Field Notes

Some observations of Malaysian Plover *Charadrius peronii* breeding behaviour in Miri, Sarawak and discussion of conservation needs

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Malaysian Plover is one of nine shorebird species (excluding buttonquails) known to breed in Malaysia. It is classified as Near Threatened under the IUCN Red List with an estimated global population of 6700-17000 mature individuals. The population trend is declining, in part due to coastal development and increased disturbance of its preferred habitat of coastal sandy beaches throughout its range in South-east Asia and the Sundas (BirdLife International 2017).

Regular waterbird counts during the Asian Waterbird Census have revealed that the state of Sarawak, with its ≥1000+km coastline, including many sandy beaches, is a national stronghold for the species, holding up to 67% of the total population in Malaysia (Bakewell *et al.* 2017).

Since moving to Miri, Sarawak, in August 2020, I have had regular opportunities to observe Malaysian Plovers on the beaches near my home.

Two pairs regularly hold territory and have attempted to breed each year from 2021 – 2023, and additional birds, which may be offspring of these two pairs or wanderers from nearby areas, are occasionally observed.

In 2021 and 2022, my observations were opportunistic, but this year (2023) I have made a more intensive effort to study the breeding behaviour of these birds. The breeding season for this species is known to be long, and pairs are often double-brooded, especially if the first nest fails (Yasué and Dearden 2008).

In 2021, courtship display was observed in April; a fledged juvenile, estimated to be 5-6 weeks old, was observed in early July and was still present in the area till at least early September.

In 2022, two nests (both with two eggs) were found on 14 May, but no juveniles were observed subsequently that year, so it is assumed that both nesting attempts failed.

Study area

The study area is orientated roughly south to north, on the west-facing coast of Miri. It is on a fairly remote area of beach accessible by a long walk, motorcycle or 4WD vehicle along the beach at low tide. At high tide it is only accessible on foot by wading through flooded vegetation (see Figure).

During 2021 and 2022, pairs held territory further south of the area shown, nearer to access points for vehicles. However, these have now been abandoned. Physical and anthropogenic changes in the last three years to the area include a gradual increase in human leisure activities, the growth of casuarina trees *Casuarina equisetifolia* planted above the high water mark, and commercial sand mining activities.

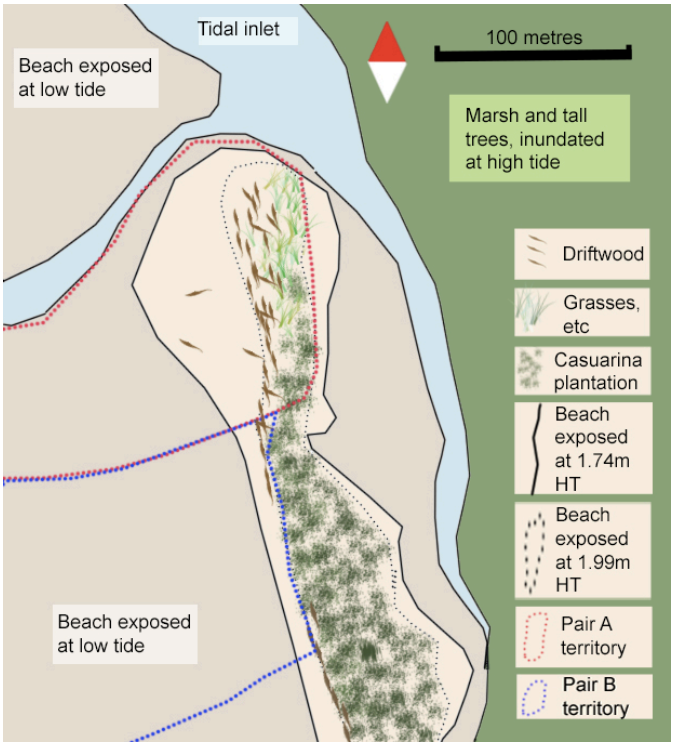

Figure: Sketch map of study area, Miri, Sarawak

At low tide, intertidal sand flats are extensive. During normal high tides a narrow strip of exposed sandy beach remains on the coastal side of the casuarina plantation, but during spring tides, only the area within the dotted black line is still exposed, and even this may be submerged during exceptional "king tides". The inland edge of the sandbar is bordered by a tidal inlet and heavily vegetated casuarina plantation and scrub.

