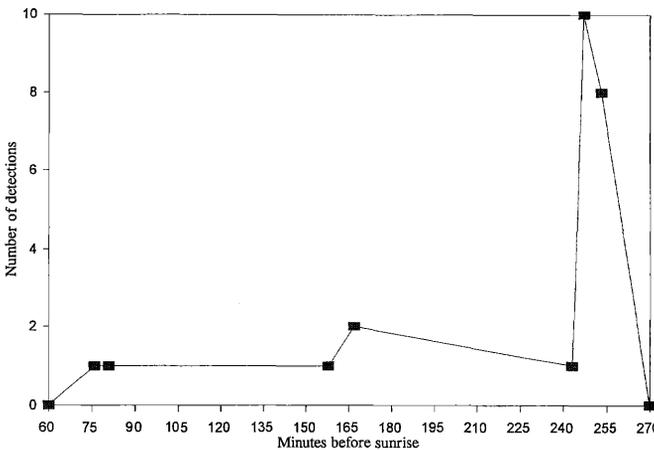


FIGURE 3. Newell's Shearwater morning activity patterns from vocalizations heard between July and October, 1993.

DISCUSSION

The Newell's Shearwater was the only seabird detected during this survey, although the Hawaiian Dark-rumped Petrel (*Pterodroma phaeopygia sandwichensis*) (Pratt et al. 1987) and the Band-rumped Storm Petrel (*Oceanodroma castro*) occur on Mauna Loa (Banko et al. 1991). We were not able to establish if these or other seabirds used Puna as a flight corridor to higher elevation breeding areas. Because seabirds call mostly near breeding areas (Ainley and Podolsky 1993), Newell's Shearwaters were more detectable than other species due to our proximity to their nesting colonies. The frequency of seabird vocalizations is thought to vary with weather, moon phase, breeding phenology, and nesting success, as well as the number, age, and sex of birds (Brooke 1978, Telfer et al. 1987). Other studies have shown a greater incidence of seabird activity and fall-out during bad weather or new moon (Telfer et al. 1987, Warham 1990). We were unable to evaluate these factors in our study.

Assuming that the evening peak in vocal activity represented arrival, arrival at colony sites peaked <1 h after complete darkness, as found by studies using radar sampling on Kauai (Day and Cooper 1995), and Hawaii (Reynolds et al. 1997). On Kauai, Day and Cooper (1995) found a peak in morning activity 30 min before sunrise. Our survey results showed morning vocalization detections were earlier (0100–0200 h) than expected for adult birds leaving burrows. Many of the early morning detections may actually have been late arrivals to the colony.

Records of nocturnal calling, visual detections, repeated activity, road kills, and old burrows provide strong evidence of Newell's Shearwater breeding activity in Puna. Prior to this study, Newell's Shearwaters were suspected to nest on windward Hawaii (Banko 1980, Conant 1980, Hall 1978, Kepler et al. 1979), but no baseline data existed on the current distribution or existence of nesting colonies. Additional surveys are needed to locate other Newell's Shearwaters nesting areas for management and conservation.

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