

# FORAGING AND SOCIAL BEHAVIOUR OF THE WHITE-FACED HERON AT PAUATAHANUI INLET

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## ABSTRACT

During a study from January to June 1982, White-faced Herons (*Ardea novaehollandiae*) visited the mudflats of Pauatahanui Inlet in greatest numbers in summer and declined after April as they dispersed to farmland. When foraging, they were essentially searchers, usually wading and walking, but occasionally standing and waiting for prey. They also used more active feeding methods, disturbing prey by foot-stirring, wing-flicking, and false striking with the bill, and pursuing prey by running, wing-flapping and hopping. How they captured and handled prey depended on the prey species.

White-faced Herons maintained variable individual distances using several agonistic displays, including forward and upright displays, chases, fights, and associated calls.

The behaviour of various members of the Ardeidae has been closely studied, particularly in North America. Meyerriecks (1960, 1962) rationalised the terminology of heron social behaviour and classified the standard foraging methods of herons as 'stand and wait' and 'wade or walk slowly,' and various forms of 'disturb and chase.' Kushlan (1976) reviewed the literature for North American herons and identified 37 distinct foraging techniques. Based on heron behaviour, morphology and ecology, Curry-Lindahl (1971) made a taxonomic revision of 42 species of herons around the world.

Among the few published descriptions of Australasian heron behaviour are studies of Reef Herons (*Egretta sacra*) in Australia (Recher 1972, Recher & Recher 1972) and New Zealand (Edgar 1978). The literature on the White-faced Heron (*Ardea novaehollandiae*) includes a study of stomach contents in New Zealand (Carroll 1967) and a study of feeding behaviour and diet in Australia (Lowe 1983). The ecology of White-faced Herons has been studied in New Zealand on the Kaikoura rocky coast (Spurr 1967a, 1967b), Akaroa Harbour mudflats (Louisson 1972) and Manawatu farmland (Lo 1982). My own study was done at Pauatahanui Inlet, north of Wellington (Moore 1982).

The aim of this paper is to provide a synopsis of the White-faced Heron behaviour that I observed at Pauatahanui Inlet and to relate this information to other studies of herons.

