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PARENT-OFFSPRING RECOGNITION IN THE JACKASS PENGUIN

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Abstract.—By transferring known-age chicks between marked nests the development of parent-offspring recognition in the Jackass Penguin (*Spheniscus demersus*) was examined. Parent recognition of offspring develops when chicks are 17–21 d old and is probably mediated by chick begging calls. Chick recognition of nest-site features appeared to develop at 12–16 d post-hatch, when chicks begin to explore outside the nest bowl.

EL RECONOCER PADRES-HIJOS EN EL PINGÜINO *SPHENISCUS DEMERSUS*

Sinopsis.—Se examinó el desarrollo de distinguir entre padres-hijos en el pingüino *Spheniscus demersus,* mediante la transferencia de pichones de edad conocida and nidos marcados. El reconocer a sus hijos, por parte de los padres, se lleva a cabo cuando los pichones tienen de 17–21 días de edad, probablemente por la vocalización de los pichones al pedir comida. El poder reconocer el pichón peculiaridades del nido, parecen desarrollarse cuando éste tiene 12–16 días, período cuando comienza a explorar los alrededores del nido.

In colonially nesting species, where the likelihood that young will intermingle is high, parents should be able to recognize their own offspring and thereby avoid investing in the offspring of neighbors (Holley 1984). Whereas parents would benefit from care directed towards offspring, chicks would benefit from any parental care (Evans 1980, but see Penney 1968, Spurr 1975, Thompson and Emlen 1968). If recognition is mediated via individually distinctive cues allowing parents to recognize both offspring and unrelated chicks, then it may be unprofitable and even dangerous for a chick to solicit from an unrelated adult. The same variables that favor parent recognition of young thus also favor offspring recognition of parents (Beecher et al. 1985). We created a series of cross-fostered broods of Jackass Penguins (*Spheniscus demersus*) to determine: (1) whether adult penguins recognize their own offspring; (2) what form discrimination against unrelated chicks takes; and (3) at what age chicks are recognized by parents; and by observing the behavior of cross-fostered chicks, (4) the approximate extent to which chicks are able to recognize parents.

METHODS

Transfers.—On Dyer Island (34°41′S, 19°25′E) between June and November 1990 we located nests containing two-chick broods. Both chicks were removed from the nest, weighed, and their culmen length and depth measured. Culmen dimensions allowed us to age chicks to within 3 d by

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reference to growth curves (van Heezik and Seddon 1992). By exchanging chicks between nests we created broods consisting of one related and one foster chick. Foster chick size (age) and weight were closely matched with those of the exchanged chick. Transfers were made of either first-hatched (A) or second-hatched (B) chicks. We also located a small sample of single chick broods, and measured and exchanged chicks as described above to create single-chick foster broods. Due to the increasing mobility of chicks it was not possible to transfer chicks older than 21 d. This study was approved by the Cape Department of Nature and Environmental Conservation, which maintains jurisdiction over all seabirds breeding on islands within the Cape Province region.

Observations.—We placed foster chicks on the edge of the foster nest bowl, within 15 cm of the sitting adult. Unfostered chicks remained in the nest. An observer then retired to approximately 8 m away and recorded the behaviors of all individuals in the nest. To allow time for birds to relax following handling, recording started about 1 min after the placement of the chick. Observations continued for 30 min during which time the behavior of the adult, the unfostered chick (in two-chick broods), and the foster chick was recorded at 10-s intervals. Behaviors were categorized as being positive, neutral or negative with respect to the foster chick. Positive behavior included all movements by the foster chick to enter the nest bowl and be brooded; and shuffling, settling, brooding movements and preening directed towards the foster chick by the adult, and preening or thigmotactic movements by the unfostered chick. Negative behavior included any movement by the foster chick away from or out of the nest bowl; and any aggressive behavior, such as pecking or flippering by adult or unfostered chick directed towards the foster chick. Neutral behavior was any action or posture not obviously positive or negative with regard to the foster chick. Brooding and lying quietly beside the adult were regarded as neutral behaviors as these may occur just before movement away from the nest. We also recorded the total amount of time the foster chick was brooded, however. We made control observations on unexchanged chicks aged 12–21 d, replaced in their own nests after being weighed, measured and handled for an equivalent time to exchanged chicks. For comparisons between control and transfer nests, all control observations have been grouped.

Growth.—We weighed foster chicks and unfostered chicks daily for 5 d after exchanges took place. Chicks that lost weight during this time were moved back to their original nests after 5 d.

RESULTS

A total of 20 transfers was made (four singles, seven A-chicks and nine B-chicks). Exchanged chicks fell into two age categories: 12–16 d old (n = 8), and 17–21 d old (n = 12). Thirty-minute observations were made at all transfer nests and at 13 control nests with unexchanged chicks (four singles, three A-chicks and six B-chicks).

All foster chicks in the 12–16-d category received food from adults, and

TABLE 1. Net weight gain by unfostered and foster Jackass Penguin chicks.

Age category	# chicks	# surviving	Mean (±SD) net weight gain (g)
12–16 d			
Foster	8	8	115 ± 123
Unfostered	8	8	195 ± 168
17–21 d			
Foster	12	7	−26 ± 222
Unfostered	8	8	150 ± 168

there was no significant difference between unfostered and foster chicks in weight gain after 5 d (Fisher's Exact $P = 0.5$). Unfostered chicks did not gain significantly more weight over 5 d than foster chicks (Mann-Whitney $U = 23$, $P = 0.19$, Table 1).

