

ATTRACTION OF THE ENDANGERED DARK-RUMPED PETREL TO RECORDED VOCALIZATIONS IN THE GALÁPAGOS ISLANDS¹

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Abstract. We report the attraction of Dark-rumped Petrels (*Pterodroma phaeopygia*), an endangered seabird of the Galápagos Islands, to playbacks of vocalizations and compare results during playback to results using control periods when no vocalizations were presented. From May to August in 1988 and 1989, during a total of 868 hours of playback, we captured 600 petrels in mist nets and observed 11,020 passes of petrels over the mist nets. Playback of vocalizations resulted in a mean capture rate of 0.83 petrels per hour whereas control periods yielded a mean capture rate of 0.38 petrels per hour. Playback of vocalizations resulted in a mean passing rate of 15.13 petrels per hour whereas control periods yielded a mean capture rate of 7.3 petrels per hour. Playback of vocalizations recorded from petrel colonies (groups of birds) usually resulted in higher capture and passing rates compared to rates during playback of vocalizations from single birds.

These results demonstrate the potential of acoustic playback for luring seabirds to non-degraded habitat or to restored habitat. In addition to having management implications for a variety of threatened colonial nesting birds, the results reported here also suggest that certain Dark-rumped Petrel vocalizations function as indicators to the quality of nesting habitat.

Key words: *Pterodroma*; petrel; Galápagos; vocalizations; attraction; endangered; playback; restoration.

INTRODUCTION

The conspicuous calls of nocturnal petrels, shearwaters and storm-petrels are generally considered to promote pair establishment through sexual advertisement (Brooke 1978, Storey 1984, James 1985). Male Wilson's Storm-Petrels (*Oceanites oceanicus*) and Swinhoe's Storm-Petrel (*Oceanodroma monorhis*) call from burrows to attract females (Bretagnolle 1989, Taoka et al. 1989). Likewise, female Manx Shearwaters (*Puffinus puffinus*) are attracted to the underground calls of males and often call while flying, which may increase the likelihood of their hearing the voice of either an established or potential mate (Brooke 1978).

In contrast, *Pterodroma* (gadfly) petrels rarely call from burrows. There is no evidence that there is any significant ground-to-air communication within this group (Warham 1988). Also, most of the aerial vocalizations that are heard over *Pterodroma* breeding colonies are probably produced by non-breeders, since breeders usually approach their burrows directly and silently (Po-

dolsky and Kress, in prep.). Most vocalizations in this group are apparently produced by pre-breeders which call while approaching and circling over nesting colonies, often in paired flight with prospective mates (Warham 1988; Wingate, pers. comm.).

In this paper, we examine the response of Dark-rumped Petrels to the playback of selected conspecific vocalizations. We test the hypothesis that Dark-rumped Petrels are attracted to recorded petrel vocalizations and show increasing attraction to recordings of increasingly large groups of birds. We interpret our results to suggest that Dark-rumped Petrels assess the quality of potential breeding habitat, in part, as a function of the presence of vocalizing conspecifics.

METHODS

Vocalizations were played from two speakers in the middle of an array of six 12 m long mist nets. Two of the six nets were set up one on top of the other extending to a height of 15 m. Vocalizations were transferred from master tapes to three-minute tape loops and broadcast at constant intensity through an automobile cassette player with built-in 5 watt amplifier (Realistic model #121984). The cassette player was driven by two

¹ Received 25 September 1991. Accepted 9 December 1991.

12-volt batteries wired in parallel, which were recharged by six 10 watt, 0.57 amp photovoltaic panels (Solarex MSX-Lite).

The capture experiment in 1989 was conducted approximately 50 m east of the Mirador Crater in the highlands of Santa Cruz Island, Galápagos, Ecuador; in 1988 the netting was conducted 1 km north of Mirador and 50 m west of Media Luna Crater. In both 1988 and 1989 the capture experiments were approximately 100 m from active petrel colonies.

