

Coastal Wetland Conservation Blueprint Project in China

Main findings and recommendations

The Chinese government gives highest priority to wetland conservation, including it as a key component for promoting ecological reform, and has taken a series of important measures to enhance wetland conservation and restoration in China. On April 25, 2015, the *Opinion of the Central Committee of the Communist Party of China and the State Council on Accelerating the Development of Ecological Civilization* was issued. This clearly states that efforts should be made to: ensure that no less than 800 million mu (about 53.33 million ha) of wetland areas will be protected; expand the wetland and other ecological spaces and wetland area; launch the programs of wetland ecological benefits compensation and returning croplands to wetlands; increase the carbon sink of wetlands; and formulate new laws and regulations concerning wetland conservation. It was also specifically requests that efforts should be made to: conduct integrated assessment on marine resources and eco-environmental conditions; implement strict measures on the control of sea reclamation total amount and natural coastlines; and establish a mechanism to integrate terrestrial and marine planning and regional cooperation in marine eco-environmental protection and restoration.

In recent years, the wetland damage in the Yellow Sea and Bohai Sea area has aroused great concern both at home and abroad. No.28 Decision of IUCN adopted at the 2012 World Conservation Congress called on all the governments and civil groups to take effective measures to contain the deterioration of wetland ecosystems in the Yellow Sea and Bohai Sea area and protect the intertidal habitats for migratory water birds. The coastal wetlands of China are facing the problems of continuing reduction of area, degrading ecological functions and depletion of coastal fishery resources. To address this issue, the Office of Wetlands Conservation and Management under the

State Forestry Administration, the Paulson Institute and the Institute of Geographic Sciences and Natural Resources Research (IGSNRR) under the Chinese Academy of Sciences (CAS) signed a tri-partite partnership agreement in Beijing on February 26, 2014, and announced the launching of the Coastal Wetland Conservation Blueprint Project in China. The project funds are granted by the Lao Niu Foundation. While the Paulson Institute is responsible for organizing the implementation of the project, a research team composed of IGSNRR, Beijing Forestry University, Beijing Normal University, Capital Normal University, Yantai Institute of Coastal Zone Research, among others, undertakes the research component. After 20 months of survey and research, we have reached the following main findings and recommendations for decision-makers.

(1) Main findings

Finding # 1: Coastal wetlands in China are key life-supporting systems. They also serve as key ecological barriers to maintain sustainable socio-economic development in the coastal zones, play an important role in ensuring the sustainable fishery development in coastal areas, and provide key habitats for migratory birds along the East Asian-Australasian Flyway. However, the importance and urgency of conserving coastal wetlands in China has yet to be fully recognized.

The coastal wetlands in China cover an area of 5.7959 million ha, accounting for 10.85 percent of the total wetland area in the country. They play a significant role in helping China achieve its socio-economic sustainable development, maintain the land and biodiversity safety of coastal zones, and promote international cooperation in terms of the “One Belt & One Road” Initiative. It is estimated that although the area of coastal wetlands represents only 0.6 percent of the total land area in China, they offer ecosystem services with a value of 200 billion US dollars each year, or 16 percent of the total ecosystem service values in the country.

First, the coastal wetlands provide key ecological barriers for the socio-economic

sustainable development of the coastal areas in China. They play an important role in purifying water quality, flood control and disaster reduction, mitigating storm tides and typhoons, providing favorable natural conditions, and protecting the safety of facilities and people in coastal zones. The mangroves, for instance, can not only function as forest ecosystems, but can fight against natural disasters including storm tides and tsunamis, prevent coastal erosion and act as a valuable carbon sink. Therefore, they serve as a multi-functional natural barrier for the coastal zones.

Second, the coastal zones and offshore waters provide key breeding sites for fish, as well as critical areas to maintain marine fish diversity. Southern and northeastern coasts of Shandong Peninsula, Laizhou Bay, Bohai Bay, Liaodong Bay, the southern coast of Liaodong Peninsula, Yancheng in southern Jiangsu, and the coastal zones in Nantong and Zhoushan Archipelago are known as the key breeding sites for fish in the Yellow Sea and Bohai Sea area, while mangroves, seagrass, seaweed beds and coral reefs provide globally-recognized and important areas for the breeding of marine fish. The production of aquatic products (including natural catches and artificial breeding) in China's coastal waters reached 28 million tons, taking up nearly 20 percent of the world's total production (in 2011). As the coastal waters in China have been over-fished for a long time, healthy coastal wetland ecosystems are urgently needed to restore these fishery resources. In particular, coastal wetlands are required to provide breeding sites for fish and favorable nursery environment.

Third, coastal wetlands in China provide critical breeding, staging and over-wintering sites for migratory birds. They are irreplaceable and integral parts of the East Asian-Australasian Flyway (EAAF). Therefore, coastal wetlands in China play a significant role in promoting global biodiversity conservation efforts and which China is obliged to protect under a variety of international conventions. Each year, as many as 246 species of migratory water birds breed, migrate, stage and/or over-winter in coastal wetlands in China. Based on 7,913 records at 243 water birds survey sites, we found that: 22 species of water birds in China's coastal wetlands are listed as globally threatened (IUCN's Red List); the populations of 99 species of water birds exceed 1

percent of their global population or their population along EAAF; the total bird numbers in each 16 of the survey sites exceeds 20,000 individuals (Tables 1 and 2); 140 water bird survey sites can meet the criteria of Ramsar sites, international important bird areas or the East Asian-Australasian Flyway Partnership (EAAFP). All these findings fully demonstrate the significant and irreplaceable role of China's coastal wetlands in global biodiversity conservation (Table 3, and Figure 1).

Nevertheless, the strategic value of coastal wetlands in China has yet to be fully recognized by some sectors, and the coastal wetland conservation efforts in China are generally at a low level. Only 20.4 percent of coastal wetland areas (not including wetland parks and marine parks) have been protected, much lower than the overall wetland protection rate nationwide (43.51 percent), which has a great gap with the developed countries and regions in Europe and USA. Moreover, much of this protected area falls within 'experimental zones' where the level of protection afforded remains weak.

- Of 22 key ecological areas for invertebrates and fish in Yellow Sea and Bohai Sea area, only six areas have been designated as national nature reserves, while others have not yet been put under protection;
- Of the 194 key habitats for water birds which can meet the criteria of Ramsar sites, international important bird areas or EAAFP, 49.3 percent have yet to be designated as protected areas;
- The coastal wetland protection rate in Zhejiang, Jiangsu and other provinces with high significance for protection is still low, compared with the mean protection rate of coastal wetlands across China (20.4 percent) (Figure 2);
- Although about 40 percent of mangroves in China have been protected, the key distribution areas for mangroves in Wenzhou Bay in southern Zhejiang, Feiyun River Estuary, Aojiang River Estuary, northern coast in Hainan Island, and Beibu Bay in Guangxi, etc. have not been put under protection; and more than 70% of original mangrove area in China has been lost.
- Similarly, the protection status of seagrass beds is not optimistic. Of the 35 surveyed seaweed bed distribution zones, 28 zones which represent 59 percent of the total area have not been effectively protected.

Finding #2: The primary driver for the reduced area of coastal wetlands in

China is the large-scale and fast conversion and land reclamation of coastal wetlands. The large-scale conversion projects in the pipeline may threaten the “redline” of conserving 800 million mu (about 53.33 million ha) of wetlands in China by 2020. Therefore, it is urgently needed to take effective measures to contain the over-development in coastal zones.

Over the last 50 years, 53% of coastal wetlands in the temperate zone, 73% of mangroves and 80% of coral reefs in China have been lost. In recent decade, the rate of loss of coastal wetlands is much higher than that for other types of wetland. The findings and results of the First and Second National Wetland Resources Inventories organized by the State Forestry Administration (SFA) suggested that: during the period of two inventories (roughly from 2003 to 2013), the area of coastal wetlands in China has decreased by 1.3612 million hectares, down by 22.91 percent, or 2.4 times of the mean loss rate of various types of wetland areas in China. Conversion and reclamation are the direct drivers behind this loss of coastal wetlands.

From 1950 to 2000, the coastal wetlands in China have been reduced by 50 percent due to reclamation. The reclamation rate has increased to 40,000 hectares a year during 2006-2010 to support rapid urbanization and economic development through constructing industrial zones, ports and other infrastructure. According to the monitoring data of the Institute of Remote Sensing and Digital Earth, the Chinese Academy of Sciences, the area of coastal wetlands in China has been reduced by 232,000 hectares from 1990 to 2000 (accounting for 16% of the total loss of wetland areas in the country). During the same period of time, the loss of shoals and coastal beaches in intertidal zones was the largest, reaching 135,800 hectares (Gong *et al.*, 2010). The analysis of our project on the spatio-temporal dynamic changes of sea reclamation in the coastal municipalities at prefectural level indicated that: to support rapid urbanization and economic development through constructing industrial zones, ports and other infrastructure, a total of 458,000 hectares of coastal wetlands have been reclaimed during the period of 2000-2010, doubling the reclamation rate during 1990-1999. The length of seawalls has increased 3.4 times (from 18 to 61% of the

total 18,000 km) over the past two decades, reaching 11,000 km in 2010 (Ma *et al.*, 2015).

The remote sensing-based monitoring results of the project on some key habitats for migratory birds showed that: 22,830 hectares of sea were reclaimed in Phase I project of Caofeidian Industrial Park in Hebei; 30,768 hectares of sea were reclaimed in the last decade in Binhai New Area, Tianjin, including 16,150 hectares reclaimed during 2014-2014; 17,919 hectares of sea was reclaimed in Jiaozhou Bay, Shandong from 2010-2014 for constructing salt pans, aquaculture farms and ports; 37,874 hectares of sea was reclaimed in Dongtai-Rudong, Jiangsu in the past 10 years; 2,515 hectares of sea was reclaimed in Qinzhou Bay during 2010-2014 (Figure 3); and 53,800 hectares of sea was reclaimed in Ningbo during 2000-2013.

The scale of sea reclamations in the planning pipeline is even larger. The statistics show that over 578,000 hectares of sea are planned to be reclaimed by 2020 to support the economic development of coastal areas in China with the implementation of a new round of coastal development strategies. If such trends cannot be contained, the “redline” of protecting 800 million mu (about 53.33 million hectares) of wetland areas in China would be threatened. Take the sea reclamation project in Dongtai City, Jiangsu Province as an example. From 1990 to the first half year of 2014, a total of 24,869 hectares of sea have been reclaimed in the area. According to the Development Plan of Coastal Areas in Jiangsu approved by the State Council in 2009, the reclamation project in Dongtai will be implemented in three stages. As of the first half year of 2014, the Phase I project in Tiaozini has been completed, with an area of approximately 6,750 hectares of sea reclaimed. By 2020, an additional area of 59,950 hectares of mudflats will be converted in Tiaozini, Dongsha and Gaoni, making the conversion rate accelerate significantly. As of October 2012, the State Council has successively approved the marine functional zoning plans of 11 coastal provinces/autonomous regions/municipalities in China. Therefore, a total area of 246,900 hectares of sea will be reclaimed for construction by 2020 (<http://www.gov.cn/>).

