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A PECK ACTIVITY RECORD FOR BIRDS FITTED WITH DEVICES

RORY P. WILSON AND MARIE-PIERRE T. WILSON

Institut für Meereskunde an der Universität Kiel
Düsternbrooker Weg 20
D-2300 Kiel 1
Federal Republic of Germany
and
Percy FitzPatrick Institute for African Ornithology
University of Cape Town
Rondebosch, 7700, South Africa

Abstract.—The validity of results derived from studies using remote-sensing and telemetric devices on birds depends on minimizing aberrant behavior caused by the devices. We describe a method for determining the number of pecks directed at devices attached to free-living birds and report field tests of the method on African Penguins (*Spheniscus demersus*). The methodology should help researchers determine the optimum shape, size, color, and positioning of telemetric and remote-sensing devices so as to minimize abnormal behavior induced by the devices.

REGISTROS DE LA ACTIVIDAD DE PICOTEO EN AVES A LAS QUE SE LE HAN PUESTO APARATOS DE MONITOREO

Resumen.—La validez de los resultados de estudios en los que se utilizan artefactos para monitorear organismos (Ej: transmisores telemétricos) dependen de la forma en que se trate de minimizar la conducta aberrada causada por estos. Se describe un método para determinar el mínimo de picotazos dirigidos a estos artefactos. Se prueba el método en el campos en pinguinos africanos (*Spheniscus demersus*). Los resultados prometen ayudar a otros investigadores en determinar de forma óptima, la forma, tamaño, color y localización de aparatos de monitoreo que les permitan minimizar los patrones aberrados de conducta causados por éstos.

Attachment of telemetric and remote-sensing devices to free-living birds enables researchers to determine aspects of animal ecology that are not otherwise accessible. Paradoxically, the use of devices often alters animal behavior to an unquantifiable extent. Indirect information on aberrant behavior induced by devices may be derived by comparing device-fitted birds with controls during periods when the animals are visible (e.g., Gilmer et al. 1974, Perry 1981, Perry et al. 1981). More direct information on the effects of devices may be obtained by recording changes in behavior with variable device size (Wilson et al. 1986).

The physical size or mass of a device may impair normal movement of a study bird. For example, Wilson et al. (1986) found that African Penguins (*Spheniscus demersus*) swim slower when carrying larger devices. Animals may also spend time attempting to rid themselves of a device by pecking and preening (e.g., Perry 1981). Tests examining the number of pecks directed at devices should be conducted on free-living animals fitted with differentially sized, colored, and positioned devices, which could then be modified so that animals behave as normally as possible.

We describe the design and use of a peck-activity recorder consisting of a pressure-sensitive sheet costing less than $0.10, which records the number of pecks that a bird directs at a device. The unit enables researchers to examine differences in pecking at physically different devices. Ultimately, researchers should be able to obtain more meaningful data by designing devices that are minimally pecked and therefore reduce stress to study animals.

METHODS

We modified plastic syringes (5 cc) to serve as imitation devices. The plungers and associated bungs were discarded and the ends of the syringe body were cut to leave a cylinder (length 60 mm × 12 mm dia.). The pressure-sensitive sheet was prepared from carbon paper and squared, white paper. Rectangles of both types of paper were cut to 50 × 40 mm. We then used a heat sealer to make polythene sachets of dimensions fractionally larger than our paper rectangles. The squared paper and the carbon paper rectangles were paired off and heat-sealed inside the sachets, making sure that no air was trapped inside. The sachets were then stuck round the syringe bodies with one layer of "Scotch" tape.

To quantify the sensitivity of the device to pressure, we constructed model beaks consisting of 'tomia' of various surface areas. These tomia were made to "bite" with specific force by weighting them with varying masses and dragging them across the pressure-sensitive sheet. The effect of the carbon paper sensor was noted in relation to the pressure exerted.

