Internationally Important Waterbird Sites in Manila Bay, Philippines

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Cover photograph:

Congregations of Black-headed Gull *Chroicocephalus ridibundus* at the Sasmuan Bangkung Malapad wetland in Pasac River, Pampanga province by Christian Perez.

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ACRONYMS

AFP	Armed Forces of the Philippines
AWC	Asian Waterfowl Census
BFAR	Bureau of Fisheries and Aquatic Resources
BMB	Biodiversity Management Bureau
DA	Department of Agriculture
DENR	Department of Environment and Natural Resources
DPWH	Department of Public Works and Highways
EAAF	East Asia- Australasia Flyway
ESSC	Environment Science for Social Change
IBA	Important Bird and Biodiversity Area (an area identified as being globally important for the conservation of bird populations)
IUCN NL	International Union for Conservation of Nature – National Committee of the Netherlands
KBA	Key Biodiversity Area (a site contributing significantly to the global persistence of biodiversity)
LPPCHEA	Las Piñas - Parañaque Critical Habitat and Ecotourism Area
NAMRIA	National mapping and Resource Information Authority
NEDA	National Economic Development Authority
NCR	National Capital Region
NGO	Non-Government Organization
PRA	Philippine Reclamation Authority
TEEB	The Economics of Ecosystems and Biodiversity
UNEP	United Nations Environment Program
WBCP	Wild Bird Club of the Philippines

SUMMARY

Information about the presence and status of migratory waterbirds and their habitats in Manila Bay, Philippines are lacking. This study presents the results of the species, numbers and distribution of migratory waterbirds as well as the status of their wetland habitats of international importance for conservation. Intertidal wetlands, such as those located in Manila Bay provide many ecosystem services but they are not well known in the Philippines. These ecosystems and migratory waterbirds, among other lifeforms, are increasingly under threat from socio-economic activities that result to their poor status.

In Manila Bay, intertidal foreshore and riverine wetlands are found both along the coastline and further inland from the Province of Bataan to Cavite Province. These wetlands are important to waterbirds and the human communities living in the coastal zone. In midwinter from 171,500 to around 208,500 waterbirds of 90 species occur in Manila Bay. About 75% of the species are migratory. They include species threatened with global extinction and that feed on the fish and invertebrates occurring in shallower areas of the Bay including intertidal mudflats. Sixteen migratory species especially feeds and roost in large internationally important concentrations in just nine geographically locations of the Bay. They represent a very high percentage of their flyway populations, for some species up to about 27%, and as such their presence are internationally important for conservation.

Both habitats and birds are threatened over the years by aquaculture expansion, water pollution and coastal development (reclamation, airports, ports, roads, etc.). Global sea-level rise attributed to climate change is recognized, but flooding from anthropogenic land subsidence is largely ignored around Manila Bay. Together with unsustainable coastal development, land subsidence and sea-level raise may substantially reduce important wetland areas with mudflats, sandbars and shell banks important especially for migratory shorebird species.

The trend in waterbird population development over a period of 15 years since 2003 in three sampling sites in northern Manila Bay and two sites within Metro Manila were analyzed. The overall trend showed a total increase by more than 80%, from around 34,100 to 61,600 waterbirds measured as the average difference in five-year intervals. The increasing population is found in the northern portion of the Bay while the wetlands in the Manila area are suffering substantial population declines; in the LPPCHEA Ramsar site as much as 90%.

There are different population trends of the different waterbird species. Analysis of 18 internationally important species populations, shows declining populations of at least 11 species, or about 60%. Of these are two egret species, one tern species and eight shorebird species depending on the declining mudflat areas in the Bay. While no populations are stable, six other species populations are increasing; they largely represents more opportunistic wetland species that also can utilize the expanding fishpond habitats at Manila Bay.

A bilateral project, the Manila Bay Sustainable Development Master Plan, between the Governments of the Philippines and Netherlands is on-going as a response to improve the status

of Manila Bay. The results of this study can be a significant contribution to the knowledge base on ecosystems and biodiversity, climate change adaptation and disaster risk reduction, inclusive growth, and other themes to achieve the goal of the continuing mandamus of the Supreme Court on Manila Bay as well as contributing to the achievement of Aichi targets of the Convention on Biological Diversity and in implementing strategies of both the Convention on Wetlands of International Importance (Ramsar Convention) and the Convention on the Conservation of Migratory Species of Wild Animals.

1. Background

Manila Bay in the Philippines covers more than 1,900 square kilometers and has a coastline of around 196 kilometers from Cavite City to Mariveles in Bataan province. It is a large semi-enclosed bay located in the West Philippine Sea and fringed by shallow intertidal areas with relicts of mud and sandflats, mangroves, and nipa swamps. However, nearly all of the original habitats have been converted to aquaculture; these include the intertidal mudflats, swamps and mangrove areas in Bataan, Pampanga, Bulacan and Cavite provinces, and increasingly also the foreshore and riverine areas in the northernmost part of the Bay (UNEP-TEEB 2017).

Northern Manila Bay is declared as an Important Bird and Biodiversity Area (IBA No. PH010) by Birdlife International covering and area of 130,465 ha with the following coordinates: 14^{o} 40' 0" North, 120o 46' 0" East (Haribon Foundation and BirdLife International 2001, BirdLife International 2017a). The wetland part of the Bay from northern Metro Manila to Bataan has a status of Key Biodiversity Area (KBA No. 25) accorded by the Department of Environment and Natural Resources (DENR) covering 96,338 ha (Conservation International 2006, IUCN 2014).

Manila Bay is very important for its fisheries production which supports a large urban population along the periphery of the Bay. There are high concentrations of different fish trapping devices and extensive areas with fishpens within the open sea area, as well as aquaculture land-uses along the shorelines (Mialhe *et al.* 2015, BirdLife International 2017a).

A very large numbers of migratory shorebirds are dependent on the intertidal areas and fishponds in Manila Bay during the ten-month bird migration season from August to May. The Bay area has consistently hosted some of the highest numbers of migratory waterbird species during the Asian Waterfowl Census (AWC) in the Philippines (Li *et al.* 2009, Mundkur *et al.* 2017, BirdLife International 2017a).

There are increasing threats to the habitats including a continued conversion of foreshore tidal areas and remaining patches of mangroves to aquaculture, sea level rise, canalizing and dredging of rivers, and pollution in the form of solid waste, domestic sewerage and industrial waste water *etc*. (Mialhe *et al.* 2015).

Recently, a private-public-partnership covering an area of about 18,000 ha from Navotas in Metro Manila to Bataan Province in the northern most portion of Manila Bay is being assessed for implementation by the Department of Public Works and Highways (DPWH 2016, PPP Center 2016). The project is called the Manila Bay Integrated Flood Control and Coastal Defense and Expressway Project, and it intends to reclaim coastal areas from Navotas City in Metro Manila to Bataan Province. It includes a design for the establishment of five artificial islands within the main habitats of commercial important fish species and partially within internationally important congregation areas for migratory waterbirds (Daily Economic 2014, Mooyart *et al.* 2015, DA-BFAR 2015b, and this study). In addition, there are several proposed land reclamation projects foreshore of Metro Manila and Cavite (UNEP-TEEB 2017), and a private sector proposal has in

principle been approved by the National Economic Development Authority (NEDA) to establish a new international airport in the largest intact coastal wetland located in Bulacan Province (PPP Center 2018).

2. Introduction

Wetland ecosystems support a variety of biodiversity and both waterbirds and human populations depend on their status. Waterbirds represent one of the most visible indicators of the health and the diversity of the wetland ecosystems. As the overall poor status of the environment is well known (DENR-ERDB 2000), the status of the waterbirds and key habitats of international importance were not. Therefore, a series of rapid surveys were conducted in Manila Bay in April 2016 (coastal waters) and from November 2016 to March 2017 and, in additional areas, from January to April 2018 (shoreline wetlands).

The surveys mapped the status of remaining habitats of crucial importance for waterbirds, especially migratory waterbirds congregating in numbers of international importance following criteria defined by the Convention for Wetlands of International Importance (Ramsar Secretariat 2017). The surveys were initiated by Wetlands International and IUCN Nl and with the assistance by volunteers of the Wild Bird Club of the Philippines (WBCP) to counter the proposals to reclamation found in the Philippine Reclamation Authority's (PRA) National Reclamation Plan (Philippine Reclamation Authority, Resolution 4161 dated February 25, 2011). PRA originally called for reclamation of 26,234 ha of Manila Bay, or 70% of the target reclamation projects within the Philippines.

3. Methods

Waterbirds: Waterbirds, mainly migratory species, was the focus of the research work. Waterbirds are species of birds that are ecologically dependent on wetlands and the ecosystems they represent for their entire life cycle.

Bird species were identified using hand-held binoculars and spotting-scopes with magnification from 20 to 40 x in combination with the use of photography. A drone was used once as an experiment to assess its applicability for identifying and counting waterbirds at a distance in the often very inaccessible areas of the Manila Bay wetlands.

The results of the waterbird counts derived from 10 boat-based surveys, two aerial surveys and a number of supplementary land-based visits to coastal localities in Manila Bay were added to the information found in the AWC and WBCP databases (Mundkur *et al.* 2017, DENR-BMB 2003-2018 and WBCP 2003-2016). Timing of the survey periods was aligned to the mid-winter period where the international waterbird census organized by Wetlands International also takes place in January.

Data analysis aimed at a) defining areas where waterbirds congregate in numbers of international importance and b) to identify what waterbird species and in what numbers they occur in Manila Bay guided by criteria defined under the Ramsar Convention on Wetlands of International Importance (Ramsar Secretariat 2017).

The results are based on data from 43 different localities along the coastline of Manila Bay from Bataan Province to Cavite Province (Annex 1). Avifauna population results and trends presented in this report represents both the peak and average counts per locality.

Analysis of the avifauna data is limited to those waterbird species occurring in Manila Bay during the winter months (November to March) in numbers representing 1% or more of the flyway populations as an indicator of their presence in a wetland of international importance for migratory waterbirds (Ramsar 2017).

Habitats: Based on the analysis of recent satellite images (Google Earth 2016) mudflats along the shoreline and rivers, and fishpond mudflats located up to an average of 2.5 km inland were located from Limay Municipality, Bataan (14°35'18.89"N, 120°35'13.07"E) to mudflats of Cavite City (14°27'40.60"N, 120°53'7.62"E). These pre-determined localities became the focus of field surveys carried out from a boat and a helicopter and by additional land-based surveys at some sites accessible by vehicle.

Ten boat-based surveys were carried out covering the coastline of Bataan Province from Balanga City to Sasmuan Municipality, Pampanga, and the entire coastline of Bulacan Province from Pampanga River to Meycauyan River and Bacoor Bay, Cavite. The boat surveys were carried out on 2 and 9 April 2016 and on 4 and 18 February and on 17 March 2017. Supplementary boat-based surveys, mainly in Cavite and Bulacan Provinces were carried out from January to March 2018. Aerial surveys using helicopter covered the coastline and inland fishponds from Limay in Bataan to Pamarawan River in Bulacan. They were carried out on 30 November and 1 December 2016.

The presence of mudflats and additional information on the extent of other habitats and conversion of these were noted throughout the surveys. Using Google Earth images from 2016 the extent of mudflats, mangroves, fishpond areas (former mangroves and nipa swamps) and foreshore areas within the 2-meter depth of the Bay were plotted and the area coverage per habitat was calculated.

4. Limitations

The different waterbird species and populations do not occur at the same time in Manila Bay. Hence, the number of birds analyzed and presented in the report does not reflect the temporary roosting numbers by trans-migrant populations occurring early or late in the migratory season (August to October and April to May). Further, the tidal scheme forces egrets and herons, but in

particular shorebirds, to shift between feeding at mudflats at low tide and roosting at higher ground during high tide. In addition, as all larger mudflats have been converted, the waterbirds tend to occur in relatively small congregations scattered over wide and sometimes nearly inaccessible areas. Hence, considering the scarcity of skilled human resources and the logistical limitations, it is not currently possible to make a count of waterbirds covering the wide areas of the Bay's wetlands within a short period of time such as the AWC period covering a few weeks in January. Within these limitations, the report presents the best estimates of waterbird populations and their distributions in the Bay.

Detailed bird species identification from a helicopter had its limitations due to speed and vibrations of the aircraft while on air. However, the approach was meant as a tool to gain access to otherwise unreachable areas and to obtain new data on major bird congregation areas. As such the use of helicopter served the purpose well. Results from the aerial surveys were limited to identification of sites with large congregations of waterbirds, and to estimating their numbers. Species identification, except for a few species (Grey Heron *Ardea cinerea*, Black-crowned Night Heron *Nycticorax nycticora,* Black-winged Stilt *Himantopus himantopus* and Black-headed Gull *Chroicocephalus ridibundus*), were limited to the level of family groups such as white egrets (*Egretta* species) and terns (*Sternidae* species, mainly Whiskered Tern *Chlidonias hybrida*). For shorebird species, these could be identified as larger species such as Black-winged Stilt and Pacific Golden Plover *Pluvialis fulva*, medium-sized species such as sandplovers (*Charadrius* species) and smaller shorebirds such as sandpipers (*Calidris* species).

Egrets, shorebirds and terns were found to be utilizing large areas with scattered, drained fishponds further inland but outside of the primary research area, particularly in Bulacan and Pampanga. Hence, a calculation of the waterbird populations present in the wider Manila Bay wetland habitats will require the use of extrapolation methods not used in this study.

5. Results

This study focused mainly on wetland areas hosting waterbirds up to an average of 2 km landwards and 2.5 km seawards; approximately 38,000 ha or about 46% of the Bay's wetlands within 2 m water depth. For distribution of the wetland habitats, see Figure 2.

5.1 Waterbirds

5.1.1 Waterbirds in Manila Bay

Waterbirds are a diverse group of over 30 families which are characteristic of, and ecologically dependent on wetland habitats. In Manila Bay they are presented by families of Grebes (Podicipedidae), Cormorants (Phalacrocoracidae), Bitterns, Egrets and Herons (Ardeidae), Ducks (Anatidae), Rails, Gallinules and Coots (Rallidae) and by shorebirds in form of Painted Snipes (Rostratulidae), Stilts and Avocets (Recurvirostridae), Pranticoles (Glareolidae), Plovers (Charadriidae), and Sandpipers, Snipes and Phalaropes (Scolopacidae). In addition there are Gulls (Laridae) and Terns (Sternidae).

Every year about 50 million migratory waterbirds migrate from southern non-breeding areas in Southeast Asia and Australasia, to northern breeding grounds, mostly in Russia, but also in China, Mongolia, Japan, Korea and Alaska. The sum of these migration routes though 22 countries, including the Philippines, is defined as the East Asian - Australasian Flyway (EAAF) (Cocklin *et al.* 2014).

Manila Bay is part of the migratory waterbirds EAAF. It serves both as a feeding and roosting area for thousands of overwintering waterbirds breeding *e.g.* in northern Russia and China and residing in the Bay from August to April, or nine months per year. In addition, a high but unknown number of transmigrant waterbirds pass Manila Bay, mainly in April and in September/October, from and to areas further south in the Philippines and countries such as Indonesia and Australia (BirdLife International 2018).

Despite massive overfishing beyond ecological caring capacities and pollution from untreated sewage water high in toxic components (UNEP- TEEB 2017), Manila Bay consistently has some of the highest numbers of waterbirds counted during the Asian Waterfowl Census (AWC) in the Philippines (Li *et al.* 2009, Mundkur *et al.* 2017). Among the waterbirds, a high number of species are fully dependent on mudflats and sandbars associated with the foreshore and riverine intertidal system. Of these, no less than 32 out of 40 shorebird species occurring in Manila Bay, are dependent on the presence of mudflats for their life cycle. The figures include nine globally threatened or near threatened shorebird species (Table 1).

Table 1. Globally threatened and Near Threatened waterbird species occurring regularly in Manila Bay. *Source*: IUCN 2017.

Species	Endangered	Vulnerable	Near Threatened
IUCN Red List of Threatened Species			
Philippine Duck *Anas luzonica*		**x**	
Chinese Egret *Egretta eulophotes*	**x**		
Asian Dowitcher *Limnodromus semipalmatus*			**x**
Black-tailed Godwit *Limosa limosa*			**x**
Bar-tailed Godwit *Limosa lapponica*			**x**
Eurasian Curlew *Numenius arquata*			**x**
Far Eastern Curlew *Numenius madagascariensis*	**x**		
Great Knot *Calidris tenuirostris*	**x**		
Red Knot *Calidris canutus*			**x**
Red-necked Stint *Calidris ruficollis*			**x**
Curlew Sandpiper *Calidris ferruginea*			**x**
Total	**3**	**1**	**7**

Plate 1. Flock of Kentish Plover *Charadrius alexandrinus* and Red-necked Stint *Calidris ruficollis* at lowtide in coastal Bulacan, February 2018. Photo: Irene Dy.

At least 90 species, or about 60%, of all waterbirds found in the Philippines occur in Manila Bay (Annex 2). In addition there are historical records of Black-faced Spoonbill *Platalea minor* and of Spot-billed Pelican *Pelecanus philippensis*; the latter now extinct in the Philippines but used to occur in Bulacan. Further, there are records of two accidentally occurring species: Vega Gull *Larus vegae* and Chinese Crested Tern *Thalasseus bernsteini* (Kennedy *et al.* 2000).

