

# Selecting a suite of potential partner sites for the Adelaide International Bird Sanctuary to aid shorebird conservation in the East Asian–Australasian Flyway

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**Abstract.** Migratory shorebird species depend on a suite of interconnected sites and protection of these sites as part of a network is an increasingly used conservation approach. Partnering sites based on shared migratory bird species can be a powerful tool for implementing conservation action. To assist the Adelaide International Bird Sanctuary (AIBS), South Australia, in expanding their conservation impact across the East Asian–Australasian Flyway, we generated a list of 81 sites to consider for potential partnerships. We developed the list using existing shorebird count data for seven high priority migratory shorebirds that spend the austral summer at AIBS, such as Bar-tailed Godwit (*Limosa lapponica*) and Great Knot (*Calidris tenuirostris*). We computed a scaled abundance across all species to develop a categorical indicator of importance of each potential site for its shared species richness and abundance. Based on assessments of literature, existing conservation plans, and interviews with experts, we also evaluated each potential site's feasibility for ecotourism, conservation management, and existing or potential partnerships. This process resulted in a list of 20 sites for the AIBS to consider for possible partnerships in nine countries that met some combination of values for shared shorebird species, inclusion in one or more current site designation schemes, existing or potential opportunities for tourism, habitat management, or partnerships. Additional sites that either have high or medium abundances of shared shorebird species or that have been designated as important by other criteria (Ramsar, Important Bird and Biodiversity Area) were identified. We recommend this methodology be applied to other sites seeking to form cross-boundary partnerships to help further the conservation of highly mobile species.

**Additional keywords:** Flyway Network Site, Ramsar Convention, Important Bird and Biodiversity Area, South Australia, migratory shorebirds, Eastern Curlew, *Numenius madagascariensis*, Great Knot, *Calidris tenuirostris*, