

## CO-OPERATIVE HUNTING IN THE BROWN FALCON *Falco berigora*

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Co-operative hunting by raptors can increase their hunting success and has been described for the genera *Aquila*, *Haliaeetus*, *Parabuteo*, *Hieraeetus* and *Falco* (Brown and Amadon 1968, Cade 1982, Czechura and Debus 1986, Hector 1986). Generally it is only used when hunting difficult-to-capture prey, such as flying birds (Ratcliffe 1980; Pruett-Jones *et al.* 1981).

Hector (1986) stated that co-operative hunts should show some of the following characteristics: individuals tend to hunt together instead of hunting alone; group members select the same prey for pursuit; division of labour occurs during hunts; communication is used to co-ordinate movements of participants; food that may normally have to be defended against other raptors (e.g., large prey) is shared among participants; and individuals monitor each others movements during hunts.

The falcons for which co-operative hunting has been described are generally small to medium sized, live in open to semi-open savannah, desert scrub and wooded grassland, and feed on a variety of prey (insects, birds, reptiles, rodents). Most are agile afoot and readily pursue prey through dense cover. They depend to some degree on the stick platforms of other birds for nest sites, and all inhabit at least sub-tropical regions, where larger raptors and corvids are abundant. Importantly, these species inhabit areas where refuges for potential prey are numerous, and unless some active flushing or pursuit of prey taking refuge in cover is adopted, prey captures are restricted to the few truly open areas.

In addition to agile footwork (usually requiring a long tarsus), this group has physically flexible plumage, minimizing feather breakages in collisions with brush, and long tails to aid in balance, braking and agility on the ground and in the air.

In such species, co-operative hunting may be an adaptation for particular terrain and quarry, a co-ordinated attack providing a solution to the problem of blocking aerial escape routes for prey while simultaneously chasing them through patches of cover (Hector 1986). In addition, co-ordinated attacks by mated pairs may also improve efficiency of nest defence and nest usurpation activities. Aplomado Falcons *F. femoralis* use near identical co-operative methods in both pursuit of prey and nest defence (Hector 1986).

Superficially, the Brown Falcon *F. berigora* has the physical attributes described above, namely long legs and tail, physically flexible feathers and some appropriate behaviours. This species will readily enter dense cover to pursue prey (Hunt 1982, pers. obs.). I compared co-operative hunting by the Brown Falcon species with data presented by Hector (1986) for the Aplomado Falcon.

### METHODS AND STUDY AREA

Most observations were made during the course of other research. However, regular observations of hunting raptors were made at the Tasman Bridge, Hobart, during winter where many thousands of Common Starlings *Sturnus vulgaris* roost (see also Mooney 1981).

Almost all observations were carried out in habitat consisting of a mosaic of pasture, scrub and dry sclerophyllous forest of varying densities, habitat typical of the drier areas of Tasmania.

I analysed my observations of attacks by adult Brown Falcons on flying birds between 1973 and 1988. (Plumage details were assessed as per Condon 1951 and my data, and were later verified by Weatherly *et al.* 1985). Hunts were categorized as being made by one or two falcons on single or several prey. When compiling data for the Brown Falcon, I only used hunts which had known end results and which were directed at birds capable of flight.

## RESULTS AND DISCUSSION

Co-operative hunts by Brown Falcons only ever involved two falcons in adult plumage. Such hunts were observed at all times of the year, except mid-October to December, when adults would have been incubating in Tasmania (unpub. data).

Co-operative hunting by a pair of Brown Falcons usually took the form of either pursuit of a single prey, which was shepherded towards the second falcon, or close harassment of a flock while the second falcon soared overhead, the aim probably being to break up the flock. Both methods occasionally involved flushing behaviour where one falcon entered cover and the other soared more or less overhead. The division of labour did not seem absolute, and roles sometimes were exchanged during the hunt. I observed that males were better at harassment and close pursuit (they are smaller and seem more agile) and females tended to soar, perhaps having higher terminal velocities in a dive (Cade 1982). Similar hunts have been previously described for the Brown Falcon (Campbell 1984).

Co-operative hunts of birds were 2.7 and 2.2 times more successful than hunts by single falcons for Brown Falcons and Aplomado Falcons respectively, an indication of the efficiency of co-operative hunting when pursuing flying birds. As a tool, it can raise the hunting success of a bird such as the Brown Falcon, with no special physical adaptations for catching flying birds, to a rate comparable with hunts by a bird such as the Aplomado Falcon with these adaptations (notably

long, thin toes), (Cade 1982). The latter species is good at catching flying birds in any case, and co-operative hunting makes it even better.

Brown Falcons used co-operative hunting on 16 per cent of occasions compared to 66 per cent for Aplomado Falcons. If co-operative hunting is so successful, why do not Brown Falcons use it more often? From my observations of the diet of Brown Falcons, some pairs specialize on bird prey and these indeed seem to use co-operative hunting regularly when attacking flying birds (42 per cent of 24 hunts). The species' physical adaptations seem oriented to reptile prey (Cade 1982). Consequently, I believe that co-operation in pursuit of flying birds has not evolved as an essential part of their hunting behaviour and is therefore not used very often. There is no published evidence that raptors physically specialized to hunt reptiles receive an advantage from co-operative hunting. The advantage of co-operative hunting for flying birds is basic — it is more successful than hunts by single raptors — and even species such as the physically unspecialized Brown Falcon will use it.