Of the waterbird species recorded in Manila Bay, 26 are resident species (28.9%), 56 species are migratory (62.2%), and eight species occur with both resident and migratory populations (8.9.%) (Table 2). Using the results of the aerial survey by helicopter in November and December 2016, the percentage breakdown of the number of waterbirds per family group is: 33.3% for Egrets and Herons, 30.3% for Shorebirds, 33.5% for Terns and 2.9% for Gulls.

Table 2. Number of resident and migratory waterbird species occurring in Manila Bay.
Source: DENR-BMB 2003-2018, WBCP 2003-2016.

Species	Resident	Migratory	Resident and Migratory	Total
Ducks	2	3	0	5
Grebes	1	0	0	1
Bittern, Egrets and Herons	8	4	4	16
Cormorants	0	1	0	1
Crakes, Rails and Coots	10	1	1	12
Shorebirds (waders)	2	37	2	41
Gulls	0	5	0	5
Terns	3	5	1	9
Total	**26**	**56**	**8**	**90**

Eleven of the species are classified by the International Union for Conservation of Nature (IUCN) as globally threatened or near threatened with the risk of extinction (Table 1). Four of these species are further listed under the Convention for Migratory Species (CMS) as Endangered Migratory Species. The Convention also lists 24 waterbird species occurring in Manila Bay as Species in Need of International Conservation Agreements (Annex 3).

5.1.2 Distribution of waterbirds

The waterbirds' life cycles are dependent on different wetland habitats for feeding, roosting and breeding purposes (Kennedy *et al.*2000). The species diversity and distribution of water birds mirrors the wetland habitat's food resources, and the extent and quality of these habitats (Choi *et al* 2016). The use of the habitats shifts during day and night and with the low and high tides. For a general overview of habitat associations of waterbirds, see Table 3.

The main distribution of waterbirds of international importance in Manila Bay is presented in Figure 1. Most are found in Pampanga (46.4%), Bulacan (25.0%) and Bataan (17.1%). Combined, NCR (Metro Manila) and Cavite only host around 11.5% of the migratory waterbirds.

Table 3. Main habitat preferences by migratory waterbirds in Manila Bay.

Family	Foreshore areas	Mudflats (coastlines and dry fishponds)	Fishponds	Mangroves
Egrets and Herons		✓	✓	✓
Larger shorebirds		✓		
Smaller/ medium-sized shorebirds		✓	✓	
Gulls	✓			
Terns	✓		✓	

Shorebirds and terns are highly mobile and they utilize large areas further inland, such as inland fishponds in Bulacan and Pampanga, which were not areas included in this study. Generating in-depth understanding of the distribution of waterbirds in the fishponds in the inland wetlands of Manila Bay will require the application of extrapolation methods not applied in this study. The size of the former wetlands and the numerous waterbird species, such as egrets and herons in man-made mudflats, make it challenging (Plate 1 and Plate 2).

Gulls and terns are mainly dependent on the shallower areas of the Bay with water depth of one to two meters. However, they also occur at deeper waters as well as in the larger river systems. Terns, especially Whiskered Terns, *Chlidonias hybrida,* feed in very large numbers across both coastal and inland fishponds.

The foreshore and riverine intertidal mudflats as well as mudflats in dried fishponds and saltpans, attracts a large number of shorebird species and populations. They use these areas, both as a primary feeding habitat and as high tide roosting areas where these are located above the maximum high tide zone. Mangroves serves as roost habitat for migratory species of egrets and herons as well as feeding and breeding sites for resident species of herons, bitterns, rails and crakes.

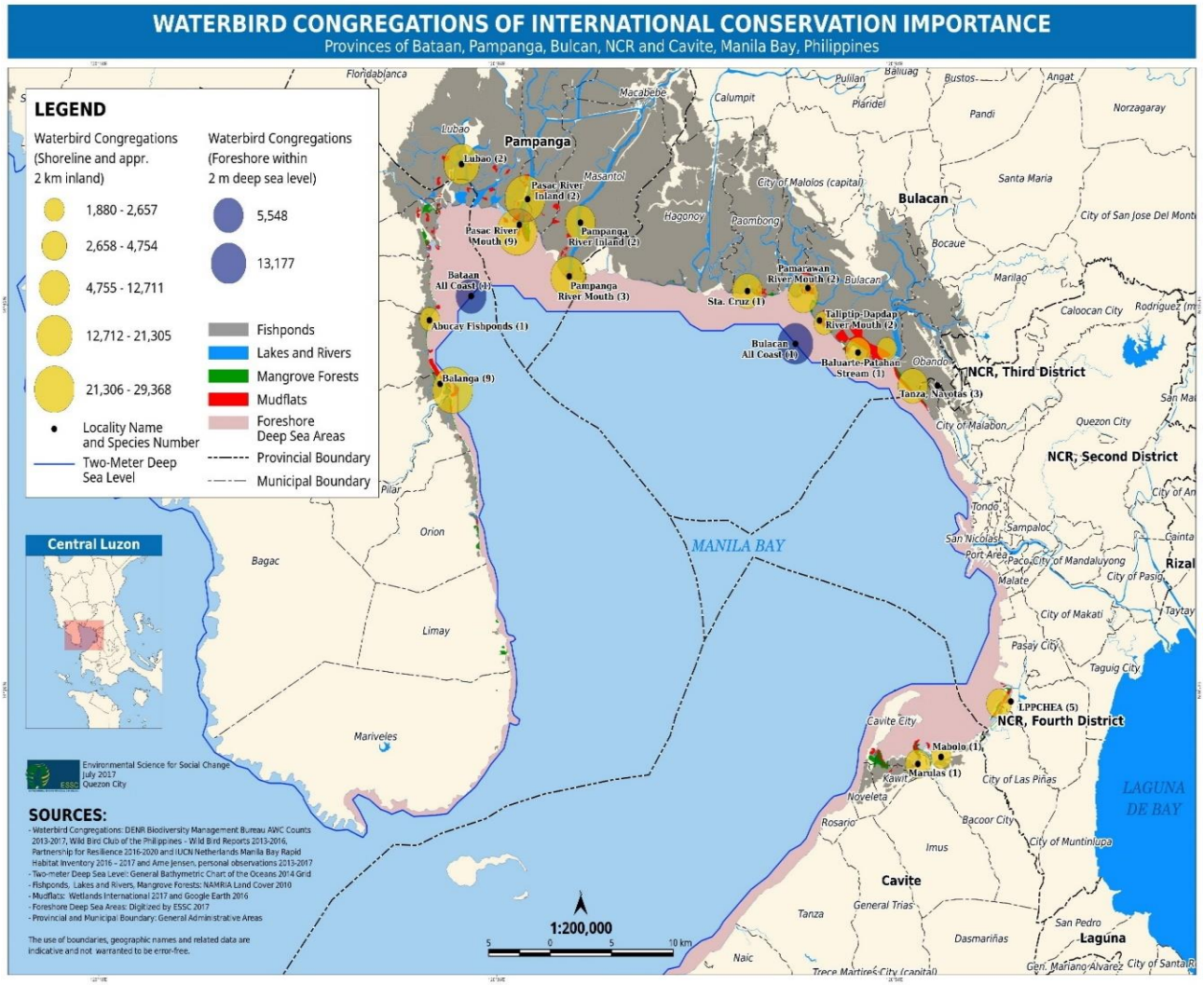

Figure 1. Distribution of waterbirds in numbers of international importance in Manila Bay.

Saltmarshes are now few and those that are left are very small in size. Hence, this habitat no longer plays an important role for either resident or migratory waterbirds. However, the now overgrown saltmarsh found in the northern portion of Freedom Island, LPPCHEA, previously functioned as an important high tide roost for migratory shorebirds roosting and feeding in the Ramsar Site.

No research has been conducted on the avifauna composition and distribution in the remnants of brackish water swamps, mainly located inland of the Pampanga fishpond areas. Following known habitat preferences, it can be assumed that the majority of the waterbird species in this habitat are resident species (Kennedy *et al*. 2000).

Plate 2. A typical feeding congregation of Great Egret *Ardea alba*, Intermediate Egret *Ardea intermedia* and Little Egret *Egretta garzetta* in a drained fishpond. Malolos municipality, February 2018. Photo: Irene Dy.

5.1.3 Population size

A minimum of around 171,500 and a maximum of around 208,500 individual waterbirds are present in the coastal zone of Manila Bay from December to early April (Table 4 and Annex 4). These figures are based on the average and the peak count results of rapid inventories mainly conducted from November 2016 to March 2017 and in supplementary sites from January 2018 to April 2018, and data from the AWC counts in January 2017 and 2018. The number of birds represents 43 coastal localities up to an average of about 2 km inland and the foreshore coastline within the two meter water levels at neap tide from Limay, Bataan to Cavite City. Boat transects in the coastal waters 2-2.5km from the coast aimed at count and estimates of gull and tern species feeding in deeper waters.

Table 4. Minimum number of waterbirds based on peak count data from 2016 to 2018 compared to average count values 2016 to 2018. *Source:* DENR BMB AWC Counts 2016-2017, WBCP – Wild Bird Reports 2014-2016, and Wetlands International and IUCN NL Manila Bay Rapid Inventory 2016 – 2018.

Province/ Region	Number of birds along shoreline and average up 2.5 km inland	Number of birds in foreshore areas up to 2 meter water depth		Number of birds along shoreline and average up 2.5 km inland	Number of birds in foreshore areas up to 2 meter water depth	
	Peak counts 2016-2018		Total	Average of counts 2016 - 2018		Total
Bataan	32,471	5,548	38,019	21,972	5,548	27,520
Pampanga	99,009	500	99,809	76,323	500	76,823
Bulacan	33,982	13,177	47,159	33,982	13,177	47,159
NCR	13,385	1,000	14,385	9,795	1,000	10,795
Cavite	7,998	1,500	9,498	7,764	1,500	9,264
Total	186,845	21,725	**208,570**	150,136	21,725	**171,561**

Plate 3. Congregations of Black-winged Stilt *Himantopus himantopus* at coastal fishponds near Balanga, Bataan, November 2016. Photo: Ivan Sarenas.

Plate 4. When hightide approaches, murmurations of large flocks of shorebirds can fill the sky over the largest intact coastal wetlands in Bulacan, February 2018. Photo: Irene Dy.

Plate 5. Flocks of Black-winged Stilts *Himantopus himantopus* and Whiskered Terns *Chlidonias hybrida* feeding in a drained fishpond in Obando, Bulacan Municipality, February 2018. Photo: Irene Dy.

5.1.4 Waterbird species and populations of international conservation importance

The Ramsar Convention's criteria for determining wetlands of international importance falls under two main criteria: Sites containing representative, rare or unique wetland types; and sites of international importance for conserving biological diversity. Other Ramsar Convention Criteria relevant to waterbirds are found in Table 5.

Table 5. Ramsar Convention criteria especially relevant for waterbirds and the habitats they are dependent on. *Source:* Ramsar Secretariat (2017).

Criteria	Definition
Criterion 2	A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities
Criterion 4	A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions
Criterion 5	A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.
Criterion 6	A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Depending on the geographical extent of a waterbird habitat in Manila Bay, there are six sites fulfilling Ramsar Criterion 5 of supporting 20,000 or more waterbirds and Criterion 6 supporting at least one percent of a population of one species (Table 6 and Annex 5). Combined, the six sites represent internationally important congregations of about 145,240, or from 70% to 85%, of the waterbirds occurring in Manila Bay from December to April.

The Convention on Migratory Species (CMS) lists several waterbirds species in Appendix I. This calls for strict protection of the species by: 'prohibiting the taking of such species, with very restricted scope for exceptions; conserving and where appropriate restoring their habitats; preventing, removing or mitigating obstacles to their migration and controlling other factors that might endanger them.' Other waterbird species are listed in Appendix II, which calls for international cooperation for the protection of species with unfavorable conservation status. Included in the CMS list are 28 waterbird species found in Manila Bay (Annex 3).

Table 6. Sites in Manila Bay that supports 20,000 or more waterbirds and/or a number of species congregating in numbers of international importance, and additional sites that support waterbirds in numbers of international importance based on presence of threatened species.

Internationally Important Waterbird Sites	Hectares	Number of waterbirds	Number of species > 1% of Flyway Population	Coordinates
BATAAN **Balanga City – Pilar Wetlands:** Barangay Sibacan, Puerto Rivas, Tortugas and Balut, and Pilar	700	Peak: 29,368 Average: 19,869	11	14°41'36.39"N, 120°33'42.92"E
PAMPANGA **Pasac River :** Sasmuan, Barangay Batang 2nd and adjacent tidal mudflats	535	Peak: 28,923 Average: 17,741	9	14°48'5.72"N, 120°36'56.67"E
Lubao Fishponds: Almacen-Baruya-Sta Teresa Bangcal Pugad	 281 312	23,700	5	 14°51'51.15"N, 120°34'33.58"E 14°50'16.69"N, 120°35'50.27"E
Pampanga River: 0 to 5.5km Westbank - Malauli, Consuelo Eastbank -Sapang Kawayan and San Roque (Hagonoy)	2080	40,235	2	From: 14°49'7.05"N, 120°39'50.14"E To: 14°46'7.34"N, 120°39'3.50"E
BULACAN **Paombong-Malolos wetlands:** Masukol, Santa Cruz, Pamarawan, Caliligawan and tidal mudflats	1870	22,767	4	From: 14°45'27.96"N, 120°46'42.94"E To: 14°45'25.10"N, 120°50'7.55"E
Bagumbayan -Bulakan wetlands: Bagumbayan, Bambang and Taliptip	2480	20,928	2	From: 14°45'3.58"N, 120°50'8.71"E To: 14°42'26.99"N, 120°53'16.30"E
Total	**8,258**	**> 145,240**	**16**	

National Important Waterbird Sites	Hectares	Number of waterbirds	Number of threatened species	Coordinates
NCR **Tanza Peninsula:** Navotas and Obando	986	Average: 6,985	8	14°41'33.74"N, 120°54'58.06"E
LPPCHEA: Las Pinas, Paranaque	397	Average: 2,810	7	14°29'32.99"N, 120°58'48.21"E
CAVITE **Imus River Mouth** : Binakayan	150	2,247	2	14°27'45.66"N, 120°54'52.59"E
Cavite City mudflats	32	3,800	1	14°27'49.24"N, 120°53'21.36"E
Bacoor Wetlands: Kawit	258	5,900	3	14°27'5.36"N, 120°53'28.74"E
Total	**1.823**	**21,742**	**9**	

Manila Bay represents some of the highest waterbird population concentrations within the Philippines. Sixteen (16) species occur in population numbers of international conservation importance, defined as of 1% or more of the East Asian - Australasian Flyway population, can be found there (Wetlands International 2017). Of the species identified, one is a duck species, three are egrets, and 10 are shorebird species. One gull and one tern species also congregate in internationally important numbers (Table 7).

Table 7. Waterbird species of international flyway importance in Manila Bay: Total estimated numbers, the percentage of the flyway population and the average percentage of the national population counted during AWC midwinter counts.

Species	Total estimated numbers in Manila Bay 2017-2018	% of Flyway Population	% of average national AWC counts 2016 and 2017
Philippine Duck *Anas luzonica*	625	8.9	3.4
Great Egret *Ardea alba*	4,664	4.7	33.0
Intermediate Egret *Egretta intermedia*	363	1.5	0.1
Chinese Egret *Egretta eulophotes*	35	1.0	5.3
Black-winged Stilt *Himantopus himantopus*	6,854	6.9	31.2
Pacific Golden Plover *Pluvialis fulva*	19,164	19.2	85.1
Little Ringed Plover *Charadrius dubius*	280	1.2	7.1
Kentish Plover *Charadrius alexandrinus*	5,246	5.3	49.9
Lesser Sand Plover *Charadrius mongolus*	831	3.2	17.9

Greater Sand Plover *Charadrius leschenaultii*	>769	1.0	34.3
Redshank *Tringa totanus*	1,629	1.6	34.2
Greenshank *Tringa nebularia*	1,850	1.9	38.3
Long-toed Stint *Calidris subminuta*	553	2.2	91.9
Red-necked Stint *Calidris ruficollis*	4,741	1.5	46.3
Black-headed Gull *Chroicocephalus ridibundus*	27,779	1.4	86.8
Whiskered Tern *Chlidonias hybrida*	53,647	26.8	73.9
Total	**129,030**		

The number of congregations in one or more percentages of the flyway populations of the 16 species listed in Table 7 represent about 75% of the average waterbird count values from 2016 to 2018 (Table 4). Some species occur in extraordinarily high flyway population numbers underscoring the international importance and thereby the need to conserve habitats for waterbirds in Manila Bay. These include more than 53,000 Whiskered Terns *Chlidonias hybrida* (26.8%), 19,000 Pacific Golden Plovers *Pluvialis fulva* (19.2%), 6,800 Black-winged Stilts *Himantopus himantopus* (6.9%) and 5,200 Kentish Plovers *Charadrius alexandrinus* (5.3%). Other species populations may be undervalued, particularly Great Egret *Ardea alba*, Intermediate Egret *Ardea intermedia*, and Little Egret *Egretta garzetta*. If the ratio of identified species and numbers are used for unidentified white egret species counted during aerial surveys, the flyway population of the Great Egret overwintering in Manila Bay would increase to 18,100 individuals or 18.1% of the flyway population and the Little Egret population would be above the one percent threshold of 10,000 individuals for this species.

