Williams (1966) assumed that there is a functionally related cost to the parent for effort channelled into the production of young. The evidence for the existence of such a cost is, in fact, fairly substantial (see Cody 1971, Trivers 1972, King 1973, Ricklefs 1974); egg production requires energy that must be obtained through feeding by the female. Lack (1968) stated that since proportionately larger eggs require more parental material in their formation, they represent a greater reproductive effort. In the Ancient Murrelet, the reproductive effort or cost is apparently spent only in egg production as the newly fledged young feed at sea with the adults.

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SHADOWS AND DETECTION OF MOVEMENT BY A BURROWING OWL (*SPEOTYTO CUNICULARIA*)

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Several nocturnal rodent species are known to avoid surface activity during moonlight (Wiley, Southwest. Nat. 16:43–54, 1971; O'Farrell, J. Mamm. 55:809–823, 1974); this behavior probably reduces their vulnerability to visually hunting predators such as owls. However, activity is also known to reach its peak during evening twilight when illumination is brighter than moonlight (Lockard and Owings, Anim. Behav. 22:262–273, 1974). This suggests that increased illumination itself is not the critical determinant of moonlight avoidance. Lockard and Owings proposed that shadows, which are cast in moonlight but not in twilight, may constitute a more important cause of increased conspicuousness to predators. The purpose of our study was to test this hypothesis by comparing the responsiveness of a Burrowing Owl

(*Speotyto cunicularia*) to a moving object when the object did and did not cast a conspicuous shadow.

We used a single Burrowing Owl for all tests. It was trapped about 5 km north of Davis, Yolo County, California. We chose this species because it is easily trapped and because it often feeds nocturnally upon terrestrial prey, including rodents, and therefore may exploit shadow cues (Thomsen, Condor 73:177–192, 1971).

The owl was kept in a plywood box that was a 91.4-cm cube with a 45.7 × 45.7-cm window centered on one side. The owl regularly used the perch in its box and faced toward the window. A red, 7-watt incandescent bulb inside the box provided illumination for viewing the owl's behavior.

Attached to the owl box on the windowed side was a second box, which contained the moving object and the shadow-casting and nonshadow-casting lighting systems. This box was open on the side that was adjacent to the owl box, so that the interior of this box was visible to the owl through the window. The moving object was a steel nut attached by monofilament fishing line to the top of this box. This object could be held outside the box and released to swing past the window.

The shadow-casting and nonshadow-casting lighting conditions were provided by one and four 7-watt incandescent bulbs, respectively. The single bulb was centered above the window. Each of the four bulbs was attached to a different edge of the windowed side of the owl box, and each was in a sanded acrylic container for diffusion of light. The single bulb cast a conspicuous shadow, the four bulbs cast four very inconspicuous shadows. The brightness of both shadow and nonshadow bulbs was adjusted to yield 0.01 ft-c. The room containing the apparatus was always dark.

We used human subjects to watch the responsiveness of the owl to the moving object. None was aware of the purpose of the experiment or that the owl was viewing the object under special lighting conditions. Each subject was told to report that the owl had detected the object if the owl moved coincidentally with the object's movement. Such movement usually consisted of abrupt visual fixation of the object by head movement. The conspicuousness of the head movement was increased by releasing the object only when the owl was not gazing directly at the window. Either a "yes" or "no" response was required for every trial.

The experimenter notified the subject at the beginning of each trial that the object was about to be released by pulling a string tied around the subject's wrist. The object was held outside its box between trials. During each trial it was released, allowed to swing across and back, then caught and held. Each subject watched the owl for 30 trials made at 30-sec. intervals.

Ten subjects were used for a total of 150 trials under each lighting condition. Lighting conditions were constant during each subject's trials and were alternated with successive subjects. We deleted five shadow and four nonshadow trials due to extraneous noises.

In the shadow conditions, the owl was judged to have detected movement in an average of 10.6 (range = 8–16) per 30 trials, whereas in nonshadow conditions detection occurred in an average of 6.4 (range = 2–11) per 30 trials. This difference was statistically significant ($t = 1.93$; df = 8; $p < 0.05$ in a one-tailed test). Hence, the owl responded to the moving object when it cast a shadow more than when it did not, even though illumination was equal in both conditions.

The results are not incompatible with the hypothesis that visual prey detection should be enhanced in lighting conditions in which shadows are cast (e.g., moonlight) relative to conditions in which shadows are not cast (e.g., twilight). We must of course exercise caution in extrapolating these results gathered from one owl under special conditions to other predators and prey. The following hypotheses should be considered with such caution in mind.

Shadows might be expected to constitute effective aids to prey detection for owls since these birds typically hunt from an elevated position. A prey individual plus shadow should subtend a larger visual angle when viewed from above than when viewed obliquely. Shadows might also be expected to constitute effective aids to prey detection in deserts for two reasons: (1) the paucity of cover in deserts increases the usefulness of vision for prey detection; (2) shadows should contrast most conspicuously with the light soil of arid regions.

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DAILY TEMPERATURE CYCLES IN BARRED, GREAT-HORNED AND SNOWY OWLS

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This paper reports preliminary data on daily rhythmic fluctuations in skin and deep body temperatures of captive owls, and is a by-product of research aimed at the development of radio-telemetric techniques suitable for continuous, simultaneous monitoring of certain physiological and behavioral activities of unrestrained birds in the wild. The work was carried out at the University of Minnesota's Cedar Creek Natural History Area, located in Anoka County, during the period February–April 1971.

MATERIALS AND METHODS

Four owls were obtained for the experiments. A Snowy Owl (*Nyctea scandiaca*) and a Barred Owl (*Strix varia*) were captured from the wild, and two Great Horned Owls (*Bubo virginianus*) were acquired from local zoos. Each owl was confined to a portable aviary, placed either outdoors or in the laboratory. During the experiments the birds were held in cages

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