During 1988, vocalizations were played for 500 hours between 22:00–06:00 hr over 64 nights beginning 1 June and ending 7 August. In 1989 vocalizations were played between 22:00–06:00 hr for a total of 368 hr over 48 nights from 25 May through 6 August. In both years the number of birds captured during playback were compared with captures during control periods when no vocalizations were broadcast. In 1988 and 1989, control periods represented approximately 30 percent of the total capture time. In both years we randomly mixed ½ hr control and playback periods, thus the schedule for each night of capture was generated on a random basis.

In 1988 the seven vocalization treatments tested were: (1) single intensity colony sounds, (2) double intensity colony sounds, (3) triple intensity colony sounds, (4) long sweet call, (5) long coarse call, (6) short sweet call, and (7) short coarse call. In 1989 tape number 5 was not used and two new vocalizations were tested. The two new recordings tested during 1989 were of birds vocalizing on the ground in a colony. Vocalization 5b, referred to as the "growl call," was a low, guttural growl recorded at dawn from a pair of birds in a natural burrow. Vocalization 7b was also recorded in an active colony but from birds standing at the entrance to a burrow. Referred to as the "grunt call," 7b contained vocalizations of three breeding adults, one pair together at the entrance of a natural burrow and a third individual at the entrance of a neighboring nest. The *grunt call* was elicited in response to the playback of Tape 2. The growl and grunt calls were observed and recorded by J. Skinner (with a Nagra IIIB and a Electrovoice model #642 dynamic omni directional microphone). All other vocalizations were recorded by Robert Tompkins (with a Nagra III and a Gibson microphone in a 46" parabolic reflector) in 1977–1978 at colonies located within 1 km of the experiments described here (Tompkins and Milne 1991). The tapes were

prepared by the Library of Natural Sounds at Cornell Laboratory of Ornithology in Ithaca, NY. Double and triple intensity colony sound tapes were created by recording over single intensity colony sounds once and twice respectively.

The relative attractiveness of the different vocalizations was measured by (1) the number of individuals captured in the nets and, (2) the number of times petrels flew over the nets (passes). Petrel passes were visible to observers because of the birds' white underparts and wing linings. On most nights there was ample ambient light to make such counts possible.

The data recorded during any experiment included: number of petrels captured, number of petrels observed passing over nets, weather conditions (fog, rain, or clear), percentage of down on the brood patch, and band number. For comparison, we recorded the condition of the brood patch of confirmed breeders from active burrows on Santa Cruz Island.

Data were analyzed by Chi-square tests on the number of petrels captured per hour versus the expected capture rate. The expected capture rate per treatment was estimated by multiplying the proportion of time a given treatment was employed by the total number of petrels captured. Probability levels ≤ 0.05 were considered significant.

RESULTS

The total number of petrels lured during the two years was 600; 282 in 1988 and 318 in 1989. The mean number of petrels captured per hour across all treatments was 0.56 in 1988 and 0.87 in 1989. In 1988, tape no. 2 (double intensity colony sounds) yielded the highest rate of capture, approximately one capture per hour versus the control period, which yielded only one capture for approximately three hours of netting (Fig. 1). In 1989 tape no. 3 (triple intensity colony sounds) had the highest capture rate and tape no. 2 was the second most attractive treatment (Fig. 1).

In the above experiment the χ^2 value observed is larger than expected indicating that some tapes lured more petrels than expected. These include the single, double, and triple intensity tapes as well as the short sweet and long sweet tapes. The long coarse tape resulted in captures below the expected capture rate.

Of 282 Dark-rumped Petrels captured in 1988, seven were recaptures of birds previously cap-

