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Does Rain Hamper Hunting by Breeding Raptors?

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Many factors conspire to prevent or depress reproductive success. An understanding of these factors is important, for they are the forces that shape and control individual survival and success and, ultimately, that of populations and species. Only in the last few years has weather been considered an important factor in the reproductive success of raptors. Most authors attribute this weather-related reproductive failure to inability of the raptor to hunt and obtain food, and to possible increased food-needs in inclement weather (Gargett 1977; Moss 1979; Newton 1979, 1986, 1988; Ristow *et al.* 1983; Kostrzewa 1989).

Olsen & Olsen (1988, 1989), working on Peregrine Falcons *Falco peregrinus* in Australia, showed that much of that bird's breeding failure in wet weather was due to flooding of poorer quality nest sites. For their population, they found no evidence that wet weather contributed significantly to breeding failure through food shortage.

If hunting of breeding raptors is affected significantly by wet weather, then an effect on the growth rate of nestlings should be evident. Here we report on the effect of wet weather on the growth of nestling raptors near Canberra, Australia.

Methods

Two broods of Peregrine Falcons were measured at the same nest site in consecutive years: 1982 was a drought year with 262 mm of rainfall (long-term mean 625 mm); 1983 was much wetter than average with 757 mm. Similarly, the month when the nestlings were in the nest (October) was dry in 1982 (11 mm; long-term mean 69 mm) and wet in 1983 (117 mm). Hatching occurred only 2-3 days later in the wet year than in the dry year.

Two broods of Brown Falcons *Falco berigora* were measured: one in a wet year (1978, 772 mm); and one in a year with average rainfall (1985). Hatching was 17 days earlier in the average year than the wet year.

Two broods of Australian Hobbies *Falco longipennis* were measured: both in wetter than average years (1981, at 660 mm, and 1983). December 1983 and January 1984, the months when the nestlings were in the nest, were both particularly wet (90 mm December, 185 mm January; long-term means 59 mm and 53 mm, respectively). A brood of Whistling Kites *Haliastur sphenurus* was also measured in 1983.

For all broods, age was taken as 0 on the day they hatched. The nestlings were weighed at 3-day intervals, until they fledged.

Results

Peregrine Falcon In both years, even in the wet year during periods of heavy rain, the nestlings gained weight steadily (Figs 1a,b).

Brown Falcon Weight increase was steady in the average year (Fig. 1c). However, in the wet year the nestlings showed more erratic weight gain with weight loss in all except one nestling associated with a period of rain storms (Fig. 1d).

Australian Hobby In both (wet) years, the nestlings showed a fairly steady gain in weight throughout the nestling period (Fig. 1 e).

Whistling Kite The nestlings showed decreases in weight during periods when daily rainfall was more than 10 mm (Fig. 1f) followed by gains when it was dry. Compared with the Peregrine Falcons (Fig. 1b), hatched 11 days later in the same year, the nestling Whistling Kites' gain in weight was erratic.

Discussion

The results from this small sample indicate that the Peregrine Falcons and Australian Hobbies were able to provide enough food to ensure steady growth of their nestlings, even during wet periods. By contrast, the Brown Falcons and Whistling Kites were less able to maintain their nestlings' increase in weight (growth) during periods of rain. While the nestlings in our sample survived, had the rain continued for a longer period it seems likely that the latter two species would have lost nestlings to starvation.

Prolonged heavy rain is thought to prevent Peregrine Falcons from hunting; they are said to eventually become wet and dispirited (Beebe 1960; Ratcliffe 1980). However, rain around Canberra seldom continues all day, and the falcons easily shake water from their plumage. The Peregrine Falcons in our study may have minimised fluctuations in food supplied to the nestlings by retrieving cached food (e.g. Treleaven 1977); the other three raptors cache food to a lesser degree.

It seems more likely, however, that differences in plumage between the raptors account for much of the apparent difference in hunting (provisioning) ability in wet weather between species. The Peregrine and Hobby have much tighter, waxier feathers than the Brown Falcon and the Whistling Kite (pers. obs.) The former two shake the moisture from their feathers; the latter two take longer to dry and remain sodden for some time. We have seen Peregrines and Hobbies hunting in heavy rain, but not the more common Brown Falcon.

Behaviour of prey in the rain, and changes in abundance related to weather, may also influence hunting success. The Peregrine and Hobby parents captured birds. Avian prey may become active after rain more quickly, or be caught more easily when wet, than the rabbit *Oryctolagus cuniculus* and insect prey of the breeding Brown Falcons. However, the Brown Falcon can also catch birds. The Whistling Kites fed their nestlings mainly scraps left by fishermen, who may be less active during wet weather.