Considering the average result of the national AWC counts of 2016 and 2017, Manila Bay hosts a very large portion of the overwintering water bird populations in the Philippines (Table 9). Of the 16 waterbird species occurring with more than one percent of the flyway population, 12 species occur with more than 30% of the overwintering Philippine populations in Manila Bay. It is particularly notable for Long-toed Stint *Calidris subminuta* (91.9%), Black-headed Gull *Chroicocephalus ridibundus* (86.8%), Pacific Golden Plover (85.1%), Whiskered Tern (73.9%), Kentish Plover (49.9%), and Red-necked Stint *Calidris ruficollis* (46.3%).

Some sites in Manila Bay host both internationally important congregations and number of waterbird species occurring with one or more percentages of the flyway population (Table 7 and Annex 5). These sites include the Balanga Wetlands in Bataan, inland portions of the Pampanga Delta in Lubao and Sasmuan Municipality and the coastal portions of Pasac and Pampanga River in Pampanga, and sections of intact coastal wetlands found in the municipalities of Malolos and Bulakan in Bulacan. Other sites host less than 20,000 waterbirds but have presence of a number of waterbird species above the flyway population threshold set under the Ramsar Convention. Of these, two remaining coastal wetlands in Metro Manila (NCR), LPPCHEA host five species and Tanza Peninsula in Navotas host three species. In Cavite, the Noveleta wetlands host two species and the mudflats at Imus River mouth one species in internationally important numbers (Annex 5).

Plate 6. Thousands of Great Egrets *Ardea alba*, Intermediate Egrets *Ardea intermedia* and Little Egrets *Egretta garzetta* overwinter in Bataan and in the Pampanga Delta, December 2016. Photo: Ivan Sarenas.

Plate 7. Congregations of more than 25,000 Black-headed Gulls *Chroicocephalus ridibundus* can be found in the coastal portion of Pampanga River. Photo: Christian Perez.

5.1.5 Globally threatened and Near Threatened waterbirds

Four out of seven globally threatened waterbird species occur in Manila Bay (Table 1). All records of these species and of Near Threatened species are found in Annex 6. A summary of the occurrence and distribution of the threatened species are presented below:

Philippine Duck *Anas luzonica* (Threat status: VULNERABLE). The species occur in Manila Bay in relatively high aggregations (8.9% of the global population). The complete conversion of its habitat in Bataan, Pampanga, and Bulacan, however, has resulted in irregular observations from just one site, the Pasac River mouth in Pampanga and in no observations from the coastal areas of these provinces. In the NCR, the only site where it is regularly found, although in small numbers, is at the LPPCHEA Ramsar Site where 123 birds were recorded in 2016. In Cavite, the remaining strongholds are fishponds in Bacoor-Noveleta and one area south of the Imus River mouth. About 75% of the Imus site is now about planted with dense mangrove stands as a results of tree planting projects. In LPPCHEA, the population is under threat from an increase in the number of visitors to the ponds where the species occur and from the permanent presence of stray dogs.

Chinese *Egret Egretta eulophotes* (Threat status: VULNERABLE). A stronghold was Tanza, Navotas with high numbers of 94 individuals or 2.7% of the flyway population present until 2014. Since then a substantial decline has occurred. The overall decline measured by counts in a five-year periods from 2014 to 2018 is 94%; or from 94 individuals to just five individuals by 2018. Another important area for this species is the coastal mudflat areas from Bambang to Taliptip in Bulacan (19 individuals in 2017) and Santa Cruz – Pamarawan, Bulacan (3 individuals 2017-2018). In six other localities only single individuals were observed. Compared to the average number of the national AWC counts of 2016-2017, 3.5% of the midwinter population in the Philippines is present in Manila Bay.

Far Eastern Curlew *Numenius madagascariensis* (Threat status: ENDANGERED). The sites where the species may occur regularly are Taliptip and Pamawaran, Bulacan, where a Philippine record high number of 68 individuals were observed in 2018. The only other site with a single record of the species is from Pasac River mouth in Pampanga (2005). Compared to the average number of the national AWC counts 2016-2017, 23.3% of the midwinter population in the Philippines can be present in Manila Bay.

Great Knot *Calidris tenuirostris* (Threat status: ENDANGERED). Manila Bay sites with a relatively high number include Talitip and Bagumbayan, Bulacan (450 in 2017 and 152 in 2018), Santa Cruz-Pamarawan, Bulacan (502 in 2018) and Pasac River mouth, Pampanga (114 in 2010). Compared to the average number of the national AWC counts 2016-2017, 29.9% of the midwinter population in the Philippines is present in Manila Bay.

Plate 8. More than 19% of the East Asian- Australasian Flyway population of Pacific Golden Plover *Pluvialis fulva* overwinters in Bulacan, especially around Taliptip in the Municipality of Bulakan. Photo: Irene Dy.

Plate 9. The rare Caspian Tern *Hydroprogne caspia* has its second Philippine main overwintering site in Manila Bay. Photo: Irene Dy.

Near Threatened Species

Asian Dowicher *Limnodromus semipalmatus*. There is one significant record of 103 individuals in 2018 roosting in a saltpan area in Santa Cruz, Bulacan. The only other record is of a single bird recorded in the Balanga Wetlands in 2007.

Black-tailed Godwit *Limosa limosa*. Insignificant, single-digit numbers were recorded from Tanza, Navotas, Pasac River, and Pampanga River, Pampanga and Santa Cruz and Talitip in Bulacan. The highest recorded number is six individuals in 2017 on Tanza Peninsula in Navotas/Obando.

Bar-tailed Godwit *Limosa lapponica*. Occurs in very low numbers regularly in Santa Cruz-Pamarawan, Bulacan (92 individuals in 2018) and in Taliptip-Bagumbayan, Bulacan (160 in 2018). Other localities include Pasac River mouth (32 individuals in 2005) and Balanga Wetlands (six individuals in 2015).

Eurasian Curlew *Numenius arquata*. Occurs only in relative high numbers in Santa Cruz-Pamarawan, Bulacan with 138 individuals counted in 2017. Fourteen individuals were found in Talitip, Bulacan in 2018 and in Pasac River mouth. Compared to the average number of the national AWC counts of 2016-2017, 16.1% of the midwinter population in the Philippines is present in Manila Bay.

Red Knot *Calidris canutus*. Found occasionally in some of the regular AWS sites. Tanza, Navotas had 95 individuals in 2005, Balanga Wetlands hosted 12 individuals in 2008, and 95 individuals were recorded from the Pasac River mouth in 2010. Taliptip, Bulacan had 85 birds in 2018. Compared to the average number of the national AWC counts of 2016-2017, 14,2% of the midwinter population in the Philippines is present in Manila Bay.

Curlew Sandpiper *Calidris ferruginea*. The species has disappeared from Tanza, Navotas where up to 157 individuals were observed in 2005. In the Balanga Wetlands the population has declined from 170 birds in 2003 to 13 individuals in 2015. A decline is also evident in Pasac River mouth, 68 birds were recorded in 2010 and just one bird was found in 2017. The only remaining stronghold for the species are the saltpan areas found in Malumot, Santa Cruz and Pamarawan, Bulacan, where 670 individuals were observed in 2018, and the wetland of Taliptip – Bagumbayan with 200 individuals in 2004 and 170 individuals in 2018). Compared to the average number of the national AWC counts of 2016-2017, 66.1% of the midwinter population in the Philippines is present in Manila Bay.

Red-necked Stint *Calidris ruficollis*. The only Near Threatened species occurring in Manila Bay with an aggregate high population of 4,741 individuals or around 1.5% of the flyway population. The number is the highest of all of the Philippine AWC sites. The species is recorded annually since 2003. However, substantially declining numbers were observed in many sites. In Tanza, Navotas from 299 individuals recorded in 2004 to 145 individuals in 2018. In the LPPCHEA Ramsar site, the 103 individuals found in 2007 were gone by 2018. In the Balanga Wetlands 2,390 birds were found in 2009 but none could be found in 2017 and 2018. In Pasac River mouth a similar decline has been observed, from 1,600 individuals in 2005 to no records in 2017. The only positive development in terms of population trends is in Malumot, Santa Cruz and Pamarawan, Bulacan where 424 birds were counted in 2017 while 3,254 were recorded in 2018. The latter count represents one percent of the flyway population. In Taliptip – Bagumbayan 256 birds were present in 2018. Compared to the average number of the national AWC counts 2016-2017, 46.3% of the midwinter population in the Philippines is present in Manila Bay.

Plate 10. The globally threatened Chinese Egret *Egretta eulophotes* occur only regularly at the coastal wetlands in Bulacan province and in Navotas, Metro Manila. Photo: Carlo Gomez.

5.1.6 Waterbird Population Trends

Fifty-five (55) % of the populations of the world's waterbird species are declining with 17% now declared as globally threatened (IUCN 2017). The most dramatic waterbird declines are occurring in Asia, with more than 50% of the waterbird species decreasing in numbers compared to only 15% with growing populations (Wetlands International 2012, BirdLife International 2017b). The loss of coastal wetlands in East and South East Asia is the single greatest threat to migratory waterbirds. Major loss of intertidal habitats since the 1980s and projected further loss, accounts together for a loss of about 75% of the coastal habitats. It will lead to a continued massive decline in the populations of many migratory waterbirds, especially the shorebirds (Conklin *et al.* 2014).

Following Conklin *et al.* 2014, the East Asian-Australasian Flyway has now more globally threatened waterbird species than any other of the world's flyways. More than 25% of the threatened and Near Threatened species in the flyway are species of shorebirds that are especially sensitive to habitat quality and habitat loss because they are top predators and their tendency to make long-distance migrations make them dependent on a limited number of key stop-over habitats such as Manila Bay.

There are no published results on the trends of waterbird populations in the Philippines. The population trends for Manila Bay presented in this study may be the first for the country but due

to a limited number of sites with monitoring data over time, it focuses only on species and populations occurring in five regular AWC sites and one other site in Manila Bay, frequently monitored by members of the WBCP: Balanga Wetlands in Bataan, Sasmuan Bangkung Malapad Critical Habitat and Ecotourism Area at the mouth of Pasac River and wetlands around the Pampanga River mouth, Pampanga and in Metro Manila (NCR), Tanza peninsula in Navotas/Obando, and the Ramsar Site Las Piñas – Parañaque Critical Habitat and Ecotourism Area (LPPCHEA). For details, see Annex 7.

Of 24 flyway waterbird species occurring in the Bay in numbers of international importance and of which 11 species are also globally threatened or near threatened, the flyway population trends of 21 of these species show substantial and continued population declines for 16 species, or 76% of these (Ducks 1, Egrets 2, and Shorebirds 13). There are at the flyway level stable populations for three species (Little Ringed Plover, Greenshank and Whiskered Tern). Only Black-winged Stilt has an increasing population (Cockling *et al.* 2014).

Overall trends

The trend in waterbird population development since 2003 in five annually monitored waterbird sites shows a total increase by more than 80%, from around 34,100 to 61,600 waterbirds measured as the average difference in five-year intervals over a period of 15 years. Waterbird populations in the wetland sites of Metro Manila are in decline, for the Ramsar site LPPCHEA with at least 37% and eventually as much as 90% percent, if data from the first year of counts in 2003 are compared to the last year of counts in 2018 (Table 8, Annex 7). In Northern Manila Bay, the populations are increasing. Especially two sites, the Balanga City Wetlands in Bataan and the lower portion of Pampanga River in Pampanga, both show significant increasing trends in the numbers of roosting and feeding waterbirds expressed as average values over 15 years (Pampanga River 9 years): An increase of 151% and 833%, respectively. The Bangkung Malapad at Pasac River mouth shows a more moderate increase of about 40%. However, across the five sites analyzed, there are different trends per families and species of the waterbirds, eventually associated with changes in their preferred habitats and availability of food sources.

Table 8. Population trends of waterbirds in Manila Bay AWC and WBCP monitored sites. Trends are expressed in percentages from first to last year of counts and as a comparison of first year counts versus end counts in 2018 (2017).

All Waterbirds	**Average Trends in %**	**Trends in % - counts per baseline year versus 2018 (2017)**
Balanga Wetlands	2003 - 2017	2003/2018
	+ 151	**+ 250**
Pasac River - Bangkung Malapad	2003 - 2017	2003/2017
	+ 41	**- 13**
Pampanga River	2009 - 2018	2009/2018
	+ 833	**+ 808**
Tanza, Navotas/Obando	2004 - 2018	2004/2008
	+ 1	**- 54**
Las Piñas–Parañaque (LPPCHEA)	2003 - 2018	2003/2018
	- 37	**- 90**

Trends of internationally important populations

Analysis of 18 international important species populations occurring regularly in one or all of the five annually monitored sites, shows declining populations of at least 11 species or about 60% in all or the majority of the sites (Table 9). Of these are two egret species, eight shorebird species and one tern species. Population increases are documented for five species: one egret species, four shorebird species and one gull species. Compared to the flyway populations trends as established by Conklin *et al.* 2014, negative trends in the flyway populations are also the case in Manila Bay for the populations of Intermediate Egret, Chinese Egret, Lesser Sand Plover, Greater Sand Plover, Great Knot, Red Knot, Curlew Sandpiper, Long-toed Stint and Red-necked Stint. For other species with declining flyway populations such as Pacific Golden Plover, the population trend in the Bay is increasing.

Table 9. Trends per species occurring with one or more percent of the flyway populations and trends for selected threatened or Near Threatened species occurring in five annually monitored sites since 2003. Negative trends are shown with red font color and positive trends with black font color. Blanks represent no trend values. DEC = Decline, INC = Increase, STA = Stable and UKN = Unknown populations. Source (EAAF trends): Conklin *et al.* 2014.

Species/Sites	Balanga	Pasac	Pampanga	Tanza	LPPCHEA	Trends, Manila Bay	Trends, EAAF
Egrets							
Great Egret	+ 68	- 82	+ 2900	- 71	+ 175	INC	UKN
Intermediate Egret	- 8	- 93	+ 200	- 85	- 33	DEC	DEC
Chinese Egret				- 92		DEC	DEC
Shorebirds							
Black-winged Stilt	+ 2340	+ 1112	+324	- 71	- 6	INC	INC
Pacific Golden Plover	- 55	+ 44	+ 2030	- 95	- 84	INC	DEC
Little Ringed Plover	- 81	- 100	- 20	- 100	- 70	DEC	STA
Kentish Plover	+ 61	+ 248	+ 48	- 61	- 72	STA?	STA
Lesser Sand Plover	- 67	- 63		- 91	- 60	DEC	DEC
Greater Sand Plover	- 22	+ 10		- 60		DEC	DEC
Redshank	+ 105	+ 36	+ 370	+ 440	- 75	INC	UKN
Greenshank	+ 113	+ 182	+ 650	+ 56	- 37	INC	STA
Great Knot		- 92				DEC	DEC
Red Knot	- 100	- 100		- 100		DEC	DEC
Curlew Sandpiper	- 93	- 96		- 100		DEC	DEC
Long-toed Stint	- 86		+ 2000	- 100	- 100	DEC	DEC
Red-necked Stint	+ 283	- 96		- 82	- 92	DEC	DEC
Gulls and Terns							
Black-headed Gull	+ 110	+ 3830	+ 3100	+ 250	- 67	INC	UKN
Whiskered Tern	- 22	- 35	+ 8300	- 51	- 32	DEC	STA

For populations with stable flyway populations, the trends for Kentish Plover has increased by 10%. Given possible variations in monitoring effort over time, however, the result may only indicate a stable population. For other stable flyway population such as those of Little Ringed Plover and Whiskered Tern, the populations of these are in decline while the population of Greenshank is increasing in the Bay. Great Egret, Redshank and Black-headed Gull for which the population trend in the flyway is unknown, their populations are in significant increase in Manila Bay. For the species occurring in international importance in the northern Manila Bay represented by the wetlands in Balanga and at Pampanga River, at these sites 10 and 13 species populations, respectively, are increasing compared to seven and one species population in decline. The reverse situation is the case for Pasac River, Tanza and LPPCHEA where more species are in decline compared to the number of increasing species populations (Table 10).

Table 10. Trends of 18 internationally important waterbird populations in annually monitored wetland sites of Manila Bay.

Sites/Trends	Increase	Decrease	Stable	Unknown	Overall Trend
Balanga Wetlands	10	7	0	0	Increase
Pasac River	7	9	0	0	Decrease
Pampanga River	13	1	0	2	Increase
Tanza Wetlands	3	15	0	0	Decrease
LPPCHEA	1	13	0	1	Decrease

Trends per families of waterbirds

Herons and Egrets (15 species, mainly Black-crowned Night Heron *Nycticorax nycticorax*, Eastern Cattle Egret *Bubulcus coromandus*, Grey Heron *Ardea cinerea*, Purple Heron *Ardea purpurea*, Great Egret, Intermediate Egret and Little Egret).

The trends for the fish-eating populations of Herons and Egrets, mainly associated with feeding in fishponds, shows substantially population increases in the northern Manila Bay, especially in the wetlands of Balanga City and the Pampanga River (Table 11). At the critical habitat and ecotourism area of Bangkung Malapad in Pampanga, the populations appear to be stable although if the numbers counted in 2003 and in 2017 are compared, there is a remarkable decline by 96%.

