Fluctuations in use of urban roost and foraging sites in Darwin by Pied Herons (*Ardea picata*)

John Rawsthorne

10 Macartney Street, Fannie Bay, NT 0820, Australia
Email: kim_john@bigpond.net.au

Abstract

Pied Herons (*Ardea picata*) are a common bird of Australia's north, strongly associated with shallow freshwater wetland and estuarine habitats. However they also use urban sites for foraging, and in particular many feed at the Leanyer Sewage Treatment Works and the Shoal Bay Waste Depot site in Darwin's northern suburbs. Pied Herons roosted on Catalina Island in Darwin Harbour from at least 2010 to 2013. Seasonal fluctuations in numbers and use of that, and nearby roost sites, are documented here, as is the more recent abandonment of harbour roost sites in favour of constructed riverside habitat at Crocodylus Park, close to the foraging sites.

Introduction

Pied Herons (*Ardea picata*) (Fig. 1) are a common bird of Australia's north, associated with shallow freshwater wetland and estuarine habitats (McKilligan 2005). However they

Fig. 1. An adult Pied Heron (*Ardea picata*) at Knuckey Lagoon, Darwin, showing nuptial plumes on the head just prior to the wet season. (John Rawsthorne)

also use urban sites for foraging, and in particular a large number arrive each day to feed at Leanyer Sewage Treatment Works and the Shoal Bay Waste Depot site in Darwin's northern suburbs (McCrie & Noske 2015; JR pers. obs.).

I was initially intrigued by large early morning flocks flying north over Darwin Railway Station at East Arm in 2010, and a suggestion by Richard Noske that the north-south daily movements were a well-established pattern by then. Further observations of evening flocks flying south over Kormilda College, Berrimah, during 2012 and a chance observation of Pied Herons arriving from the north at dusk at Catalina Island in East Arm, Darwin Harbour were the catalyst for a more formal investigation of these movement patterns.

Here I document roosting places of these urban birds, their flight path – including potential conflict with Darwin Airport flight paths – and seasonal fluctuations in numbers.

Methods

Bird activity sites

Catalina Island (12.4900ºS, 130.9070ºE) is a small (50 x 200 m, 1 ha) island in East Arm, Darwin Harbour. In addition to terrestrial trees including one tall Peanut Tree (*Sterculia quadrifolia*) (Richard Willan pers. comm.), it has fringing mangroves including Grey Mangrove (*Avicennia marina*) and Mangrove Apple (*Sonneratia alba*), which approximately double the vegetated area to around 2 ha. At low tide, a sand spit and rocky areas are exposed around the island.

Shoal Bay Waste Depot and the Leanyer Sewage Treatment Works are on the north-east fringe of suburban Darwin, about 12 km and 14 km, respectively, north of Catalina Island. Crocodylus Park is close to the waste depot and sewage works, about 3 km south of the waste depot.

Evening roost surveys

Pied Herons were counted flying from the north to evening roosts in East Arm (Fig. 2) monthly from November 2012 to October 2013. Counts were performed from either East Arm Boat Ramp (about 0.7 km north-east of Catalina Island) or Berrimah Road near the Vopak Fuel Depot (about 1.5 km north of Catalina Island), depending on wind conditions and roost site being used. In September 2015 a follow-up count was performed at Crocodylus Park.

Birds generally arrived to roost in flocks, mostly of less than 100 birds, but occasionally in much larger flocks of several hundred individuals. Counts were of individual birds where flocks were less than approx. 50 in number, but for larger flocks or for those in quick succession, estimates of the number of birds were made based on 'blocking up' from smaller counts.