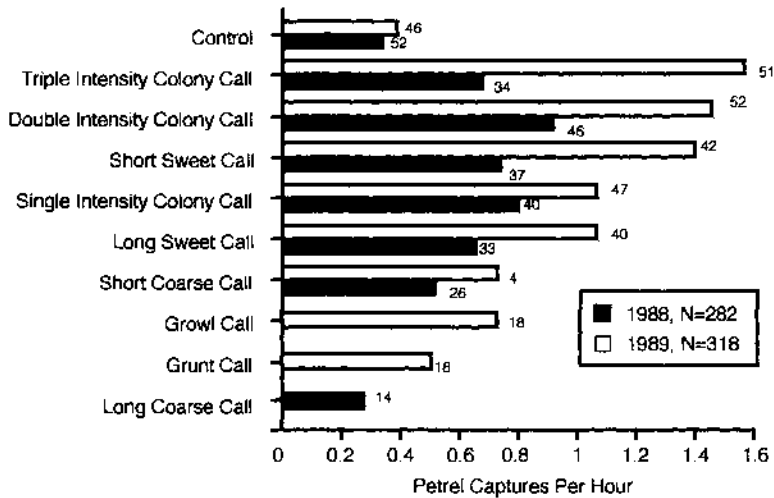


FIGURE 1. The number of petrels captured per hour of mist netting for each sound treatment (for 1988; $\chi^2 = 134.59$, 7 df, $P < 0.01$, $n = 500$ hr, for 1989; $\chi^2 = 388.07$, 8 df, $P < 0.01$, $n = 368$ hr).

tured in 1988 and three were recoveries of birds banded before 1988. The recapture rate was 2.5%. The first recovery was a three-year-old bird banded on Santa Cruz Island in 1985. The other two recoveries were of breeding birds banded in 1979 in burrow #40 and in 1986 in burrow #43. These burrows were within 50 m of our net lanes.

Throughout the two seasons, 93% of all the net-captured birds had over 60% down coverage on their brood patches, indicating that most were pre-breeders. In contrast, 93% of known breeders taken from active natural burrows during the

same time period had less than 50% down coverage of their brood patches.

During the two field seasons, 11,020 passes were observed. The number of passes of Dark-rumped Petrels was strongly influenced by which playback tape was presented (Fig. 2). The χ^2 value observed for passes is larger than expected thus indicating that some tapes attracted more petrels to the vicinity of the nets than expected. The single, double, and triple intensity tapes as well as the short sweet tape yielded the highest number of passes per hour. Control periods

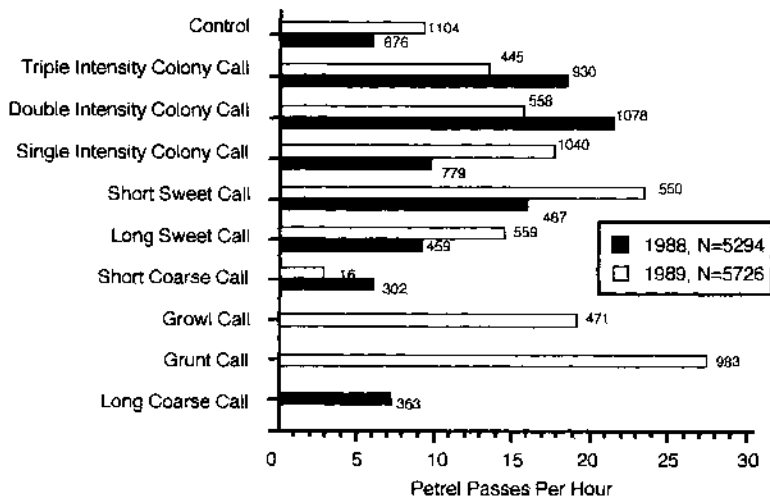


FIGURE 2. The number of petrels passing over the mist net per hour for each treatment for 1988 and 1989 (for 1988; $\chi^2 = 4633.37$, 7 df, $P < 0.01$, $n = 500$ hr, for 1989; $\chi^2 = 3210.33$, 8 df, $P < 0.01$, $n = 368$ hr).

