

The results of seabird surveys in Pangpang Bay, East Java, Indonesia

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ABSTRACT. Pangpang Bay is a wetland area that is geographically part of the East Asia Australia Flyway (EAAF) for migrating seabirds. This area is a potential stopover site for seabirds during their migration. Seabird surveys were conducted for three periods, i.e October 2020, October 2021, and October 2023 in Pangpang Bay with motorboat. The survey results showed that there were 10 species of seabirds in Pangpang Bay which consisted of three family i.e Fregatidae (Frigatebird), Laridae (Tern), and Phalacrocoracidae (Cormorant). There are five species i.e lesser crested tern *Thalasseus bengalensis*, little tern *Sterna albifrons*, whiskered tern *Chlidonias hybrida*, little pied cormorant *Microcarbo melanoleucos*, and little black cormorant *Phalacrocorax sulcirostris* which is new records for the Blambangan Peninsula. Species *T. bergii* has the highest number of individuals in the Pangpang Bay during the survey periods (200-221 individuals). These preliminary data show that Pangpang Bay is one of the essential ecosystems in East Java that seabirds use as stopover sites during their migration. Availability of food and the roosting place is thought to be an important factor in it.

Keywords: East Java; Pangpang Bay; rare migratory seabird; seabird survey; stopover

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INTRODUCTION

Pangpang Bay is a wetland ecosystem located on the coast of East Java, Indonesia with an area of approximately 3,174.58 Ha (Hendroyono, 2021). Administratively, this area is located in Banyuwangi Regency, which is in two sub-districts i.e Muncar and Tegaldlimo (Neka, 2019). The Pangpang Bay area has been designated as one of the essential ecosystem areas (EAA) in Indonesia through the Decree of the East Java Governor number 188/338/KPTS/013/2020. In addition, Pangpang Bay also has been designated as one of the biological sites (Biosite) of Ijen Geopark Unesco Global Geopark (UGGp) which has a high biodiversity value outside the conservation area and it has a close relationship with existing geological processes (Geopark Ijen, 2022). Geographically, this Biosite is located on the east coast of Java Island which is an important route for the seabird migration of the East Asian-Australasian flyway (EAAF) (Newton, 2008).

The existence of a seabird community in Pangpang Bay has never been reported before. In fact, this area has the potential to become a stopover for migrating seabirds that cross the eastern coast of Java. Previous research from Grantham (2000) reported that there were 15 seabird's species (*Fregata minor*, *F. ariel*, *F. andrewsi*, *Anhinga melanogaster*, *Sula leucogaster*, *Peleoanus conspicillatus*, *Stercorarius pomarinus*, *S. parasiticus*, *Larus* sp., *Chlidonias leucopterus*, *Gelochelidon nilotica*, *Sterna hirundo*, *St. sumatrana*, *St. anaethetus*, and *St. bergii*) found in the coast of Alas Purwo National Park (APNP) which is located on the Blambangan Peninsula. This park is directly adjacent to Pangpang Bay, more precisely to the south of this bay. Furthermore, in this Bay also were found many bagan or sero (cages of fishermen) scattered throughout the water area, making it a potential location for seabirds to roosting. As reported by Tirtaningtyas & Yordan (2017), there are seven species of seabirds in the Jakarta Bay perch on sero to rest.

Mostly of seabirds in Indonesia are migratory birds. This is in accordance with the statement of Sukmantoro et al. (2007) that there are approximately 149 species of migratory birds that cross Indonesia, and among them are seabirds. Sea waters provide the needed food sources and serve as good navigation for birds to carry out the migration process (Schreiber and Burger, 2002; Grecian et

al., 2016). The existence of seabirds in a coastal area can show the good stability of an ecosystem. Seabirds have been used as bioindicators of marine ecosystems due to cause-effect association with different microclimate and habitats (Rajpar *et al.*, 2018). The coastal habitat in Indonesian, especially Java Island is still a good alternative as a stopover site for the seabird migration. However, information regarding the geographical area of seabirds found on Java Island is still limited. Thus, this research tries to survey the seabird's existence in one of the potential stopover sites in Pangpang Bay over three years period (2020-2022). The results of this study are expected to provide important information regarding the location of potential stopover sites for seabird migration in East Java. Therefore, it can also become a policy basis for the government to carry out conservation efforts in this wetland, which is in fact an area outside of conservation.

