COLONY LOCATION BY LEACH'S PETREL

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LEACH'S Petrel, *Oceanodroma leucorhoa*, is one of a number of Procellariiformes that locate nest burrows under a forest canopy at night (Table 1), although some of these species also nest in nonforested terrain. During a study of the sensory bases of navigation in *Oceanodroma leucorhoa* breeding on Kent Island, New Brunswick in the Bay of Fundy (Grubb, 1971), I tested the possibility that incipient breeders of this species use senses other than vision to find active colonies under the Kent Island spruce-fir forest in which to begin nest building.

Leach's Petrels, like many seabirds, do not reproduce until several years old. Petrels spend the first 2 years of life at sea, visit breeding islands during their 3rd and 4th summers, and generally start breeding during the 5th summer (Huntington and Burtt, 1970). Mist netting has revealed that many young birds with downy brood patches (brood patches of breeding adults are bare and vascularized) occur among the thousands of birds coursing over Kent Island each summer night from mid-June to September. I have watched petrels investigating nooks and crannies on the forest floor. Perhaps these are 3- and 4-year-olds hunting for burrow sites. The distribution of petrel nesting colonies within Kent Island's forests is clumped, sections of seemingly good nesting habitat remaining empty. Petrels digging new burrows probably find colonized areas by other than visual means as the tree canopy conceals the colonies.

Sounds from existing colonies might help young birds establish burrows there. Leach's Petrels have two calls: (1) the chatter call, a stereotyped pattern sequence of eight or more syllables with a descending cadence voiced by birds in flight, on the ground, and very commonly by breeding birds just after entering their burrows, and (2) the long, drawn-out purring call of indefinite length ("r-r-r-r-r-r-r-r-ooee-chur-r-r-r-r-r-r-r-r-ooee-chur, etc."; Ainslie and Atkinson, 1937), given rarely in flight or on the ground, but commonly in burrows, often as duetting by mated pairs. On Kent Island Huntington nets petrels attracted to unnaturally loud tape recordings of both calls.

A potential olfactory stimulus is also present. The typical musky petrel odor permeating the area around the burrows is apparent to the human nose. Procellariiformes have highly developed olfactory organs (Bang, 1966). Adult Leach's Petrels apparently use a sense of smell to find their individual nest burrows at night under the Kent Island forest (Grubb, 1971). It seems, then, that birds seeking breeding sites

TABLE 1
SHEARWATERS AND PETRELS THAT LOCATE THEIR NESTS AT NIGHT UNDER A FOREST CANOPY

Species	References
Pachyptila desolata	Tickell, 1962
Puffinus creatopus	Murphy, 1936: 658
P. gravis	Rowan, 1952; Woods, 1970
P. bulleri	Falla, 1924
P. griseus	Murphy, 1936: 670
P. p. newelli	Sincock and Swedberg, 1969
Pterodroma phaeopygia	Murphy, 1936: 699
Pt. cookii	Murphy, 1936: 715
Oceanodroma leucorhoa	Gross, 1935; Grubb, 1970
Pelecanoides urinatrix	Richdale, 1945

might land in active colonies after hearing the calls of residents or after smelling nest burrow odors.

METHODS

A small clearing in the forest about 100 m from the nearest known petrel burrows was selected as a test site. Petrels flying over this clearing were presented sequentially with four different stimuli: (1) a purring call played on a Nagra III tape recorder loop at a volume similar to that coming from burrows in other parts of the forest, and a 0.18 M^2 metal tray covered with nest material collected and stored in plastic bags the day before to furnish colony odor, (2) a purring call with sham nest material of needles, twigs, leaves, and cones gathered daily from the forest floor several hundred meters from the colonies and presented on an identical tray to that holding nest material, (3) nest material with a blank loop played on the tape recorder, and (4) the blank loop and forest floor litter. Each of these stimuli was presented for 15 minutes as one of four randomly ordered trials begun at 01:10 each test night. During 5-minute intertrial periods, tape loops were changed and the idle tray removed about 50 m from the clearing. Throughout each trial I lay on my back in the center of the clearing between tape recorder and tray and counted the number of times petrels, silhouetted against the sky, entered my vertically directed visual cone of 60°. These flights were used in measuring responses to the sound and odor stimuli. The assumption that order effects were prevented by the 5-minute intertrial periods allowed me to examine response differences using one-tailed Wilcoxon matched-pairs signed-ranks tests (Siegel, 1956).

