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THE BREEDING DIET OF DIFFERENT BROWN FALCON (*FALCO BERIGORA*) PAIRS OCCUPYING THE SAME TERRITORY OVER TWENTY YEARS APART

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Food is of critical importance in determining reproductive success in birds (Lack 1954), including raptors (Newton and Marquiss 1981, Meijer et al. 1989, Wiehn and Korpimäki 1997). Even within the same population, between-pair differences in diet can have marked influences upon fitness (Holthuijzen 1990, Slotow and Perrin 1992, Olsen et al. 1993, Swann and Etheridge 1995). This is also true of the Brown Falcon (*Falco berigora*) from southeastern Australia, where the focal population maintains a very broad diet consisting of invertebrates, reptiles, birds and mammals (McDonald et al. 2003). Despite this, within-pair dietary breadth is comparatively narrow, with most pairs taking the majority of their prey items from just one of five dietary groups: lagomorphs (rabbit [*Oryctolagus cuniculus*] kittens), ground prey (e.g., rodents and invertebrates), small birds (passerines <40 g), large birds (e.g., feral Rock Doves [*Columba livia*]), and reptiles (e.g., eastern tiger snakes [*Notechis scutatus*]; McDonald et al. 2003). These between-pair differences in diet had important impacts on reproduction, as pairs taking smaller prey (ground prey and small birds; geometric mean mass 59 g) were less likely to initiate breeding attempts compared to those taking larger prey (lagomorphs, large birds, and reptiles; mean mass 155 g; McDonald et al. 2004). This difference is presumably due to a difference in the amount of resources available to pairs, as smaller prey were not delivered to nests more frequently than larger prey (McDonald 2004).

While McDonald and colleagues (2003) were unable to census prey abundance during their study, the population monitored was the same as that examined by Baker-Gabb (1982) in 1979–80. We therefore had the opportunity to examine dietary differences of pairs occupying the same areas over two decades apart.

STUDY AREA AND METHODS

Initial samples were collected between September 1979 and December 1980, with subsequent sampling between July 1999 and June 2002, approximately 35 km southwest of Melbourne, at the Western Treatment Plant (WTP), Werribee, Australia (38°0′S, 144°34′E). Details of the study area have been described elsewhere (Baker-Gabb 1982, McDonald et al. 2003). The diets of pairs were assessed during the breeding season by collecting fresh pellets and/or prey remains from under known roosts (of both sexes) and nest sites, as well as opportunistically recording direct hunting observations. Materials were evaluated by hand and the minimum number of individual prey items present in each pellet/remains recorded. During 2000 and

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Table 1. Diet of different pairs of breeding Brown Falcons occupying the same territories between 1979–80 and 1999–2002. Minimum number of prey items identified via pellet analysis, prey remains/direct hunting observations (Obs. *N*), or video surveillance at nests are shown, as well as the percentage of those prey items categorized as lagomorphs (L), small ground prey (GP), small birds (SB), large birds (LB) and reptiles (R). Large prey items were lagomorphs, large birds and reptiles, with small ground prey and small birds small prey items. Pianka's overlap index and prey size defined as in text.