In the wetlands of Metro Manila, the trend data shows different values: a decline by nearly 30% since 2003 at Tanza but an increase by around 40% in LPPCHEA. However, if comparing actual count results in 2003 and 2004 compared to counts in 2018, the number of Herons and Egrets were reduced by half in LPPCHEA but had increased by almost 75% in Tanza.

The populations of Great Egret, Intermediate Egrets and of Chinese Egret occurring with one percent or more of the flyway populations, show different patterns: for Great Egret a very substantial increase in the Balanga Wetlands and at the Pasac River and Pampanga River but declines in the Metro Manila sites. Intermediate Egret, on the contrary, suffered substantial declines in all sites but Pampanga River. The Chinese Egret population at its only regularly monitored site at Tanza, dropped from an average of 52 birds (2004-2008) to just about four birds (2014-2018).

Table 11. Population trends of Heron and Egret species in Manila Bay AWC and WBCP monitored sites.

Herons and Egrets	Trend %	Trend%
Balanga Wetlands	2003- 2017	2003/2018
	+ 484	**+ 49**
Pasac River - Bangkung Malapad	2003- 2017	2003/2017
	+ 16	**- 96**
Pampanga River	2009- 2018	2009/2018
	+ 123	**+ 106**
Tanza, Navotas/Obando	2004- 2018	2014/2018
	- 29	**+ 73**
Las Piñas–Parañaque (LPPCHEA)	2003-2018	2013/2018
	+41	**- 50**

Shorebirds (40 species, mainly Stilts: Black-winged Stilt, Plovers: Pacific Golden Plover, Grey Plover *Pluvialis squatarola*, Sand Plovers: Little Ringed Plover, Kentish Plover, Lesser Sand Plover *Charadrius mongolus* and Greater Sand Plover *Charadrius leschenaultii*, Godwits and Curlews: Bar-tailed Godwit *Limosa lapponica*, Whimbrel *Numenius phaeopus*, Eurasian Curlew and Far Eastern Curlew, Tringa Sandpipers: Redshank *Tringa totanus*, Marsh Sandpiper *Tringa stagnatilis*, Greenshank *Tringa nebularia*, Wood Sandpiper *Tringa glareola*, and Calidris Sandpipers: Red Knot, Great Knot, Sharp-tailed Sandpiper *Calidris acuminata*, Curlew Sandpiper, Long-toed Stint and Red-necked Stint.

Overall, the monitored sites in northern Manila Bay show significant increase in population trends for shorebirds, in Balanga Wetlands as much as 121% and in Pampanga River over 300% (Table 12). At Pasac River, the increase over time is more modest and in 2018 the populations at this site were in decline, eventually due to conversion of mudflat habitats. In Metro Manila, the populations show a reverse and substantial decline, most notable in LPPCHEA where the trend is a negative 58%, or even a negative 78%, if the first count result from 2013 is compared with the last count result from 2018.

There are substantial and very large trend differences between the different populations of the different species of shorebirds (Table 12). Except in LPPCHEA, the populations of *e.g.* Black-winged Stilt, Redshank and Greenshank are significantly increasing. The Black-winged Stilt population is increasing, perhaps favored by an increase in the extent of the fishpond wetland habitats which it favors.

Table 12. Trends of shorebird species in the Manila Bay AWC and WBCP monitored sites.

Species/Trends	Average Trend %				
	Balanga 2003-2017	**Pasac River** 2003-2017	**Pampanga River** 2009-2018	**Tanza** 2004-2018	***LPPCHEA*** 2003-2018
Overall Trend	**+ 121**	**+ 74**	**+ 311**	**+ 31**	**- 58**
Stilts	**+ 2340**	**+1112**	**+ 324**	**- 71**	**- 6**
Plovers	**- 39**	**+44**	**+ 2030**	**- 95**	**- 84**
Sand Plovers	**- 19**	**+ 100**	**+ 103**	**0**	**- 71**
Godwits, Curlews	**+ 7**	**- 47**	**0**	**-13**	**- 64**
Tringa Sandpipers	**+ 307**	**+ 10**	**+ 722**	**+ 90**	**- 67**
Calidris Sandpipers	**+ 146**	**- 95**	**+ 1095**	**- 93**	**- 93**

Plovers: Represented mainly by Pacific Golden Plover, both wetlands in Metro Manila and the Balanga Wetland suffered population decline, around 40% in Balanga. However, at Pasac and Pampanga Rivers, there were increase in population. At Pampanga River, the trend increase was very high and more than 2000%.

Sand Plovers: Little Ringed Plover, Lesser Sand Plover and Greater Sand Plover populations are decreasing in the Bay in general; the Little Ringed Plover in all five of the monitored sites. Kentish Plover populations shows decline in the wetlands of Metro Manila but increases in the northern Manila Bay.

Tringa Sandpipers: The populations of Redshank and Greenshank in all monitored sites except LPPCHEA show significant increases. Of other Tringa species occurring in relatively large numbers, Marsh Sandpiper *s* is declining in Metro Manila and at Pasac River by 52% while the population at the Balanga Wetland increased by 95%.

Calidris Sandpipers: In general, the populations of five regularly occurring sandpipers present in Manila Bay are in decline (Table 9). Positive trends though, can be noted for Red-necked Stint at the Balanga Wetland and for Long-toed Stint at Pampanga River (Table 12). Other species such as Sharp-tailed Sandpiper are not anymore recorded in the Metro Manila wetland sites and only irregularly in the other sites.

Gulls (5 species, only Black-headed Gull): Both in northern Manila Bay and to a much lesser extent in Tanza, Metro Manila, there are very remarkable population increases of the Black-headed Gull that mostly feeds on fish species in the foreshore areas (Table 13). Most notable are the increases that have taken place in the costal section of Pasac River and Pampanga River where the congregation of Black-headed Gull is the largest in the Philippines and representing 1.4% of the flyway population, or more than 29,000 individuals. In contrast, in LPPCHEA, the very small overwintering population has nearly disappeared.

Table 13. Trends of Gull and Tern species in the Manila Bay AWC and WBCP monitored sites.

Sites	Trend % Gulls	Trend % Terns
Balanga Wetlands 2003- 2017	**+ 63**	**+ 65**
Pasac River – Bangkung Malapad 2003- 2017	**+ 3830**	**- 49**
Pampanga River 2009- 2018	**+ 3102**	**+ 1764**
Tanza, Navotas/Obando 2004- 2018	**+ 250**	**-18**
Las Piñas–Parañaque (LPPCHEA) 2003-2018	**- 67**	**- 32**

Terns (9 species, predominantly Whiskered Tern): There is a 26.8 percent of the flyway population of Whiskered Tern occurring in Manila Bay. The species mainly feed on smaller fish species in shallower portions of the Bay's foreshore areas but it also feeds in its thousands in fishponds, even very far from the coastline. Notable increasing population trends can be seen in the Balanga Wetlands but especially in Pampanga River (increase by >1760%) whereas a decline of nearly 50% has taken place in the Pasac River area around the protected area of Bangkung Malapad (Table 13). In Metro Manila, the populations at both LPPCHEA and at Tanza show a substantial decrease, possibly a decline in fish biomass measured in direct count numbers by comparing counts from the first year with counts in 2018. The decrease in Tanza is over 60% and in LPPCHEA, it is close to 100%.

5.2 Habitats

There are six distinct wetland habitats in Manila Bay totaling about 81,675 ha supported by more than 20 river systems and intertidal movements (Figure 2):

1) Submerged foreshore areas, in some sites with seagrass beds, within two meter water depth (18,183 ha)

2) Foreshore and riverine intertidal sandbars and mudflats and mudflats in fishponds up to an average of 2.5 km inland (1,343 ha)

3) Natural mangrove stands (679 ha)

4) Fishponds, formerly mangroves, nipa swamps and other brackish water swamps (61,271 ha)

5) Brackish water swamps of Nipa and other swamp vegetation (estimated at >100ha based on aerial survey)

6) Salt marshes (estimated through sampling < 5 ha).

The reduction is wetlands habitats is 64,047 ha or 71% over a period of around 125 years. The changes are shown in Table 14.

Table 14. Estimated changes in Manila Bay wetlands within 2- meter water depth. No data are indicated by question marks. *Source:* PEMSEA 2004, NAMRIA 1997, UNEP-TEEB 2017.

Habitats	Ha/ Year	2017 (ha)	Reductions (ha)		Reductions (%)
Foreshore areas less 2 meter water depth	Est. 23,183 (Year 1977)	18,183	Est. 5,000		21.6
Mangroves	54,000 (Year 1890)	679	53,321		98.7
Mudflats	4,996 (Year 1977)	1,343	3,653		73.1
Nipa Swamps	Est. 2,272 (Year 1890)	> 100	2,172		95.6
Salt marshes	No data	< 5	?		?
Total	**84,451**	**20,404**	**64,047**		**71.1%**

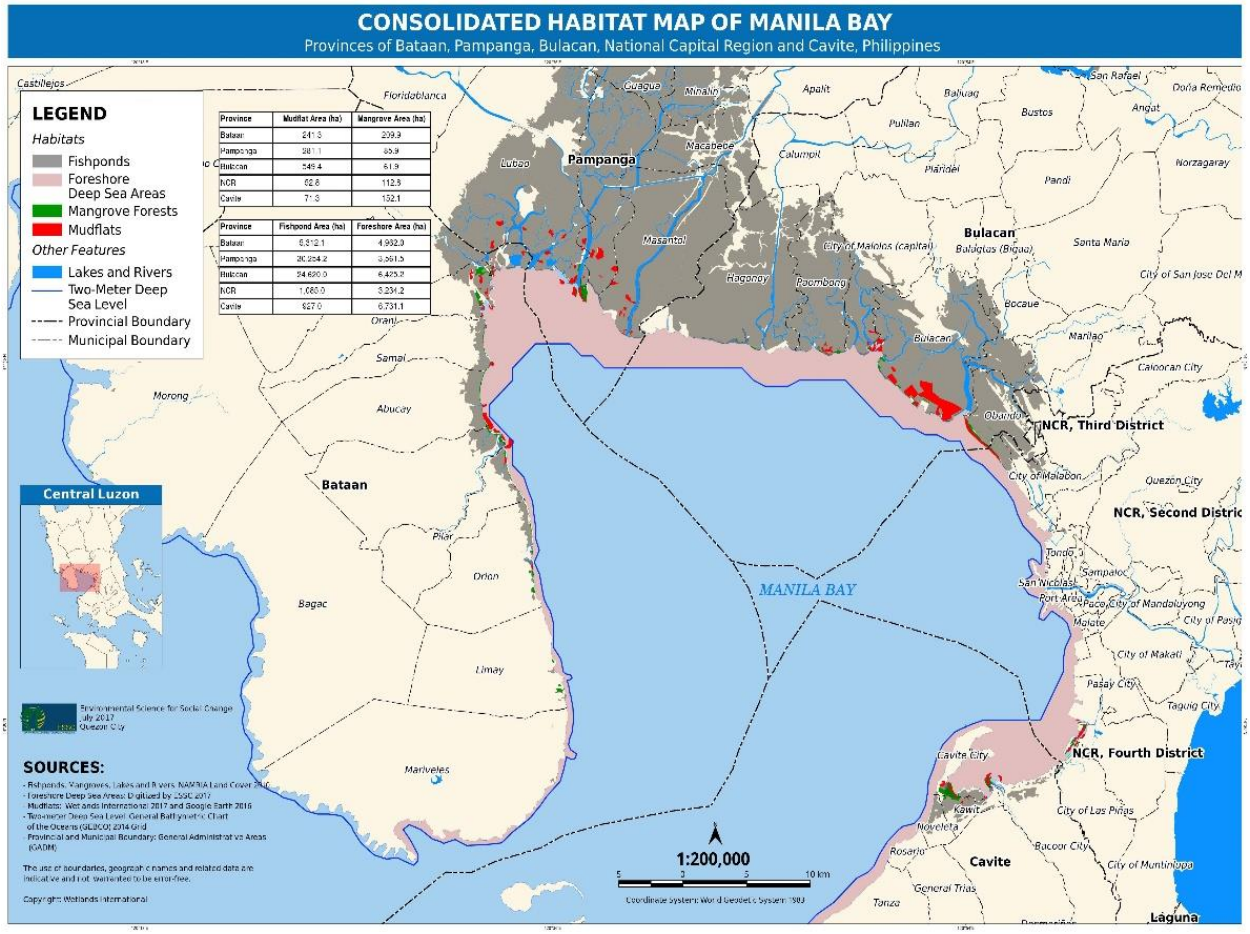

Figure 2. Distribution of main wetlands habitats in Manila Bay 2017.

5.2.1 Foreshore areas

Foreshore areas are defined as the shallow intertidal areas within the two-meter seaward depth. The relative shallow foreshore areas in this study represent 18,183 ha, mainly north of Metro Manila, see Figure 2. This diverse ecosystem includes fragmented seagrass areas, mainly offshore of portions of Bataan and Bulacan. The habitat is the main growth areas for a large number of fish species vital for both the local economy (Bendaño *et al.* 2016, UNEP – TEEB 2017) and for waterbirds such as terns and gulls, especially the Whiskered Tern and the Black-headed Gull. Densities of demersal fish positively correlate with the distribution of terns and gulls in Bataan and Pampanga (see Figure 3).

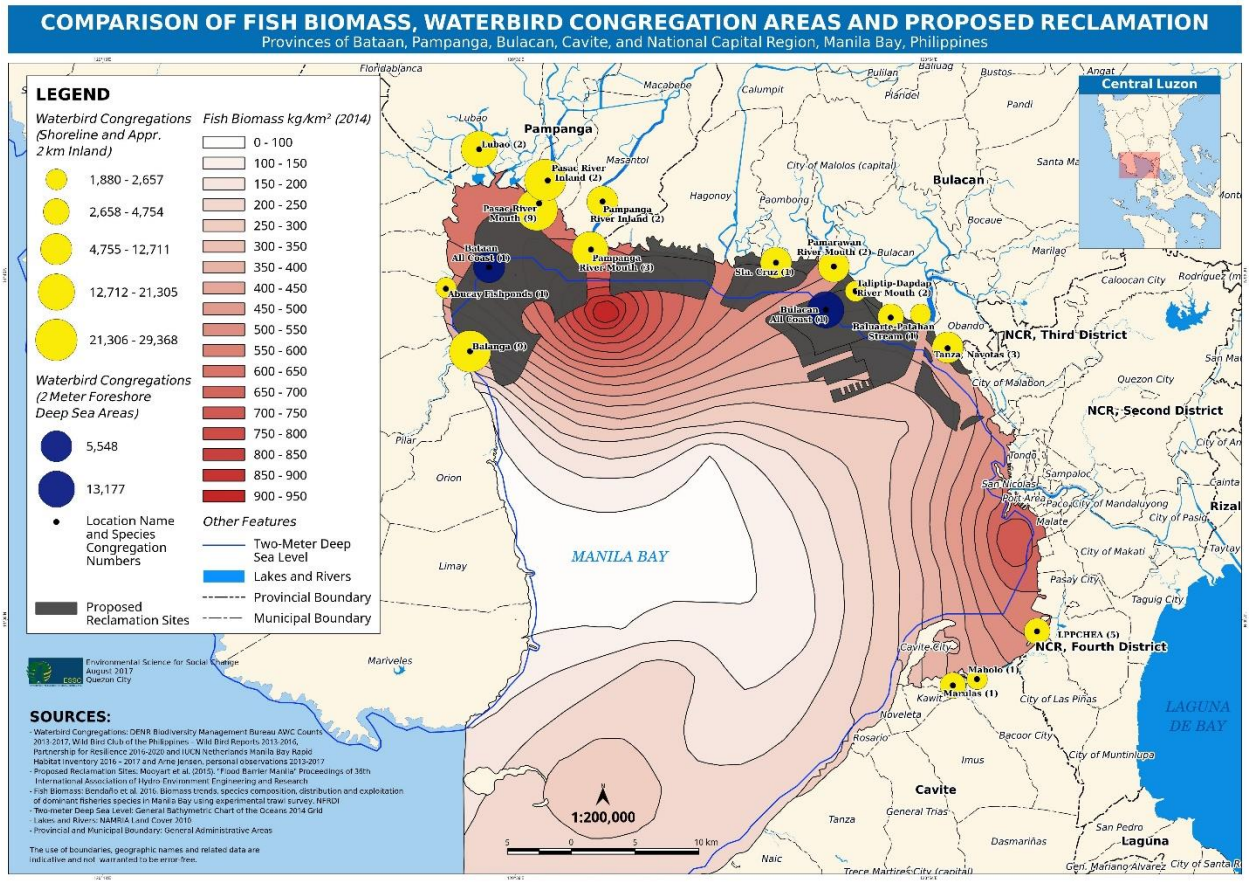

Figure 3. Fish biomass distribution in 2015, waterbird congregation areas and proposed reclamation area in northern Manila Bay. *Source*: BFAR 2015a, Bendano *et al.* 2016.

Historically, data over 47 years (1944 to 1991) shows that the foreshore areas within two-meter seaward depth of Bataan, Pampanga and the Metro Manila coast has shallowed whereas the Cavite coast to Cavite City there were no changes and the Bulacan coastline indicated a deepening (PEMSEA 2004). Progradation, seaward from Bataan to Metro Manila, was about 3,416 square meters, gained from 1977 to 1991. During this period the coast also changed to a more linear configuration as a results of expanding fishpond construction. Prior to this period most of the coast used to be covered by mangroves (PEMSEA 2004).