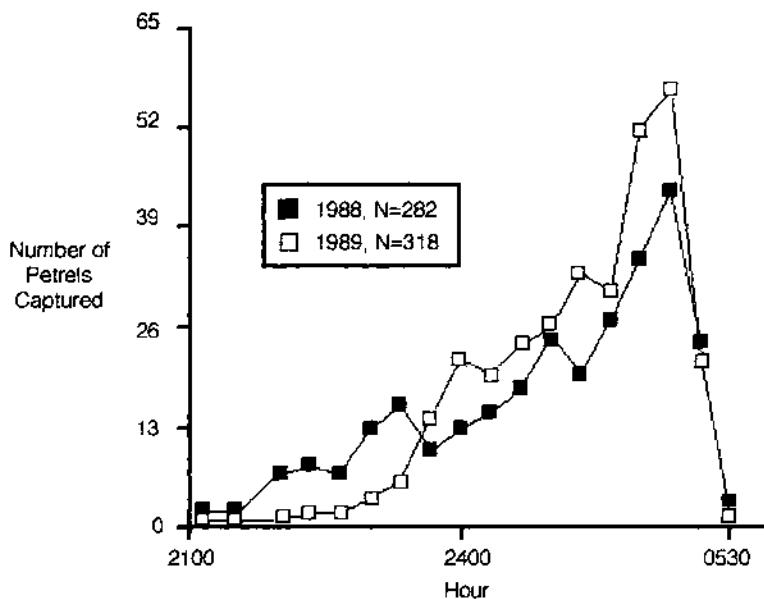


FIGURE 3. The number of petrels captured during both control and playback for 1988 and 1989.

yielded 5.8 and 9.2 passes/hr in 1988 and 1989, respectively. The number of passes was not influenced by fog and rain. Between 1 June–26 July 1988, clear periods versus foggy and/or rainy periods yielded 6.6 and 7.7 passes/hr during control periods, respectively. In both 1988 and 1989, captures began at 21:00 hr and built to a peak number at 04:30 hr and then quickly dropped off at 05:30 hr (Fig. 3).

DISCUSSION

Some Gadfly petrels are known for the ease with which they are attracted to human shouts or imitation of their calls. Beebe (1935) described how hungry sailors in the early 1600s called thousands of Cahows from the wing to the ground in Bermuda. Similarly, Berger (1981) described how Dark-rumped Petrels (*Pterodroma phaeopygia*) were taken by Polynesians who called them to the ground. Warham (1988) observed the response of Providence Petrels (*Pterodroma solandri*) to hand clapping and "war-whooping" which effectively lured birds to the ground. Most of these birds were non-breeders, which led him to suggest that the birds which were attracted to his calls were unpaired and possibly prebreeding males which responded to sounds resembling those of unpaired females. Recently Tennyson and Taylor (1990) have shown that both sexes are attracted to this stimulus. Recorded vocali-

zations have also proved attractive to some procellariids. Adult storm-petrels are strongly attracted to recordings of their vocalizations (Grubb 1973, Ainley et al. 1976, Furness and Baillie 1981, Podolsky and Kress 1989).

Artificial presentation of seabird colony sounds and visual stimuli such as models have resulted in establishment of new colonies for terns (*Sterna* spp.) (Kress 1983), Atlantic Puffins (*Fratercula arctica*) (Kress and Nettleship 1988), and Laysan Albatross (*Diomedea immutabilis*) (Podolsky 1990). On several islands off mid-coastal Maine, the playback of vocalizations attracted Leach's Storm-Petrels (*Oceanodroma leucorhoa*) to the vicinity of speakers and eventually led to breeding in adjacent artificial burrows (Podolsky and Kress 1989).

It is usually advantageous for pairs that have bred successfully to return to the same colony, and for young birds seeking sites to join an established colony, since the presence of breeding birds is the best indication that a site is safe (Lack 1966). Birds apparently evaluate the suitability of habitat by the presence of conspecifics (Orlans 1966). It follows that the stimuli associated with the presence of breeding conspecifics contains information regarding the quality of a site and this information influences the behavior of non-breeding individuals.

Social facilitation in seabirds probably evolved

because of certain characteristics associated with colonial nesting. Seabirds have delayed sexual maturation and spend several years "sampling" their environment. Gulls and terns do not attain breeding age for three years and petrels, shearwaters and albatrosses for five to ten years (Lack 1968). During this pre-breeding period, many seabirds are known to "wander" or "prospect," visiting a number of potential breeding sites (Fisher and Lockley 1954, Kress and Nettleship 1988).

For many species, the sites visited include established colonies, former breeding sites and uncolonized sites. Presumably, the prospecting period is the time during which pre-breeders are assessing the relative quality of different sites. Factors such as availability of mates, food abundance, the presence of predators and conspecifics could all be important for deciding where to breed. During this prospecting period many seabirds will form a pairbond, go through courtship and occupy a nest site or burrow without breeding (Fisher and Lockley 1954). Some seabirds return in subsequent years to breed at the precise site visited as a prospector.