Field trials were conducted at Marcus and Malgas Islands, Saldanha Bay (33°03′S, 17°58′E), Cape Province, South Africa between 14 Sep. and 2 Oct. 1987. Twenty-seven devices were attached to African Penguins and six devices were attached to Cape Gannets (*Morus capensis*) for periods ranging from 4 to 63 h. The devices were attached to feathers in the mid-line of the back using 2 one centimeter wide strips of Tesa tape looped, adhesive surface uppermost, under a few feathers before being wrapped around either end of the device (cf. Wilson and Wilson 1989). Ten devices were also fitted to penguins and then immediately removed to examine the effects of operator handling on the device.

RESULTS

Response of sheeting to pressure.—In general, force applied to the pressure-sensitive sheet caused the carbon from the carbon paper to be transposed to the white, squared paper. However, the sheet did not register any pressures less than 1.2 kg/mm^2 made by the model beaks. Pressures between 1.9 kg/mm^2 and 5.6 kg/mm^2 produced a distinct grey mark of essentially invariant intensity. Subsequent, repeated marking of one area with equivalent pressures did not increase the density of blackening of the initial mark. Pressures greater than 5.6 kg/mm^2 produced denser black marks and, at a pressure of ca. 7.5 kg/mm^2 the carbon came off in lumps onto the squared paper producing a very dense black mark. Again,

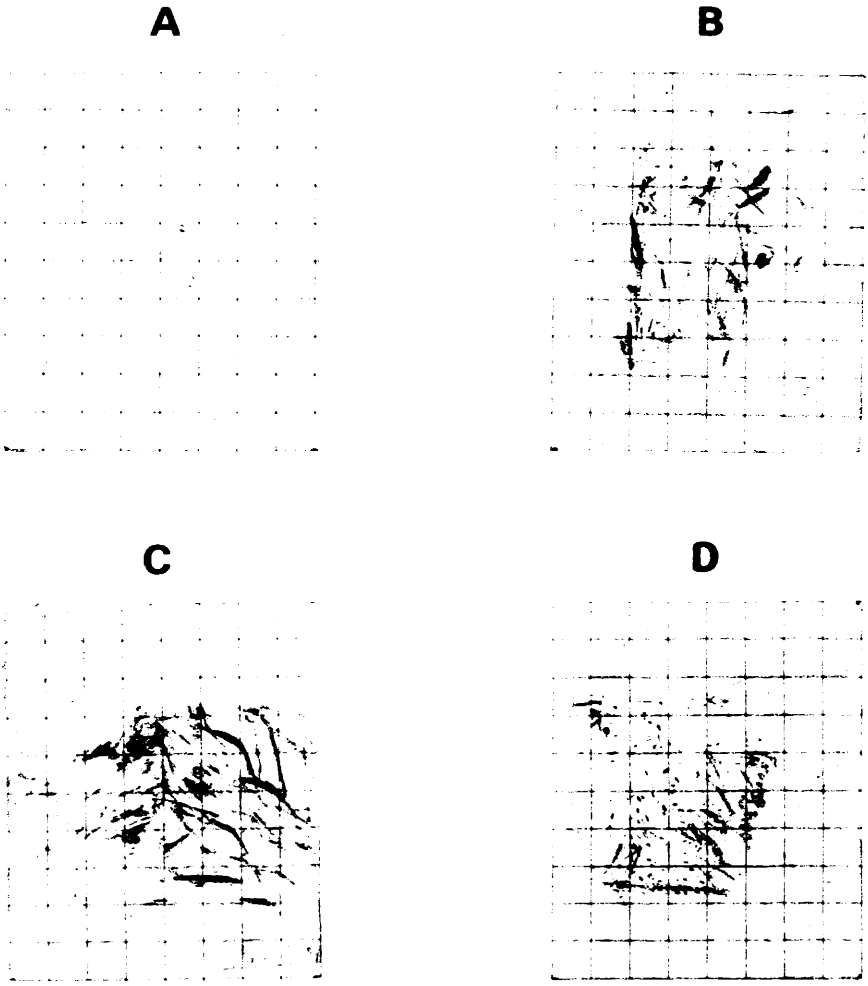

FIGURE 1. Marks produced on the squared paper underneath the carbon paper in the peck recorder that was: (A) operator handled but never attached to a bird. (B) placed on an African Penguin for 4 h. (C) and (D) placed on gannets for 4 h.

repeated marking in the same spot did not change the density of blackening of the initial mark.