MATERIALS AND METHODS

Study area. Pangpang Bay is located in the south of Banyuwangi which is directly adjacent to Alas Purwo National Park (south and east sides) and Bali Strait (north side). This wetland area has a length of 8 km and a width of 3.5 km with a total open area of 3,175.48 ha and a mangrove forest of 2,926.6 ha (BKSDA Jatim, 2018). This mangrove vegetation grows on the east, west, and south sides of Pangpang Bay (Geopark Ijen, 2022). Every year, the total area of mangroves in Pangpang Bay continues to grow due to the rehabilitation program that has been carried out since 2000. Increasing mangrove areas is suspected to provide greater ecological benefits for fauna that uses them as habitat, one of which is seabirds. The Pangpang bay is also adjacent to community ponds (west side). Hence, in the bay area, we also found many cages of fishermen (bagan or sero as a locally name) scattered throughout the water area which are suspected to be used by seabirds for roosting.

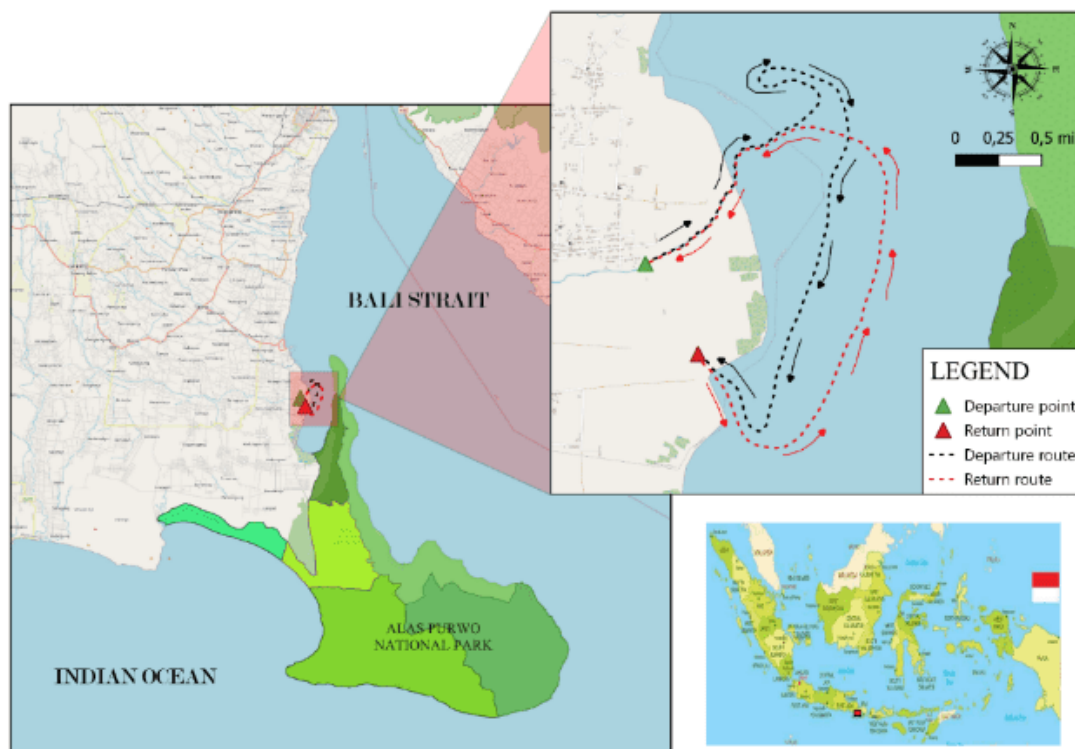


Fig. 1. Study site and survey routes of in Pangpang Bay, East Java

Procedures and data analysis. Seabird surveys were conducted for the three periods, i.e October 2020, October 2021, and October 2022 in Pangpang Bay ($8^{\circ}29'19''$ S and $114^{\circ}22'19''$ E) (Figure 1). The survey is conducted once in each period, accordance with the migration period of seabirds in East Java.. Data collection was carried out using a water survey method by driving a motorboat (Howes *et al.*, 2003; Johansen *et al.*, 2015; Ramos-Vazquez *et al.*, 2021). The data collection was carried out for

approximately 45 minutes with a distance of around 15.39 km. The water survey route is determined based on the fishermen's route and the presence of sero which is often used by seabirds to perch or rest (Tirtaningtyas & Yordan, 2017). Survey time starts at 10.00 AM - 02.00 PM. Data collection using field equipments such as Binoculars Aculon Powerview 10x50, Camera DSLR Canon EOS 60D and 70D, telephoto lens Tamron 75-300 mm and Canon 55-250 mm, hand counter, Global Positioning System (GPS) Garmin 64s, and stationary note. Data collection was carried out using a motorized boat moving at a speed of approximately 20 km/h.