Plate 11. Dredging of shallow foreshore areas and of rivers is a widespread activity in Manila Bay. Photograph shows dredging offshore Orani City, Bataan, February 2018. Photo: Arne Erik Jensen.

The largest foreshore areas are located in Bulacan (6,425 ha followed by Bataan (4,962 ha), Pampanga (3,562 ha), and NCR (3,234 ha). A comparison of topographic maps of the National Mapping and Resource Information Authority (NAMRIA) from 1977 and 2016 shows that an estimated 5,000 ha, or 17% of the foreshore areas in the provinces of Bataan, Pampanga and Bulacan have been converted to fishponds. This conversion is continuing especially in Bataan and Pampanga and may not be regulated by the Philippines Reclamation Authority (PRA) despite its mandate (Plate 12).

Proposed coastal reclamation projects will intersect or potentially cover 23,590 ha of shallow foreshore and marine waters in Manila Bay and is projected to have detrimental impacts on the livelihoods for the coastal fishing communities, especially in Pampanga, Bulacan and Cavite (Beaumont *et al.* 2008, Sun *et al.* 2015, UNEP-TEEB 2017). It will consume most of the fish nursery and macro-benthic foreshore areas and substantially reduce feeding areas for a number of waterbird species and displace those populations that are dependent on the shallow marine and tidal areas.

The technical quality of the dikes fronting Manila Bay are generally poor and maintenance insufficient. In several areas of coastal Pampanga and Bulacan, portions of the dikes have collapsed, eventually as a result of the impact of waves generated by cyclones and typhoons passing Manila Bay. One such case is Typhoon Pedring in September 2011 that broke substantial portions of the seawall dike in Barangay Taliptip in Bulacan according to local community

informants. As a result, the coastal areas of Barangay Taliptip and other areas that are important to fishery and waterbird conservation are regenerating back to their original wetland habitat.

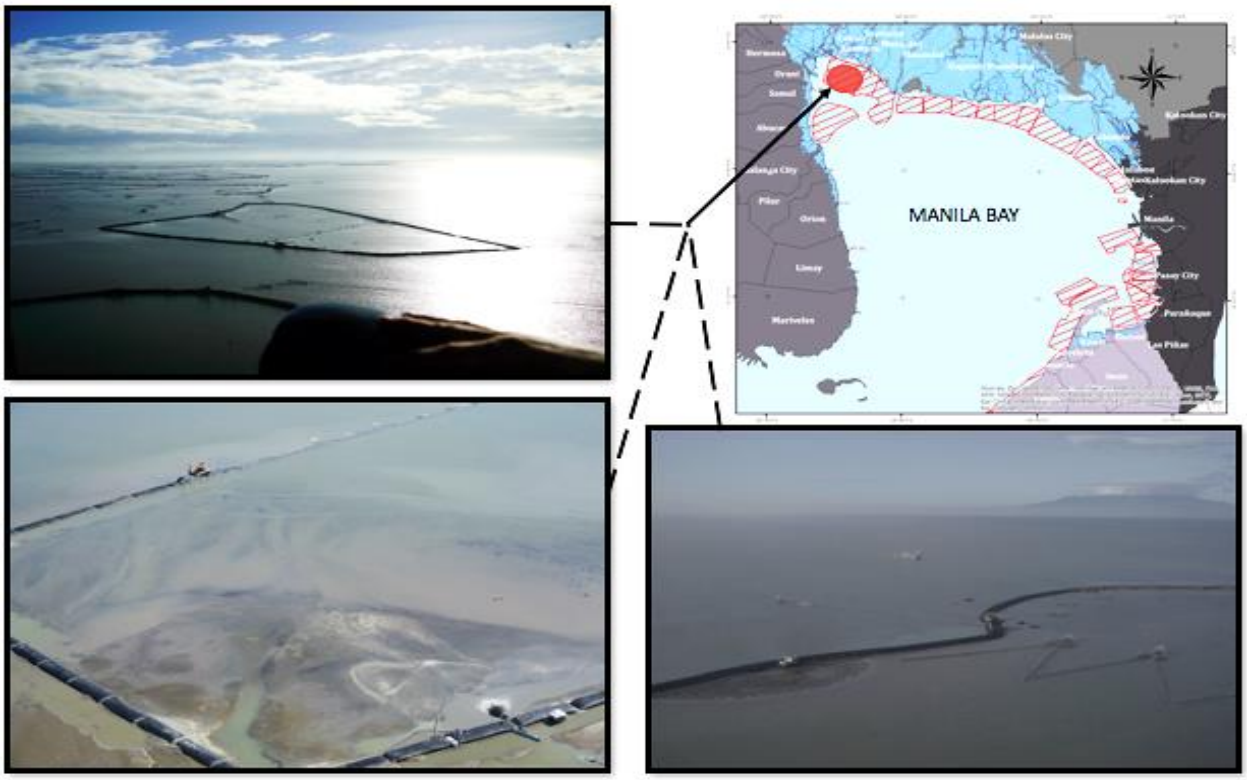

Plate 12. Aerial photograph of foreshore area under conversion into fishponds in Bataan and Pampanga Province, 30 November 2017. Photo by Ivan Sarenas. Map: UNEP - TEEB 2017.

Since the 1960s there has been a 40cm raise in sea-levels mainly due to land subsidence caused by extreme levels of ground-water extraction, and to a much lesser extent, probably caused by climate change (World Bank 2005, Rodolfo and Siringan 2006). Currently sea-level raise is about 2.6cm annually in Manila Bay. Although newer dikes are build 2.5 - 3 m high in some parts of Manila Bay, a probable scenario of a 1- m raise in sea-levels by 2100 would inundate about 5,555 ha areas along the coast and nearby areas (World Bank 2005). Consequently, a substantial part of the shallow portion of the Bay and its mudflat areas may be dramatically reduced.

5.2.2 Mudflats

Natural mudflats are found in areas under influence of tides and river flows. The majority of the habitat is submerged during high tide and mainly exposed during low tide. Nutritious sediments are deposited in these areas where they are the basis for a rich and diverse flora and fauna of microorganisms and benthic organisms (Plate 13). They are a vital food source for the majority of the waterbirds, especially for more than 30 shorebird species regularly occurring in Manila

Bay. Similarly important are semi-permanent mudflats found scattered in drained fishponds and in saltpan areas across 61,271 ha of fishponds located primarily in the northern Manila Bay. For the location of mudflats, see Figure 2.

Plate 13. Mudflat sample from Barangay Taliptip, Bulacan, December 2017 showing the richness of macrobenthic organisms. Photo: Arne Erik Jensen.

Based on Google Earth 2016 and validated by aerial surveys, the UNEP –TEEB Philippine Country Study (2017) identified a total of 87 mainly smaller coastal mudflats each averaging about 12 ha. These are located in 40 clusters along the shores of Manila Bay and about 2.5 km inland, totaling 1,343.3 ha (Table 15). The largest remaining mudflat and sandbar areas in Manila Bay in a good ecological condition is found in Barangay Bulakan in Bulacan (>313 ha). See Plate 14.

Table 15. Mudflat areas per province in Manila Bay 2016 digitized from Google Earth and ground-truthed by Wetlands International 2016 – 2017. *Source*: UNEP-TEEB 2017, ESSC 2017.

Province/Region	Areas	Clusters	Hectares	Largest Mudflats (hectares)
Bataan	33	12	223.5	48.66: Pilar, Balanga
Pampanga	34	19	408.1	42.53: Batan II, Sasmuan
Bulacan	19	8	513.2	313.27: Bulakan, Bulacan 52.00: Pamarawan- St. Cruz, Malolos
NCR	2	2	117.3	60.22: Tanza, Navotas
Cavite	3	3	81.02	59.28: Kawit, Cavite
Total	**87**	**40**	**1,343.3**	

The survey result of 1,343.3 ha of mudflats and sandbars in 2017 includes both intertidal, coastal and riverine mudflats and semi-permanent mudflats in drained fishponds up to average 2.5km inland. Of that area, the most important and ecologically productive mudflats for migratory shorebirds in intertidal areas is around 1,000 ha. In 1995 it was reported that Manila Bay had about 4,600 ha of wetlands (BFAR 1995) whereas there was 4,996 ha in 1977 (NAMRIA 2017). Using NAMRIA 1977 as the calculation, the reduction is 3,653 ha or 73 % over a period of 40 years, an annual average decline of 89 ha. The largest reduction in mudflats areas occurred in Pampanga and Bulacan, followed by Bataan.

The conversion of mudflat areas to fishponds, establishment of mangrove plantations and ground water extraction causing land subsidence in connection with sea-level raise, are the main human pressures on the rapid disappearance of the mudflat habitat. From an ecosystem and biodiversity point of view, coastal areas where dikes have eroded away can be seen as a positive development as it increases the likeliness of regeneration of wetland areas suitable as nursery areas for fish species and feeding areas for waterbirds. The mudflat habitat is the single most important habitat for a large diversity of migratory waterbirds of which shorebirds are especially dependent on the presence of mudflats as their primary feeding area.

Where infrastructural obstacles are put up, they likely have caused modifications in water movement. Changes in water movement impacts wave velocity which again causes impact in form of sediment increase or decrease along the coastline (Siringan 2015). There are sediment build-up at the mouth of rivers visible at satellite images, but there are no projections published on net loss or gain of tidal mudflats versus sea-level rise over time. A complication factor in projecting mudflat trends is the lack of data on the distribution and extent of possible land subsidence in the tidal foreshore areas.

Plate 14. Images of mudflat habitats found in the province of Bulacan 2017 and 2018. Photos: Arne Erik Jensen and Cristina Cinco.

5.2.3. Mangroves

A Fisheries Sector Program - Resource and Ecological Assessment of the Manila Bay reported an estimate of 54,000 ha of mangroves in 1890 (PEMSEA 2004, DA-BFAR 1995). By 1990 mangrove areas declined to approximately 2,000 ha and were further reduced to only 794 ha in 1995 (PEMSEA 2001). NAMRIA maps from 1977 showed a mangrove area of 956 ha along the coast area of Manila Bay. In 2010 NAMRIA maps showed that only 496 ha of the coastal mangroves remained. The UNEP-TEEB 2017 Philippine Country Study calculated 529.4 ha of coastal mangroves and estimated 150 ha of upstream mangroves in 2017, or a total of 679.4 ha. For distribution of coastal mangroves (see Figure 4).

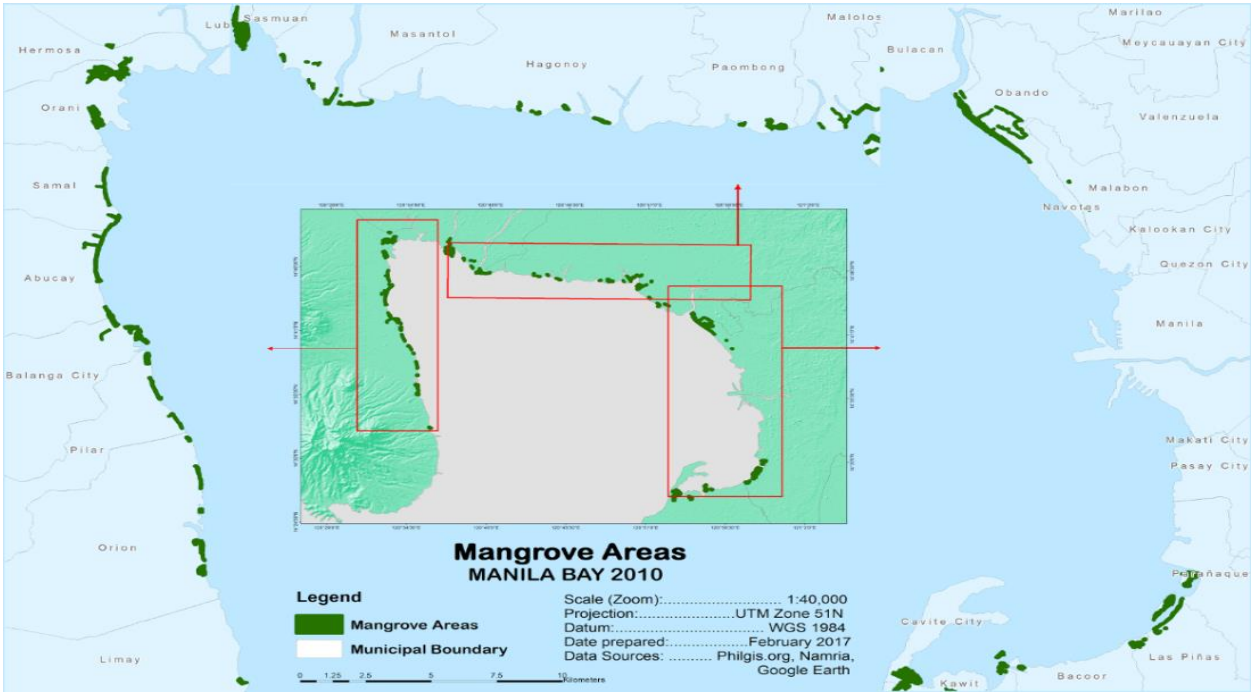

Figure 4. Distribution of coastal mangroves in Manila Bay 2010. *Source:* UNEP-TEEB 2017.

Most of the natural mangroves are found in Bataan (37.4%) and NCR (20.1%) followed by Pampanga (15.3%), Cavite (16.1%) and Bulacan (11.1%).The total area with natural mangroves in the Manila Bay wetlands is unknown. Sources only refer to mangroves along the coastline of Manila Bay and no calculations have been made of the mangroves along rivers and creeks inland, including patches of mangroves found upstream up to 20 km inland in Pampanga and Bulacan. This study, based on ground-truthing and aerial surveys, however, conservatively estimates that inland mangroves along rivers and streams to cover at least 150 ha. Together with the coastal mangroves, the total natural mangroves found in Manila Bay may be more than 679 ha.

These natural mangroves composed of 16 species dominated by *Avicennia marina* and open mangrove sub-habitats are important for resident populations of waterbirds (DENR- NCR 2012, Gestiada 2014, Kennedy *et al.* 2000). Species of rails, crakes and allies (*Rallidae*) use these as breeding areas, and egrets and herons (*Ardeidae*) use the trees as roost or breeding areas. The endemic Philippine Duck *Anas luzonica* also favors this habitat.

Despite the massive decline from 54,000 ha in 1890 to around 679 ha in 2017, mangrove coverage appears to have increased in the coastal areas of the Bay since 2011 (Figure 5). This increase can be attributed to the establishment of monoculture mangrove plantations with *Rhizophora* mangrove species at mudflats and foreshore areas. Since 2011 the National Greening Program of the DENR, the BFAR under its Silviculture Program (Dieta *et al.* 2014), local governments, universities and NGOs with support from the private sector have undertaken foreshore planting in Manila Bay.

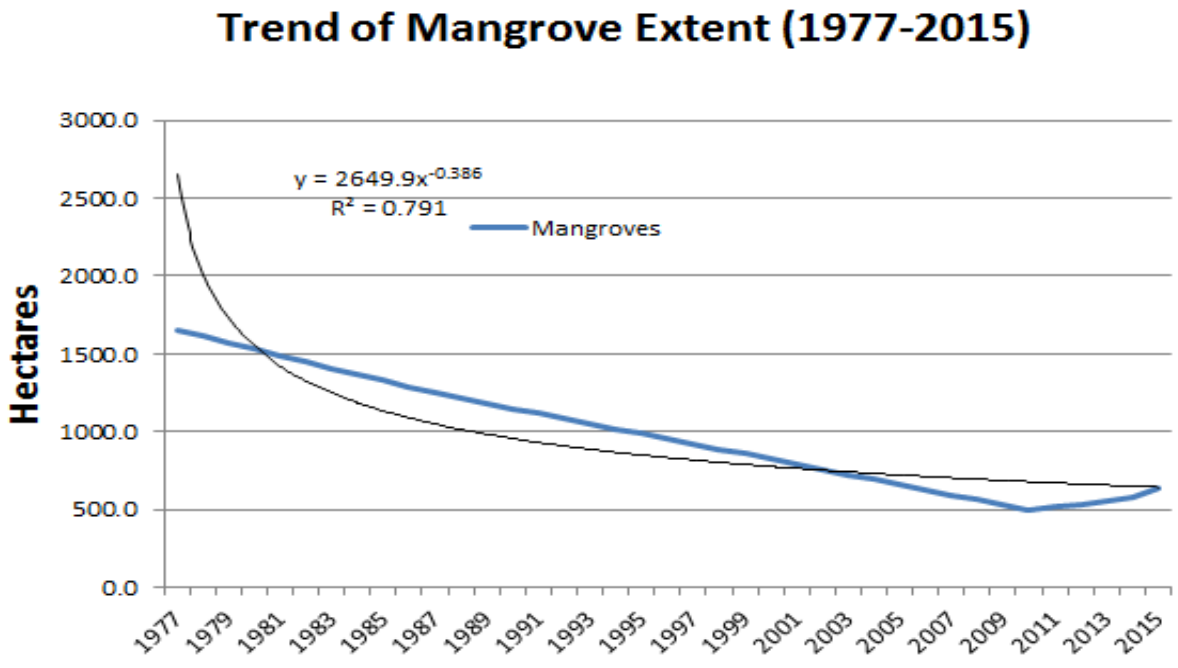

Figure 5. Trend of mangrove extent in hectares of mangroves along the coastline of Manila Bay from 1977 to 2015. *Source:* UNEP -TEEB 2017.

Plate 15. Patches of old growth, natural mangroves are found at several locations in Bulacan province. Photo: Arne Erik Jensen.

Plate 16. Most of the foreshore intertidal mudflats in Manila Bay were converted to mangrove plantations from around 2011. Uppermost picture from Bangkung Malapad, Pasac River, Pampanga. Succeeding pictures are from Bacoor Bay, Cavite, April 2017. Photo: Arne Erik Jensen.

Using a planting effort of four seedling per square meter (Melana *et al.* 2000), BFAR alone has planted around 125 ha of mudflats and shallow foreshore areas with five million saplings (BFAR, pers. comm. 2018). For samples of foreshore planting, see Plate 15. Mortality rates of the planted saplings of *Rhizophora* mangroves and likely decrease in macrobenthic species important for local livelihoods are not known. Generally foreshore planting of mangroves with *Rhizophora* species are not recommended due to high mortality rates and impacts on habitats important for fishery resources and migratory waterbirds (Erftemeijer and Lewis 1999, Samson and Rollon 2008, Garcia *et al.* 2013, Gestiada 2014, Primavera *et al.* 2016, Partners of the Building with Nature and Ecoshape Consortium 2017).

Plate 17. Mudflats of Sasmuan Bangkung Malapad Critical Habitat and Ecotourism Area have been converted into a mangrove plantation reducing migratory shorebirds' feeding area. Photo: Robert Hutchinson & Ivan Sarenas.

Critical ecosystems and habitats primarily set aside as protected areas also for waterbirds were also included in the planting projects. It included the important congregation site for shorebirds of Sasmuan Bangkung Malapad Critical Habitat and Ecotourism Area at the mouth of Pasak River, Pampanga. The planting effort comes at a great expense for mudflat-dependent shorebird species (Plate 17).

5.2.4 Fishponds (Former mangroves, nipa swamps and foreshore areas)

The long-term conversion of more than 61,000 ha of mangroves, nipa swamps and other brackish wetlands, mainly in northern Manila Bay, has undergone at least three phases. These were facilitated by major socio-economic developments that had detrimental negative impacts on the natural habitats and ecosystem functions of the areas. Habitats available for the majority of resident waterbirds such as species of ducks, rails and bitterns, and also for many migratory waterbird species, have been greatly reduced. On the other hand, fish-dependent species such as egrets, herons, and marsh tern species are benefitting from the conversion.

The first evidence of aquaculture in Manila Bay is from 1840. Aquaculture took place in natural bodies of water and was dependent on the intertidal system with rice cultivation dominant along the major rivers (Larkin, 1993; McLennan, 1980). Since 1996 all former rice-production areas have been converted to fishponds.

In 1976, fishponds mainly occupied natural wetland areas, however, conversion of the wetlands has increased dramatically over time. The fishpond expansion in the Pampanga Delta and in Hagonoy, Bulacan from 1976 to 2013 is from 3,109 ha to 17,995 ha This represent a loss of nearly 15,000 ha in less than 40 years (Mielhe *et al.* 2015) (Figure 6 and Annex 8).

In the absence of inland wetlands to convert, conversion of the intertidal foreshore and riverine areas to fishponds increased, mainly in Bataan and Pampanga. Combined, the original wetlands and converted foreshore areas today cover 61,271 ha of Manila Bay's wetlands (Figure 2).

The massive conversion of wetlands to fishponds was accompanied by major government infrastructure projects such as the construction of about 20 kms of channels along the downstream portion of the course of Pampanga River (Gaillard *et al* 2008). The engineering works caused constriction of the floodplain and reduction of alluvial sedimentation of the wetlands (JICA 2004). In parallel, pond dikes have disconnected the natural tidal inundation of nearly all of the wetland areas (Plate 17).

Land subsidence due to over extraction from deep water wells occur in most of the Pampanga Delta and further south to Metro Manila. Sea-level rise, mostly because of land subsidence also occur with an average of 2.5 cm per year (Mielhe *et al.* 2015). In conjunction with destructive typhoons such as Typhoon Pedring in 2011 and poor maintenance and quality of foreshore dikes, many have collapsed and as a consequence some coastal wetlands important for fish and waterbirds have regenerated.

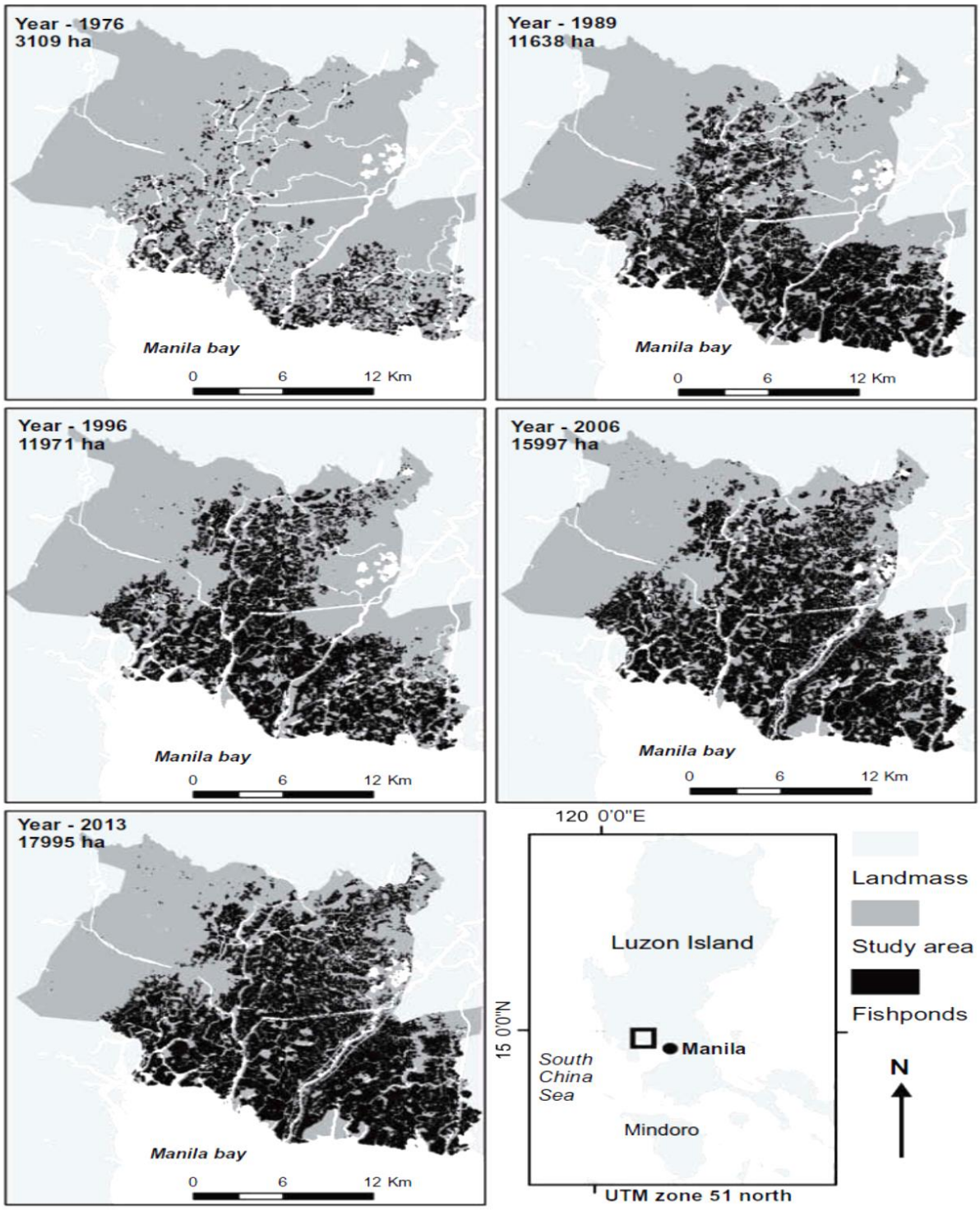

Figure 6. The development of fishponds in the Pampanga Delta and Hagonoy, Bulacan from 1976 to 2013. *Source*: Mialhe *et al.* (2015).

Plate 18. Pond dikes are disconnecting the tidal inundation of natural mangroves in the process of converting mangroves to fishponds in the Pampanga Delta, December 2016. Photo: Ivan Sarenas.

5.2.5. Brackish tidal swamps

There were originally (around 1890) an estimated 54,000 ha of mangroves within the 61,271ha fishpond areas identified during this study (PEMSEA 2001). The difference in the area, about 7,270 ha, is mainly due to an estimated 5,000 ha of foreshore areas converted to fishponds (PEMSEA 2004, this study). The remaining difference of 2,270 ha may represent scattered Nipa swamps and other remnants of original tidal wetlands such as oxbow lakes and mudflats further inland of the Pampanga Delta.

Aerial transect flights along the coastline of northern Manila Bay and over large parts of the inland delta of Pampanga and inland parts of Bulacan in November and December 2016 revealed that no larger areas of natural swamps exist. However, patches of about two ha of Nipa per patch were observed in Pampanga Province only (Plate 18). An indicator of the scarcity of the swamp habitat is the absence of wild duck species such as the Wandering Whistling Duck *Dendrocygna arcuata.*

Plate 19. Nipa located in the central Pampanga Delta, December 2016. Photo: Ivan Sarenas.

5.2.6 Saltmarshes

Coastal saltmarshes occur only in the upper coastal intertidal zone between land and the Bay's saltwater area, where it is regularly flooded by the tides. It is dominated by dense stands of salt-tolerant plants such as herbs and grasses. This habitat is now extremely rare as nearly all natural shorelines have been diked. In Manila Bay, it is mainly found in a narrow band along the shoreline at Tanza Peninsula, Navotas, NCR. About two to three ha are located in LPPCHEA in areas where shorebirds roost at high tide. However, due to mangrove overgrowth in the Ramsar site, the saltmarsh has nearly disappeared. Other remnants of the saltmarsh habitat were observed at newly reclaimed parts of Tubo-tubo Island, Bataan.

6. Conclusions

Waterbirds. Manila Bay is included in the list of Philippine Key Biodiversity Areas and as a globally Important Bird Area.

This study utilized data gathered through rapid inventories in conjunction with waterbird data available at Wetlands International, DENR – BMB and the WBCP. It leads to the conclusion that Manila Bay, especially its northern section from Manila to Bataan, hosts the largest congregation of coastal waterbirds in the Philippines. Overall the number of waterbirds present in Manila Bay during mid-winter, is from around 171,600 to 208,600 individuals, and represents up to 45 % of the average of all waterbirds counted in the Philippines during the AWC in 2016 and 2017.

At least 90 waterbird species, or about 60%, of all waterbirds found in the Philippines occur in Manila Bay. Of these, more than 62%, or 64 are the migratory and are not breeding in the Philippines. Based on aerial surveys, their populations are represented by around 33% of Egrets and Herons, 30% of Shorebirds, nearly 34% of Terns and about 3% of Gulls.

Most waterbirds are found in Pampanga (46.4%), Bulacan (25.0%) and Bataan (17.1%). NCR (Metro Manila) and Cavite combined host around 11.5% of the birds. More species and populations are dependent on shallower foreshore areas and mudflats including those found in ecologically intact, drained fishponds (Egrets and Herons, Shorebirds, Gulls and Terns). Moderately water-filled fishponds attract Egrets, Herons and Terns, while only the mangrove stands are important to Egrets and Herons among the migratory waterbirds.

Following criteria used to consider site inclusion under the Ramsar Convention on Wetlands of International Importance, 70-85% or about 145,000 waterbirds of 16 species congregate in Manila Bay during midwinter months in numbers of international importance. These internationally important congregations are concentrated in six geographical areas located north of Metro Manila, two areas in Metro Manila and one area in Cavite. In addition, the Bay hosts 24 migratory waterbird species are listed under the Convention of Migratory Species as needing conservation and management through international agreements. In addition 12 waterbird species are considered globally threatened or near threatened with possible extinction risks. All the species mentioned above occur within proposed reclamation areas and a new airport area north of Manila.

Some species occur in extraordinarily high percentages of the East Asian-Australasian Flyway waterbird population. Of the 16 waterbird species occurring with more than one percent of the flyway population, 12 species occur with more than 30% of the overwintering Philippine populations in Manila Bay. It is particularly notable for Long-toed Stint (91.9%), Black-headed Gull (86.8%), Pacific Golden Plover (85.1%), Whiskered Tern (73.9%), Kentish Plover (49.9%), and Red-necked Stint (46.3%). Compared to the known flyway populations Manila Bay host at least 53,000 Whiskered Terns (26.8%), 19,000 Pacific Golden Plovers (19.2%), 6,800 Black-winged Stilts

(6.9%) and 5,200 Kentish Plovers (5.3%). These figures underscores the international importance of Manila Bay and highlights the extraordinary responsibilities of the Philippines to safeguard these critical populations and their habitats.

The trend in waterbird population development over a period of 15 years since 2003 in three sampling sites in northern Manila Bay and two sites within Metro Manila show a total increase by more than 80%, from around 34,100 to 61,600 waterbirds measured as the average difference in five-year intervals. The increasing population is found in the northern portion of the Bay while the wetlands in the Manila area are suffering substantial population declines; in the LPPCHEA Ramsar site as much as 90%.

There are different population trends of the different waterbird species. Analysis of 18 internationally important species populations, shows declining populations of at least 11 species or about 60%. Of these are two egret species, one tern species and eight shorebird species depending on the declining mudflat areas in the Bay. While no populations are stable, six other species populations are increasing; they largely represents more opportunistic wetland species that also can utilize the expanding fishpond habitats at Manila Bay.

Habitats. In over a little more than a century, Manila Bay, the largest coastal wetland in the Philippines, has undergone significant and, in most cases, irreversible habitat changes. These changes have reduced mangroves, mudflats, and associated brackish tidal wetlands at estuaries and along river systems up to 50 km inland.

Nearly all of the original wetlands habitats have been converted to aquaculture; these include former tidal mudflats, saltmarshes, swamps, and mangrove areas in Bataan, Pampanga, Bulacan and Cavite Provinces, and increasingly, also the foreshore areas in the northernmost part of the Bay. The conversion resulted in a reduction of natural habitats by at least 64,000 ha or 71% of the wetlands. The largest reduction in original habitats are from the conversion of mangroves, 98.7%, tidal mudflats, 73.1%, and of foreshore areas within two meter water depth, 21.6%, while saltmarshes have largely disappeared.

The wetlands of Manila Bay have progressively become a uniform landscape of fishponds as a result of the acceleration of habitat conversion that began in the 1970s. In the last three to four decades shallow foreshore areas and nutrient-rich mudflats were increasingly likewise converted. Since 2010, conversion to mono species mangrove plantations has taken place in nearly all mudflats and many shallow foreshore areas adjacent to existing coastal mangroves. The mangrove forestation takes place without knowledge on the dependence on the mudflat habitat by the majority of migratory waterbirds. Except in cases where severe shoreline damages from typhoons occur, foreshore mangrove planting should be avoided.

The conversion of habitats and the changing land-uses is socio-economically driven. The Philippine Development Plan (2017 – 2022) underscores the importance of the role of ecosystem

protection and services to ensure ecological integrity and improve the socio-economic conditions of resource-based communities through sustainable integrated area development. However, the development of Manila Bay appears to lack an overall land-and-seascape zoning based on approaches in local and regional development planning that takes into consideration ecosystem-based habitat and biodiversity management and protection.

Legally, there would have been options to set aside additional areas in Manila Bay for the protection of waterbirds, *e.g*., as prescribed in the Presidential Order no. 1412-A (2007) that established LPPCHEA. Resistance from local governments, *e.g.* in Hagonoy, Bulacan, and Navotas, NCR, may have made it a difficult task for the DENR to carry out further protection of wetlands in Manila Bay. However, the DENR in 2017 proposed to and got approved by the 12th Conference of the Parties of the Convention on Migratory Species (CMS) a resolution promoting conservation of critical intertidal and other coastal habitat for migratory species. The aim is to enhance efforts to conserve and promote the sustainable use of intertidal wetlands and other coastal habitats of importance for migratory species worldwide, and to withdraw or modify any perverse incentives to convert intertidal or other coastal area. The resolution further encourages to recognize the international importance of intertidal wetlands for migratory species and ecosystem services by halting further approval of intertidal flat conversion at priority sites for migratory species and other biodiversity (CMS Resolution 12.25).

The Philippine Government has recently also taken other important initiatives. Through the DENR, a number of very important actions was taken to fulfill its obligations to the international community and in so doing help safeguard waterbird populations of international importance and the habitats they are dependent upon. These actions include the proposal to and approval by the Parties to the Convention on Migratory Species of Resolution 12.25 "Promoting Conservation of Critical Intertidal and Other Coastal Habitat for Migratory Species" and the Ramsar Resolution 18.22 Resolution on promoting the conservation and wise use of intertidal wetlands and ecologically-associated habitats". Further, the adoption of a "Sustainable Integrated Area Development Strategy" and the current development of the policy 'Strategic Environmental Assessment on Resilience' could serve as key instruments in crafting of future policies and designing programs that may lead to more responsive decision-making that takes into account increased ecological stability and ecosystem protection (GIZ 2018).

