COMPARATIVE ECOLOGY AND BEHAVIOUR OF SWAMP HARRIERS CIRCUS APPROXIMANS, SPOTTED HARRIERS C. ASSIMILIS AND OTHER RAPTORS IN AUSTRALIA AND NEW ZEALAND

The Swamp Harrier (*Circus approximans*) and secondarily, 7 other species of avian predator [the Whistling Kite (*Haliastur sphenurus,*) Brown Goshawk (*Accipiter fasciatus,*) Brown Falcon (*Falco berigora,*) Black-shouldered kite (*Elanus notatus,*) Barn Owl (*Tyto alba,*) Southern Boobook (*Ninox novaeseelandiae*) and Little Raven (*Corvus mellori*)] were studied at Werribee in coastal Victoria, Australia, during 1979-80.

All overwintering Swamp Harriers hunted overlapping home ranges, and home ranges of "permanent residents" (366 ha) and males (324 ha) were smaller than those of "temporary residents" (1255 ha) and females (384 ha). "Visiting" Harriers were trapped, individually marked and then not resighted more than twice. Most of the Harriers left Werribee in spring. Adults (290 km) travelled on average much further than juveniles (55 km) and 6 marked Harriers were sighted or retrapped in Tasmania. One-third of the marked birds returned in autumn to hunt their former home ranges. Over-wintering population densities of Swamp Harriers (one per 60 ha), all raptors (one per 34 ha) and all avian predators (one per 16 ha) were recorded.

Seven search and 6 attack techniques were described. Also described for all of the raptor species were potential species separting mechanisms such as: hunting behaviour, habitats hunted, interspecific interactions, temporal activities and diets. Seasonal fluctuations in the population densities of the avian predators were recorded. Only 4 prey species [(the Rabbit (*Oryctolagus cuniculus,*) House Mouse (*Mus musculus,*) Eurasian Coot (*Fulica atra*) and Field Cricket (*Teleogryllus commodus*)] comprised the bulk of the diet of the 7 species of raptor. However, 3 distinct sets of raptor were identified.

The above feeding ecology and behaviour parameters and the morphology of Swamp Harriers in Australia were compared with those of a New Zealand population. There were no clear trends in phenotypic variability or sexual dimorphism between the two populations. Swamp Harriers from New Zealand have undergone considerable ecological release and density compensation. These differences were discussed with reference to theories on island biogeography.

In 1980 a study of communal roosting by Swamp Harriers and field experiments were conducted to test the information centre hypothesis. The results of the baiting experiments were ambiguous. The number of Harriers attending 5 communal roosts peaked in mid-winter. Few (7%) birds followed others from the roosts, but followers were nearly always among the first birds out of the tall, concealing vegetation in the morning. Some Harriers attempted to discourage followers by attacking them. On the hunting grounds the Harriers' dispersal was significantly and positively correlated with that of their major food species: Coots and ducks. The waterfowl population density fluctuated from day to day within census areas and exhibited marked differences between areas. Overall, the results support circumstantially the information centre hypothesis.

Some 25 km south-west of Werribee, 18 pairs of monogynous Swamp Harriers bred at the density of one pair per 67 ha. Nests were on average 525 m apart. Clutch sizes averaged 3.6 eggs and 24 young were fledged from 12 of the 18 nests. Nestling periods of 43 days (males) and 45-46 days (females) were recorded. Asynchronous hatching, fratricide and the evidence for double clutches in the Swamp Harrier were discussed.

During 1980-81 the Spotted Harrier (*Circus assimilis,*) and secondarily, 9 other species of diurnal raptor [the Whistling Kite, Black Kite (*Milvus migrans,*) Brown Goshawk, Peregrine Falcon (*Falco peregrinus,*) Black Falcon (*Falco subniger,*) Brown Falcon, Little Eagle (*Hieraaetus morphnoides,*) Wedge-tailed Eagle (*Aquila audax*) and Australian Kestrel (*Falco cenchroides*)] were studied near Mildura in arid north-western Victoria. In 1980, 19 Spotted Harrier territories were evenly dispersed over the 134 km^2 study area, but the following year only 2 pairs nested there. In 1980 nest sites averaged 2.8 km apart and territories were about 550 ha. Nests took about 2 weeks to build, incubation periods averaged 33 days and nestling periods 38 days (males) and 42 days (females). A mean clutch size of 3.0 eggs and an average fledging success of 2.2 young per successful nest and 1.3 young per nest site were recorded. Similarly, data were collected on the breeding density, clutch size, nestling periods and breeding success of the 9 other raptor species.

The breeding behaviour of the nomadic Spotted Harriers, from territory establishment to the fledging of their young, was described. Evidence was collected in support of the suggestion that the Spotted Harrier was once a ground-nesting bird like other harriers (*Circus* spp) and that it subsequently became a tree-nester.

It was argued that sexual differences in plumage colour of harriers may best be correlated with their predominant mating system, and not with sexual dimorphism or with hunting and nesting in open country as has been proposed. Data on 6 species of harrier were analyzed to test the above thesis and a previous classification of harriers. A theory on harrier mating systems was proposed. It was suggested that harriers are most often polygynous when optimal nesting habitat is in short supply ("resource defence polygyny"), when food is abundant and perhaps unevenly distributed and when the breeding density of harriers is high.

Rabbits were the main food of 8 of the 10 species of raptor breeding near Mildura, both in terms of numbers eaten (40-75%) and biomass consumed (60-92%). The Starling (*Sturnus vulgaris,*) Stubble Quail (*Coturnix novaezelndiae*) and Galah (*Cacatua roseicapilla*) were the next most important prey species. It was estimated that in 4 months the raptor guild consumed about 14% of the immature Rabbits in the study area.

The breeding behaviour, density and success of Brown Falcons at both Mildura and Werribee were described.

The morphometric and diet data from the thesis were incorporated into a review of current hypotheses proposed to explain the degree of sexual dimorphism in raptors and why females of most raptor species are larger than males.

Baker-Gabb, David John. 1982. Comparative ecology and behaviour of Swamp Harriers *Circus approximans*, Spotted Harriers *C. assimilis* and other raptors in Australia and New Zealand. Ph.D. thesis. Monash University, Melbourne, Australia. 286 pp.

GROWTH AND PRODUCTIVITY OF RED-TAILED HAWKS (Buteo jamaicensis) IN SOUTH-CENTRAL KANSAS

Growth and mortality data were collected from 54 nests of Red-tailed Hawks over three nesting seasons. The purpose of the study was to determine how the productivity of Red-tailed Hawks is affected by the type of habitat (cropland, mixed, or pastureland) dominating the habitat within a three-quarter mile radius of the nest. Nestlings were weighed and the length of their tarso-metatarsus (tarsus) measured at intervals of two to eight days. Growth was measured by comparing changes in body weight and tarsal length with age. Asymptote (fledging) values and growth constants were derived by fitting growth curves after the method of Ricklefs and these two measures of growth were compared