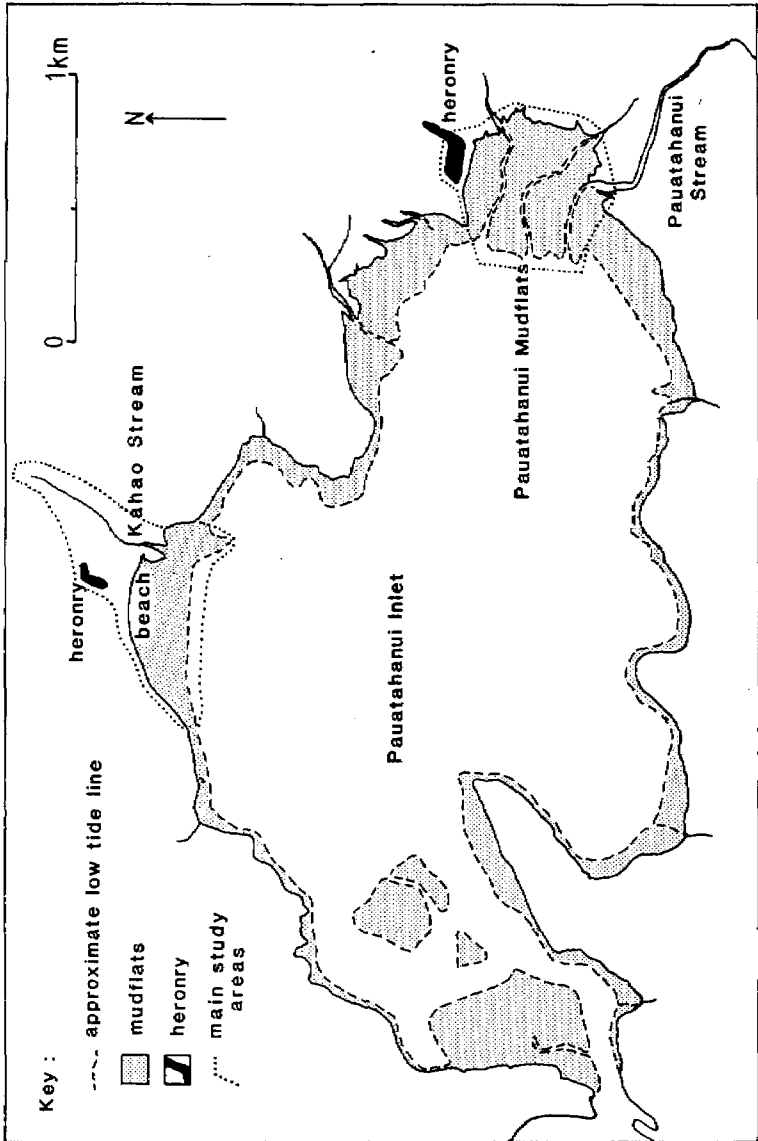


FIGURE 1 — Pauatahanui Inlet

### STUDY AREA

Pauatahanui Inlet is the eastern arm of Porirua Harbour, situated north of Wellington on the west coast of the North Island. Because it is a tidal estuary, extensive mudflats are exposed in the main bays at low tide (Fig. 1). Stream channels dissect the mudflats, particularly in the east, at the head of the estuary. Aquatic vegetation covers the less frequently exposed mudflats and includes eel grass (*Zostera capricornii*), red algae and sea lettuce (*Ulva*). Small areas of sea rushes (*Juncus maritimus*) are found in northern and eastern parts of the estuary but roadways separate most of the inlet from farmland, and in the west, from city suburbs.

The main study areas were the Pauatahanui mudflats, at the head of the estuary, and the Kahao mudflats and adjacent farmland, on the northern side of the inlet (Fig. 1).

### METHODS

Field work was done between January and June 1982, most intensively from late January to early March and during May. Observations were made with binoculars (8x30mm) and a telescope (25x and 60x).

I counted White-faced Herons from the roadside around the inlet and observed their behaviour at the main study areas for several hours each visit. I noted and sketched all heron behaviour. When studying the behaviour of individual herons in detail I used observation periods of at least 3 minutes and used a written code to describe the activity. For this purpose I had categorised 31 actions, for example, walking, standing still, attempting to capture prey, and stirring the substrate with the foot.

### SEASONAL AND DIURNAL USE OF THE INLET

At low tide during the summer, between 13 and 42 White-faced Herons foraged on the estuarine mudflats around Pauatahanui Inlet. The highest numbers of herons were attracted to the inlet in calm conditions and when the mudflats were exposed to their greatest extent. Heron activity was influenced by the combined effects of winds and the lunar cycle on the state and timing of the tides and by such direct effects of the weather on feeding conditions as strong winds buffeting herons and stirring up the water.

The Pauatahanui mudflats at the eastern end of the estuary were the most popular feeding ground, especially during summer low tides when up to 31 herons were present. The herons foraged by walking on or wading over mud or beds of aquatic vegetation and wading in stream channels on the mudflats. During high tide, when the feeding areas were flooded, some herons roosted beside the rushes bordering the mudflats, but up to 21 herons gathered at a beach near Kahao Stream on the northern side of the inlet.

At night, herons gathered in trees near the main feeding and

roosting areas. As many as 18 birds roosted at the 'Pauatahanui Heronry,' a grove of tall kanuka (*Leptospermum ericoides*), while another 16 occupied the 'Kahao Heronry,' a line of macrocarpas (*Cupressus macrocarpa*). Apparently requiring a certain level of light to feed, herons usually arrived one at a time at the heronries, on average, 21 minutes (SD = 15.1, n = 144) after the official sunset time, and left, on average, 26 minutes (SD = 17.1, n = 93) before sunrise.

After April, the numbers of White-faced Herons that visited the inlet declined and in one count in June only five birds were seen. During this period, herons used pasture adjacent to the estuary more often than in summer.

### FORAGING BEHAVIOUR

The White-faced Heron is a predator that depends on vision and captures prey with a variety of methods. Foraging can be divided into searching for prey, disturbing, pursuing, capturing and handling prey.

#### *Searching*

When foraging at Pauatahanui Inlet, the White-faced Heron was very much a searcher, using two main techniques.

*Wade or walk slowly:* Most foraging was done by wading and walking slowly. When walking the heron used a smooth leg action and in shallow water the feet were lifted above the surface with each step. However, when the water was deeper than about 9 cm (the length of the tarsus), the feet usually remained underwater. As a heron walked, the head was moved back and forth, periodically exaggerating the neck movement to search for prey.