The conspicuous visual and auditory courtship displays of many seabirds also support the importance of social facilitation. Such courtship displays have a variety of functions to nesting birds (Smith 1977) including finding a mate (Tinbergen 1953, 1959; Alexander 1967; Bastock 1967), assessing the quality of a mate (Nisbet 1973, 1977) and coordinating intra-pair activities (Smith 1977). Another possible function may be to attract prospectors and thereby to increase the size of the colony. This assumes that conspicuous displays benefit the established breeders as well as the prospectors. The costs of this attraction to established breeders are the energy expended to produce the displays, the risk of attracting predators to themselves and/or their offspring and the increase in competition for their own nest site. These costs are balanced against the benefit of reduced risk of predation because of the advantages of a larger colony (Hamilton 1971). Likewise, prospecting subadults may benefit by joining established breeders where risks from predators are possibly lower than at an uncolonized site.

In the present study, we interpret the high passing rate during playbacks of double and triple-intensity recordings as evidence that these calls were more attractive to pre-breeding age petrels

than were recordings of single bird vocalizations. We interpret this increased passing rate as evidence that pre-breeding age petrels are attracted to areas where they hear concentrations of conspecifics.

CONSERVATION IMPLICATIONS

Dark-rumped Petrels are confirmed to nest on only four islands in the Galápagos archipelago (Harris 1970; Cruz and Cruz 1987, 1990). Predation by exotic mammals occurs at all known colonies, but it is especially severe on Santa Cruz island where the remnant population nests in remote areas within the *miconia* zone above 800 m. Although most pigs, horses, burrows, cattle and goats have been removed from these highlands, rats (*Rattus rattus* and *R. norvegicus*) are a continuing and increasing threat (Coulter 1984, Coulter et al. 1985).

The attraction of Dark-rumped Petrels to playback of conspecific vocalizations has conservation implications, since petrels may also breed in the vicinity of playback recordings (Kress and Podolsky, in prep.). Because Dark-rumped Petrels show a high degree of tenacity to the same nest between years, once pairs are established in artificial burrows, they would likely continue breeding at these sites. The attraction of pre-breeding petrels to artificial burrows may prove a useful tool for managers who could then influence the nest-site selection process by encouraging first-breeding petrels to concentrate their breeding activity in clusters of artificial burrows. At such sites, predator control may be more efficient and hence more effective than in the present, highly dispersed nesting distribution.

ACKNOWLEDGMENTS

This is a cooperative project sponsored by the Galápagos National Park, The Charles Darwin Research Station and the National Audubon Society. We thank the park wardens at Medja Luna for their patience and hospitality. At the Galápagos National Park we thank Intendente Fausto Cepeda Proano. Sr. Nelson Ballasteros assisted tremendously with logistical support to and from the highlands. This project would not have been possible if not for the support, beginning several years ago, of Felipe Cruz, of the Galápagos National Park Service.

At the Charles Darwin Station, we thank the Current Director Daniel Evans and the former Director Gunther Reck, Manager Oscar Aguirre, Director's Assistants Sylvia Harcourt and Fuenueña Walsh and the rest of the administrative staff. Special thanks goes to Sr. Luis Ramos for his undaunting assistance with transportation and supplies to and from the highlands.

We also thank the Library of Natural Sounds at the Cornell Laboratory of Ornithology for providing tape recordings of petrel vocalizations and sound equipment.

Funding for this project came in part from the National Audubon Society, Rolex Awards for Enterprise, Montres Rolex S.A. Geneva, Mr. Rodman Rockefeller, and Mr. and Mrs. Henry B. Dennis. We also thank Cabellas, Inc. for donating tents and Olympus Camera Company for loaning cameras. Finally, we thank our very capable field assistants, Washington Arevalo, Manuel Fajardo, Bennett Sandler, Hector Serrano (of Galápagos National Park), Jerry Skinner, Justine Cruz and David Fairmen Jickling. Cindy Martin assisted with data analysis.

This paper benefited from reviews by Chris Clark, Rob Marchsall, Greg Budney and two anonymous reviewers. This is contribution #483 of the Charles Darwin Foundation for the Galápagos Islands.

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