Four of the 12 foster chicks in the 17–21-d category were not fed and never gained weight on any day of the 5-d monitoring period; one of these chicks died. An additional four foster chicks died in the nest, despite small weight gains at some time during the 5 d. Three chicks gained weight and survived, and one chick suffered a net weight loss but also survived. Three out of the four 17–21-d singleton foster chicks suffered a net weight loss. There was a significant difference between unfostered and foster chicks in the incidence of net weight gain (Fisher's Exact $P = 0.03$), with nine of the 12 foster chicks losing weight or dying within 5 d. Unfostered chicks in the 17–21-d group gained significantly more weight than foster chicks (Mann-Whitney $U = 7$, $P = 0.04$, Table 1).

Two foster chicks in the 17–21-d category were replaced in their original nests after suffering weight losses of 180 g and 235 g (25% and 32% of initial body weight), respectively. Within 1 d of return the chicks had been fed and had gained 95 and 210 g (increasing to 180 and 385 g), respectively after 4 d.

All chicks were accepted into nests, but negative behavior directed towards foster chicks by adults (primarily pecks) was greater, although not significantly so, in transfer compared with control nests (Table 2). There was an associated trend in positive behavior by adults, greatest in control nests, intermediate in the 12–16-d category and least in the 17–21-d group (Table 2). Chicks appeared to respond to unfamiliar adults or nests, showing low negative behavior (moving out of or away from the nest bowl) in control nests, intermediate negative behavior in the 12–16-d group, and significantly higher negative behavior in the 17–21-d group (Mann-Whitney $U = 27$, $P < 0.02$, Table 2); a reverse trend held for positive behavior (moving into the nest bowl and under the sitting adult) (Table 2). Overall, chicks were brooded or rested quietly beside adults significantly more in control nests than in the 17–21-d category (Mann-Whitney $U = 32$, $P < 0.02$, Table 2). Unmanipulated chicks in both

TABLE 2. Behavior (mean ± SD) of adults and foster chicks in the first 30 min after chick transfer. See text for definitions of negative and positive behaviors.

Category	# nests	% time brooded	% time negative behavior	% time positive behavior
Control	13	88.6 ± 13.6		
Foster			1.1 ± 2.7	8.7 ± 11.1
Adult			0.1 ± 2.8	4.7 ± 5.5
12–16 d	8	82.3 ± 21.2		
Foster			2.5 ± 4.0	5.3 ± 5.6
Adult			0.3 ± 0.5	2.4 ± 3.2
17–21 d	12	74.3 ± 25.5		
Foster			6.9 ± 8.7	5.4 ± 3.1
Adult			0.3 ± 0.6	1.3 ± 1.3

control and transfer nests showed neither negative nor positive behavior towards introduced chicks.

DISCUSSION

The acceptance and feeding of all foster chicks in the 12–16 d old age group suggests that Jackass Penguins, like Adelie Penguins (*Pygoscelis adeliae*) (Davis and McCaffrey 1989), are unable to recognize offspring before this time. Chicks in the 17–21 d old age group were not fed normally, and intermittent daily weight gains may reflect incidental food theft by foster chicks. This may be interpreted as suggesting that parents have the ability to distinguish between foster and unfostered chicks by 17–21 d post-hatching. As chicks in this age category were accepted into the nest bowl in the absence of any vocalizations, it is possible that offspring recognition in Jackass Penguins, as in Adelie Penguins (Penney 1968), is mediated by vocal cues whereby adults discriminate against chicks with unfamiliar begging calls. Weight loss by singleton foster chicks suggests that this discrimination is not dependent on the presence of related offspring, and observations suggest that adults do not regurgitate in response to unfamiliar chick begging, even in isolation.

Although all foster chicks were accepted into nests, there was a tendency for parents in control nests to demonstrate less negative behavior toward chicks than did adults in experimental nests. This may reflect an adult response to chick behavior, however, rather than any visual recognition of unrelated chicks by adults. Foster chicks in the 12–16-d category were fed and brooded, but after introduction undertook extensive exploration away from the nest bowl. This greater amount of time spent out of the nest is reflected in the lower brood time. An increase in the tendency for adults to peck foster chicks in this category may have been due to the stimulus presented by an approaching chick. Adults will peck chicks that approach from outside the nest, and indeed, several control chicks were pecked by parents before gaining the safety of the nest confines.

In ground-nesting seabirds physical barriers restricting brood movements are often absent. Initial contact between young and parents may be maintained simply by strong nest-site attachment (Evans 1980). Before the development of offspring recognition, adults may direct care towards any young that are in or near the nest (Conover et al. 1980). It may be expected, therefore, that there is no pressure for chicks to be able to recognize parents because they would be able to solicit successfully from any brooding adult with a similar-aged brood. Away from their natal nests, however, chicks may find themselves in competition with full broods of two chicks. For this reason, in the period before offspring recognition develops, it is in the best interests of a young chick to be able to recognize and stay in its own nest, where parental care will be directed, and competitors will be limited to a single sibling. The increased movements of 12–16 d old foster chicks immediately after transfer suggests that chicks are able to recognize a nest or nest surrounds as being unfamiliar. This cognitive ability develops at a time when chicks are first able to explore outside the immediate confines of the nest bowl.

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