Fig. 2. Satellite image of Darwin area showing Pied Heron daytime feeding sites in the north, Crocodylus Park roost site in mid-image and Catalina Island roost site near East Arm Wharf in the south. The large white arrow shows the general evening flight path of birds flying to harbour roosts from their daytime feeding sites. **Left inset**: Catalina Island showing terrestrial vegetation and mangroves. **Right inset**: Crocodylus Park artificial river roosting site (prior to current vegetation growth). (Images via Google Maps)

Results

In November 2012 several preliminary counts and tests of counts were made (4357 individuals on 1 November and 5895 individuals on 8 November). These counts were treated as training exercises to refine the counting procedure. Some tests were made of my counts of larger flocks against photographs of those same flocks, confirming the general accuracy of my counts. On 22 November, two independent counts were made by Gavin O'Brien and me, producing counts of 5138 individuals (GO'B) and 4953 individuals (JR) arriving to roost on that evening. These tests confirmed the broad accuracy of the counts, and suggested that they might be regarded as being ± 5%, rather than precise counts of individuals. In the data that follow, I have used the average of the two 22 November counts (5045 birds) as the data point for November 2012.

The number of birds counted in individual surveys (Fig. 3) ranged from a high of 5895 individuals (preliminary count, November 2012) to a low of 1705 individuals (February 2013). The average number of birds by count across all months in 2012/13 was 2771 individuals.

Roost counts were conducted for 12 months, from November 2012 to October 2013. In the first few months of the survey, birds exclusively flew to Catalina Island to roost, and were easily counted flying directly overhead of the East Arm Boat Ramp (Fig. 2). In later months birds also sometimes appeared to roost on South Shell Island, a smaller treeless island about 2 km west-south-west of Catalina Island, while in some evening

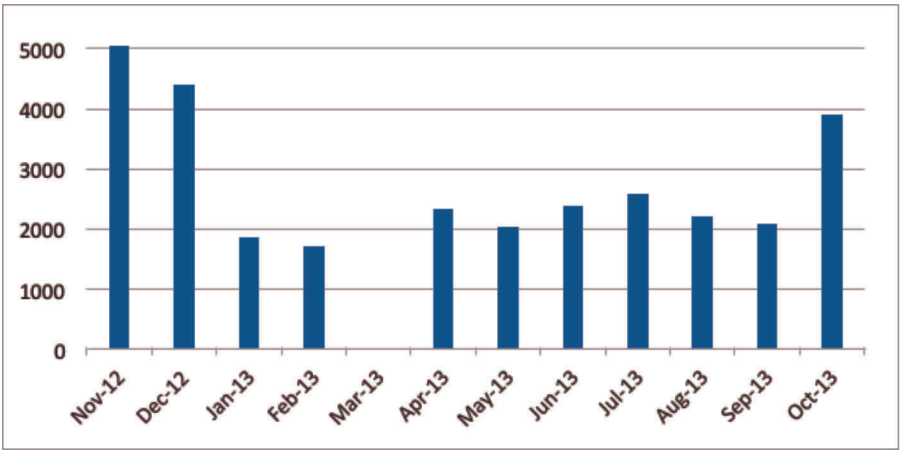

Fig. 3. Monthly count of Pied Herons (*Ardea picata*) arriving from the north to roost in Darwin Harbour, November 2012–October 2013. There is a notable peak in the early wet season, with lowest numbers in the late wet season.

surveys birds flew further west beyond the islands in East Arm, and at least as far as the mangroves fringing Wickham Point.

Follow-up observations in September 2015 indicated that Pied Herons had ceased to roost in East Arm, and were now roosting much closer to the sewage ponds and waste depot, at an artificial river at Crocodylus Park on the corner of Vanderlin Drive and McMillans Road. Construction of this habitat commenced in 2007 and was finalised in May 2014. A one-off count on 28 September 2015 counted approximately 3300 Pied Herons roosting at this site.

Flight paths

All birds arriving to evening roosts arrived from the north. Observations of mid-flight paths for flocks indicated a quite direct flight path between the Shoal Bay Waste Depot and East Arm, with no intermediate stops and no birds coming on to the flight path any further south than about McMillans Road (Fig. 2). Evening and morning observations in the northern suburbs did not detect birds arriving to or leaving from the northern sites in any direction apart from the south. I did not conduct any night-time surveys at the day time feeding sites.

The actual flight paths used by commuting Pied Herons were within about 1 km of Berrimah Road. Depending on the wind direction, birds deviated in their evening southward flight slightly east or west of Berrimah Road, but corrected their path as they came closer to roost. The flying height of birds was measured using binocular focus distances. I focused on birds flying directly overhead, and then measured the distance along the ground to the same focus distance. Birds typically flew at a height of about

50–70 m above me at observation points, but appeared to be flying higher, up to 100 m high, at the mid-point of their commute.

The flight path of birds travelling to Crocodylus Park was directly south of the waste depot. Some birds had a direct path over Holmes Jungle to Crocodylus Park. However most birds appeared to follow Vanderlin Drive, with a distinct left-hand turn shortly before McMillans Road, for the short distance across to the roost site at Crocodylus Park.

Discussion

All the Pied Herons using the East Arm roost came from the Shoal Bay/Leanyer/Holmes Jungle area of Darwin's northern suburbs. I cannot be sure that some birds did not also roost at the feeding sites or at other roosts such as the later-identified roost at Crocodylus Park, although the large numbers roosting at Crocodylus Park is a post-2014 phenomenon (Grahame Webb *pers. comm.*). Thus, my urban population estimates of 1700–5900 individuals should be regarded as minimum counts. Chatto (2000) estimated the Pied Heron breeding population in the Top End to be over 22,600 individuals based on aerial surveys of breeding colonies, with the majority of breeding occurring in the north-western part of the Top End, within about 300 km of Darwin. Morton *et al.* (1993) estimated that the maximum Pied Heron population in the Alligator Rivers region alone was around 50,000 individuals. The peak population of Pied Herons in Darwin of more than 5000 individuals in the late dry season represents a moderate fraction of the overall Top End population. The food available at the sewage ponds and waste depot appears to be an important resource for a small but significant proportion of the Top End population of this species during the late dry season, and may be maintaining the overall population in the north-west Top End at a slightly higher level than would otherwise be possible.

Pied Herons are present, but do not breed, in the Darwin urban environment throughout the year. The fewer birds remaining during the late wet season and early dry season correspond with the identified active period of breeding colonies from January to May (Chatto 2000), suggesting that the majority of Pied Herons leave the urban area for breeding sites in the wet season. The closest breeding colonies – within 100 km of Darwin – are in the mangrove-lined mouths of the Finniss and Adelaide rivers. The largest colony observed by Chatto was about 3000 individuals, while the average colony size was around 1000 individuals (Chatto 2000). The drop in urban population from the 2012 late dry season peak to the 2013 breeding season low of over 3000 birds is larger than the size of any one breeding colony, thus most likely comprising individuals that arrive from and depart to more than one breeding colony.

An alternative to local movements is that the significant increase in the number of Pied Herons in Darwin's urban sites in the early wet season is made up of migratory birds, recently returned to Australia from the north where they had migrated to escape the

food and habitat shortages of the late dry season. Pied Herons are known to migrate regularly across the Torres Strait between North Queensland and Papua New Guinea for the dry season (Garnett & Bredl 1985; Marchant & Higgins 1990; McKilligan 2005). Although they are present in Papua New Guinea year-round, they are not known to breed there (Coates 1985; Beehler *et al.* 1986). I am not aware of any records of Pied Herons departing from or arriving to the Top End from the north, but migration of the Top End populations to Papua New Guinea or Indonesia should not be ruled out and is worthy of further investigation.

