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# DIET, OCCUPANCY AND BREEDING PERFORMANCE OF WEDGE-TAILED EAGLES *Aquila audax* NEAR CANBERRA, AUSTRALIA 2002–2003: FOUR DECADES AFTER LEOPOLD AND WOLFE

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We compared the diet and breeding performance of Wedge-tailed Eagles *Aquila audax* near Canberra in 2002–2003 with that found in the same area in 1964 by Leopold and Wolfe (1970). We located a total of 44 active territories, and checked 26 of the 32 territories originally found by Leopold and Wolfe. Twenty-two (85%) of the 26 were still occupied after nearly four decades. Contrary to what was found in the 1964 survey, nine active nests were located inside the city limits, with an average distance to paved roads of 720 ± 132 metres (range 130–1 270 m) and to suburbs of 1 117 ± 251 metres (range 260–2 000 m). Four nests were less than 500 metres from houses, but only one territory was completely surrounded by urban areas.

Fledgling rates were greater in 2002–03 than in 1964 (1.1 versus 0.8 young per territory) mainly because more pairs fledged two young in the 2002–2003 survey, and there was a decrease in the number of pairs that fledged no young.

In 2002–2003, 492 prey items were recorded from 33 territories. Fifty-seven different species were found: 19 mammals, 20 birds, seven reptiles and one crustacean. Mammals and birds were the dominant groups by number, 54.7 and 41.9 percent respectively, and mammals dominated by biomass (95.3%). The breeding diet in 2002–2003 was dominated by macropods, representing 19.9 percent (n = 98) of the total items and 45.6 percent of biomass. The most important species among these macropods was the Eastern Grey Kangaroo (13.6 and 31.2% by number and biomass respectively). Other important items were the European Rabbit (16.9 and 9.5% by number and biomass) and adult sheep (3.3 and 19.7%). Among birds, the parrots and cockatoos, Order Psittaciformes, represented 12.8 percent of the total items, but their contribution to the biomass was negligible (1.1%). The Galah (5.1%, n = 25) and Australian Magpie (6.1%, n = 30) were the most important bird prey species.

The proportional contribution of the different prey categories was significantly different between the two time periods. Three groups decreased significantly: European Rabbit (43.8% in 1964 v 16.9% in 2002–2003), Hare (15.8 v 7.9%) and lamb (8.9 v 1.8%); and three others showed significant increases: macropods (1.9 v 19.4%;), parrots (3.5 v 10.9%) and Other Birds (4.6 v 17%).

As long as the current high levels of diverse prey are available for the eagles near Canberra, it is likely that the population will remain stable, and young fledged per territory will remain high.

## INTRODUCTION

The Wedge-tailed Eagle *Aquila audax* is one of Australia's best-studied raptors (Marchant and Higgins 1993). Near Canberra in 1964, 66.7 percent of 15 territories (defined as a pair with nest and eggs) fledged a mean of 0.8 young per territory and 1.2 young per successful nest (= brood size: Leopold and Wolfe 1970). Diet consisted largely of European Rabbits *Oryctolagus cuniculus*, about 46 percent of the total number of items. Brown Hares *Lepus capensis* were the next most important species, followed by birds, sheep and lambs *Ovis aries*, small mammals, and lizards. Mammals accounted for 78 percent of *A. audax* diet near Mildura, Victoria and all but three percent of this was rabbit (Baker-Gabb 1984). In Western Australia 52–95 percent of the items in the diet were mammals (Brooker and Ridpath 1980), similar to that found for central Australia (79% – Aumann 2001), and on the Northern Tablelands of NSW (76% – Debus and Rose 1999).

To determine if breeding parameters and diet of Wedge-tailed Eagles had changed since 1964, we studied breeding eagles in the same area in the 2002 and 2003 breeding seasons, including many of the territories surveyed by Leopold and Wolfe (1970). In this paper we report the occupancy, reproductive success and breeding diet of the eagles, and compare our findings with those reported by Leopold and Wolfe. We also evaluated the 2002 and 2003 occupancy of the territories reported in the 1964 survey and document the establishment of new territories.

## METHOD

*Study Area*

The study area incorporated the Australian Capital Territory (ACT) and bordering areas of New South Wales (NSW)(Figure 1). The northern part of the ACT is mostly covered by the city of Canberra, while the outskirts of the city and surrounding areas of NSW are mainly farmland. Most of the undeveloped hills and ridges in and around urban Canberra are protected nature reserves that, together, cover an area of 5 720 hectares. The major vegetation associations in these reserves are dry sclerophyll forest, open savannah and woodland. Two protected corridors run along the Upper Molonglo and Murrumbidgee

rivers, up to four kilometres wide and along the full length of the Australian Capital Territory (66 and 18 km respectively). The vegetation here is dominated by River She-oaks *Casuarina cunninghamiana*, Scribbly Gum *Eucalyptus rossii*, Brittle Gum *E. mannifera*, Red Stringybark *E. macrorhyncha* and Blakely's Red Gum *E. blakelyi* woodland, and Red Box *E. polyanthemos* and Yellow Box *E. melliodora* in more open areas (NCDC 1988). The understorey has abundant tussock grasses (Poa spp.), with the shrub *Cassinia longifolia* dominating more open areas. The Namadgi National Park (106 000 ha) covers much of the rest of the southern end of the study area. The habitat in the Park is mainly wet sclerophyll forest, dry forest with open grassy valleys in the lower elevations, and alpine woodland in the higher areas. (A more complete description of the habitat and climatic parameters can be found in Taylor and COG 1992.) During the period of study, the region was under severe drought.