	1979–1980									1999–2002							
Territory No.	Pellet *N*	Obs. *N*	L	GP	SB	LB	R	Prey Size	Overlap Index	Prey Size	Pellet *N*	Obs. *N*	Video *N*	L	GP	SB	LB	R
1[a]	16	1	58.8	11.8	23.5	5.9	0	Large	0.93	Large	2	2	8	41.7	8.3	25	8.3	16.7
2[a]	51	0	2	56.9	17.6	2	21.6	Small	0.94	Small	1	1	24	3.8	76.9	19.2	0	0
3[a]	19	0	5.3	68.4	26.3	0	0	Small	0.96	Small	3	1	25	20.7	62.1	13.8	3.4	0
4[a]	41	0	43.9	26.8	22	0	7.3	Large	0.88	Large	4	1	12	23.5	35.3	35.3	5.9	0
5[a]	16	8	0	45.8	41.7	8.3	4.2	Small	0.87	Small	0	2	24	3.8	76.9	19.2	0	0
6[a]	32	0	0	53.1	40.6	0	6.3	Small	0.92	Small	0	10	37	2.1	38.3	36.2	21.3	2.1
7[a]	84	3	25.3	37.9	33.3	1.1	2.3	Large	0.89	Large	0	3	11	42.9	35.7	14.3	0	7.1
8[b]	35	3	55.3	7.9	26.3	2.6	7.9	Large	0.51	Small	0	5	0	20	60	20	0	0
9[b]	25	0	32	24	32	0	12	Large	0.76	Large	0	1	4	60	40	0	0	0
10[b]	31	12	11.6	37.2	27.9	23.3	0	Large	0.68	Large	0	0	8	50	25	25	0	0
11[b]	8	0	12.5	62.5	25	0	0	Small	0.88	Small	0	0	9	11.1	66.7	0	0	22.2
12[b]	50	0	6	50	40	4	0	Small	0.91	Small	3	2	0	0	60	20	20	0

[a] Pairs where total $N \geq 10$.
[b] Pairs where total $N \geq 5$.

2001, diets of breeding pairs were assessed throughout the nestling phase using surveillance cameras at nests (McDonald et al. 2003). Pairs were then classified as taking one of the five diet groups based on either (i) abundance >50% of prey items were from one diet category (seven of 12 pairs from 1979–80, eight of 12 in 1999–2002) or (ii) biomass, if one prey category did not account for the majority of prey items by number (biomass calculated using values from McDonald et al. 2003). In all but three cases (Territory 4 in 1979–80, Territories 7 and 10 in 1999–2002), the prey group contributing the largest biomass was also the most commonly taken. In addition, the degree of dietary overlap between pairs occupying the same territory in the two studies, in terms of abundance of each of the five dietary groups, was assessed using Pianka's index:

$$O_{jk} = \sum_{i}^{n} p_{ij} \times q_{ik} \Big/ \left(\sum_{i}^{n} p_{ij}^2 \times \sum_{i}^{n} q_{ik}^2 \right)^{-2}$$

where p_{ij} and q_{ik} equal the proportion of diet group i on territories examined between 1979–80 (j), and 1999–2002 (k; Pianka 1973). This index ranged from 0 (no overlap) to one (complete dietary overlap).

RESULTS AND DISCUSSION

Based on detailed maps from both studies, nesting sites and thus falcon territorial ranges had changed little over the sampling period. Habitat composition of each territory did not change markedly between sampling periods (WTP Management Committee pers. comm.). At least 10 prey items were collected in both studies for seven territories, with high dietary overlap indices between the two studies, ranging between 0.87 and 0.96 (Table 1). A further five territories had at least five prey items recorded in both studies; overlap indices between these pairs were also high, averaging 0.75 and ranging between 0.51 and 0.91 (Table 1). Thus, despite differences in sampling methodology between the studies, which have been shown to influence diet composition analyses (Collopy 1983, Simmons et al. 1991, Redpath et al. 2001), dietary overlap between pairs occupying the same territory 20 yr apart was very high, averaging 0.84 ± 0.04 ($\bar{x}$ ± SE, Table 1; $N = 12$).

We also assessed differences in prey size between the sampling periods, and, for pairs from which at least 10 prey items were collected in each study, all were taking the same size prey in both samples (two-tailed binomial test $P = 0.016$, $N = 7$, Table 1). Among the five territories for which at least five prey items were recorded in both studies, four (80%) were also taking the same prey size in both samples, giving a total of 11 (91.7%) of the 12 pairs taking the same prey size in both studies (Table 1; two-tailed binomial test $P = 0.006$).

Despite relatively small samples, the results of this study clearly demonstrate a high degree of overlap between the type and size of prey taken by Brown Falcon pairs occupying the same territories over 20 yr apart. Although this suggests the prey type available on territories is relatively stable over time, a detailed study assessing prey choice relative to prey availability on each territory would further improve our understanding of this species' feeding ecology.

