

Shorebird Records from Pangpang Bay, East Java, Indonesia

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Abstract. Pangpang Bay is one of the essential ecosystem areas located in East Java and also it is part of the East Asia Australia Flyway (EAAF). This area is an important habitat as a stopover site for migratory shorebirds. However, heretofore scientific reports are still limited. Therefore, we conducted a shorebird survey in this area on October 1-2, 2022 using concentration count methods at three potential areas. A total of 610 individuals of shorebirds belong to 13 species from two families (Scolopacidae and Charadriidae). Among the observed shorebirds, Whimbrel had the highest number of individuals (n=426), followed by Eurasian Curlew (n=45), Common Sandpiper (n=43), Pacific Golden Plover (n=43), Bar-tailed Godwit (n=14), Common Redshank (n=9), Wood Sandpiper (n=7), Terek Sandpiper (n=5), Ruddy Turnstone (5), Grey Plover (n=3), Common Greenshank (n=3), Javan Plover (n=2), and Greater Sandplover (n=1), respectively. Twelve species are wintering migratory shorebirds and one species (Javan Plover) is a resident species (mostly in Java). Furthermore, shorebirds in Pangpang Bay occupied three habitat types, i.e. mudflat, mangrove forest, and fishpond bordering the mangrove forest. Based on these results, Pangpang Bay is an important habitat for several shorebirds indeed, especially migratory wintering as a stopover site during their migration.

1 Introduction

Pangpang Bay is a prominent wetland enclave within Banyuwangi Regency located adjacent to the Bali Strait and the Indian Ocean. This area encompasses an expansive water area spanning 3,000 hectares [1] and mangrove forests that cover approximately 571.68 ha [2] that play a crucial role as a buffer ecosystem on the eastern side of Java Island. Therefore, to protect this ecosystem, the Indonesian government designated Pangpang Bay as an essential ecosystem area (EEA) in 2020 through East Java Governor Decree number 188/338/KPTS/013/2020. In addition, this area is also part of Ijen Geopark as a bioheritage or biological site due to its biodiversity, one of which is shorebirds [3]. The existence of

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shorebirds in an ecosystem is a highly important indicator for wetland ecosystems [4]. They are mud specialists and sentinels of mudflat ecosystem functioning.

Pangpang Bay is suspected to be a Migratory Stopover Habitat for shorebirds of the East Asia Australasian Flyway (EAAF). It has also been previously reported that this area is a habitat for waterbirds [5, 6] and stopover sites for seabirds [7]. This route covers the habitat of breeding in Siberia, China, Alaska, and stopover site areas in several Southeast Asian and Australasian regions such as Indonesia, Papua New Guinea, New Zealand, and Australia [8,9]. According to [10], there are nine important sites for EAAF priority shorebird populations in Indonesia; Benoa Bay, Kuala Tungal, Eastern Coastal of North Sumatra, Komolom Island, Sekopong Bay, Sungai Cemara Beach, Wasur National Park, and Ujung Pangkah. Wetland areas on Java Island are thought to have geomorphological characteristics that are able to provide resting places and food sources for migratory shorebirds during their migration. Therefore, these ecosystems are suitable stopover habitats for migratory shorebirds.

Even though Pangpang Bay has a diverse ecosystem and biodiversity, data on the occurrence of shorebirds in this wetland is still limited. The closest conservation area that has preliminary information is Alas Purwo National Park (APNP) that reported to have 27 species of shorebirds [11]. Given its status as an essential ecosystem area, the imperative of identifying pivotal inhabitants becomes paramount, with a particular focus on shorebirds. This emphasis is especially pertinent considering that Pangpang Bay holds substantial potential as a crucial stopover habitat for migratory shorebirds. This will boost shorebird distribution data in Indonesia and can also support to improvement of conservation efforts in Pangpang Bay.