Courtship

Malaysian Plovers are monogamous (Yasué and Dearden 2008). On 3 Apr 2021, interaction involving one female and three males, which I interpreted as competition for a female, was observed. It was assumed that the group consisted of an established pair and two would-be male suitors. The males competed over the female, with two males in particular being involved in running disputes for over half an hour. In the initial stage of the conflict, the males would face each other, standing almost vertically, with black nuchal collar and white flanks fluffed out (see Plate 1).

Plate 1: Courtship behaviour of the Malaysian Plover

Whenever an intruding male approached the vicinity of the female the aggression of what I assumed to be the resident male intensified, with much calling and trilling. The two males frequently sparred in mid-air (see Plate 1), and chased one another along the sand. The female sat quietly except when the males came close, when she would join in the calling by uttering a dense, buzzy trill. I did not see the outcome of the interaction as they were still fighting when I needed to leave the site.

Nest site

Nests were always located above the high tideline in an open sandy area with minimal vegetation. The nest, a small depression in the sand, was located between or near small sticks or pieces of bamboo. Presumably this provided some camouflage, as well as limited shelter from wind, while allowing the incubating bird a wide unobstructed view on all sides to enable early detection of potential predators.

Eggs and incubation

According to Yasué and Dearden (2008), clutch size varies from one to five eggs, with three being the average. Of the four nests I located, all had two eggs. At the one nest I observed intensively from 27 Jun – 6 Jul 2023, both parents took turns incubating the eggs, with each taking approximately hourly shifts.

The changeover process was initiated by the non-incubating partner running up the beach from the tideline, using driftwood perches to scan the area (with much head bobbing and looking in all directions) for threats. The approach toward the vicinity of the nest was slow and cautious. The incoming bird gave a single trill when still over 10 meters from the nest, which was the signal for the incubating bird to leave. It did so by suddenly taking flight directly from the sitting position and flying straight out to the tideline, thus making it very difficult for any predator to be able to pinpoint the location of the nest. The incoming bird would then continue its slow approach before settling on the eggs. The eggs were continuously incubated by one parent throughout the heat of the day, but around two to two and a half hours before sunset, when the heat of the sun was much reduced, both birds would leave the nest unattended for extended periods.

During the incubation period, weather conditions varied from extreme heat to strong winds and torrential rain. In extreme heat, the incubating bird fluffed out its feathers and panted with bill open in an attempt to dissipate heat. In rain and strong wind, it squatted low to the sand with feathers compressed close to the body and eyelids closed. Prior to one heavy squall, I observed the male being 'blasted' by sand whipped up by strong wind, even building up as small deposits in front of the eyes (see Plate 2 and additional material). Regardless of the weather, the sitting bird regularly stood up and rotated its position, presumably turning the eggs with its feet as it did so.

Plate 2: Malaysian Plover incubating in a storm

Once off-duty, the non-incubating bird frequently went to a shore-pool to bathe, probably to cool off, and then began foraging.

Since I did not discover a nest before eggs were laid, I was unable to determine the period of incubation. Yasué and Dearden (2006) noted of pairs in Thailand that the average incubation period was 30 days.

Development of young

On 9 July 2023 I observed 2 chicks which were not more than 1-2 days old (the eggs were still being incubated on 6 July) (see Plate 3). The nest had already collected small pieces of debris, so I judged that it had not been used for at least 24 hours.

Days-old chicks seemed to have outsized legs, bills and eyes. The downy head seemed about half the size of the body which was also covered in down. The bill and eyes appeared blackish while the legs were greyish. The entire underparts, including the wing-buds, chin and throat, were white, as was the forehead and nape. The 'top half' of the bird was quite rich sandy brown with blackish vermiculations and speckles. These coalesced to form several dark lines – one extending back from the eye to the rear crown, one from the leading edge of the inner wing to the wing base, and a third running from the rear edge of the wing to where the tail would eventually emerge. There was also a less distinct dark central crown line and blackish "tail bristles". There was no down on the neck, and the skin was black.

Plate 3: Malaysian Plover juveniles at 1-2 days of age

At one to two days old, the chicks were already highly mobile, feeding some distance away from the parents, able to run and climb up suitably angled pieces of driftwood.

The first juvenile feathers emerged at around 3 weeks old, the wing coverts being the most obvious. By 4 weeks, most of the juvenile underpart, upperpart and crown feathers were well-grown. The flight feathers were still 'in pin' but were starting to emerge (see Plate 4). By about 7 weeks after hatching, young birds were capable of sustained flight, though the flight feathers had not finished growing.

Plate 4: Malaysian Plover juveniles at 3 weeks, 4 weeks, and 4 weeks of age respectively

Parental care

Once the chicks had hatched, one parent was always 'on duty' within the vicinity of the chicks. This was usually the female. The male stayed further away but maintained vigilance, often perching on a large log when not feeding, to oversee the area. The main natural predator in the study area appeared to be Collared Kingfisher *Todiramphus chloris*, and on one occasion, I watched the male Malaysian Plover fly after and chase off a kingfisher which strayed into the area.

Chicks foraged solitarily, usually at some distance from the parent bird on duty. At regular intervals, the adult squatted on the sand calling softly, and this was a signal for both chicks to run to and burrow under the parent's underpart feathers (see Plate 5). This appeared to occur not only in response to a perceived threat, and perhaps performed a temperature regulation function for the chicks, in addition to protection from predators. The usual contact call given by parents at this stage was an up-slurred 'queet'.

Plate 5: Adult female Malaysian Plover calling juveniles to come and take shelter under its wings

When the family was foraging on the sandflats at low tide, the presence of a potential threat prompted the 'on duty' parent to utter an alarm call. This was usually responded to by at least one of the chicks running to shelter under the parent. If a chick was too far from the calling parent, it would squat down on the sand and remain motionless. The other parent then ran toward it, so that it could shelter beneath the adult. If the birds were foraging near the high tide mark, chicks quickly hid beneath driftwood or vegetation if the parent gave an alarm call.

The fledgling observed in 2021 stayed near the parents for some months after fledging. However, in the case of Pair A (see Figure for location) in 2023, the parents chased away the fledged young from the first brood. I observed this on 7 June 2023. This was confusing for the fledgling, which at times appeared to solicit food, at others it would lie prone on the sand when threatened by both parents (see Plate 6). Often they chased it off completely, but it would return after a short while and an uneasy peace resumed. I did not observe this juvenile for certain after this date, and very shortly thereafter, the parents began incubating a second clutch.

Plate 6: Fledged young Malaysian Plover in submissive posture when approached by parent.

Breeding success

Table 1: Summary of breeding success of Malaysian Plovers at a site in Miri, Sarawak

Date	No of pairs	Nest/eggs	Chicks	Fledged
2021 12 Jul – 12 Sep	2	None seen	None seen	1
2022 14 May	2	2 (2/2)	None seen	0
2023 17 Apr – 7 Jun	2	None seen	3	1
27 Ju – 20 Jul	2	2 (2/?) Pair B nest not found but behaviour indicated incubation. Nest assumed destroyed by the king tides of 3-6 Jul.	2 (1 lost at c 1 week old; the other at c.2 weeks old)	0

In Thailand, c. 50% of breeding attempts produced at least one fledgling (Yasué and Dearden 2008). The birds in my study represented a far smaller sample, but such data as there was suggested that a) clutch sizes may be smaller than in Thailand and b) mortality rate may be higher. Out of a minimum of 10 eggs laid, only 2 resulted in fledged young.

Threats

Macro-level threats to Malaysian Plovers which are likely to be causing an impact throughout their range include rising sea level, increase in extreme weather events and coastal development.

A study of Malaysian sea levels derived from 19 years of data revealed that sea levels rose from 2-6.5mm/year between 1993 and 2011 (Din *et al*. 2017). Sea levels in Sarawak are projected to rise 0.43 – 0.64 m by the year 2100 (Awang *et al*. 2013).

This trend of rising sea level is likely to already be having an impact on breeding success of Malaysian Plovers. The species is particularly susceptible because it lays its eggs directly on coastal beaches. Assuming the incubation period to be approximately 4 weeks, and that chicks are unable to fly for the first 7-8 weeks after hatching, each breeding cycle the birds will need to survive inundation by five spring tides to successfully raise offspring.

Long-term studies of climate change and extreme weather in Sarawak have shown a significant increase in extreme rainfall, particularly during the South-West monsoon period (May to September) (Sa'adi *et al*. 2023). This is likely to exacerbate threats from high tides during the breeding season.

Coastal development, including the construction of coastal defence against rising sea levels, is likely to negatively impact Malaysian Plover breeding success, since it effectively cuts off access to higher ground for unfledged chicks. At the study area, the recent planting of casuarina trees, perhaps in an attempt to reduce coastal erosion, has destroyed access to higher ground for unfledged chicks. This almost certainly had a negative impact on fledging success.

Site-level threats to the Malaysian Plovers in my study area included anthropogenic threats. While Malaysian Plovers are tolerant of a certain level of human-related disturbance during the non-breeding season, they are much more sensitive to disturbance while breeding. At the study area, the increase of temporary and permanent dwellings along the coast, and the increasing popularity of the beach for fishing and recreational activities, as well as an increasing population of feral dogs, resulted in the Malaysian Plovers deserting long stretches of beach which they occupied in 2020-2021. In 2022, commercial sand-mining activities caused the destruction of one nest, as well as significantly increasing disturbance throughout the area. In 2023, the remaining birds held territories directly adjacent to one another at the remotest extremity of the beach. Other anthropogenic threats included the recent arrival of two invasive avian species - House Crow *Corvus splendens* and Common Myna *Acridotheres tristis* - which could potentially predate Malaysian Plover eggs and chicks.

Fortunately, natural predators were relatively scarce. No raptors were regularly present at the site. Collared Kingfishers were probably the main threat to chicks. Although I did not witness predation from Collared Kingfisher, as noted above, the parent birds evidently considered the presence of a Collared Kingfisher a threat. I observed Collared Kingfishers opportunistically diving at migrant shorebirds at a nearby site, in one instance, striking and injuring a Greater Sand Plover *C. leshchenaultii*.

What conservation measures can be taken?

Beach-nesting shorebirds of several species, both resident and migratory, are threatened the world over, and are an increasing focus of both *in situ* and *ex situ* conservation action.

An example of *in situ* conservation action is the Conservation Action Plan for Hooded Plovers *Thinornis cucullatus* in Greater Geelong, Victoria, Australia (City of Greater Geelong, 2022). It focuses on raising public awareness of the plight of the species, protection of breeding sites through signage and patrols, regulation of commercial activity on beaches during the breeding season, control of invasive predators such as cats and foxes and management of vegetation to ensure optimum breeding conditions.

Although such *in situ* conservation action could help reduce human disturbance of Malaysian Plovers, it requires a high level of voluntary manpower, as well as cooperation by stakeholders. Since the major threat to breeding success for Malaysian Plovers appears to be macro-level threats such as rising sea level and climate change, *in situ* conservation measures for Malaysian Plover are likely to be of limited use, as well as being problematic in terms of implementation due to limited manpower availability.

Several well-established captive-rearing programmes for Snowy Plovers *C. nivosus* and Piping Plovers *C. melodus* in the U.S. are examples of *ex situ* conservation (e.g. Powell *et al.* 1997, Neuman *et al.* 2013). Known as "headstarting", such programmes are considered most suitable for species where productivity is lost primarily to flooding, predation, or disturbance during the incubation and chick-rearing stages, where there is adequate habitat remaining for birds to be released back into the wild after fledging and where survival threats are reduced once birds are fledged. Such seems to be the situation with Malaysian Plovers. Simpson (2020) summarises the process of headstarting: *"Headstarting is a method of circumnavigating the most vulnerable part of a ground nesting bird's life, from egg to fledging. Eggs are taken from wild nests and hatched in captivity; the chicks are provided with suitable feeding opportunity, protected from predators, and then released once they have fledged."* (Simpson, 2020).

Relative to *in situ* conservation measures, headstarting requires less manpower, but a higher level of specialised knowledge, 24/7 care for the duration of the bird's captivity and the creation of a suitable facility, including incubator, rearing enclosure, etc. It should ideally be linking to a marking scheme (colour-ringing) to enable ongoing monitoring and research once captive-reared birds have been released.

Headstarting facilities could perhaps be trialled by Sarawak Forestry Corporation (or Perhilitan in Peninsular Malaysia) and, if shown to be effective, set up in areas where they are most needed. Assistance in establishing such a facility and training of staff from experts in the US or elsewhere would help minimise unnecessary trial and error.

Conclusion

My somewhat anecdotal study of Malaysian Plovers in Miri, Sarawak revealed a concerningly low breeding success. If the breeding success detailed here is typical of the wider population, as there are reasons to believe it might be, then there is cause for alarm over the future sustainability of the species. The findings of more thorough research, undertaken by Kang-Woei Ong (in prep) are awaited with interest. The establishment of a headstarting and colour-marking programme

in Malaysia is one potential practical conservation measure which could alleviate pressure on the declining population of Malaysian Plovers in Malaysia.

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Additional Material
Additional information on the nesting behaviour can be seen in the video links:
Malaysian Plover incubation changeover: https://www.youtube.com/watch?v=Ae81pyp4vhU
Malaysian Plover incubating in a storm: https://www.youtube.com/watch?v=N5D5EWb87YA
Malaysian Plovers with juvenile: https://www.youtube.com/watch?v=Sb9o6t42NEU

More information on the Malaysian Plover available here (members only):
https://birdsoftheworld.org/bow/species/malplo1/cur/introduction

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