Some other falcons are reported to hunt successfully in rain. African Hobbies *Falco cuvierii* feed in the rain on emerging termites; they shake themselves dry every few minutes (Elkins 1983). European Hobbies *F. subbu-*

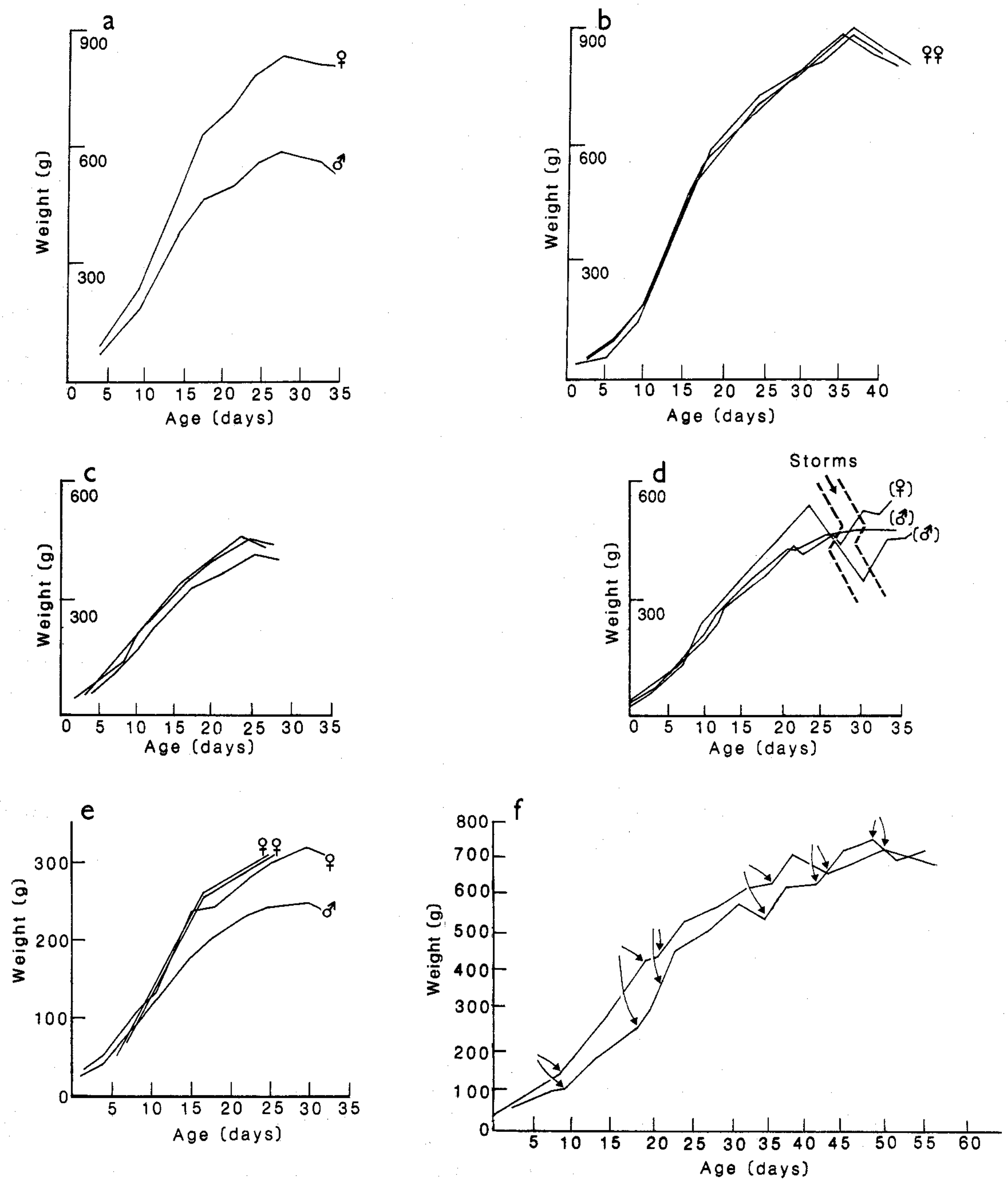

Figure 1 Increase in weight of individual raptor nestlings until fledging (leaving the nest). Age at hatching is day 0. (a) Peregrine Falcon: 1982 drought year. (b) Peregrine Falcon: 1983, wetter than average year. (c) Brown Falcon: 1985, year of average rainfall (nestlings all male). (d) Brown Falcon: 1978, wetter than average. (e) Australian Hobby: 1981 and 1983, both, particularly 1983, wetter than average. (f) Whistling Kite: 1983, wetter than average year. Arrows indicate that rainfall exceeded 10 mm on at least one day since the previous weighing day.

teo also benefit from rain; they catch swifts weakened by inability to hunt in cold, wet, windy weather (Elkins 1983).

We urge caution in assuming that in raptors reproductive failure associated with inclement weather is due solely to an inability to hunt. A number of factors come into play and their effect will differ according to species and circumstance.

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A Population of Rainbow Lorikeets *Trichoglossus haematodus flavicans* Roosting and Nesting on the Ground

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Rainbow Lorikeets regularly rest and roost communally in thickly foliaged trees and nest as single pairs in deep, unlined holes in limbs or trunks of large trees (Coates 1985; Forshaw 1989; Ulrich, *et al.* 1972; Utschick & Brandl, 1989; and pers. obs.). Activity at presumed nesting holes has been recorded in most months of the year and juvenile specimens have been taken in September and November (Coates 1985; Ulrich *et al.* 1972).

In contrast, one of us (KK) has long known that this species nests and roosts on the ground on Poy-yai (= Parta-uw, 2°11.5′S, 147°07.5′E) and at least two other islets, Tuluman and Niakuni, in the Admiralty Islands, Manus Province, Papua New Guinea. Poy-yai has an area of less than 0.5 ha and rises no more than 10 m above high water level. This rocky islet, 5.5 km west of Peré Village, is entirely covered by thick tree, palm and shrub vegetation to the high water level. In July 1988, two of us (ML and WSP), at the suggestion of KK,