2 Materials and Methods

The study was carried out in Pangpang Bay, Wringinputih District, Banyuwangi Regency, East Java on October 1-2, 2022 (Figure 1). Observation of shorebirds was conducted at three concentrate points (CP) in the Pangpang Bay areas: CP1 (mangrove forest: 8°28'17.70"S, 114°21'38.75"E), CP2 (mudflat: 8°28'29.08"S, 114°22'2.74"E), and CP3 (fishpond bordering mangrove forest: 8°29'36.84"S, 114°21'37.50"E) using the concentration count method for 30-50 minutes at each CP [12] along two days observation.

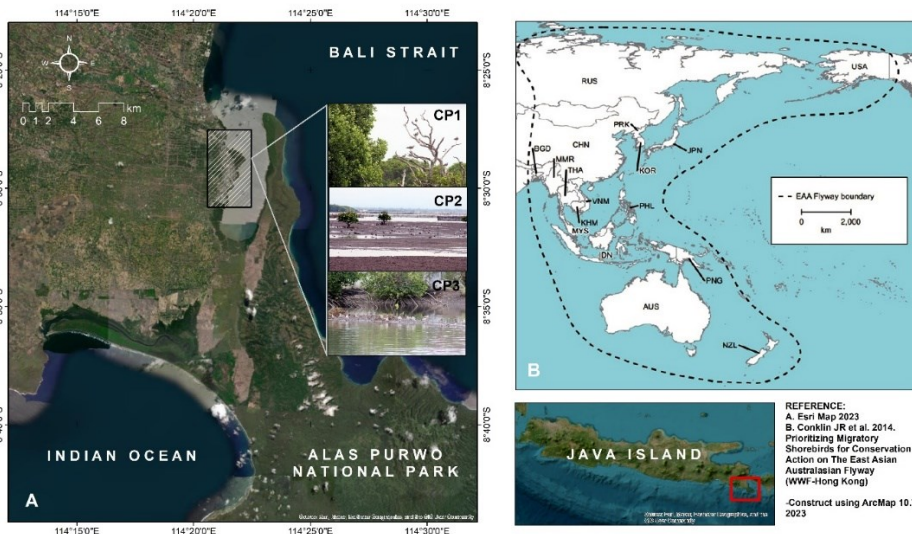


Fig. 1. Survey sites at Pangpang Bay (A), the East Asia Australasian Flyway (EAAF) (B).

The equipment used during the survey were a Binocular Aculon A211 10x50, Binocular Bushnell Powerview 10x50, DSLR camera Canon EOS 60 D, DSLR camera Cannon EOS 70D, Telephoto lens Thamron75-300 mm, Telephoto lens Canon 55-250 mm, and notes. Species and individual counts for each species were recorded using the Camera and Binocular, while species identification was conducted using morphological characteristics and then confirmed by using field guides [13, 14, 15]. Furthermore, for seasonality, we referred to information from scientific reports [10] and field guides [15].

3 Results and Discussion

A total of 610 individuals of 13 species of shorebirds were recorded in three concentrate points which belong to two families (Scolopacidae and Charadriidae) (Table 1). Regarding individual counts, the Whimbrel (*Numenius phaeopus*) emerges as the most frequently encountered among the observed species (n=426), followed by Eurasian Curlew (*Numenius Arquata*) (n=45), Common Sandpiper (*Actitis hypoleucos*) (n=43), Pacific Golden Plover (*Pluvialis fulva*) (n=43) and Bar-tailed Godwit (*Limosa lapponica*) (n=18). Furthermore, Common Redshank (*Tringa totanus*) (n=9), Wood Sandpiper (*Tringa glareola*) (n=7), Terek Sandpiper (*Xenus cinereus*) (n=5), Ruddy Turnstone (*Arenaria interpres*) (n=5), Grey Plover (*Pluvialis squatarola*) (n=3), Common Greenshank (*Tringa nebularia*) (n=3), Javan Plover (*Charadrius javanicus*) (n=2) recorded few times and Greater Sand Plover (*Charadrius leschenaultii*) (n=1) is the lowest encountered species. All of these species have also been reported previously in Alas Purwo National Park [11].

Table 1. Shorebird species in Pangpang Bay

Family	Species Name	Common Name	Seasonality	Conservation Status		
				IUCN*	CITES*	IR*
Charadriidae	<i>Charadrius javanicus</i>	Javan Plover	R	NT	NA	PR
	<i>Charadrius leschenaultii</i>	Greater Sand Plover	M	LC	NA	NP
	<i>Pluvialis fulva</i>	Pacific Golden Plover	M	LC	NA	NP
	<i>Pluvialis squatarola</i>	Grey Plover	M	LC	NA	NP
Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper	M	LC	NA	NP
	<i>Arenaria interpres</i>	Ruddy Turnstone	M	LC	NA	NP
	<i>Limosa lapponica</i>	Bar-tailed Godwit	M	NT	NA	NP
	<i>Numenius arquata</i>	Eurasian Curlew	M	NT	NA	PR
	<i>Numenius phaeopus</i>	Whimbrel	M	LC	NA	PR
	<i>Tringa glareola</i>	Wood Sandpiper	M	LC	NA	NP
	<i>Tringa nebularia</i>	Common Greenshank	M	LC	NA	NP
	<i>Tringa totanus</i>	Common Redshank	M	LC	NA	NP
	<i>Xenus cinereus</i>	Terek Sandpiper	M	LC	NA	NP

Notes: Resident (R); Migratory (M); Least Concern (LC); Near Threatened (NT); Non-Appendix (NA); Non-Protected (NP); Protected (PR)

*IUCN: International Union for Conservation of Nature,

*CITES: Convention on International Trade in Endangered Species,

*IR: Indonesian Regulations (P.106 /MENLHK /SETJEN /KUM.1/12/2018)

Furthermore, according to IUCN Redlist status, 10 species are listed as least concern and three species as near threatened (Table 1). However, in the Regional Red List, some shorebirds are considered to be more threatened. *Pluvialis squatarola* (*squatarola*), *N. phaeopus* (*variegatus*), *A. interpres* (*interpres*) are listed as near threatened while *C. leschenaultii* (*leschenaultii*) and *L. lapponica* (*menzbieri*) as vulnerable [10]. All of these subspecies were recorded in Pangpang Bay during their migration. In addition, all shorebird species in Pangpang Bay are listed as non-appendix in CITES. However, three of the 13 species found in Pangpang Bay are protected by the Indonesian Government; they are *C. javanicus*, *N. arquata*, and *N. phaeopus*. This finding strengthens the status of Pangpang Bay as an essential ecosystem area, further affirming its pivotal role as a sanctuary for protected species. Finally, Despite the global conservation status of found shorebirds being least concerned and near threatened, the occurrence of three protected species in Pangpang Bay is certainly a priority for conservation.

Javan Plover (*Charadrius javanicus*)

Two individuals of this species were recorded in mudflat areas in Pangpang Bay. It was found in a mixed-species flock with *L. lapponica*, *P. fulva*, *P. squatarola*, *N. phaeopus*, *A. hypoleucos*, and *A. interpres*. This species is a resident of Java and Bali, moreover, it has reportedly extended its range to Sumatra, Bangka, Belitung, Sulawesi, Nusa Tenggara [16,17], Timor Leste [18], and Singapore [19].

Greater Sand Plover (*Charadrius leschenaultii*)

A single individual was recorded in mudflat areas in Pangpang Bay. This species was observed to have foraging activity in mudflats. Species *C. leschenaultii* is a wintering migrant in Indonesia and commonly found in the Greater Sunda Islands [15]. According to [10], this species has breeding habitats in western China, Mongolia, and southern Siberia. Whilst for non-breeding habitat, approximately 75% is widely distributed in coastal Australia, Papua New Guinea, Indonesia, Philippines, Southeast Asia, and southern Japan [10, 20].

Pacific Golden Plover (*Pluvialis fulva*)

There are 43 individuals were recorded in mudflat areas and fishpond bordering the mangrove forest in Pangpang Bay. This species was also found in a mixed-species flock with other shorebird species. Species *P. fulva* is reported to breed in Siberia and Alaska and migrate to the south (common visitors in the Greater Sundas) [10,15]. During their migration, this species often occupies coastal wetlands, mangroves, rice fields, and open grasslands [21].

Grey Plover (*Pluvialis squatarola*)

Three individuals of this species were recorded in mudflat areas in Pangpang Bay. Species *P. squatarola* was found in a mixed-species flock with *A. hypoleucos* and *T. nebularia* while foraging. This species is a wintering migrant that is commonly found in the Greater Sunda Islands, particularly the coastal areas [15]. Species *P. squatarola* has a breeding habitat in the Siberian Arctic, east to western and northern Alaska, and will migrate to Southeast Asia and Australia [10].

Common Sandpiper (*Actitis hypoleucos*)

Species *A. hypoleucos* is the most common species found In Pangpang Bay, 43 individuals were observed in all habitat types, and it is quite frequent in mixed flock species with other shorebirds. This species is a common migratory shorebird in the Greater Sunda Islands [15]. This species has breeding habitats in Europe to Siberia and will migrate to Africa, Asia, and Australia [14].

Ruddy Turnstone (*Arenaria interpres*)

There were five individuals within small groups in the fishpond bordering the mangrove forest in Pangpang Bay. This species occupies areas that have a rocky substrate characteristic. This species is also a wintering migrant that is commonly found in the Greater Sunda Islands, particularly the wetlands near coastal areas [15]. Species *A. interpres* has a breeding habitat in the Arctic northeastern Siberia and western Alaska. Whilst for non-breeding habitat, it is widely distributed to China (including Taiwan), Southeast Asia, Indonesia, Papua New Guinea, New Zealand, and Australia [10].

Bar-tailed Godwit (*Limosa lapponica*)

Around 18 individuals within a group were reported in the mudflat area and fishpond bordering the mangrove forest in Pangpang Bay. Species *L. lapponica* was observed in a mixed flock with *P. fulva* and *C. javanicus* during foraging activity. This species has a breeding habitat in the northern Siberia east of the Kolyma River. Whilst for non-breeding habitat, it was widely distributed to primarily northwest Australia, but smaller numbers in coastal southern China, Taiwan, Southeast Asia, and Indonesia [10]. Furthermore, this species is commonly a wintering migrant in the Greater Sunda Islands, particularly the wetlands near coastal areas [15].

Eurasian Curlew (*Numenius arquata*)

There were 45 individuals were observed in mudflat areas and mangrove forests during the survey. The birds flocked together with *N. phaeopus*. Species *N. arquata (orientalis)* is a wintering migrant in the Greater Sunda Islands, particularly the wetland areas [14]. Species *N. arquata* has a breeding habitat in Europe and Asia, then migrates to Africa, Southeast Asia, and Australia [15].

Whimbrel (*Numenius phaeopus*)

The most abundant shorebird species with approximately 426 individuals were found in Pangpang Bay. This species was also observed in mixed flocks with *N. arquata* and plover groups. Species *N. phaeopus (variegatus)* has a breeding habitat in northeastern Siberia, both Arctic and subarctic. Whilst for non-breeding habitat, this species migrates to Australia, Asia, and Indonesia [10]. In addition, this subspecies is a commonly wintering migrant in the Greater Sunda Islands [15].

Wood Sandpiper (*Tringa glareola*)

Seven individuals were observed within a group in mudflat areas in Pangpang Bay. This species is also a wintering migrant in the Greater Sunda Islands, particularly the wetland areas around coastal or lagoon [14]. Whereas, its breeding habitat is in Siberia and Europe [15].

Common Greenshank (*Tringa nebularia*)

There were three individuals within small groups in the mudflat in Pangpang Bay. Species *T. nebularia* was also observed in a mixed flock with *L. lapponica* and *A. hypoleucos* with foraging behavior. This species has a breeding habitat in Siberia and Europe, whereas non-breeding habitats are in Africa, Asia, and Australia [14]. It is also a common wintering migrant in the Greater Sunda Islands [15].

Common Redshank (*Tringa totanus*)

This species was recorded by nine individuals flying around the mangrove forest. As well as observed foraging in mudflat areas. Species *T. totanus* have a breeding habitat in Europe,

Siberia, China, India, and Tibet [14, 22]. It also is a wintering migratory species in the Greater Sunda Islands [15].

Terek Sandpiper *Xenus cinereus*

Five individuals were recorded within a small group in mudflat areas. This species was also observed in a mixed flock with *Egretta garzetta*. This species is a wintering migrant in the Greater Sunda Islands, particularly the coastal areas [15]. Species *X. cinereus* has a breeding habitat in Europe, and Siberia, then migrates to Africa, Asia, Australia, and New Zealand [14, 15, 23].



Fig. 1. Shorebirds documentation from Pangpang Bay. Pacific Golden Plover (A); Javan Plover (B); Common Greenshank and Terek Sandpiper (C); Bar-tailed Godwit (D); Whimbrel (E); Grey Plover (F); Ruddy Turnstone (G); Common Redshank (H); Mix-flocced shorebird species (I).

We documented 13 shorebird species in Pangpang Bay which represent 21% of the shorebirds found in the Greater Sunda Islands (Sumatra, Kalimantan, Java, and Bali). This shows that Pangpang Bay is indeed an important habitat for shorebirds, particularly in the East Asian-Australasian Flyway. Pangpang Bay was confirmed to be a stopover habitat for 12 species of wintering migrants in October 2022. However, the layover periods have not

been recorded yet. Therefore, it is crucial to conduct further research related to the layover period. In addition, it is also necessary to monitor shorebirds every month, particularly during migration season in August–February. Our findings suggest that mudflats and mangrove forests in Pangpang Bay are two important shorebird habitats. These findings confirmed a previous study on the coast of North Sumatra that found mudflats were essential habitats for shorebirds [24]. Shorebirds mostly use mudflats as foraging habitats during low tide, while the mangrove forest is a perch location during high tide.

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References

1. A. Ariyanto, E. Hidayati, W. Iswandi, Managing Mangrove Essential Ecosystem Area: A Strategy Analysis in Pangpang Bay Area, Wringinputih Village, East Java, Indonesia. *Journal of Saemaology*, **5**, 2, p. 33-64 (2020).
2. K.-C.-P. Hapsari, D.-A. Permatasari, Changes of mangrove area in Pangpang Bay, Banyuwangi 2014-2018 using Landsat-8 imagery. *Journal of Physics: conference series* **158**, p. 1-6 (2020). <https://doi.org/10.1088/1742-6596/1528/1/012063>
3. Geopark Ijen, Pang-Pang Bay. Available at: <http://geopark-ijen.jatimprov.go.id/detail-biosite/pangpang-bay.html> (Date accessed: August 14, 2023] (2022).
4. B.-D. Hansen, J.-K. Szabo, R.-A. Fuller, R.-S. Clemens, D.-I. Rogers, D.-A. Milton, Insights from long-term shorebird monitoring for tracking change in ecological character of Australasian Ramsar sites. *Biological Conservation*, **260**, p. 1-9 (2021). <https://doi.org/10.1016/j.biocon.2021.109189>
5. A.-M. Siddiq, H. Sulistiyowati, R. Wimbaningrum, R. Setiawan, N. Qisti, D. Supriadi, The Diversity of Waterbirds Species in Jatipapak Mangrove Ecosystem at Kucur Resort, Alas Purwo National Park, East Java. *Biosfer*, **14**, 2, (2023). <http://dx.doi.org/10.24042/biosfer.v14i2.17185>
6. A.-M. Siddiq, R. Wimbaningrum, H. Sulistiyowati, R. Setiawan, S.-D. Febrianti, F.-S.-N Sabila. The Diversity of Birds in Mangrove Forest at Biosite Pangpang Bay, Ijen Geopark. *Life Science and Biotechnology*, **1**, 2, p. 52-58 (2023). <https://doi.org/10.19184/lbs.v1i2.44165>
7. A.-M. Siddiq, H. Sulistiyowati, R. Wimbaningrum, R. Setiawan, R.-P. Ananda, N. Qisti, The results of seabird surveys in Pangpang Bay, East Java, Indonesia. *Biogenesis*, **11**, 2, (2023). <https://doi.org/10.24252/bio.v11i2.39030>
8. S. Nebel, Differential migration of shorebirds in the East Asian–Australasian Flyway. *Emu*, **107**, p. 14-18 (2007). <https://doi.org/10.1071/MU06006>
9. B.-D. Hansen, R.-A. Fuller, D. Watkins, D.-I. Rogers, R.-S. Clemens, M. Newman, E.-J. Woehler, D.-R. Weller, Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species (Unpublished report for the Department of the Environment. BirdLife Australia, Melbourne 2016).
10. J.-R. Conklin, Y.-I. Verkuil, B.-R. Smith, Prioritizing Migratory Shorebirds for Conservation Action on The East Asian Australasian Flyway (WWF-Hong Kong 2014).
11. M.-J. Grantham, Birds of Alas Purwo National Park, East Java. *Kukila*, **11**, 97-121 (2000).