RESULTS

Purring call.—The purring call's attractiveness was emphatic. During 8 trials totaling 2 hours, 4,505 flights over the call were recorded, significantly more than the 249 flights recorded during 8 trials over the blank tape loop ($P < 0.005$; Table 2). Flights over the blank loop were direct and higher than the surrounding trees, but many petrels spiralled down to pass and repass as low as 1–2 m over me when the purring call was being played. Because petrels probably passed through my visual

TABLE 2
LEACH'S PETREL FLIGHTS OVER EXPERIMENTALLY EXPOSED TAPE LOOP AND NEST MATERIAL

Date	Flights			
	Call plus nest material	Call	Nest material	Neither call nor nest material
4 July 1970	353	354	20	21
6 July	557 (2)[1]	842	32	28
8 July	772 (3)	295	18	8
9 July	923	465	67	19
10 July	1,041 (2)	674 (1)	103	61
18 July	144	542	7	9
19 July	1,095	791	74	54
4 August	852	542	97	49
	5,737	4,505	418	249

[1] Number of birds landing.

field several times as they circled above the purring call, the number of flights is not a population index of attracted birds. At times, though, 10–15 birds or more fluttered over the call simultaneously. Seldom did I see more than one at a time over the blank loop.

Nest material.—I counted 418 petrels flying over the nest material and noted only 249 over the forest leaf litter during an equal time ($P < 0.025$; Table 2). Birds flying over nest material did not descend from tree top level as they did to the purring loop, nor did they circle persistently within the clearing.

Purring call plus nest material.—I tallied 5,737 flights over the call playback and nest material together, significantly more than the 418 counted over the nest material alone ($P < 0.005$), but not significantly more than the 4,515 for the purring call alone ($P > 0.05$; Table 2). Petrels approached and circled closer to the combined stimuli than to either separately; seven birds landed within 1–2 m of me in response to calls and odor together while only one did so during purring call and none during nest material or double control trials (Table 2).

DISCUSSION

Weather variation partially determined differences in flight counts among test nights. For example, the high counts of 10 July and 19 July were on clear, moonlit nights; reduced counts on 4 July and 18 July occurred during poor visibility in heavy fog. Such night-to-night variation did not affect the relative numbers of flights over different stimuli during any one test session.

The concentration of flights over the purring playback suggests the sense of hearing is paramount in locating active colonies. Lower flight altitudes, increased circling, and more landings in the presence of nest material support the interpretation that the sense of smell plays a supporting role in the decision to land. The comparative intensities of response to the two stimuli may not be valid, as the odor cue probably did not approach the sound cue in simulating the conditions within a colony of many smelly burrows.

While walking through the forest at night, I have occasionally heard a petrel calling from the ground in an area devoid of burrows. I have also encountered small groups (5–10) of musky-smelling yet empty burrows. If young petrels normally are stimulated to land and begin burrow excavation by the sounds and odors emanating from breeding birds on the ground, their chances of building within a flourishing colony are heightened. And if social stimulation enhances successful breeding, petrels digging burrows within existing colonies would have a selective advantage.

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SUMMARY

Leach's Petrels flying over the treetops of a nesting island in the dark were attracted to the playback of tape-recorded petrel calls and also to the scent of nest material. The results suggest that young petrels may use the senses of hearing and smell to locate nesting colonies concealed from sight under a forest canopy, there to begin nest building.

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