The survey starts from the departure point using a motorboat which moved according to the route directed by local fishermen to potential locations for seabird occurrence (Fig. 1). During the survey, the observer identified and documented the seabirds found by taking photos of total individuals (other than counting directly), then taking more specific photos of just a few individuals to support the species verification process. In verifying seabird species using the field guild of birds in the Greater Sundas (MacKinnon *et al.*, 2010; Taufiqurrahman *et al.*, 2022).

RESULTS AND DISCUSSION

The survey results showed that there were 10 species of seabirds in Pangpang Bay which consisted of three family i.e Frigateidae (Frigatebird), Laridae (Tern), and Phalacrocoracidae (Cormorant). There are five species i.e Lesser Crested Tern, Little Tern, Whiskered Tern, Little Pied Cormorant, and Little Black Cormorant which are new records for the Blambangan Peninsula. It is reinforced by the non-reporting of these five species of seabird listed in Alas Purwo National Park which is part of the Blambangan Peninsula (Grantham, 2000).

Table 1. Seabird composition in Pangpang Bay

Group	Species	Seasonality	IUCN Status	National Regulation	Survey Periods		
					Oct 2020	Oct 2021	Oct 2022
Frigatebird	Great Frigatebird	M	LC	P	√	-	√
Tern	Lesser Crested Tern*	M	LC	P	√	√	√
	Greater Crested Tern	M	LC	P	√	√	√
	Black-naped Tern	M	LC	P	√	-	-
	Little Tern*	M	LC	P	√	√	-
	Whiskered Tern*	M	LC	P	√	-	-
	Gull-billed Tern	M	LC	P	√	-	-
	Common Tern	M	LC	P	√	√	√
Cormorant	Little Pied Cormorant*	M	LC	NP	-	-	√
	Little Black Cormorant*	M	LC	NP	-	-	√

Notes: Migrant (M); International Union for Conservation of Nature (IUCN); Least Concern (LC); Protected (P); Not Protected (NP), Oct (October); species in (*) refer to new records for the Blambangan Peninsula.

Great Frigatebird *Fregata minor*. This species was recorded on October 2020 (four individuals) and October 2022 (five individuals). Species *F. minor* was found roosting on sero with occasional foraging activity by swooping down to catch fish in the waters (Fig. 2.C). This species is a member of the Frigateidae which is spread in tropical waters around the world (Lovette and Fitzpatrick, 2016; Taufiqurrahman *e228ndi*, 2022), but it is rarely in APNP (Grantham, 2000), and singlebirds were recorded in Jakarta Bay with flying or resting on fish traps four times: 31 July 2011, 20 August 2011, 17 September 2011, and 4 December 2011 (Tirtaningtyas and Yordan, 2017). The nearest breeding is known on Christmas Island in the Indian Ocean (MacKinnon *et al.*, 2010; Tirtaningtyas and Yordan, 2017).

Lesser Crested Tern *Thalasseus bengalensis*. Documented in each survey period with a total of 10-22 individuals. This species was documented mixed with *Thalasseus bergii* and *Egretta garzetta* by AMS, which was roosting on the sero (Fig. 2.B). However, the number of individuals is relatively less compared to *T. bergii*. Species *T. bengalensis* has never been reported before in APNP by Grantham (2000), so it is a new record for the Blambangan Peninsula. This species is a rare migratory

seabird from Africa and Asia (*bengalensis*) and a more common migratory seabird from Australia (*torresii*) (Taufiqurrahman *et al.*, 2022). MacKinnon *et al.*, (2010) revealed that *T. bengalensis* is a regular non-breeding visitor in Great Sunda (Kalimantan, Sumatra, Java, and Bali). Perera and Ilangakon (2016) also found this species in south-western Sri Lanka with low abundance on September (one individual) and December (two individuals) on 2008, then Februari (24 individuals), March (14 individuals), April (11 individuals) on 2009.

Greater Crested Tern *Thalasseus bergii*. Species that have the highest encounter during the survey in Pangpang Bay. This species was recorded in each survey periods (Fig. 2.E). The highest record was on October 2020 (221 individuals). Grantham (2000) also states that this species is commonest terns in APNP, 229ndi s is similar with reported by Tirtaningtyas and Yordan (2017) in survei Bay. Perera dan Ilangakon (2016) also found *T. bergii* insurvei survei (September 2008 - April 2009, except Februari) in south-western Sri Lanka. In Seribuat Archipelago, Johor, Malaysia, it was also reported that the highest encounter with 200 individuals was in August 2017 (Hamza *et al.*, 2019). Species *T. bergii* has a fairly wide distribution covering several islands in the Pacific Ocean, Persian Cape, Tropical Pacific Ocean, Australia, and S229ndi 229ndi Africa. It is common in the Gr229ndi sndi sSundas and is reported to breed on the Karimun Jawa, and also thought to breed on a small island off the coast of Sumatra (MacKinnon *et al.*, 2010).



Fig. 2. Representative seabird documentation from Pangpang Bay: a. Mix-flocked of Tern species; b. Lesser Crested Tern and Little Egret; c. Great Frigatebird; d. Little Pied Cormorant; e. Greater Crested Tern; f. Gull-billed Tern; g. Common Tern; h. Little Tern.

Black-naped Tern *Sterna sumatrana*. This species was only surveyed in one survey period on October 2020 with a total of 15 individuals. Observed flying across with the small groups. In APNP, this species was found for the first time in 1997, precisely on Plengkung coast with 40 individuals (Grantham, 2000). Tirtaningtyas and Yordan (2017) also reported the presence of *sumatrana* in Jakarta Bay on October 2011 with a total of two individuals. Whereas in Seribu Archipelago, Johor, Malaysia found 1,448 individuals in 2017 (Hamza *et al.*, 2019). This species has a global distribution on tropical islands and coasts in the Indonesian Ocean and the Pacific Ocean to northern Australia (MacKinnon *et al.*, 2010). De La Rosa *et al.* (2019) discovered a new breeding site for *S. sumatrana* on islets in Lanuza Bay, Surigao del Sur province, north-east Mindano, Philippines.