*Survey and Reproductive Parameters*

During July–December 2002 and June–November 2003, we searched suitable habitat in the study area to locate as many eagle territories as possible, and visited most territories located in the previous survey (Leopold and Wolfe 1970) to assess occupancy. We used a global positioning system to fix the location of nests found and to measure the distance to roads, suburbs and urban limits when it was impossible to take these measurements in the field (mean accuracy 5.7 ± 1.1 m). A Bushnell Yardage pro-1000 laser rangefinder with an accuracy of ± 1 metre was used to take the same measurements directly in each location when suitable.

The located occupied territories were monitored monthly during the breeding season (July–February) to assess the pair's reproductive status. Following Steenhof (1987), we defined an occupied nesting territory as an area containing one or more nest within the home range of a pair of eagles. A pair was considered active or breeding only if eggs were laid. When egg-laying could not be confirmed, an adult observed in incubating posture on at least two occasions constituted evidence of breeding activity. Successful pairs were those in which at least one young reached fledging age.

*Diet*

Prey Collection and Analysis

We estimated diet by analysing pellets and prey remains collected during the breeding season from inside and under nests and roosts. Some observations of prey deliveries or kills were also included, after we confirmed that these items did not show in the following prey collection. Pellets and remains were stored separately, and each pellet was placed in an individual zip-lock bag.

Quantitative and Statistical Techniques

We identified and counted body parts to estimate the minimum number of prey items (MNI) in a pooled sample of pellets, prey remains and observations in order to minimise biases in the food estimations (Collopy 1983; Seguin *et al.* 1998; Simmons *et al.* 1991). We did not assume that one pellet represented one individual prey item. Feathers were identified

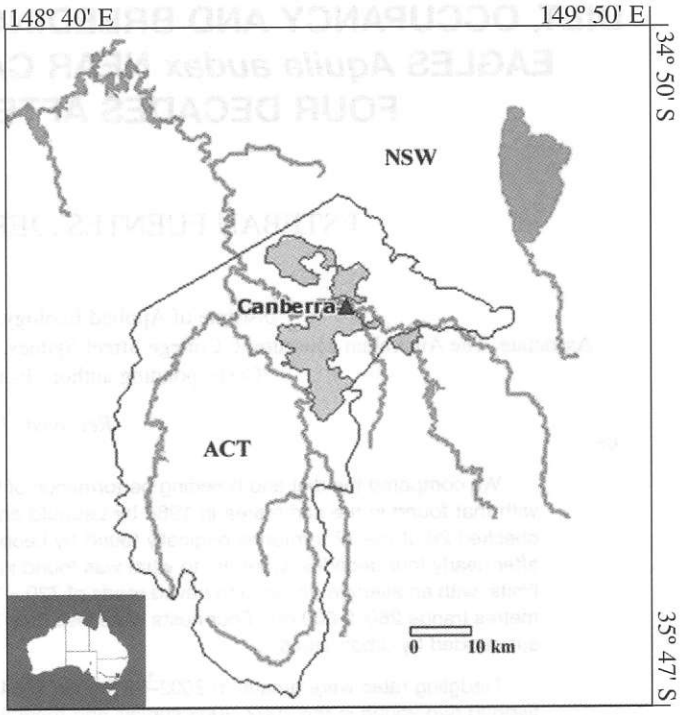


**Figure 1.** *The study area (34° 50' – 35° 47' S, 148° 40' – 149° 50' E).*

through comparison with collections and museum specimens when necessary. Bones, hair, and scales were identified by microscopy (following Brunner and Coman 1974 for mammalian hair) and by comparison with museum reference material.

Because Leopold and Wolfe (1970) did not present an estimation of pellets and remains combined, another estimation based on the MNI identified in fresh prey remains only (no pellets or observations) was used to compare the food habits of the eagles in 2002–2003 with those in 1964. For the purpose of this comparison, the prey species were grouped into eleven categories based on those reported in the Leopold and Wolfe study: rabbit, hare, macropods, sheep, lamb, other mammals, ravens, magpie, parrots, other birds and reptiles. Leopold and Wolfe also reported the frequency of occurrence of different prey types in pellets. This method, however, is one of the most biased estimators of food habits in birds of prey (Marti 1987) because of the production of multiple pellets from one item, and because nestlings and adults often share large prey items. Therefore, this approach was not considered for statistical analysis, but the trends observed are discussed.

Because Leopold and Wolfe (1970) presented their prey data in the categories noted above, we used the mean biomass contribution of the levels in each of their categories as the weight for that particular prey group:

$$\sum^{n} (No.\ Items\ L_n * Weight\ L_n) / \sum^{n} No.\ Items\ L_n$$

where *Ln* is each level included in the category for which mass is being estimated (for example, in the category Ravens, the three levels included were adult Australian Raven, juvenile Australian Raven and Little Raven). This formula was applied to six of the eleven categories described above; the other five