Brown Falcons used co-operative hunting with similar relative frequencies whether they hunted flocks or single birds (Table 1, 12.8 per cent and 14.6 per cent, respectively). I believe most tandem hunts by Brown Falcons started as a matter of opportunity, not deliberation, as may happen with the Aplomado Falcon (Hector 1986). Generally, Brown Falcons prey on a large variety of small animals (see, for instance, Baker-Gabb 1982), and the required high level of foraging activity would not necessarily be facilitated by pairs staying together for co-operative hunting.

A common occurrence in late summer in south-eastern Australia is social foraging by juvenile Brown Falcons, where up to 30 birds may be seen feeding on invertebrates within only several hectares (Baker-Gabb 1982, pers. obs.). In those temporary situations, no co-ordinated hunting appears to occur. Such social foraging is well described for a number of raptor genera, such as *Buteo* (Bent 1937) and *Aquila* (Cramp and Simmons 1980), and probably has little or no effect on hunting success besides helping other similar raptors locate the food source.

TABLE 1

Hunting success of Brown Falcons and Aplomado Falcons on flying birds. One hundred and seven hunts by Brown Falcons and one hundred hunts by Aplomado Falcons were examined. Data for Aplomado Falcons from Hector (1976).

Number of attacking falcons	Number of birds attacked						Total			
	1			2 or more			Successful	Unsuccessful	%Success	
	Successful	Unsuccessful	%Success	Successful	Unsuccessful	%Success				
Brown falcon	1	5	37	11.9	3	45	6.3	8	82	8.8
	2	2	5	28.6	2	8	20	4	13	23.5
Aplomado falcon	1							7	27	20.6
	2							30	36	45.5

A hunt involving multiple raptors of the same species is not necessarily co-operative. Occasionally simple competitiveness for prey occurs and two non-associating individuals may chase the same prey, with inevitable attempts at piracy. Such competition can also occur between species and was common at the large winter roost of Common Starlings at the Tasman Bridge, Hobart (Mooney 1981). Interestingly, success was higher in hunts involving several raptors, whether the competitors were of the same or different species: Single Brown Falcons 9.1 per cent success (N=86), more than one Brown Falcon 14.9 per cent (N=31), more than one bird of different species 15.4 per cent (N=36), and co-ordinated hunts by two Brown Falcons 20 per cent (N=11). The general confusion among prey that results from attacks by several raptors apparently assists predation. Often when a flock was attacked, the confusion after one bird has been caught allowed the capture of a second.

When harassing other raptors, particularly Marsh Harriers *Circus aeruginosus*, nesting Brown Falcons often showed co-operative efforts similar to the shepherding form of co-operative prey attack. This co-operative nest defence was so effective that harriers often were forced to seek refuge on the ground.

Despite the Brown Falcon having some of the behavioural and physical features apparently associated with co-operative hunting (Hector 1986), I believe that the similarities in plumage

and leg length between Aplomado and Brown Falcons are somewhat coincidental. Closer examination of foot structure suggests the former has a bird-catching foot with typically long toes, while the latter has the short thick toes and heavy scaling more typical of reptile eaters, as has been previously suggested (Cade 1982; Sonter and Debus 1985). The large beak of the Brown Falcon supports this. The beak is used by falcons to break the neck of their prey, and it would be advantageous to quickly kill poisonous snakes. The long legs and supple plumage of the Brown Falcon indeed permit pursuit on the ground and in cover, and the long tail allows excellent manoeuvrability. However, its large wings and long tail also allow hovering, like many specialist reptile eaters (Brown and Amadon 1968), a hunting method very rarely used by raptors physically specialized for catching birds. I conclude that the Brown Falcon occupies a wide niche, having special reptile hunting capacities, but also an ability to hunt vastly different types of food, by active pursuit if necessary.

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## HEAT REGULATION IN THE GREAT-BILLED HERON *Ardea sumatrana*

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The Great-billed Heron *Ardea sumatrana* may suffer heat stress while feeding. This may result in a conflict between the needs to feed and to regulate temperature.

### INTRODUCTION

There is little information about herons in Australia, apart from papers by Hindwood (1933), Recher and Recher (1968, 1972), Recher (1972a, b), Lowe (1983) and Recher *et al.* (1983). Gill (1979) describes the display of the Great-billed Heron, a species occurring from Australia to South-east Asia. The following account is of an opportunistic observation that I have interpreted as heat regulation in this species.

### SITE AND WEATHER CONDITIONS

Middle Arm Jetty consists of an improvised

boat ramp on the right (north-east) bank of the Blackmore River, which merges into Haycock Reach and Middle Arm, Port Darwin, Northern Territory. The waterway is lined with mangroves, and the locality, about 14 km west of the Stuart Highway, is rarely visited except by fishing parties, birdwatchers and museum collectors.

On 13 April 1983 I arrived at the boat ramp at about 1300 hr. A Bushnell 600 mm telescope fitted with a 25× eyepiece was set up on a tripod to scan the mangroves on the left (south-west) bank of the river, which is about 400 m wide at this place.