Little Tern *Sternula albifrons*. This species was only found in two survey periods, i.e. October 2020 and October 2021. AMS obtained photos of *St. albifrons* mixing with *T. bergii* on sero (Fig. 2h). This species is also a new record for Blambangan Peninsula, because it has never been reported before in APNP by Grantham (2000). Furthermore, Perera dan Ilangakon (2016) also found this species in south-western Sri Lanka with the highest encounter on February 2009 (124 individuals). In other Indonesian waters, *St. albifrons* is also found in Jakarta Bay on July 2013 (Tirtaningtyas and Yordan, 2017) and Kupang Bay on June 2014 (Trainor and Hidayat, 2014). This species was distributed in Africa, Europe, Asia, and Australia. Palearctic visitors as well as locally common breeding settlers in the Greater Sundas (*sinensis*). Commonly found in coastal habitats, estuaries, coastal, sometimes fresh waters to inland (Taufiqurrahman *et al.*, 2022).

Whiskered Tern *Chlidonias hybrida*. This species was only found in one survey period on October 2020. AMS observed 15 individuals flying low over the water's surface. Species *C. hybrida* is a new record in Blambangan Peninsula, because it has never been reported before in APNP by Grantham (2000). This species also found in Jakarta Bay during 2011–2013, with the highest encounter on May 2013 (23 individuals). Furthermore, Perera and Ilangakon (2016) also found *C. hybrida* in south-western Sri Lanka with relatively frequent encounters in 2008–2009, and the highest encounter was on February 2009 (293 individuals). Iqbal *et al.*, (2021), also found *C. hybrida* in Nibung River on the east coast of the Banyuasin Peninsula, South Sumatra Province, Indonesia. This species was distributed in Africa, Europe, Asia to Australia and is a common visitor on the Great Sunda. Visiting muddy beaches, estuaries, reservoirs, rivers, marshes and fish ponds (Taufiqurrahman *et al.*, 2022).

Gull-billed Tern *Gelochelidon nilotica*. This species was only found in one survey period (October 2020). AMS observed two individuals with one individual flying low over the water's surface, and one individual roosting on sero (Fig. 2.F). The species *G. nilotica* has also been reported as a single record in APNP in 1995, precisely in Sembulungan which borders the Pangpang Bay area by Grantham (2000). Furthermore, Perera and Ilangakon (2016) also observed rare encounters species *G. nilotica* in south-western Sri Lanka. Meanwhile, this species is not found in Jakarta Bay (Tirtaningtyas & Yordan, 2017) and Seribu Archipelago (Hamza *et al.*, 2019). This species has a wide distribution, i.e. breeding in America, Europe, Africa, Asia, and Australia. Then it will pass through Indonesia and Irian Island. Species *G. nilotica* is common in the Sumatra and Kalimantan waters, but not in Java and Bali (MacKinnon *et al.*, 2010).

Common Tern *Sterna hirundo*. Recorded in all survey periods with a total of 40–75 individuals (Fig. 2.G). Also reported by Grantham (2000) in APNP but with the category of rarely non-breeding visitor, with a maximum encounter of 140 individuals on the rocky shore at Plengkung on July 1997. Furthermore, in Jakarta Bay, this species is common non-breeding visitor, it was recorded from September (maximum 85 birds) through October (54) and November (160) to December (three) in 2011, on July 2012 (74) and July 2013 (two). The similar report from Perera and Ilangakon (2016) which stated that frequent encounters with *S. hirundo* in Sri Lanka (September 2008–April 2009), it was always found with the highest encounters in February 2009 (413 individuals). This species breeds in North America, Europe and Asia (Becker and Ludwigs, 2004; Taufiqurrahman *et al.*, 2022).