The seasonal cycle of movements of Pied Herons in the Darwin region is not as clear as for other Top End systems. For example, a study on the Magela Creek floodplain in April 1981 (i.e. towards the end of the Pied Heron breeding season) identified that over 90% of individual Pied Herons observed were in immature plumage (Recher *et al.* 1983; see also Garnett 1985). This is consistent with a broader seasonal pattern in the Magela Creek system of near-complete absence during the wet season and a gradual increase over the dry season, with corresponding later offsetting pulses of birds in different nearby systems linked to wetting and drying cycles of the different floodplains (Morton *et al.* 1993). Most likely, the April 1981 birds were newly fledged from one of the now-identified breeding colonies on the East or South Alligator rivers (Chatto 2000), and they are gradually joined on the floodplains by adults as they depart the heronries each May. The seasonal offsetting patterns identified by Morton *et al.* (1993) weakly suggest that birds from that area do not migrate north to Papua New Guinea or Indonesia, but are able to find suitable habitat in the late dry season within the mosaic of drying wetlands in the western Arnhem Land region.

There is a pool of non-breeding Pied Herons in Darwin through each wet season that do not congregate in heronries, and there may be others scattered across a wide area of wet floodplain or other habitat. This would explain the larger population estimate of 50,000 birds in the Alligator Rivers region by Morton *et al.* (1993) compared to Chatto's (2000) estimate of 22,600 birds present at all breeding colonies in the western Top End. Pied Heron plumage varies by age, with juvenile and immature birds having different crown feather colour and other more subtle differences to adults. HANZAB indicates a juvenile plumage and two immature plumages (Marchant & Higgins 1990), suggesting that Pied Herons most likely do not breed until at least the end of their second year of life. Pied Herons are never completely absent from the urban area of Darwin, unlike other waterbirds such as Magpie Geese that visit the urban area for limited periods and then have seasonal absences, and it may be that the remaining (approx. 2000) herons are immature. As a starting point, closer observation of the plumage of individuals foraging in Darwin at different parts of the seasonal cycle may shed further light on population and breeding dynamics

An alternative explanation for the presence of Pied Herons in Darwin during the breeding season may be that the food supply in Darwin in the late dry season is limiting and that the urban area acts as an ecological trap (*sensu* Robertson & Hutto, 2007) from

which some birds struggle to escape. Pied Herons are regularly trapped accidentally at Crocodylus Park within food preparation areas, and are often noted to be either very skinny or otherwise injured or in poor condition (Simon Ferguson, pers. comm.). In addition to studying the plumage of birds through the seasons, observation of body condition of individuals roosting at Crocodylus Park at different parts of the seasonal cycle may provide insights into source/sink dynamics for the Top End population.

Flight path conflict with Darwin airport

There is some potential for conflict between Pied Herons when they are flying to or from the harbour roost sites and the short final approach of aircraft arriving at Darwin International Airport from the east. Given the large size of flocks identified in this study, the potential for multiple strikes exists, although the most common flight path of flocks of Pied Herons appeared to be safely lower than the approach paths of aircraft arriving from the east. Planes taking off to the east appear to climb steeply after take-off, and birds appeared much less likely to conflict with departing planes. Although Darwin airport has a high number of recorded bird strikes, Australian Transport Safety Bureau (ATSB) statistics for the period 2001–2013 indicate only five identified bird strikes at this airport were associated with Pied Herons, out of 1004 bird strikes involving identified species (ATSB 2012, 2014).

The flight path to the new roost site at Crocodylus Park does not cross the airport approach paths, so potential for bird strikes does not currently exist. However, the ability of Pied Herons to change roost sites is demonstrated here, and if in future the birds abandon Crocodylus Park in favour of new harbour roosts then careful monitoring may be required. Roost sites further west than Catalina Island in Darwin Harbour, e.g. the mangroves around Reichardt or Bleesers creeks, may present a more direct threat to aircraft.

Roost site fidelity

Observations through the 2012–2013 study suggest that the roost site fidelity towards Catalina Island may have broken down during that time. Increased activity in the East Arm of Darwin Harbour associated with Inpex, including substantial night-time activity including bright lights, may have caused the Pied Herons to change roost sites. Alternative nearby roost sites over 2013–2014 include the settlement ponds at East Arm (Amanda Lilleyman pers. comm.) while in some evening surveys Pied Herons flew further south-west to South Shell Island, or beyond to at least as far as the mangroves fringing Wickham Point. These longer commutes between feeding and roosting sites added around 1–5 km to the twice-daily flight of Pied Herons.

The follow-up observations in 2015 show that Pied Herons have abandoned the harbour roost sites, and now roost quite close to the feeding sites at Crocodylus Park. The roost site itself, the artificial tree-lined river habitat at Crocodylus Park, does not appear to be a limiting factor for Pied Herons, as they only roosted on a fraction of all available

trees. Simon Ferguson, Zoo Supervisor living on-site at Crocodylus Park, noted that the roosting of birds became apparent after completion of the artificial river and also that there had been many Pied Herons roosting at this spot continuously from around May 2014 to the present (September 2015). My single count at the end of September 2015 of about 3300 birds is broadly consistent with the September and October 2013 counts of about 2100 and 3900, indicating that this is a complete count of local roosting Pied Herons, and that the overall population of Pied Herons feeding and roosting in Darwin has not changed dramatically with the change in roost site.

It appears that there is a range of roosting options, so the abandonment of Catalina Island, possibly due to disturbance associated with Inpex, does not appear to be a critical disturbance to the urban population of Pied Herons.

Acknowledgements

The data presented in this paper have been collected through the efforts of several people, including Matthew Rawsthorne, Kim Rawsthorne, Gavin and Megan O'Brien and Jon Clark, all of whom are heartily thanked. I thank Grahame Webb for allowing access to Crocodylus Park to observe roosting there, and Simon Ferguson for explaining the recent history of the roost at Crocodylus Park and providing feedback on a draft of this paper.

References

ATSB (2012) *Australian aviation wildlife strike statistics. Bird and animal strikes 2002 to 2011*. Australian Transport Safety Bureau, Canberra.

ATSB (2014) *Australian aviation wildlife strike statistics 2004 to 2013*. Australian Transport Safety Bureau, Canberra.

Beehler B.M., Pratt T.K. and Zimmerman D.A. (1986) *Birds of New Guinea*. Princeton University Press, Princeton, New Jersey.

Chatto R. (2000) *Waterbird Breeding Colonies in the Top End of the Northern Territory. Technical report 69/2000*. Parks and Wildlife Commission of the Northern Territory, Palmerston.

Coates B.J. (1985) *The Birds of Papua New Guinea*. Dove Publications, Alderly.

Garnett S.T. (1985) Heronries of the Mitchell River Delta. *Sunbird* 15, 1–4.

Garnett S.T. and Bredl R. (1985) Birds in the vicinity of Edward River Settlement. Part 1. Introduction, Methods, Study Area, List of Non-passerines. *Sunbird* 15, 6–23.

Marchant S. and Higgins P.J. (eds) (1990) *Handbook of Australian, New Zealand and Antarctic Birds (HANZAB). Volume 1: Ratites to Ducks*. Oxford University Press, Melbourne.

McCrie N. and Noske R. (2015) *Birds of the Darwin Region*. CSIRO Publishing, Clayton South.

McKilligan N. (2005) *Herons, Egrets and Bitterns*. CSIRO Publishing, Collingwood.

Morton S.R., Brennan K.G. and Armstrong M.D. (1993) Distribution and abundance of herons, egrets, ibises and spoonbills in the Alligator Rivers Region, Northern Territory. *Wildlife Research* 20, 23–43.

Recher H.F., Holmes R.T., Davis Jr. W.E. and Morton S. (1983) Foraging behavior of Australian Herons. *Colonial Waterbirds* 6, 1–10.

Robertson B.A. and Hutto R.L. (2006) A framework for understanding ecological traps and an evaluation of existing evidence. *Ecology* 87, 1075–1085.