*Stand and wait:* In the least active method of foraging, the White-faced Heron stood still and waited for prey to come into sight or within reach. The stance varied from upright with the neck extended to crouched with the neck retracted. These postures were occasionally used when fishing in or at the edge of deep water or when strong winds made normal foraging difficult. Herons also stood and waited when prey were plentiful and easily caught, such as when flies were attracted to dung-piles or sheepskins.

#### *Disturbing prey*

As well as the searching methods of foraging, White-faced Herons used active methods which disturbed prey so that they could be seen and captured.

*Foot-stirring:* The most widely documented form of active foraging used by the White-faced Heron is foot-stirring. At Pauatahanui Inlet, herons, while looking down into the water, would slowly extend a leg forward, raking or vibrating with the foot, and then withdraw it. Sometimes the same foot was used successively to stir in a small area

TABLE 1 — The use of some foraging methods by White-faced Herons and their feeding success

	Number of Observation Periods	Percent Feeding Success $\pm$ SD	Percent Occurrence
No disturbance	387	50.7 $\pm$ 25.3	62.3
Foot stirs	95	40.3 $\pm$ 19.9	15.3
Foot stirs + False strikes	61	39.6 $\pm$ 19.9	9.8
False strikes	78	46.4 $\pm$ 20.5	12.6
	621		

but usually both feet were used alternately while moving slowly ahead with each stir. Foot-stirring usually occurred over eel grass or algae, and especially in the mudflat stream channels. On one occasion a heron foot-stirred to agitate some high tide debris after it had dropped an insect.

Hérons, including juveniles, foot-stirred independently but sometimes several birds in a feeding area foot-stirred at the same time.

Of 621 periods where a White-faced Heron was observed for 3 minutes or more, foot-stirring occurred on 25% of occasions (Table 1). These particular herons caught prey in only 40% of their total capture attempts, which is highly significantly less ( $p < 0.01$ ) than the 51% success for herons that did not use disturbance techniques.

*False striking:* Before striking at prey with the bill, herons made at least small head movements, presumably because they had seen prey or prey movement. Sometimes, however, I concluded that bill motion had occurred when the heron had not seen prey. I called this activity *false striking*. Typically, a heron would make a series of rapid vertical stabs at the water or substrate when foraging over exposed or submerged eel grass or algae. When a heron did see prey, of course, it often made rapid successive strikes also, but it would be more alert, as shown by eye and head movements, and the strikes would be directed not at one spot but in a sequence and direction that showed it was following an escaping animal.

A characteristic of false striking was that the beak was often opened wider than usual (Fig. 2) and remained open in both downward and upward movements of the head, which was not apparent during normal strikes. The speed of false strikes sometimes varied. For example, in deep water herons slowly immersed the beak and head several times in succession.

False strikes were often associated with foot-stirring and some herons alternated both actions for several minutes at a time. Being nearly as common as foot-stirring, false striking occurred in 22% of observations. Herons which used false striking alone captured prey in 46% of attempts, which is less successful (although not significantly so) than herons which did not disturb prey. However, this level of success is significantly higher ( $p < 0.05$ ) than for those herons which foot-stirred only or those that foot-stirred and false struck in the same observation period.

*Wing-flicking:* The use of quick wing movements to disturb prey was rare. One wading heron quickly extended and withdrew its folded wings, repeated the action several steps later, and by its quick head movement showed that it had seen prey, which it then tried to catch. Another wading heron flicked its wings twice in quick succession, the second being a full extension. In several minutes, it made three such movements.

#### *Pursuing prey*

Once a White-faced Heron had found prey it often had to pursue the animal before it could be caught.



FIGURE 2 — White-faced Heron 'false striking.' The bill is held open wider and for longer than in normal attempts to capture prey

*Running:* Herons sometimes ran up to 20 paces after detecting prey, in deep water usually lifting their feet above the surface to increase speed. Fish, the largest and most active prey, often had to be chased. Characteristically, the heron ran an erratic, twisting path before attempting a capture, usually a deep thrust of its head into the water. If unsuccessful, the heron would quickly raise its head, scan for the prey, and resume the chase.