Sea reclamation is deemed as the quickest and cheapest way to increase land supply in China's eastern coastal areas. It can also bring about large benefits. According to the survey of the project team in Hangzhou Bay, Zhejiang; Yancheng, Jiangsu; and Luannan, Hebei, the mean engineering cost of sea reclamation is estimated to be RMB 0.6-1.05 million per hectare, while the cost for land restoration (including land leveling, topsoil restoration and farmland water conservancy costs) is about RMB 0.3-0.45 million per hectare. Therefore, the total cost to convert coastal wetlands into farmlands is estimated to be RMB 0.9-1.5 million per hectare. While the transaction price for farmlands between/among different municipalities/counties is about RMB 4.5 million per hectare, that for construction lands surrounding the urban areas may range between RMB 1-150 million per hectare (depending on the location and use).

The huge economic returns from reclamation have prompted local governments to “bypass” regulations issued by the central government. For example, the State Council of the People's Republic of China ruled that reclamation projects over 50 ha must be approved by the central government. To evade this, local governments simply divide large projects into smaller ones (Ma *et al.*, 2015).

It was stipulated in the *Opinion of the Central Committee of the Communist Party of China and the State Council on Accelerating the Development of Ecological Civilization* that the wetland area should be kept to no less than 800 million mu (about 53.33 million hectares). The present figure is 801 million mu (about 53.40 million hectares) (State Forestry Administration, 2014). If a total demand of 578,000 hectares for coastal wetland reclamation by 2020, or 115,000 hectares each year within the next five years, is taken into account, the area of coastal wetlands in China will be reduced to 5.21 million hectares by the end of 2016. Even if the loss of other types of wetland is not included, the “redline” of “keeping wetland area no less than 800 million mu (about 53.33 million hectares)” will be broken.

Finding #3: The loss of habitats for migratory water birds due to coastal

wetlands reclamation has directly threatened the living of migratory water birds including waders. It is one of the primary drivers for the reduced population of water birds along EAAF.

Of the water birds along EAAF, at least 33 species are severely threatened (e.g., Siberian crane, Spoon-billed sandpiper, Spotted greenshank, Dalmatian pelican, Chinese crested tern, Oriental white stork, Black-faced spoonbill etc.), among which 24 species mainly live in China's coastal wetlands. At present, 19% of globally threatened water bird species live along EAAF.

Coastal wetlands reclamation has directly converted the natural mudflats and shallow seas used by water birds into agricultural and industrial lands, and led to the loss of habitats for water birds. Meanwhile, sea reclamation has damaged the substrate of the surrounding mudflats through sand pumping. This has resulted in the food shortage for migratory water birds, reduced the function of mudflats as habitats for these birds, and threatened the living of water birds which need to stage in coastal wetlands. Take red knot (*Calidris canutus*) as an example. It breeds in the Arctic, and over-winters in Australasia. Its distance of one-way migration can be more than 10,000 km. The northern and western parts of Bohai Bay in China are used by the bird as the most important staging site during its northward migration. Along EAAF during the migration period each spring, 80% of red knots will stage in Luannan coast, Hebei for a month before they continue to fly northward. Thus, whether most of the bird species can successfully reach the Arctic to breed there, as well as their general fate will largely depend on the protection status of Luannan coast in Hebei.

Due to the ongoing large-scale reclamation of coastal wetlands in China, the populations of most water birds along EAAF tend to decline, posing a risk to their survival. The migratory water birds including waders become concentrated in large numbers and normally use some key staging sites because of their co-adaptation with the environment over thousands of years and their special requirement for staging or recharge sites. If important coastal mudflats are destroyed; these birds have to concentrate in even more limited habitats (e.g., Luannan coast in Hebei). Once the last

habitats are lost, the survival of these migratory birds will be severely threatened.

Some migratory water birds may disappear if they cannot adapt to the habitat changes in time. This is already evidenced by the change of migratory water birds population in coastal wetland areas in Tangshan, Hebei. Indeed, the natural mudflat reclamation projects in Tianjin and Tangshan coastal areas have led to the severe loss of mudflats in Bohai Bay. More specifically, the key habitat area for red knots has shrunk dramatically due to reclamation projects, resulting in the reduced area and degraded functions of suitable staging sites for these birds. Since 2007, while the total population of waders along EAAF has declined, the population of red knots that stage in Tangshan coastal areas has increased from more than 10,000 individuals to over 60,000 individuals, with the suitable habitats mainly occurring in Nanpu Wetland. Unfortunately, driven by sea reclamation, oil exploration and other human activities in recent years, the population of red knots in the local area has decreased to only 20,000 individuals in 2015.

Finding # 4: Conservation of coastal wetlands is still a weak component in wetland conservation in China, as a sound protection system and some key habitats have yet to be established. The economically developed coastal provinces/autonomous regions/municipalities are required to make greater contribution to promoting conservation of coastal wetlands and migratory water birds.

The results of the Second National Wetland Resources Inventory in China showed that: 1.3904 million hectares of coastal wetlands are protected within 11 coastal provinces/autonomous regions/municipalities in the country. At present, 126 protected areas of coastal wetlands have been established, including 40 national nature reserves, 52 provincial nature reserves and 34 protected areas of other types. They consist of: 1.0424 million hectares of wetland nature reserves, 30,300 hectares of wetland parks, 48,400 hectares of protection plots and 269,400 hectares of other types of protected areas. Only 20.4 percent of coastal wetlands have been designated as protected areas, much lower than the mean wetland protection rate across China (43.51 percent). In this sense, a sound system of coastal wetland conservation in

China has yet to be made available, and there still exists a significant gap in this field.

Water birds are recognized as the best indicators of wetland ecosystem health. Their population and distribution can directly demonstrate the quality of wetland ecological conditions. Some coastal wetlands in China have high conservation values and have reached the international criteria based on water bird protection, although they have not yet been included in the conservation system. These coastal wetland areas include Luannan in Hebei, Ganyu and Rudong mudflats in Jiangsu. Our study indicated that: 69 (49.3 percent) of 140 survey sites that have reached the international criteria on basis of water bird conservation have not yet been designated as protected areas (Figure 3). Apart from some national nature reserves, other types of protected areas for coastal wetlands have failed to take effective measures to protect water birds and their habitats.

The coastal wetlands in China's economically developed provinces/municipalities (e.g., Zhejiang, Jiangsu, Tianjin and Shandong) have high conservation values, such as Dongying in Shandong (Bohai Bay), Binhai New Area in Tianjin and Yancheng coast in Jiangsu. These coastal wetlands are vital passage sites for the migration of some waders along EAAF. They are also the hot targets for reclamation in the near future, thus posing a severe challenge to the protection of existing habitats. In such circumstances, the economically developed coastal provinces/municipalities are required to make greater contribution to promoting conservation of coastal wetlands and migratory water birds.

Finding # 5: The legal system and effective legal basis remains inadequate to conserve coastal wetlands in China. Coastal wetland conservation efforts in China are still confronted with conflicts of multiple institutions and mechanisms, and are facing many difficulties. No uniform coordination mechanism has been made available. Therefore, the coastal conservation efforts in China still face arduous tasks.

The conservation of wetland ecosystems and their services depends on the integrity of such ecosystems. However, adequate or specific laws or regulations focusing on wetland protection and wise use have not yet been approved in China. Most of the existing laws and regulations are only related to the protection and management of some wetland factors. They include: Marine Environment Protection Law, the Forest Law, Water Pollution Prevention and Control Law, Land Administration Law, Law on the Protection of Wildlife, the Agriculture Law, the Fishery Law and the Grassland Law, etc. In the land use classification system under the Ministry of Land and Resources, wetland has not been listed as a land-use type. The marshes, mudflats and reed lands in coastal wetland areas are classed as ‘unused’ lands, and are thus become the targets of encroachment in balancing the cultivated land’s occupation and supplement, and in supplementing construction lands. In addition, under the interaction between land and sea, the area of coastal wetlands is constantly changing; no fixed boundary of coastal wetlands can be determined, making it hard to implement the protection. Furthermore, as various wetland ecosystem services have always been separated into different resource factors, and been managed by different agencies, the results of wetland conservation and use are contradictory, leading to severe degradation of these ecosystems.

At local level, the legislation on wetland conservation in coastal provinces/autonomous regions/municipalities still lags behind compared with other inland land types. Provincial-level regulations on wetland conservation are local regulations to promote wetland conservation efforts. In particular, the economically developed coastal provinces should lever their advantages in terms of economic output and fast growth to lead the way in wetland conservation and to make greater contribution to promoting conservation of coastal wetlands and migratory water birds. However, as of August 2015, provincial-level regulations on wetland conservation have not yet been promulgated in Tianjin, Jiangsu, Shanghai, Fujian or Hainan. In this respect, they lag behind the inland provinces such as Heilongjiang. This does not match the socio-economic development level in economically developed coastal

provinces.

The conservation efforts of coastal wetlands in China, in particular the water bird habitats, are still facing many institutional, mechanic, planning and technical obstacles. It is vitally important to better balance protection and development. As a factor-based management system is adopted for wetland (including coastal wetland) conservation in China, different management activities under multiple government agencies (e.g., agriculture, environmental protection, forestry and marine) may be overlap in the same wetland area. These activities have direct or indirect conflicts. For instance, a wetland area may involve cultivation under the management of agricultural sector, fishing activities under the fishery sector, water conservancy projects (water diversion with sluice gate) under the water resources sector, and bird management under forestry sector. This often results in the segmentation of wetland ecosystem management. In such context, different authorities just highlight the importance of their own management activities to achieve their own management objectives. Lack of coordination leads to poor management and does not contribute to the protection and management of various factors of a wetland area, to say nothing of protecting and managing the integrity and health of wetland ecosystem in an integrated way.

Moreover, conflict in wetland protection and economic development also exists between central and local governments. In furtherance of economic growth, some local governments are unwilling to include coastal wetlands into nature reserves. In Yancheng National Nature Reserve, for instance, there exists serious conflict between the national development plans and wetland conservation effort. As the area demanded for reclamation is too large but the pace of investment promotion cannot keep up, many mudflats that have been reclaimed are left unused or cannot be used efficiently. In addition, many local governments have neither acquired appropriate technologies for wetland conservation or restoration, nor have taken reasonable measures to protect their coastal wetlands. For example in the building of a national ecological park in Tianjin Binhai New Area, the excessive pursuit of large size and

focusing more on economic benefits than on ecological ones can be seen in conceptual plans, which may pose new risk to the health of local coastal wetland areas.

Finding # 6 : China and the United States have already conducted many explorations and practices on coastal wetland conservation. Many best practices and tools have been published to provide demonstration and reference for coastal wetland protection and management efforts. However, as the coastal wetland conservation efforts in China lag behind the United States, there are still many gaps in basic research, applied research and management models demonstration, making it a hard task for China to provide effective scientific and technological support for its coastal wetland conservation efforts.

Through years of research and experimental practice, China has developed many best practice management models for coastal wetlands:

- Successful coastal wetland conservation models include: the canceling of proposed reclamation project and implementation of wetland conservation project in Minjiang River estuary in Fujian; regulation of land use for the experimental zone in Yellow River Delta National Nature Reserve in Shandong; entrustment of Shenzhen Futian Mangrove National Nature Reserve in Guangdong to an NGO for protection and management; a win-win situation between mangrove protection and local community's economic development in Beilun River Estuary National Nature Reserve in Guangxi; and resources monitoring-based protection of Chongming Dongtan National Nature Reserve in Shanghai;
- Coastal wetland restoration models include: the wetland restoration model based on ecological water replenishment for Yellow River Delta National Nature Reserve in Shandong; mangrove restoration model of Zhanjiang Mangrove National Nature Reserve in Guangdong; and the model of restoring industrial wasteland to mudflat for Wusong Paotai Bay National Wetland Park in Shanghai;
- Water birds habitat management models include: the management model according to habitat types of Deep Bay and Mai Po wetlands in Hong Kong;

habitat management model focusing on the control of alien species at Chongming Dongtan National Nature Reserve in Shanghai; and habitat management model for Saunders' gull (*Larus saundersi*) at Shuangtai River Estuary National Nature Reserve in Liaoning;

- Wise use of coastal wetlands models include: the development of sustainable shellfish industry at Panjin Geligang wetland in Liaoning; wetland eco-tourism at Yellow River Delta National Nature Reserve in Shandong; wetland bird-watching at Dandong Yalu River Estuary National Nature Reserve in Liaoning; and the extensive cultivation of fish at fish farms in Haifeng wetland in Guangdong.

However, as the United States has started the protection efforts of coastal wetlands and waders relatively early, it has already established more advanced institutional and technical systems in this field, which can provide relevant reference for the coastal wetland conservation efforts in China. These best practices include: legislation on coastal wetland conservation; the model of combining the protection of wetland and water birds; mitigation bank; protecting easement; wetland restoration based on monitoring and scientific research; wetland restoration to reserve space for climate change; coordination and balance between/among different stakeholders; habitat management targeting different species; control of water level; prescribed fire; planting crops or wetland rotation plan; duck stamp system; wetland bird watching; and agricultural cropping based on water birds protection.

In our project, the case studies on coastal wetland protection and restoration in the United States, such as those in Chesapeake Bay, the Gulf of Mexico, Puget Sound Bay and Tijuana Estuary, are presented in detail. All these cases can provide inspiration for wetlands, in particular coastal wetlands, conservation in China.

As the wetland ecosystem protection and research efforts in China lag behind those on cropland, forest, grassland and marine ecosystems, basic research on the wetland ecosystem's structures, functions and processes is still weak. Furthermore, the applied research on wetland monitoring, protection, restoration and sustainable use is

insufficient, and the legislation and regulatory framework, policy and planning on wetland management need to be fundamentally improved. The short-comings and barriers in terms of basic research technical system and management tools on coastal wetland conservation in China are mainly evidenced in the following areas:

- The coastal wetland monitoring capacity in China is still weak, lacking monitoring of coastal wetland ecosystem's structures, functions and processes on a long-term, site-specific and dynamic basis, which has limited our understanding about the patterns of coastal wetland changes in China;
- Although the synchronous survey groups on coastal water birds and bird-watching associations in China have conducted such survey work on their own, the domestic data on China's coastal water birds is characterized by short time series and small number of survey sites compared with other systematic water birds data in USA (e.g., Audubon Society) with a time scale of more than 100 years;
- Although a large number of coastal wetland protection and restoration projects have been implemented in China over the last decade, these projects are short of scientific and technological support, and the basic research, R&D of key technologies, and demonstration of management models remain isolated with no integration or upscaling;
- The legislation and policy research capacity on wetland management in China is very weaker. Most of the financing and investment channels for wetland protection and restoration efforts depend on government channels, while administrative means are often used in wetland management.

(2) Main recommendations

Coastal wetland conservation efforts in China involve many agencies including forestry, marine, fishery, land and environmental protection sectors, as well as 11 coastal provinces/autonomous regions/municipalities. Therefore, the central government should, from a more systematic perspective, integrate the protection and restoration of coastal wetlands nationwide. Our specific recommendations

include the following:

Recommendation # 1: Strengthen wetland legislation at national level; revise the provisions of existing laws and regulations on coastal wetland conservation; enhance law enforcement and accountability; and develop an integrated management system on coastal wetlands.

It was stipulated at the 18th CPC National Congress that the country should be governed strictly according to law. The national legislation on wetlands including coastal wetlands, i.e., the formulation of *Regulations of the People's Republic of China on Wetland Conservation*, will be the most powerful approach to mainstream wetland conservation. It is also suggested that China should promote the revision of provisions related to coastal wetlands conservation under the existing laws and regulations in line with the international standards and conventions, decisions of the contracting parties' conferences, as well as the guiding principles of the CPC Central Committee and the State Council. These laws and regulations include: *Marine Environmental Protection Law of the People's Republic of China (1999)*, *the Forest Law of the People's Republic of China*, *Water Pollution Prevention and Control Law of the People's Republic of China*, *Land Administration Law of the People's Republic of China*, *Law of the People's Republic of China on the Protection of Wild Life*, *the Water Law of the People's Republic of China*, *the Fishery Law of the People's Republic of China*, *Regulations of the People's Republic of China on the Implementation of Terrestrial Wildlife Protection (1992)*, *Regulations of the People's Republic of China on the Implementation of Aquatic Wildlife Protection (1993)*, *Regulations of the People's Republic of China on Nature Reserves (1994)*, etc. It is important to clarify the legal definition of wetland, organize integrated survey and assessment on coastal wetlands on a systematic and regular basis, and effectively protect coastal wetlands. Meanwhile, efforts should be made to promote the five provinces/municipalities of Tianjin, Jiangsu, Shanghai, Fujian and Hainan to promulgate more specific provincial-level regulations on wetland conservation.

On the basis of relevant laws, a comprehensive law enforcement system on wetland conservation should be developed for key protected areas (e.g., Ramsar sites, wetlands of national importance, wetland national nature reserves, national marine protected areas, national wetland parks and national marine parks) to streamline the integrated management system of wetland ecosystems. It is also necessary to establish a coordination mechanism to balance the relationship between different agencies, between the central and local governments, and between protection and development interests.

Legal tools should be employed to restrict local governments' over-emphasis on economic development and hold government officials accountable for their disregard of laws or negative environmental consequences of their decisions. The area and healthy status of coastal wetlands should be included explicitly within the *Measures for Bringing Party and Government Officials to Account for Damage to the Ecological Environment*. Moreover, a scientific and systematic wetland monitoring system, as well as a system to assess the wetland ecological health should be established to conduct science-based assessment on the damage of coastal wetlands during the government officials' tenure as part of their performance appraisal. Effective measures should be taken to mainstream the coastal wetland conservation efforts into the key agendas of local party and government officials.

Recommendation #2: Incorporate coastal wetland conservation efforts into the overall planning of land spatial development and protection, implement pilot projects on integrated planning at coastal municipal/county levels; reassess and suspend the implementation of coastal wetlands conversion and sea reclamation projects that have previously been approved.

The *Integrated Reform Plan for Promoting the Ecological Civilization* was published by the CPC Central Committee and the State Council on September 21, 2015. This document specifies that an integrated spatial plan should be prepared at the national level to provide “guidance for national spatial development, spatial blueprint for sustainable development, and basis for implementing various development activities”;

it also specifies that integral planning should be gradually made available at the municipal/county level. To balance the relationship between economic development and eco-environmental protection, it is suggested that: the central government agencies take the lead in developing an integrated land spatial development and protection plan for eastern coastal areas of China; adopt an integrated ecological “redline” for the 11 coastal provinces/autonomous regions/municipalities; incorporate the coastal wetland areas which have key ecological functions but have not yet been designated as protected areas into the system of national nature reserves, provincial nature reserves, national marine protected areas and those sites defined by our project into the ecological “redline”, and implement appropriate protective measures.

It is necessary to carry out pilot projects on integrated planning in counties (municipalities) with large areas of coastal wetlands, mainstream coastal wetland conservation efforts into the production, living and ecological space plans at municipal/county level so as to provide best practices on integrated planning that can be expanded across the country. In the pilot projects, the land and resources agencies should focus on addressing the categorization of wetland, including the often overlooked inter-tidal zone, in national land categorization standards. If wetlands are still registered as “unused lands” in the integrated land spatial planning, the natural wetlands that have not yet been included into nature reserves or other types of protected areas cannot be put under effective protection, leaving them vulnerable to the impact of uncoordinated management activities.

Efforts should be made to balance the relationship between coastal wetland protection and reclamation, giving coastal wetland protection a heightened priority. The *Opinion of the Central Committee of the Communist Party of China and the State Council on Accelerating the Development of Ecological Civilization* specifies that efforts should be made to “implement strict systems on the control of sea reclamation total extent and natural coastlines; and establish a mechanism that integrates terrestrial and marine planning and regional cooperation on marine eco-environmental protection and restoration”. It is recommended to: conduct assessment on the reclamation projects that have been completed to define the advantages and disadvantages of these projects in economic and ecological development and ecological civilization and provide

theoretical support for the next-step economic planning; reassess the coastal wetland reclamation plans that have been approved but not yet implemented, strictly limit the approval of new mudflat reclamation projects, conduct ecological restoration on the coastal wetlands that have been converted but not developed to make them become appropriate habitats for water birds and other important marine life; and suspend the approval and construction of all the sea reclamation projects before the integrated land spatial development and protection plan has been developed for eastern coastal areas of China.

In 2002, Chinese President Xi Jinping, who served as governor of Fujian Province, ordered a halt to the wetland reclamation project in Minjiang River estuary in Fujian Province. Before that, Changle Municipal (a city at county-level) Government in Fujian had begun to conduct feasibility study on the proposed Shanyu Floodplain Reclamation Project. In 2001, Changle Municipal Planning Commission approved a reclamation project with an area of 1,000 mu (about 66.67 hectares). In response to a special report entitled “Experts call on conducting rescue-based protection of Minjiang River estuary” which was published on Bamin Express (Bamin Kuaixun), Xi Jinping made an important instruction on April 15, 2002: “Wetland conservation is a key component of ecological conservation. To build a province focusing on ecological conservation, we should pay attention to wetland conservation.” After that, Changle Municipal Government canceled the proposed Minjiang River estuary reclamation project, and established Minjiang River Estuary Nature Reserve at County Level in 2003. It was upgraded to a provincial-level and national nature reserve in 2007 and 2013, respectively. In 2006, Minjiang River Estuary National Wetland Park was established by Changle Municipal Government to the southwest of the nature reserve. At present, Minjiang River estuary provides key feeding sites for Chinese crested tern (*Thalasseus bernsteini*), one of the most critically endangered species in the world, which has also become a best practice for mainland China and Taiwan to jointly conduct nature conservation.