The tradeoffs between development and conservation of habitats and maintenance of ecosystem services in Manila Bay is a thorny issue for investors, planners, and decision-makers. Currently, only about 1.5% of the Manila Bay's shoreline wetlands are legally protected. Marine Protected Areas cover less than 1%. Regulatory measures on foreshore uses are mandate-driven and the mandates for different laws and policies are shared by a number of local, regional, and national government agencies. Aside from these agencies, jurisdiction over Manila Bay is also shared by about 30 local government units.

An agreement on the development of a sustainable master plan for Manila Bay, the “Manila Bay Sustainable Development Master Plan”, was entered into by the Philippines and the Netherlands in 2017. The development of this Master Plan can follow an inspiring example of integrated coastal zone management that adheres to sustainable and ecologically sound principles as seen in the shared wetlands management of the World Heritage and Transboundary Ramsar Site, the Wadden Sea in Europe. The “Manila Bay Sustainable Development Master Planning” could be a major step forward in protecting the ecosystems and habitats of Manila Bay, and importantly, in restoring some of the wetland ecosystems with clear benefits for both coastal communities and for biodiversity.

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ANNEXES

Annex 1

Coastal localities in Manila Bay searched for waterbirds from 2016 to 2018.

Bataan	
Balanga City Wetlands	Sibakan, Puerto Rivas, Tortugas and Wawa
Balanga – Abucay- Orani	Coastal Fishponds
Orani	Mudflats, Tubotubo River and Tubotubo Island
Pampanga	
Lubao	Maugut, Carpintero, and Pamunsuc River
Sasmuan	Pusad, Mabuanbuan and Malubag River
Sasmuan	Pasac River and Bangkong Mapalad
Consuelo and Masantol	Pampanga River
Bulacan	
Hagonoy	River mouth
Paombong	Masukol: Malumot
Paombong	Pulo-pulo and Mantakalin
Paombong	Santa Cruz: Wawa, Balot, Binakod, Katsang Wawa, Wawa Bitas and Vitas
Malolos City	Caliligawan
Malolos City	Pamarawan: Villongco, Santos, Pulo-pulo
Bulakan,	Talitip : Baluarte, Patahan Stream and Meucauayan River
Bulakan	Taliptip: Dapdap, Wawang Capis and Taguan Salambao
Bulakan	Bambang: Dapdap and Taliptip River
NCR	
LPPCHEA Ramsar Site	Las Pinas and Paranaque
Tanza Peninsula	Navotas
Cavite	
Imus River mouth	Bacoor to Binakayan
Kawit, Bacoor Bay	Inner Bacoor Bay and fishponds in Kawit
Noveleta and Cavite City mudflats	Noveleta and San Juan
Cavite City	Cavite City mudflats

Annex 2

Taxonomic list of waterbirds recorded in Manila Bay from 2003 to 2018. *Source:* DENR-BMB AWC Database 2003-2018, WBCP Wild Bird Records 2003-2016 and Wetlands International – IUCN Nl Rapid Inventories in Manila Bay 2016-2018.

Taxonomic treatment follows Gill F. & D. Donsker (Eds) 2017. IOC World Bird List (v 7.2) IOC and Checklist of Birds of the Philippines 2017 (WBCP 2017).

Ducks (5)	**Painted Snipes**
Wandering Whistling Duck *Dendrocygna arcuata*	Painted Snipe *Rostratula benghalensis*
Common Shelduck *Tadorna tadorna*	**Snipes**
Eurasian Widgeon *Anas penelope*	Swinhoe's Snipe *Gallinago megala*
Philippine Duck *Anas luzonica*	**Dowichers, Godwits and Curlews**
Tufted Duck *Aythya fuligula*	Asianc Dowitcher *Limnodromus semipalmatus*
Grebes (1)	Black-tailed Godwit *Limosa limosa*
Little Grebe *Tachybaptus ruficollis*	Bar-tailed Godwit *Limosa lapponica*
Bitterns, Herons and Egrets (16)	Little Curlew *Numenius minutus*
Yellow Bittern *Ixobrychus sinensis*	Whimbrel *Numenius phaeopus*
Cinnamon Bittern *Ixobrychus cinnamomeus*	Eurasian Curlew *Numenius arquata*
Black Bittern *Dupetor flavicollis*	Far Eastern Curlew *Numenius madagascariensis*
Black-crowned Night Heron *Nycticorax nycticorax*	**Tringa Sandpipers**
Rufous Night Heron *Nycticorax caledonicus*	Redshank *Tringa totanus*
Striated Heron *Butorides striata*	Marsh Sandpiper *Tringa stagnatilis*
Chinese Pond Heron *Ardeola bacchus*	Greenshank *Tringa nebularia*
Javan Pond Heron *Ardeola speciosa*	Green Sandpiper *Tringa ochropus*
Eastern Cattle Egret *Bubulcus ibis*	Wood Sandpiper *Tringa glareola*
Grey Heron *Ardea cinerea*	Terek Sandpiper *Xenus cinereus*
Purple Heron *Ardea purpurea*	Common Sandpiper *Actitis hypoleucos*
Great Egret Ardea *alba*	Grey-tailed Tattler *Heteroscelus brevipes*
Intermediate Egret *Ardea intermedia*	**Turnstones**
Little Egret *Egretta garzetta*	Ruddy Turnstone *Arenaria interpres*
Pacific Reef Heron *Egretta sacra*	**Calidris Sandpipers**
Chinese Egret *Egretta eulophotes*	Great Knot *Calidris tenuirostris*
Cormorants (1)	Red Knot *Calidris canutus*
Great Cormorant *Phalacrocorax carbo*	Ruff *Calidris pugnax*
Rails, Moorhens and Coots (11)	Broad-billed Sandpiper *Calidris falcinellus*
Barred Rail *Gallirallus torquatus*	Sharp-tailed Sandpiper *Calidris acuminata*
Buff-banded Rail *Gallirallus philippensis*	Curlew Sandpiper *Calidris ferruginea*
Slaty-breasted Rail *Gallirallus striatus*	Long-toed Stint *Calidris subminuta*
Plain Bush-Hen *Amaurornis olivacea*	Red-necked Stint *Calidris ruficollis*
White-breasted Waterhen *Amaurornis phoenicurus*	Sanderling *Calidris alba*
Ruddy-breasted Crake *Porzana fusca*	Dunlin *Calidris alpina*
White-browed Crake *Porzana cinerea*	**Phalaropes**
Watercock *Gallicrex cinerea*	Red-necked Phalarope *Phalaropus lobatus*
Common Moorhen *Gallinula chloropus*	**Prantincoles**
Philippine Swamphen *Porphyrio pulverulentus*	Oriental Prantincole *Glareola maldivarum*
Common Coot *Fulica atra*	**Gulls (5)**
Shorebirds (Waders) (41)	Black-headed Gull *Chroicocephalus ridibundus*

Stilts and Avocets	Laughing Gull *Leucophaeus atricilla*
Black-winged Stilt *Himantopus himantopus*	Black-tailed Gull *Larus crassirostris*
Avocet *Recurvirostra avosetta*	Slaty-backed Gull *Larus schistisagus*
Plovers	Lesser Black-backed Gull *Larus fuscus*
Grey-headed Lapwing *Vanellus cinereus*	**Terns (10)**
Pacific Golden Plover *Pluvialis fulva*	Gull-billed Tern *Gelochelidon nilotica*
Grey Plover *P.squatarola*	Caspian Tern *Hydroprogne caspia*
Small Plovers	Great Crested Tern *Thalasseus bergii*
Common Ringed Plover *Charadrius hiaticula*	Little Tern *Sternula albifrons*
Little Ringed Plover *Charadrius dubius*	Aleutian Tern *Onychoprion aleuticus*
Kentish Plover *Charadrius alexandrinus*	Roseate Tern *Sterna dougallii*
Malaysian Plover *Charadrius peronii*	Common Tern *Sterna hirundo*
Lesser Sand Plover *Charadrius mongolus*	Black-naped Tern *Sterna sumatrana*
Greater Sand Plover *Charadrius leschenaultii*	Whiskered Tern *Chlidonias hybridus*
	White-winged Black Tern *Chlidonias leucopterus*

Annex 3

Waterbird species in Manila Bay listed under the Convention for Migratory Species as Appendix I – Endangered Migratory Species and as Appendix II - Migratory Species in Need of Conservation through International Agreements. *Source:* Convention on the Conservation of Migratory Species of Wild Animals 2017.

CMS Appendix I and II Waterbird Species	**Appendix I**	**Appendix II**
Chinese Egret *Egretta eulophotes*	**x**	
Eurasian Widgeon *Anas penelope*		**x**
Common Coot *Fulica atra*		**x**
Avocet *Recurvirostra avosetta*		**x**
Grey Plover *Pluvialis squatarola*		**x**
Common Ringed Plover *Charadrius hiaticula*		**x**
Little Ringed Plover *Charadrius dubius*		**x**
Kentish Plover *Charadrius alexandrinus*		**x**
Lesser San Plover *Charadrius mongolus*		**x**
Greater Sand Plover *Charadrius leschenaultii*		**x**
Black-tailed Godwit *Limosa limosa*		**x**
Whimbrel *Numenius phaeopus*		**x**
Eurasian Curlew *Numenius arquata*		**x**
Far Eastern Curlew *Numenius madagascariensis*	**x**	
Redshank *Tringa totanus*		**x**
Marsh Sandpiper *Tringa stagnatilis*		**x**
Greenshank *Tringa nebularia*		**x**
Green Sandpiper *Tringa ochropus*		**x**
Wood Sandpiper *Tringa glareola*		**x**
Terek Sandpiper *Xenus cinereus*		**x**
Common Sandpiper *Actitis hypoleucos*		**x**
Ruddy Turnstone *Arenaria interpres*		**x**
Red Knot *Calidris canutus*	**x**	
Great Knot *Calidris tenuirostris*	**x**	
Dunlin *Calidris alpina*		**x**
Sanderling *Calidris alba*		**x**
Curlew Sandpiper *Calidris ferruginea*		**x**
Broad-billed Sandpiper *Calidris falcinellus*		**x**
Caspian Tern *Hydroprogne caspia*		
Common Tern *Sterna hirundo*		
Roseate Tern *Sterna dougallii*		
Total	**4**	**24**

Appendix I – Endangered migratory species

Parties that are a Range State to a migratory species listed in Appendix I shall endeavor to strictly protect them by: prohibiting the taking of such species, with very restricted scope for exceptions; conserving and where appropriate restoring their habitats; preventing, removing or mitigating obstacles to their migration and controlling other factors that might endanger them.

Appendix I comprises migratory species that have been assessed as being in danger of extinction throughout all or a significant portion of their range. The Conference of the Parties has further interpreted the term "endangered" as meaning "facing a very high risk of extinction in the wild in the near future" and defined the term 'endangered' as defined within CMS and the IUCN Red List Criteria.

Appendix II - Migratory species conserved through Agreements

Appendix II covers migratory species that have an unfavorable conservation status and that require international agreements for their conservation and management, as well as those that have a conservation status which would significantly benefit from the international cooperation that could be achieved by an international agreement. The Convention encourages the Range States to species listed on Appendix II to conclude global or regional Agreements for the conservation and management of individual species or groups of related species.

Annex 4

Localities with waterbird concentrations, the peak number of waterbirds, and the average number of waterbirds in Manila Bay. *Source:* DENR BMB AWC Counts 2014-2018, WBCP – Wild Bird Reports 2016-2017, and Wetlands International/ IUCN Nl Manila Bay Rapid Habitat Inventories 2016 – 2018.

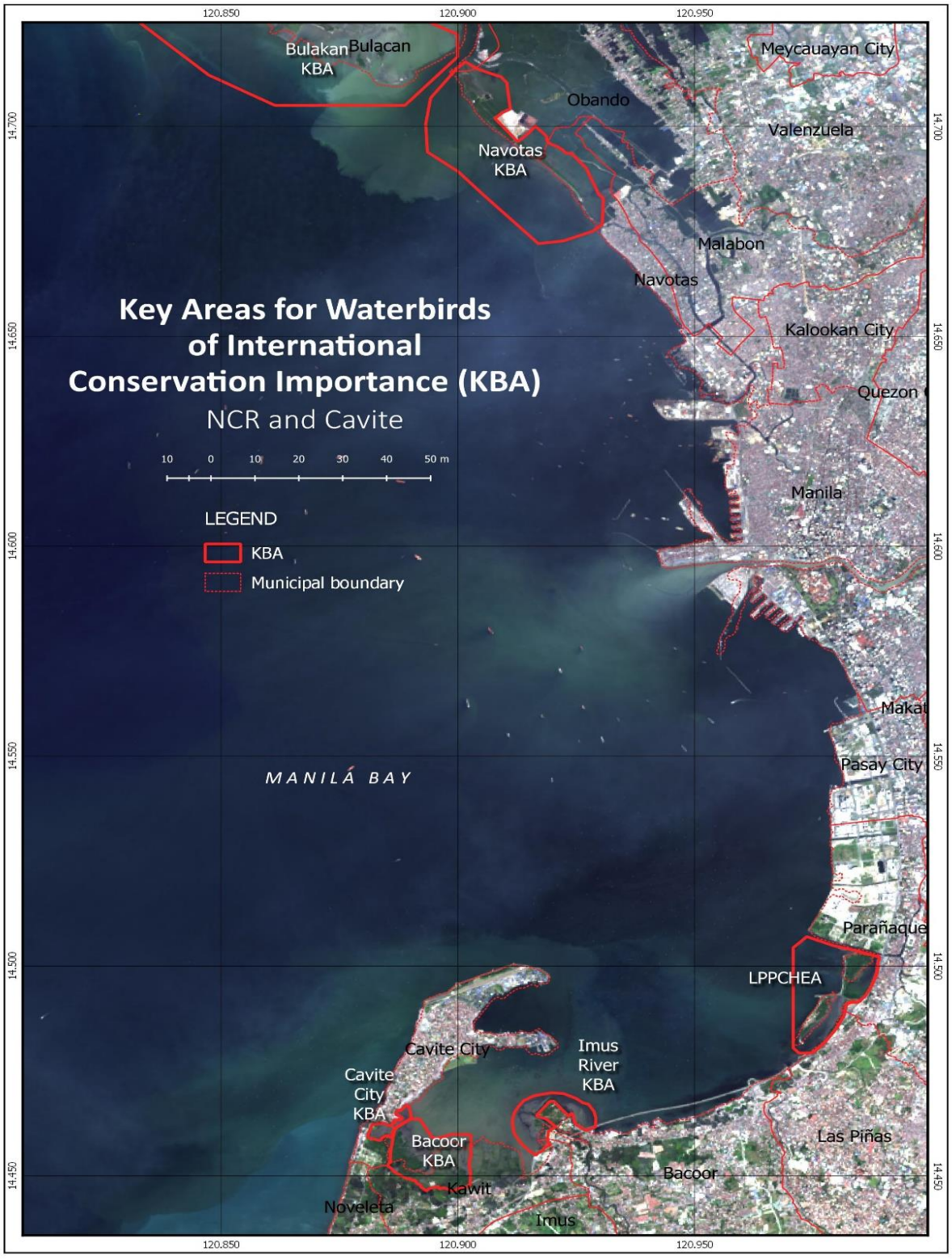
Locality	**Coordinates**	**Number of birds (peak counts 2016-2018)**		**Total**	**Number of birds (average 2014-2018)**		**Total**
		A. Shoreline and average 2,5 km inland	**B. Foreshore 2 meter deep waters**		**A. Shoreline and average 2.5km inland**	**B. Foreshore 2 meter deep waters**	
Bataan				**Bataan**			**Bataan**
Balanga City, Barangay Puerto Rivas, Sinacan, Turtugas, Balut	From: 14°41'40.85" N, 120°34'0.90"E To:	29,368	(included in column A)		19,869	(included in column A)	
Coast Limai - Orani	From:14°34'54.24"N, 120°36'5.35"E To: 14°48'55.70" N, 120°32'50.54" E		5,548			5,548	
Abucay-Samal Fishponds	From: 14°44'34.78" N, 120°32'22.41" E To:	2,103			2,103		
Total		32,471	5,548	**38,019**	21,972	5,548	**27,520**
Pampanga				**Pampanga**			**Pampanga**
Sasmuan: Pusad River and Mabuanbuaun river	From: To:	4,190			4,190		
Barangay Batan II: Pasac River Mouth	From: 14°47'50.72"N, 120°36'55.48"E To:	14,134	(included in column A)		17,741	(included in column A)	
Consuelo-Malauli, and San Roque – Sapang Kawayan – Sagrada : Pampanga River and river mouth	From: 14°46'5.98"N, 120°39'14.62"E To:	40,235	(included in column A)		13,942	(included in column A)	