*Wing-flapping:* Occasionally, herons pursued fish in spectacular fashion, running through the water and flapping their wings horizontally. A school of fish was a major attraction and several herons at once would chase prey in this manner.

*Hopping:* Herons made short jumps or flights ('hops') while wing-flapping to keep up with escaping fish. At times, this came close to aerial feeding. For example, a heron chasing a large fish flew close to the water with dangling legs, following an erratic course before striking successfully as it landed.

The most unusual example of 'disturb and chase' foraging that I have seen was a heron on exposed eel grass which made a short erratic flight ('hop') with trailing legs, looking down as it did so. When it landed it closed its wings, flicked them, made a false strike, and 'hopped' again. It repeated similar sequences several times but did not capture anything.

### *Capturing prey*

The amount of stealth shown by herons when they saw prey and attempted captures by striking with the bill depended on the prey type. Little happened if the prey was small or lacked special means of escape. This was the case for oligochaete worms in damp pasture, which were struck at as soon as a heron saw them. Usually, though, strikes were preceded by an orientation of the heron towards the prey (e.g. Fig. 3) while walking or after a short run. If interest was sustained, presumably because the prey remained visible and within striking range, the heron leaned forward with the neck curved, poised to strike. This posture varied from looking vertically down, when foraging for polychaete worms in eel grass or algae, to a stealthy, almost horizontal, stance with the body held close to the water, when fishing. When stalking insects above the high tide line or on farmland, herons often swayed the neck slightly while leaning forward.

Depending on the activity of the prey, a strike could occur as a continuation of the orientation movement or after a pause. The neck was rapidly extended and the prey was grasped between the mandibles. The most vigorous strikes were made to catch crabs and, particularly, to catch fish in deep water. The heron usually ran a few steps and plunged its head into the water as it lifted the folded wings away from its body.



FIGURE 3 — White-faced Heron leaning forward and looking down after seeing prey in front of it



### *Handling prey*

After capture, food was usually tossed back into the heron's throat by a quick backward motion of the head, particularly small prey such as insects. Sometimes food was lost in this movement. They had to juggle long prey, such as worms, to get them in the mouth. Herons usually shook crabs, probably to re-position them in the beak before swallowing. They often held larger crabs by the legs and broke the body off with a quick shake of the head, repeating this several times before swallowing the crab's body. Large fish, especially flatfish, were usually carried above the waterline to be dropped and re-oriented before swallowing.

Prey with defence mechanisms had to be subdued. One type of polychaete worm would wrap itself round the heron's beak, and once a heron dropped and struck a worm 16 times before it could be swallowed. Eels acted similarly and writhed vigorously when captured, and on one occasion a heron struck and prodded an eel 425 times in 9 minutes before it was subdued and swallowed.

## SOCIAL BEHAVIOUR

### *Social aggregation*

At Pauatahanui Inlet, White-faced Herons generally foraged independently as part of scattered flocks at the major estuarine feeding areas. They were aggressive to one another, maintaining variable individual distances (spacing between birds). Although most herons did not consistently defend foraging areas, one heron in a flock was usually more aggressive than the others. Close aggregations sometimes formed when herons were attracted to within a few metres of each other by a school of fish or the sight of a heron pursuing prey.

In contrast to their almost solitary foraging, White-faced Herons roosted together at high tide during the day. They also gathered at night to roost and sleep at two heronries adjacent to the estuary, especially in summer. A family group roosted some distance away from the Kahao heronry.

### *Agonistic display*

White-faced Herons used several displays to keep others away. The intensity and apparent causes of displays could vary. Figure 4 shows the various agonistic displays, divided into those tending toward attack and those tending toward escape. The lines joining the actions allow for different combinations of displays in any social interaction. Aggressive displays could result in the other heron displaying aggressively also or, more often, submissively.

Aggressive behaviour often caused disorder among a flock. For example, a heron supplanted from its position at a day roost could displace a neighbour, resulting in a chain reaction. However, a social hierarchy was not apparent because a supplanted heron would sometimes return to its position and displace the original antagonist.