Little Pied Cormorant *Microcarbo melanoleucos*. This species was only found in one survey period (October 2022). AMS observed one individual roosting on sero, and two individuals flying around for 5-7 minutes (Fig. 2.D). Species *M. melanoleucos* is also a new record for East Java waters, because it has never been reported before in this region by Akbar et al (2020) and Taufiqurrahman *et al.*, (2022). Likewise, Grantham (2000) did not find this species in the APNP. Species *M. melanoleucos* has a global distribution in New Zealand, Australia, New Guinea and eastern Indonesia (MacKinnon *et al.*, 2010). Taufiqurrahman *et al.*, (2022) stated that this species is a common visitor on Bali Island and is rarely found in the coastal areas of East Java. This species was found in the lagoon area of Serangan Island, Bali on 2016-2017 (Vitrayanthi *et al.*, 2019). The species *M. melanoleucos* was also recorded visiting South Kalimantan several times (Myers, 2016; Taufiqurrahman *et al.*, 2022). This species is usually found solitary, in small or large groups, and tends to forage in the sea near the coast (Schreiber & Burger, 2002; Arlott, 2018).

Little Black Cormorant *Phalacrocorax sulcirostris*. This species was only found in one survey period (October 2022) with one individual on the water's surface. The species *P. sulcirostris* is also a new record in the Blambangan Peninsula, because it has never been reported in APNP by Grantham (2000). This species is a resident cormorant and it was distributed from Indonesia to the east to New Guinea Island, Australia, Tasmania and northern New Zealand (Taufiqurrahman *et al.*, 2022). In Java Island, this species is spread in several areas such as Pulau Rambut Wildlife Sanctuary (Mardiastuti, 2022) and Ujung Pangkah (Ilmar and Santoso, 2019). Furthermore, Jumilawaty and Andriyani (2019) reported that *P. sulcirostris* was found breeding in Tanjung Rejo, North Sumatra on March-June.

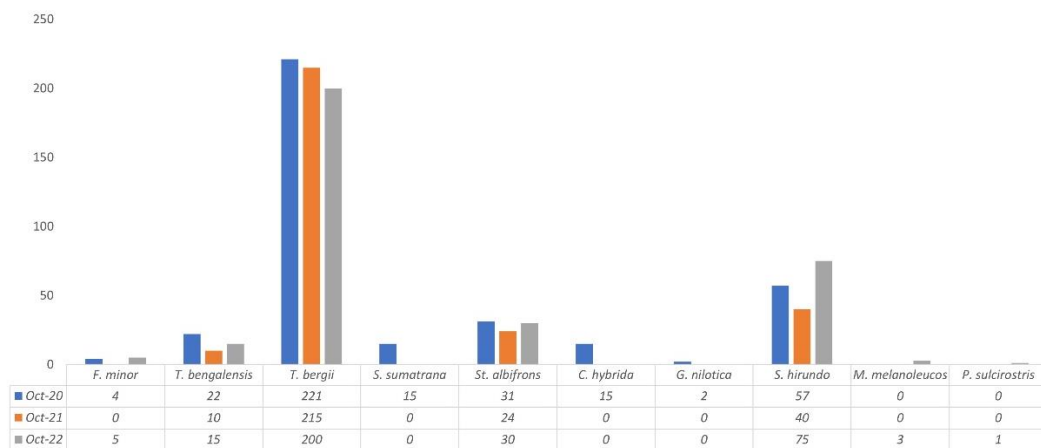


Fig. 3. Total individuals of seabird species in Pangpang Bay

Based on the IUCN Redlist, all the seabird species found in Pangpang Bay are included in the least concern category. However, there are three species, (*S. albifrons*, *G. nilotica*, and *F. minor*) which have a declining population trend (Birdlife International, 2019a; Birdlife International, 2019b; Birdlife International, 2020), whereas three species (*C. hybrida*, *T. bengalensis*, and *T. bergii*) are stable, and four species (*S. sumatrana*, *S. hirundo*, *M. melanoleucos*, *P. sulcirostris*) are unknown for population trend. Furthermore, based on the national regulation by The Ministry of Environment and Forestry number P.106 2018, there are eight protected species (*F. minor*, *S. sumatrana*, *S. hirundo*, *St. albifrons*, *G. nilotica*, *C. hybrida*, *T. bengalensis*, and *T. Bergii*), whereas two other species (*M. melanoleucos* and *P. sulcirostris*) have not been protected. The determination of this protected status is based on consideration of population and threats level conditions that exist in Indonesia. So that the eight protected species (*F. minor*, *S. sumatrana*, *S. hirundo*, *St. albifrons*, *G. nilotica*, *C. hybrida*, *T. bengalensis*, and *T. Bergii*) in the Pangpang Bay need particular attention, especially from potential fishing activities by fishermen. Zainudin *et al.*, (2017) revealed that several seabird species are included in one of the fishing lists of fishermen in Indonesia. Based on this, it is possible to reduce