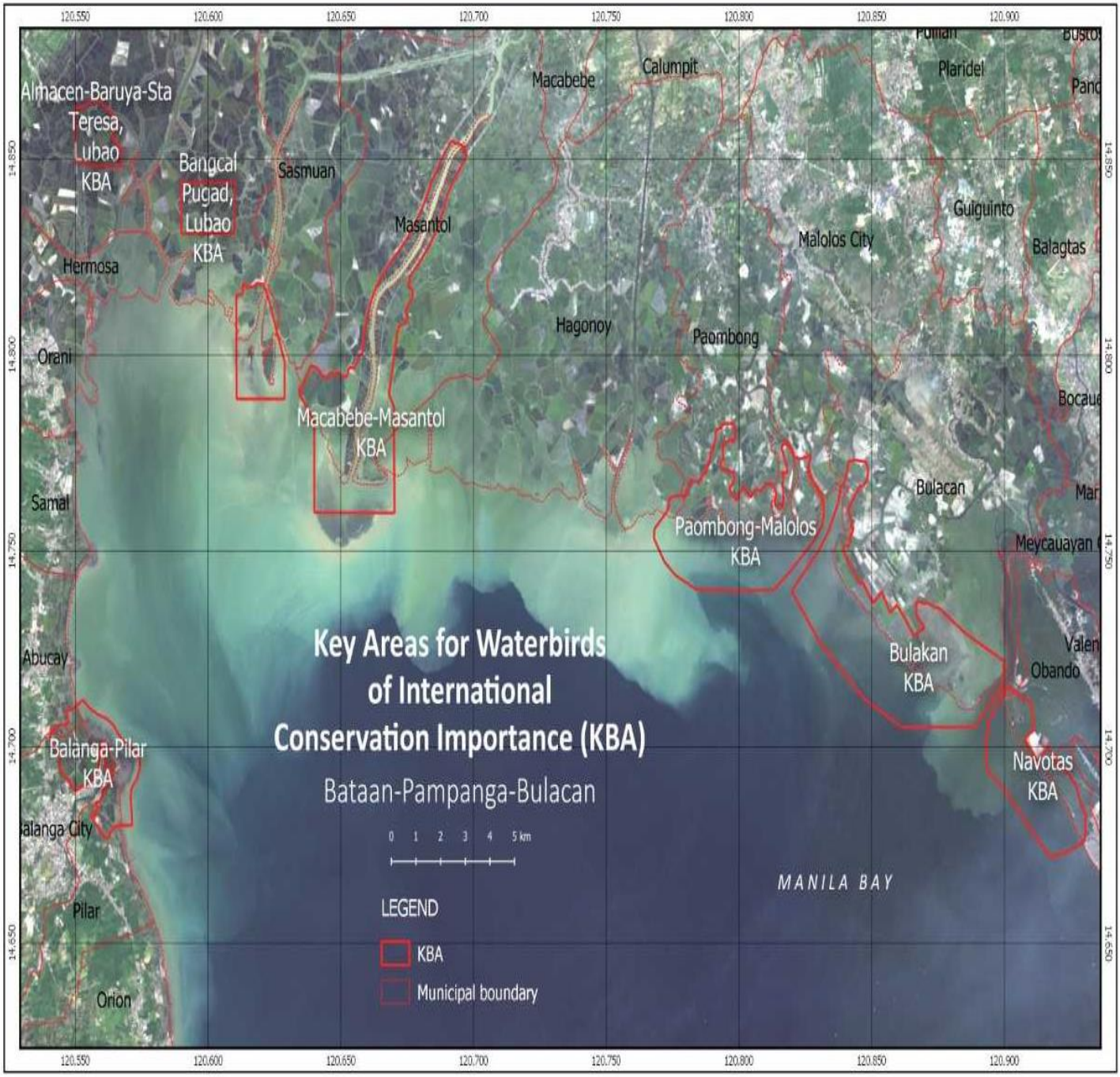
Aerial Survey: Sasmuan Inland Ponds (2.5- 3.0 km upstreams Pasac))	From: 14°49'55.98"N, 120°37'29.67"E To: 14°48'24.25"N, 120°37'4.98"E	23,700			23,700		
Aerial Survey: Lubao Inland Ponds (1- 6km upstreams Pamunsuc, Pina and Piunaua River)	From: 14°49'14.88"N, 120°34'24.78"E To: 14°51'35.96"N, 120°34'24.22"E	16,750			16,750		
Aerial Survey: Coast Sasmuan to Hermosa	From: 14°46'5.98"N, 120°39'14.62"E To: 14°48'46.48"N, 120°34'57.68"E		500			500	
Total		99,009	500	**99,509**	76,223	500	**76,823**
Bulacan				**Bulacan**			**Bulacan**
Barangay St. Cruz – Malumot mudflats and saltpans	From: 14°45'38.36"N, 120°46'18.92"E To: 14°45'24.27"N, 120°48'24.00"E	8,343			8,343		
Barangay Pamarawan mudflats and saltpans	From: 14°45'27.08"N, 120°49'16.00"E To: 14°45'19.20"N, 120°50'23.99"E	7,346			7,346		
Barangay Taliptip mudflats	From: 14°44'18.10"N, 120°50'48.38"E To:	4,849			4,849		
Barangay Baluarte – Patahan - Capiz Wetlands	From: 14°42'34.29"N, 120°53'18.29"E To: 14°43'47.76"N, 120°51'21.59"E	10,564			10,564		
Meucauyan River to Bambang River	From: 14°42'34.29"N, 120°53'18.29"E To: 14°44'0.91"N, 120°53'58.76"E	2,880			2,880		
Coast from Meucauyan River to Pampanga River	From: 14°42'34.29"N, 120°53'18.29"E To: 14°46'5.98"N, 120°39'14.62"E		13,177			13,177	
Total		33,982	13,177	**47,159**	33,982	13,177	**47,159**
NCR (Metro Manila)							

LPPCHEA	From: 14°30'11.89"N, 120°59'5.62"E	1,683	(included in column A)	**NCR**	2,810	(included in column A)	**NCR**
	To: 14°28'46.85"N, 120°58'21.26"E						
Tanza, Navotas	From: 14°40'56.91"N, 120°55'36.79"E	11,702	(included in column A)		6,985	(included in column A)	
	To: 14°42'45.12"N, 120°54'4.02"E						
Coast from Pasay City to Navotas City	From:		Est 1,000			Est 1,000	
	To:						
Total		13,385	1,000	**14,385**	9,795	1,000	**10,795**
Cavite							
Barangay Noveleta III&IV – San Juan and Cavite City mudflats	From:	3,804	(included in column A)	**Cavite**	3,804	(included in column A)	**Cavite**
	To:						
Bacoor: Imus River Mouth and coastal mudflats	From:	2,247	(included in column A)		2,247	(included in column A)	
	To:						
Kawit: Barangay Marulas and Bacoor: Barangay Mabolo Fishponds	From:	1,947			1,713		
	To:						
Coast from Imus River to Zapote River	From: 14°28'39.42"N, 120°58'8.97"E		Est.1,500			Est.1,500	
	To: 14°42'33.86"N, 120°54'2.84"E						
Total		7,998	1,500	**9,498**	7,764	1,500	**9,264**
GRAND TOTAL		186,845	21,725	**208,570**	1149,836	21,725	**171,561**

Annex 5

Key Areas in Manila Bay for Waterbirds of International Conservation Importance.




Key Areas for Waterbirds of International Conservation Importance (KBA)
Bataan-Pampanga-Bulacan
0 1 2 3 4 5 km
LEGEND
KBA
Municipal boundary
MANILA BAY
Almacen-Baruya-Sta Teresa, Lubao KBA
Bangcal Pugad, Lubao KBA
Macabebe-Masantol KBA
Paombong-Malolos KBA
Bulakan KBA
Navotas KBA
Balanga-Pilar KBA
Macabebe
Calumpit
Plaridel
Sasmuan
Masantol
Malolos City
Guiguinto
Balagtas
Hermosa
Hagonoy
Paombong
Orani
Samal
Bulacan
Meycauayan
Obando
Abucay
Balanga City
Pilar
Orion
120.550
120.600
120.650
120.700
120.750
120.800
120.850
120.900
14.850
14.800
14.750
14.700
14.650

Annex 6

Migratory Threatened and Near Threatened waterbird species in Manila Bay wetland sites and numbers of individuals recorded 2003 – 2018. *Source:* DENR-BMB AWC Counts 2003-2017, WBCP Wild Bird Report 2003 - 2016, Wetlands International and IUCN NL Manila Bay Rapid Habitat Inventory 2016 – 2018.

Threatened Species			
Species	**Site**	**Number**	**Year**
Philippine Duck	LPPCHEA	Peak Numbers	Yearly since 2004
Anas luzonica		80	2003-2007: 2006
		78	2008-2012: 2008
		123	2013- 2017: 2016
		11	2018
	Balanga Wetlands	2	2011
	Pasac River mouth	14	2003
		16	2010
		3	2015
	Marula, Kawit	9	2016
	Mabolo, Bacoor	9	2016
		12	2017
	San Juan, Noveleta	115	2018
	Imus River mouth	390	2018
Chinese Egret	Tanza, Navotas	Peak Numbers	Yearly since 2004
Egretta eulophotes		94	2004-2009: 2007
		41	2010-2014: 2009
		6	2015-2018: 2017
	LPPCHEA	1	2013
		1	2008-2012
		6	2014
		1	2015- 2016
	Balanga Wetlands	1	2017
	Pusad River, Sasmuan	1	2018
	Pasac River Mouth	1	2014
		1	2017
	Pampanga River mouth	1	2016
	Santa Cruz, Malolos	2	2017
	Pamarawan, Malolos	1	2017
		3	2018
	Bambang, Bulacan	18	2017
	Taliptip, Bulacan	1	2018
		1	2017
		3	2018
Far Eastern Curlew	Pasac River mouth	9	2005
Numenius madagascariensis	Taliptip, Bulacan	4	2017
		1	2018
	Pamarawan, Malolos	68	2018
Great Knot *Calidris tenuirostris*	Tanza, Navotas	1	2004
		2	2006
	LPPCHEA	1	2010
	Pasac River mouth	12	2003
		114	2010
		1	2015
		1	2016
	Talitip, Bulacan	4	2004
		420	2017

		95	2018
	Bagumbayan, Bulacan	57	2018
	Santa Cruz, Bulacan	1	2017
		383	2018
	Pamarawan, Bulacan	19	2017
		19	2018
Near Threatened Species			
Asian Dowitcher	Balanga Wetlands	1	2007
Limnodromus semipalmatus	Santa Cruz, Bulacan	103	2018
Black-tailed Godwit	Tanza, Navotas	2	2006
Limosa limosa		6	2017
	Pasac River mouth	2	2005
		1	2014
	Pampanga River mouth	1	2017
	Santa Cruz, Bulacan	2	2017
	Talitip, Bulacan	2	2004
Bar-tailed Godwit	LPPCHEA	1	2004
Limosa lapponica	Balanga Wetlands	2	2012
		6	2015
	Pasac River mouth	20	2003
		32	2005
	Santa Cruz, Bulacan	17	2016
		2	2017
		4	2017
	Pamarawan, Bulacan	92	2018
	Bagumbayan, Bulacan	86	2018
	Taliptip, Bulacan	74	2018
Eurasian Curlew	LPPCHEA	1	2015
Numenius arquata	Balanga Wetlands	1	2005
	Orani mudflats	1	2018
	Pasac River mouth	4	2011
		1	2012
		4	2015
	Santa Cruz, Malolos	135	2017
	Pamarawan, Bulacan	3	2017
		3	2018
	Talitip, Bulacan	14	2017
		9	2018
		54	2017
		59	2018
Red Knot	Tanza, Navotas	95	2005
Calidris canutus	Balanga Wetlands	12	2008
	Pasac River mouth	95	2010
	Pampanga River	8	2014
	Santa Cruz, Bulacan	2	2017
	Pamarawan, Bulacan	3	2018
	Taliptip, Bulacan	85	2018
Curlew Sandpiper	Tanza, Navotas	157	2004
Calidris ferruginea		113	2005
		53	2006
		2	2007
	LPPCHEA	1	2016
	Balanga Wetlands	170	2003
		50	2004
		1	2005
		11	2009
		17	2010

		32	2011
		30	2012
		13	2015
	Pasac River mouth	68	2010
		1	2015
		1	2016
	Pampanga River	1	2017
	Santa Cruz -Malumot, Bulacan	585	2018
	Pamarawan, Bulacan	30	2017
		85	2018
	Bagumbayan, Bulacan	41	2018
		200	2004
	Taliptip, Bulacan	129	2018
Red-necked Stint	Tanza, Navotas	Peak Numbers:	Yearly since 2003
Calidris ruficollis		299	2004-2009: 2004
		0	2010-2014: 0
		145	2015- 2018: 2018
	LPPCHEA	103	2003-2007: 2007
		50	2008 -2012: 2008
		17	2013-2017: 2015
		0	2018
	Balanga Wetlands	360	2003-2007: 2004
		2390	2008 -2012: 2009
		1143	2013-2017: 2013
		0	2018
	Orani mudflats	44	2018
	Pasac River mouth	1600	2005
		11	2012
		83	2016
	Pampanga River	15	2014
		90	2015
		12	2016
		380	2017
		230	2018
	Taliptip, Bulacan	405	2004
		83	2017
		178	2018
	Bagumbayan, Bulacan	78	2018
	Santa Cruz -Malumot, Bulacan	207	2017
		679	2018
	Pamarawan, Bulacan	217	2017
		2575	2018
	Marulas, Kawit	10	2010
	Imus River mouth	122	2018

Annex 7

Sites in Manila Bay that supports 20,000 or more waterbirds and/or a number of species congregating in numbers of international importance, and additional sites that support waterbirds in numbers of international importance based on presence of threatened species.

Internationally Important Waterbird Sites	Hectares	Number of waterbirds	Number of species > 1% of Flyway Population	Coordinates
BATAAN **Balanga City – Pilar Wetlands:** Barangay Sibacan, Puerto Rivas, Tortugas and Balut, and Pilar	700	Peak: 29,368 Average: 19,869	11	14°41'36.39"N, 120°33'42.92"E
PAMPANGA **Pasac River :** Sasmuan, Barangay Batang 2nd and adjacent tidal mudflats	535	Peak: 28,923 Average: 17,741	9	14°48'5.72"N, 120°36'56.67"E
Lubao Fishponds: Almacen-Baruya-Sta Teresa Bangcal Pugad	281 312	23,700	5	14°51'51.15"N, 120°34'33.58"E 14°50'16.69"N, 120°35'50.27"E
Pampanga River: 0 to 5.5km Westbank - Malauli, Consuelo Eastbank -Sapang Kawayan and San Roque (Hagonoy)	2080	40,235	2	From: 14°49'7.05"N, 120°39'50.14"E To: 14°46'7.34"N, 120°39'3.50"E
BULACAN **Paombong-Malolos wetlands:** Masukol, Santa Cruz, Pamarawan, Caliligawan and tidal mudflats	1870	22,767	4	From: 14°45'27.96"N, 120°46'42.94"E To: 14°45'25.10"N, 120°50'7.55"E
Bagumbayan -Bulakan wetlands: Bagumbayan, Bambang and Taliptip	2480	20,928	2	From: 14°45'3.58"N, 120°50'8.71"E To: 14°42'26.99"N, 120°53'16.30"E
Total	**8,258**	**> 145,240**	**16**	

National Important Waterbird Sites	Hectares	Number of waterbirds	Number of threatened species	Coordinates
NCR **Tanza Peninsula:** Navotas and Obando	986	Average: 6,985	8	14°41'33.74"N, 120°54'58.06"E
LPPCHEA: Las Pinas, Paranaque	397	Average: 2,810	7	14°29'32.99"N, 120°58'48.21"E
CAVITE **Imus River Mouth** : Binakayan	150	2,247	2	14°27'45.66"N, 120°54'52.59"E
Cavite City mudflats	32	3,800	1	14°27'49.24"N, 120°53'21.36"E
Bacoor Wetlands: Kawit	258	5,900	3	14°27'5.36"N, 120°53'28.74"E
Total	**1.823**	**21,742**	**9**	

Annex 8

Summary of "The development of aquaculture on the northern coast of Manila Bay (Philippines): and analysis of long-term land use changes and their causes". *Source:* Mialhe *et al.* 2015.

"The aquaforestry, dependent on the wetlands original eco-system functions and the wide areas of mangroves lasted about 150 years. In the late nineteenth and early twentieth centuries, the wetlands were mainly used to the harvest of nipa palms *Nypa fructicans* for sugar and wine production to collection of mangrove firewood. Competition from the sugar cane industry let to the collapse in the nipa-based production in the mid-1930s followed by a transformation to aquaculture products.

After decades of mono aquaculture (milkfisk *Chanos chanos*), economic incentives created a shift toward shrimp production. The high profit margins dramatically increased conversion of the wetlands. However, increases in number of environmental constrains such as decline in river discharge caused by dam-related irrigation system in the uplands, changes in water salinity, floods and drought caused by regulation in the flow of the main rivers together with fish diseases have created a more diversified approach. Aquaculture today includes extensive polyculture and semi-intensive monoculture with species of shrimps, crabs, tilapia, and milkfish. Ponds devoted to these productions dominate the present-day landscape. Except for tilapia, all other productions are operated in a brackish water environment in fishponds that ranges from 1 hectare to > 100 ha.

In 1976, fishponds mainly occupies natural wetland areas and conversion of the wetlands has increased dramatically over time. Since 1996 largely all former rice-production areas have been converted to fishponds. The fishponds expansion in the Pampanga Delta from 1976 to 2013 is from 3,109 ha to 17,995 ha, or nearly 15,000 ha over less than 40 years."