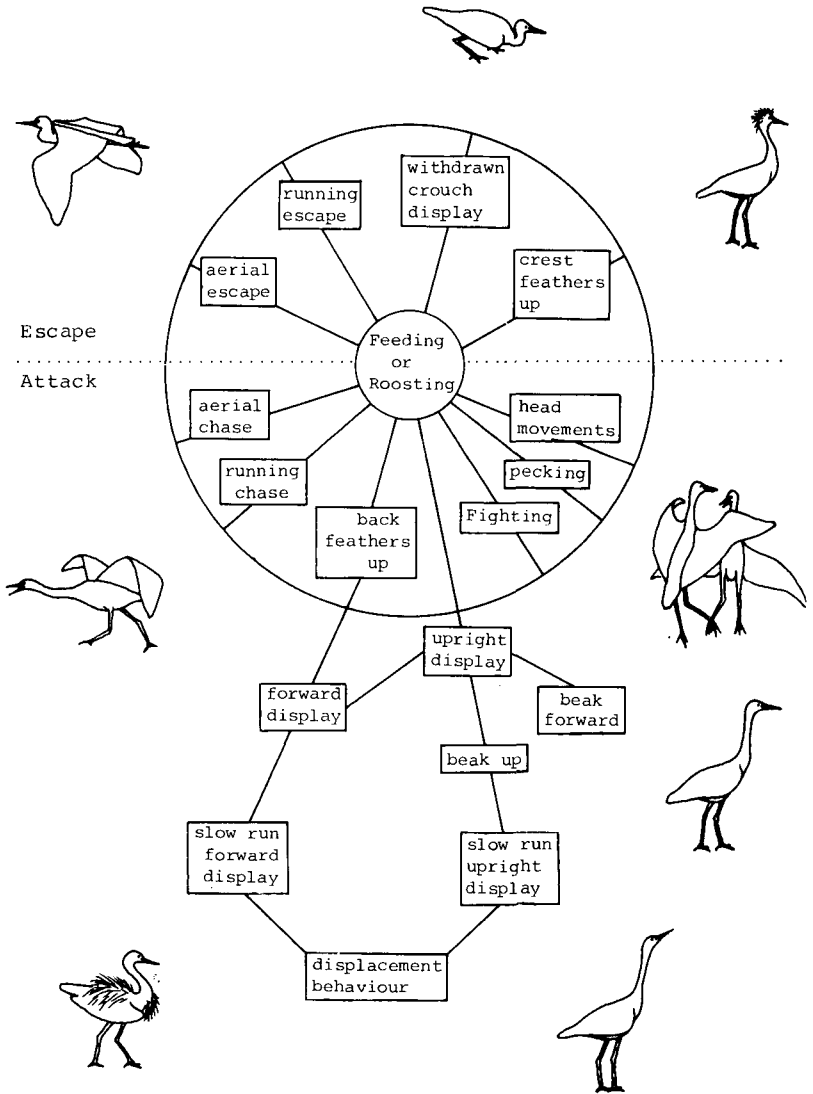


FIGURE 4 — Agonistic displays, showing corresponding attack and escape tendencies. Lines indicate sequence of events and the many combinations of displays.

*Forward display:* When a heron came too close to another, the defender erected the long plumes of its back and the feathers of its chest (Fig. 4), and the intruder usually moved away. The distance between herons could be less than 1 metre when the herons had congregated during high tide, or more than 10 metres when feeding on the estuary.

In a more intensive version of the forward display the chest was held further forward and down than normal, the wings held out from the body and down slightly, and the neck curved back over the body with the beak pointing forward, usually toward the intruder. This intimidatory posture increased the apparent size of the heron.

Normally, in response to the forward display, the neighbouring heron raised its crest feathers (Fig. 4) before moving away, but if not, the antagonist, while still in the forward posture, walked towards or parallel to its neighbour. The second heron might then retreat, but sometimes it became equally aggressive and both would begin a slow strutting run parallel to each other.

*Upright display:* Apparently as an alternative to other aggressive displays, the heron extended its neck upward without raising any feathers. The approach of a heron to a day roost was sometimes prevented by the occupant rapidly extending its neck with its beak pointed forward. Occasionally, successive forward head movements were exchanged before one heron moved away.

Another upright display was used when two herons were equally aggressive, sometimes displaying up to 20 metres apart on a feeding ground. Both birds fully extended their necks with the beaks inclined upwards and took small steps forward and back perhaps expressing a conflict between attack and escape tendencies. Once, two herons were observed running parallel to each other in this upright posture. One heron then ran in small circles and began a forward display while making slow, apparently ritualised strikes and foot-stirs. Although these seemed an integral part of the display, they may have been irrelevant displacement behaviour resulting from the conflict situation. Often, after an encounter, the birds would repeatedly peck at twigs and the substrate.

Upright displays were highly aggressive and, although they look similar to alert postures, the latter were used in response to disturbance by humans or Australasian Harriers (*Circus approximans*) and seemed to have in them a strong element of escape as well as being a means of watching the intruder's progress. Perhaps the clear signals of the alert postures have been ritualised into the upright displays.

*Chasing:* Less stylised interactions included chases. When a heron ran directly at another it usually extended its neck forward and flapped its wings. At other times an antagonist flew at another heron and chased it away or relentlessly pursued it with its neck outstretched. The escaping heron always flew with its neck retracted and tried to

evade the antagonist by turning and circling. Whenever herons were grouped while foraging, they would eventually be dispersed by an aggressive heron sweeping over them. Once, in response, a heron crouched close to the substrate with the head withdrawn (Fig. 4), a submissive posture.

*Fighting:* Actual combat was rare. Two herons would face each other, wings flapping, and rise up a few metres while jabbing at each other with their beaks. No contact was apparent and the encounters soon ended with one heron leaving. Roosting herons sometimes pecked at their neighbours.

*Vocal display:* The main call has been described as a repeated guttural *graaw* (Moon 1967). There were subtle differences in pitch and note within and between calls, depending on the individual and the situation. Herons often advertised their arrival at feeding grounds, particularly at dawn, by making three or four long, loud calls. The calls were softer as herons flew from a heronry but were loud strangled cries as they flew after a fight or disturbance.

Social calls also varied and were most often heard at heronries. When a heron landed near another, it called a version of *griaaw graaw bock bock bock*. Sometimes both herons then uttered short high-pitched sounds best described as loud chattering. Another call, a high screech, was heard whenever a heron flew into a heronry and was apparently repulsed by another heron. At dawn, when herons awoke and gradually became active, they made short and high *garik* calls which were probably contact calls.

#### *Juvenile behaviour*

Several juveniles were seen regularly at Pauatahanui Inlet in summer. They were easily distinguished from adults by their lighter grey back, wings and breast feathers; very little white on the face, apart from feathers around the eyes and chin, continuing as a thin line down the throat; white downy abdominal plumage; and the lack of plumes on the back.

At the Pauatahanui mudflats, a juvenile and an adult came and went together several times during most feeding periods in February. Two other juveniles which were usually in the vicinity of the Kahao Stream-mouth also interacted with an adult, presumably their parent. These juveniles often fed together in the stream or around drying sheepskins on the farm nearby and therefore had a different activity pattern from many adults that responded to the estuary tides. However, when not feeding they sometimes joined the adults on the beach at high tide.

The parent also foraged in the stream and on the farm, probably because it needed to forage at high tide to sustain itself and its offspring. Several times a day it landed, calling loudly, near a juvenile, which responded by opening its beak widely, revealing the bright

red mouth, and 'begging' with its wings slightly open and its legs bent and well spread. The adult usually erected its crest and ran off, scattering nearby herons, with the juvenile in close pursuit, until it managed to grasp its parent's beak and stimulate it to regurgitate a meal.

### *Courtship*

In May, I observed two herons that regularly foraged together on a small area of pasture and at a dump of sheep carcasses, and that roosted in the same stand of macrocarpas at night. During the day, they spent 40% of their time resting and preening on pasture, fence posts or tall trees, especially in the late morning and again in the early afternoon.

During these roosting periods the herons' social behaviour suggested pair-bond formation. One heron would raise its back plumes when close to the other and usually move a few paces away. Sometimes the other heron delicately snapped its beak at the first's back or tail. Once, the first heron then picked up a twig and dropped it at the feet of its companion, which also grasped the twig. When they moved apart the first heron began pecking at a grass stem in apparent displacement behaviour.

## DISCUSSION

### *Function of foraging methods*

Foot-stirring, one of the most important methods that White-faced Herons used at Pauatahanui Inlet to disturb prey into movement, is widely documented for other heron species. A heron should forage in a manner with the least cost in energy while gaining the most energy in the food available. Therefore, although foot-stirring herons captured less food than those that did not disturb prey or those that false struck, the method must have been more efficient in other ways, for example, for capturing favoured types or sizes of prey or for foraging under certain environmental conditions. Imitation of relatively successful feeding methods may also be involved because foot-stirring flocks sometimes occurred.

False-strikes may also be used by White-faced Herons to disturb prey, particularly as foot-stirring was often used at the same time, and as they were used only over aquatic vegetation, where prey could be hidden. Alternatively, this use of the bill may be a displacement activity because sometimes a heron which had apparently seen prey movement ran forward, stared down for several seconds as if the prey had gone, and made several false strikes. If these strikes are acts of frustration and can accidentally disturb prey, birds may come to use them for deliberate foraging.

False-striking herons were more successful than foot-stirrers except when both methods were used. This suggests that in situations when feeding success will be low, false striking has less effect on that success than foot-stirring.

Although false striking has not been recorded for White-faced Herons before, it is not localised, as I have seen them doing it at Waikanae, Whakaki Lagoon, Lake Wairarapa and in Australia. This behaviour may be more widespread in herons than is realised because Willard (1977) described a similar activity in a study of five North American herons as 'sandpiper-style pecking' or 'repeated rapid striking with no apparent orientation toward individual prey items.' However, the herons were not particularly successful using this feeding method.

Wing-flicking probably disturbs prey into movement by casting shadows over the water. Meyerriecks (1962) believed that more complex wing movements, 'open wing,' 'underwing,' and 'canopy feeding,' reflect an evolutionary sequence in herons. If this is so, the White-faced Heron has apparently developed only as far as wing-flicking. Spurr (1967b) believed that the pursuit activity that I have described as 'wing-flapping' was actually 'open wing feeding,' although other species hold a wing out and whirl the body to disturb prey. The White-faced Heron behaviour seems more akin to that of the Louisiana Heron (*Egretta tricolor*) whose flapping wings seem to herd fish as the herons run (Jenni 1969).

Rare foraging methods that have been described for the White-faced Heron but were not seen at Pauatahanui Inlet include 'foot-dragging,' 'hovering' (Spurr 1967b) and 'head tilting' (Lowe 1983). Future studies in varied habitats are likely to reveal the use of other techniques.

### *Social behaviour*

The variety of agonistic displays used by White-faced Herons serves to reduce dangerous fighting while maintaining their individual distances. This aggressive behaviour at the feeding grounds probably reflects the compromise between the need for spacing out to prevent undue prey disturbance and the advantage of flocking to locate prey patches, as described for the Great Blue Heron (*Ardea herodias*) (Krebs 1974).

### *Comparison with other herons*

Kushlan (1976) listed 28 foraging methods that were used in various combinations by 12 North American species of heron. By using at least 9 methods the White-faced Heron has a more varied behaviour than bitterns and most night herons; uses a similar number of methods to inactive day herons such as the Great Blue Heron; and less than active herons such as the Snowy Egret (*Egretta thula*), which uses 17 methods.

In North America, where many heron species live sympatrically, they use different foraging zones and feeding methods and thus take different prey, which presumably has the effect of reducing inter-specific competition (Willard 1977). The influence of competition on White-faced Heron behaviour is unknown, but since there are few sympatric heron species in Australasia this factor may be less important

than in North America. This may explain the White-faced Heron's generalist diet.

In general, smaller heron species (e.g. Snowy Egret, 64 cm long) have very active courtship, agonistic and foraging behaviours, whereas larger herons (e.g. Great Blue Heron, 127 cm) are rather inactive (Meyerrieks 1960). In contrast, the White-faced Heron (66 cm) seems to be inactive for its size, foraging mainly by slow walking and seldom being violently aggressive.

The White-faced Heron could be regarded as 'semi-social' because it roosts socially but is relatively solitary when feeding and breeding. This is the reverse pattern to that characteristic of North American semi-social herons which are normally solitary but form colonies to breed (Meyerrieks 1960). Because the Reef Heron is usually a solitary nester, and the White-necked Heron (*Ardea pacifica*) in Australia sometimes is also (Hancock & Elliot 1978), the breeding colony may be less important as an anti-predator device in Australasia than in North America, where few sites are free of avian and mammalian predators (Jenni 1969).

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