COMPARACIÓN DE LA DIETA REPRODUCTIVA DE DISTINTAS PAREJAS DE HALCONES *FALCO BERIGORA* QUE OCUPAN EL MISMO TERRITORIO LUEGO DE VEINTE AÑOS

RESUMEN.—*Falco berigora* mantiene una dieta amplia a nivel poblacional. Sin embargo, estudios previos han demostrado que la amplitud de la dieta en una pareja determinada es relativamente estrecha. Debido a que el tipo de dieta es un factor importante que influencia el éxito reproductivo en esta especie, investigamos si las dietas de parejas que ocupan el mismo territorio difieren entre dos estudios realizados en 1979–80 y en 1999–2002. Once de doce parejas (91.7%) que utilizaron el mismo territorio durante estos periodos de tiempo tomaron presas del mismo tamaño en ambos estudios, con un índice promedio de superposición de la dieta entre parejas del 84%. Esto sugiere que el tipo de presa disponible en cada territorio es relativamente estable a través de periodos largos.

[Traducción del equipo editorial]

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LITERATURE CITED

BAKER-GABB, D.J. 1982. Comparative ecology and behaviour of Swamp Harriers *Circus approximans*, Spotted Harriers *C. assimilis* and other raptors in Australia and New Zealand. Ph.D. dissertation, Monash University, Clayton, Australia.

COLLOPY, M.W. 1983. A comparison of direct observations and collections of prey remains in determining the diet of Golden Eagles. *J. Wildl. Manage.* 47:360–368.

HOLTHUIJZEN, A.M.A. 1990. Prey delivery, caching, and retrieval rates in nesting Prairie Falcons. *Condor* 92:475–484.

LACK, D. 1954. The natural regulation of animal numbers. Clarendon Press, Oxford, U.K.

MCDONALD, P.G. 2004. The breeding ecology and behaviour of a colour-marked population of Brown Falcons *Falco berigora*. *Emu* 104:1–6.

———, P.D. OLSEN, AND D.J. BAKER-GABB. 2003. Territory fidelity, reproductive success and prey choice in the Brown Falcon *Falco berigora*: a flexible bet-hedger? *Aust. J. Zool.* 51:399–414.

———, ———, AND A. COCKBURN. 2004. Weather dictates reproductive success and survival in the Australian Brown Falcon *Falco berigora*. *J. Anim. Ecol.* 73:683–692.

MEIJER, T., D. MASMAN, AND S. DAAN. 1989. Energetics of reproduction in female kestrels. *Auk* 106:549–559.

NEWTON, I. AND M. MARQUISS. 1981. Effect of additional food on laying dates and clutch sizes of sparrowhawks. *Ornis Scand.* 12:224–229.

OLSEN, J., P.D. OLSEN, T. BILLET, AND J. JOLLY. 1993. Observations on the reproductive diet of the Peregrine Falcon *Falco peregrinus* in South Australia. Pages 81–83 *in* P.D. Olsen [ED.], Australian Raptor Studies. Australasian Raptor Association, Melbourne, Australia.

PIANKA, E.R. 1973. The structure of lizard communities. *Ann. Rev. Ecol. Syst.* 4:53–74.

REDPATH, S.M., R. CLARKE, M. MADDERS, AND S.J. THIRGOOD. 2001. Assessing raptor diet: comparing pellets, prey remains, and observational data at Hen Harrier nests. *Condor* 103:184–188.

SIMMONS, R.E., D.M. AVERY, AND G. AVERY. 1991. Biases in diets determined from pellets and remains: correction factors for a mammal and bird-eating raptor. *J. Raptor Res.* 25:63–67.

SLOTOW, R. AND M.R. PERRIN. 1992. The importance of large prey for Black-shouldered Kite reproduction. *Ostrich* 63:180–182.

SWANN, R.L. AND B. ETHERIDGE. 1995. A comparison of breeding success and prey of the Common Buzzard *Buteo buteo* in two areas of northern Scotland. *Bird Study* 42:37–43.

WIEHN, J. AND E. KORPIMÄKI. 1997. Food limitation on brood size: experimental evidence in the Eurasian Kestrel. *Ecology* 78:2043–2050.

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