12. G.-H. Volpato, E.-V. Lopes, L.-B. Mendonça, R. Boçon, M.-V. Bisheimer, P.-P. Serafini, L. Anjos, The use of the point count method for bird survey in the Atlantic forest. *ZOOLOGIA*, **26**, 1, p. 74–78 (2009). <https://doi.org/10.1590/S1984-46702009000100012>
13. J. Howes, D. Bakewell, Y.-R. Noor, Panduan Studi Burung Pantai (Wetlands Internasional – Indonesia Programme, Bogor, 2003).
14. J. Mackinnon, K. Philips, Bv. Balen, Burung-burung di Sumatera, Jawa, Bali, dan Kalimantan (Puslitbang Biologi-LIPI, Bogor, 2010).
15. I. Taufiqurrahman, P.-G. Akbar, A.-A. Purwanto, M. Untung, Z. Assiddiqi, M. Iqbal, W.-K. Wibowo, F.-N. Tirtaningtyas, D.-A. Triana, Panduan Lapangan Burung-Burung di Indonesia Seri I: Sunda Besar (Birdpacker Indonesia-Interlude, Batu, 2022).
16. M.-I. Iqbal, I. Febrianto, H. Zulkifili, The occurrence of Javan Plover *Charadrius javanicus* in Sumatra, Indonesia. *Wader Study Group Bulletin*, **118**, 2, p. 131-133 (2011).
17. M.-I. Iqbal, Javan Plover *Charadrius javanicus* on Belitung Island, a new site for Sumatra (Indonesia). *Wader Study*, **122**, 2, p. 160-162 (2015).
18. C.-R. Trainor, The waterbirds and coastal seabirds of Timor Leste: new sites record clarifying residence status, distribution and taxonomy. *Forktail*, **27**, p. 63-72 (2011).
19. L.-M. Seng, Records Committee Reports 2022. Bird Group Records Committee, Singapore. 2022).
20. E. Hirshchfeld, C.-S. Roselaar, H. Shirihai, Identification, taxonomy and distribution of Greater and Lesser Sand Plovers. *British Bird*, **93**, p. 162-189 (2000).
21. I. Taufiqurrahman, N.-S. Budi, Rudyanto, K. Baskoro, M. Iqbal, A. Rahmat, Atlas Burung Indonesia: wujud karya peneliti amatir dalam memetakan burung Nusantara (Yayasan Atlas Burung Indonesia, Batu, 2020).
22. R. Valle, F. Scarton, Status and distribution of Redshanks *Tringa tetanus* breeding along Mediterranean coasts. *Wader Study Group Bull*, **81**, p. 66-70 (1996).
23. M. Golovatin, W. Meissner, S. Paskhalny, Updated breeding range of the Terek Sandpiper *Xenus cinereus* with additional data on nest densities. *Wader Study Group Bull*, **117**, p. 157-162 (2010).
24. C.-A. Putra, D. Perwitasari-Farajallah, Y.-A. Mulyani, Habitat use of migratory shorebirds on the Coastline of Deli Serdang Regency, North Sumatra Province. *Hayati Journal of Biosciences*, **24**, 1, p. 16-21 (2017). <https://doi.org/10.1016/j.hjb.2017.04.003>