seabird's population in the future. Although during the survey in Pangpang Bay this fishing activity has never been recorded.

Species *T. bergii* has the highest number of individuals in the Pangpang Bay during the survey periods (200-221 individuals) (Fig. 3). This causes *T. bergii* to have a group behavior (large or small) for foraging in its migratory activities (MacKinnon *et al.*, 2010). In addition, this grouping behavior is a strategy for migratory birds to minimize the threat of predators (Schreiber and Burger, 2002). In the western part of Java Island, Tirtaningtyas and Yordan (2017) stated that *T. bergii* is commonly found in Jakarta Bay with the most individual encounters in September 2011 of 27 individuals. This species has food preferences like fish in coastal areas such as seas, beaches, peninsulas, and bays (Tambunan *et al.*, 2016). Weller (2007) revealed that this species can dive to a depth of 0.8 m to prey on fish. This information also indicates the abundance of prey in the form of fish in the Pangpang Bay area. On the other hand, there are four species that have a relatively low number of individuals (<10 individuals), i.e *F. minor*, *P. sulcirostris*, *M. melanoleucos*, and *G. nilotica*. Only 4-5 individuals of *F. minor* were found perched on sero. This species sometimes forages in small groups during its migration. This species also has the uniqueness of robbing prey in the form of fish from other birds such as booby, tropicbirds, and petrels (Arlott, 2018; Taufiqurrahman *et al.*, 2022).

The result of this survey is an important part of updating the distribution or stopover sites for the migration seabirds in Indonesia. Based on Taufiqurrahman et al (2022), approximately 58 species of seabirds were found in the Greater Sundas, and in this study, it was found that 10 species (17% in Greater Sundas) were found in Pangpang Bay as a stopover site along migration. This shows that Pangpang Bay is one of the essential ecosystems in East Java waters, especially as a stopover site for migratory seabirds in Indonesia. Seabirds are in the stopover sites for approximately seven days, a minimum of 1 day and a maximum of 31 days (Dias *et al.*, 2012). However, there are no scientific information regarding duration-time visit of each seabird species at Pangpang Bay, so further research is needed to uncover the above problems. In addition, the wetlands characteristics also affect the richness and abundance of seabirds resting at the stopover. The most important factor is the availability of food to meet the needs of these birds in preparation for continuing migration (Newton, 2008). Based on this, it shows that Pangpang Bay has habitat characteristics as a stopover site for seabirds. The availability of resources such as potential prey (fish) and resting places (sero) is suspected to provide suitable habitat for seabirds during migration periods in this wetland. Furthermore, this area must be managed and maintained in a sustainable manner, either by the government or the community around the area.

CONCLUSION

Pangpang Bay is one of the most important stopover sites for migrating seabirds, especially in the East Java part of EAAF. This is proved by the discovery of 10 seabird species during the three observation periods (October 2020, October 2021, and October 2022). Furthermore, five species were also found i.e lesser crested tern *T. bengalensis*, little tern *St. albifrons*, whiskered tern *C. hybrida*, little pied cormorant *M. melanoleucos*, and little black cormorant *P. sulcirostris* which are new records for the Blambangan Peninsula, with a comparison of exploration conducted at Alas Purwo National Park 20 years ago. So that this area needs to be managed properly by the government or contributions from the local communities.

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