Field trials.—Two of the 10 control devices showed apparent "pecks" (2 pecks recorded by one device and 4 by the other) caused, presumably, by the operators fingernails. Five devices showed slight smudging and three showed no trace of any kind (Fig. 1).

Of the 27 devices attached to penguins, one was lost and six recordings were ruined due to water entering the sachet. All birds fitted with peck recorders had apparently bitten the devices, even with wearing periods as short as 4 h (Fig. 1). The density of the bite marks indicated that all penguins except two bit their devices at pressures less than 5.6 kg/mm^2. We assume that all recorded marks were caused by bites exerting pressures in excess of 1.2 kg/mm^2 since this represented the lower recording threshold of the pressure-sensitive sheeting (see above). Carbon came off in lumps in two instances indicating that the birds had exerted pressures greater than 7.5 kg/mm^2. The marks made by African Penguins were fairly invariant, having a mean length of 4.47 mm (SD = 2.70, n = 57) and a mean width of 0.46 mm (SD = 0.46, n = 20). We could not differentiate the marks made by the upper mandible from those made by the lower (cf. Wilson and Duffy 1986) except in a few cases. Overall, penguins produced 12.5 marks (SD = 12.7, n = 20) on the sensor for every hour the device was worn. The individual variability was too great in relation to our sample size to enable us to determine whether there was any significant change in peck rate as a function of wearing time or whether peck rate changed according to whether the birds were at sea or on land. However, molting penguins pecked at their devices significantly more than breeding birds ($\bar{x}$ = 20.1, SD = 12.5, n = 11 and $\bar{x}$ = 3.1, SD = 2.5, n = 9, respectively, t = 4.0, $P < 0.01$).

Of the six devices attached to gannets three were lost. Recoveries were low because three device-fitted birds flew out to sea within an hour of being equipped and our limited time in the breeding colony (6 h) did not allow us to wait for their return. The three recovered devices were all worn for 4 h, during which time none of the birds left the colony. All devices had been marked. Gannets apparently either bit at their devices, producing characteristic slash marks (Fig. 1C), or stabbed, in which case the trace was covered in dots (Fig. 1D).

DISCUSSION

Our laboratory and field trials indicate that a small, cheap, robust peck activity recorder can be readily constructed and deployed on free-living animals. Examination of the trace may enable the researcher to determine whether the bird has bitten, pecked, or stabbed at the device. Stabbing (e.g., Fig. 1) may immediately be recognized as aberrant behavior since it does not constitute normal preening.

Although the recorder cannot determine the 'normal' incidence of preening in free-living birds, the selective sensitivity of the pressure sheeting to high pressure bites means that all records are likely to result from device-induced biting. Most marks recorded by African Penguins during our field trials probably resulted from birds biting as hard as they could because the maximum pressure that African Penguins can exert with most of the biting surfaces of the bill varies between 2 and 6 kg/mm^2 (Wilson and Duffy 1986). The sensitivity of the sheeting can be altered by varying the thickness of the covering tape and protective polythene. Thus, only relatively 'high pressure bites' (depending on the species) need to be recorded. Such marks can be immediately attributed to non-normal preening behavior.

Our work describes the construction and deployment of the recorder. Other studies have used the method to ascertain that Adelie Penguins (*Pygoscelis adeliae*) peck devices corresponding to their plumage color far less than they do contrasting colors (Wilson et al. subm.). These birds also peck devices more at sea than on land and show no habituation up to the maximum device wearing period of 14 d (Wilson et al. subm.).

Overall, the device should be most useful for comparing variability in peck rate according to device color, size, shape, positioning, and attachment methodology. The devices may also be used to examine whether intersex, or interage-group differences exist or whether animals wearing remote-sensing devices habituate over time. Ultimately, results from such studies can be used in the design of remote-sensing and telemetric packages so that aberrant behavior is minimized and recorded data are more meaningful.

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