Recommendation #3: Establish a sound ecological civilization performance appraisal and accountability system, conduct pilot projects on a long-term wetland conservation compensation mechanism; enhance coastal wetland eco-compensation, protection and restoration projects, and improve the quality and ecological services of coastal wetlands.

As the coastal wetlands in China are facing severe challenges, the strictest policy on coastal wetland conservation should be implemented. It is necessary to define a system on the ownership, responsibility and regulation of wetland use, establish a system of “zero loss” for wetland conservation, and mainstream “zero loss” of coastal wetlands into the ecological civilization performance appraisal and accountability system of the governments in China’s 11 coastal provinces/autonomous regions/municipalities and prefectural-level municipalities. Zero loss should include zero loss of habitat area and also zero loss of functional ecological service.

Enhancing the development and management of coastal wetland protected areas. Efforts should be made to support the development of nature reserves, national wetland parks and other conservation-based infrastructural development projects, as well as the coastal wetland ecological monitoring system, public awareness and training system, implement projects related to the restoration of habitats for migratory water birds, returning aquatic farms to tidal mudflats, prevent and control invasive alien species, and restoration of mangroves; demonstrate the ecological integrated use of high-efficiency and three-dimensional agriculture, the wise use of mangrove and other wetlands so as to develop a more rational and sustainable use model for coastal wetlands; introduce a independent third-party appraisal mechanism to assess the conservation projects which have been completed and to summarize the best practices and models on coastal wetland protection and management.

China should assess the values of coastal wetland ecosystem services, compensate for wetland conservation efforts according to those findings, and develop a mechanism for determining ongoing investments in coastal wetland protection and restoration. The best practices and concepts both at home and abroad on wetland conservation can

be used as reference to expand diverse financing mechanisms for wetland conservation. In particular, the experiences of the USA can be learned to conduct pilot projects on “mitigation banks” and “transaction of easement” in China’s coastal areas, and adopt such policies as “supplementing after occupying” or “supplementing before occupying” of natural coastal wetlands in order to maintain the area of natural coastal wetlands in the country. As for the coastal wetland areas that are of national and international importance and have high biodiversity conservation values (in particular the key habitats for migratory birds, fish spawning grounds, feeding grounds and wetland areas that can help mitigate and adapt to the impact of climate change), it should be strictly prohibited to reclaim or assign such coastal wetlands. The measures including “transaction of easement” (e.g., through redemption or lease) can be taken to regulate the right of wetland use without changing its ownership. These measures are aimed to limit the over-exploitation of key coastal wetland resources and achieve effective conservation of coastal wetland ecosystem and biodiversity.

Recommendation #4: Implement a system of managing coastal wetland areas according to different levels, build new coastal wetland protected areas or expand the scope of existing protected areas to establish a sound system of coastal wetland conservation.

Implement a system of managing coastal wetlands according to different levels. Depending on the importance, the coastal wetland areas will be categorized into wetlands of national importance (including Ramsar sites), wetlands of local importance and wetlands of general importance. The wetlands of national importance can consist of national key ecological function areas defined in the National Main Functional Area Planning, national nature reserves, national special marine reserves, national wetland parks and other types of wetland protected areas at national level. The wetlands of local importance will be designated by provincial governments. Other types of wetlands will be listed as wetlands of general importance.

To address the problems of gaps and spatial mismatching in coastal wetland

conservation, wetland protected areas such as wetland nature reserves and wetland parks should be established in the areas which have not yet been put under effective protection. This is designed to increase the protection area of coastal wetlands, enabling the coastal wetland protection rate to rise from the current 24 percent to the mean level of national wetland protection rate (43.5 percent).

At present, 22 species of water birds in China's coastal wetlands are globally threatened. It is suggested to select some threatened species such as Spoon-billed sandpiper (*Eurynorhynchus pygmeus*), Chinese crested tern (*Thalasseus bernsteini*), Red-crowned crane (*Grus japonensis*), and Oriental white stork (*Ciconia boyciana*) as flagship species to promote key protection. The key habitats with important protection values for migratory water birds along EAAF should be selected as key protected areas to build new nature reserves or expand the scope of existing nature reserves. By comprehensively analyzing water bird population data and the existing protection system, our project has selected 11 such habitats for water birds (Table 4 and Figure 4).

- The governments of coastal provinces/municipalities (e.g., Liaoning, Jiangsu, Zhejiang and Shanghai) are suggested to urgently establish eight new nature reserves in critical water bird habitats that have not yet been included into the protection system. These habitats include: Luannan wetland in Hebei; Binhai wetland in Binhai New Area, Tianjin; Ganyu, Lianyungang and Rudong mudflats in Jiangsu; Haiwan Town beach in Shanghai; Hangzhou Bay and Wenzhou Bay wetland in Zhejiang.
- The environmental protection and forestry agencies are suggested to change or expand the area of three nature reserves: include the surrounding beaches of Dandong Port in Liaoning into Liaoning Yalu River Estuary National Nature Reserve; include the coastal mudflats in Dongtai, Jiangsu into Jiangsu Yancheng National Nature Reserve; and include Nanxiaohe area in Panjin into Liaohe River Estuary National Nature Reserve.
- The State Forestry Administration (SFA) and other competent authorities are suggested to develop a special programmatic plan for coastal wetland

conservation, provide technical guidance and financial support for the protection and restoration of such coastal wetlands, and protect EAAF as a whole.

On the basis of integrating data from various sources, and according to the findings on protection priority areas and gap analysis, the project has defined 94 key coastal wetlands that have not yet been included in the protection system. These coastal wetlands, including habitats for water birds, coastal habitats for mollusks, mangroves, seaweed/seagrass beds, and other representative ecosystems, are suggested to be included into the list of ecological protection redlines (Table 5). A total of 198 coastal wetland sites, including 32 existing national nature reserves, 51 existing provincial nature reserves, and 21 existing national special marine reserves, should be listed into the first group of coastal wetlands that are included into ecological redline (Figure 5).

Recommendation #5: Enhance basic scientific research on coastal wetlands, proactively carry out monitoring and assessment of coastal wetland ecosystem, study and develop technical models for coastal wetland protection and restoration to provide a strong scientific and technological support system for coastal wetland protection and management.

To address the challenges and bottlenecks in terms of scientific and technological support system for coastal wetlands in China, the relevant government authorities are suggested to align research institutions and universities to fully enhance scientific research on coastal wetlands, solve key technical problems on restoration of degraded coastal wetlands, and study the roles of coastal wetlands in tackling climate change.

As coastal wetland ecosystem is a dynamic transition zone between the land and the sea, it involves a complex and unique mechanism in ecosystem formation and process maintenance. Therefore, it is important to conduct monitoring and experiment on coastal wetlands on a long-term, site-specific and dynamic basis. A monitoring and

research network on coastal wetlands should be established to include key coastal wetlands into the planning and operational scope of National Eco-environmental Monitoring Network Programme. More specifically, coastal wetland monitoring indicator systems and technical protocols should be developed to build a sound technical platform for basic research on the structures, functions and processes of coastal wetland ecosystem, and to provide scientific data for assessing coastal wetland ecosystem services.

Coastal wetlands in China provide key habitats for migratory birds along EAAF. As the species, population and distribution of migratory birds during different seasons vary from each other, they have quite different needs for food and habitats. Conducting synchronous survey and reporting on coastal water birds, therefore, is considered an important tool to acquire these scientific data and establish real-time monitoring of the major flocks of migratory shorebirds. The relevant authorities are suggested to proactively organize and lead international environmental protection NGOs, environmental protection civil society groups, and bird-watching lovers, etc. to conduct synchronous survey on migratory birds on regular basis, and to provide scientific data for the protection and restoration of coastal habitats for water birds.

The basic research on coastal wetland ecosystem, the R&D of key technologies on restoration of degraded ecosystem, and demonstration of technologies for optimal ecosystem management in typical areas constitute an inter-connected, scientific and technological innovation chain. Thus, the Ministry of Science and Technology (MOST), SFA and other agencies are suggested to launch the science and technology action plan on the restoration of degraded coastal wetlands at the earliest possible date, integrating the basic research on the structures, functions and processes of coastal wetland ecosystem, R&D of key technologies for the restoration of degraded ecosystem, and demonstration of optimal ecosystem management. At the current stage, focus should be made on solving the technical problem of preventing and controlling the fast spread of *Spartina alterniflora*, an alien pest species doing much damage along coastal areas.

In addition, the best practices of the United States and other countries in coastal wetland management should be learned and applied to promote the research on wetland legislation, institution, policy and planning in China, and to develop a suitable coastal wetland management system, mechanism and institution with Chinese characteristics. In the near future, focus should be made on: studying the wetland legislation and financing and investment systems; implementing pilot projects on such policies as coastal wetland entrustment-based management (i.e., entrusting the coastal wetland management to international environmental protection NGOs or domestic environmental protection civil society groups), “wetland net loss” or “transaction of easement”; and effectively engaging the social forces (in particular the wetland occupiers) in providing financial support for the protection and restoration of coastal wetlands.

Recommendation #6: Promote the development of a coastal wetland conservation network in China, extensively implement activities to raise public awareness on the importance of conserving coastal wetlands and migratory water birds, involve the general public and social forces in conserving coastal wetlands and migratory water birds, and actively participate in international cooperation and exchange on coastal wetlands and migratory water birds conservation.

It is important to promote the development of coastal wetland conservation network in China and build a communication and cooperation platform involving diverse stakeholders and the general public. Different organizations (e.g., China Wetland Conservation Association, China Coastal Wetlands Conservation Network, local bird-watching associations, domestic and international environmental protection NGOs) should be fully levered to organize activities that raise public awareness on the importance of conserving coastal wetlands and migratory water birds, and to engage them in conservation activities. It is also necessary to advocate and promote nationwide bird-watching and eco-tourism activities in coastal wetlands. To

disseminate knowledge on the conservation of coastal wetlands and migratory water birds, the relevant organizations or institutions can compile and publish some brochures and reports in this area, such as the Handbook on Bird-Watching in Coastal Wetlands (Series of books), Report on the Status of Coastal Wetlands Protection in China, and Technical Protocols on Synchronous Survey and monitoring of Coastal Water Birds.

China is a state contracting party of a number of international conventions including Ramsar Convention, and the Convention on Biological Diversity. It has also signed bilateral agreements on migratory birds protection with Japan, South Korea, Australia and other countries. The relevant government agencies are obliged to conscientiously implement the international conventions and agreements related to wetland conservation; promote China to join the Convention on the Conservation of Migratory Species of Wild Animals (CMS); further improve the mechanism of implementing EAAFP; expand the Flyway Site Network; enhance the bilateral cooperation mechanism on the conservation of migratory water birds; and strengthen international cooperation in terms of wetland scientific research, protection and management.

Efforts should also be made to facilitate international cooperation and exchange on wetland conservation with relevant international NGOs, and engage them in coastal wetland protection and management in China. This will play a significant role in promoting sustainable development of eastern coastal areas in China, helping perform the obligations of China in global conservation, and demonstrating China's image as a responsible major country.

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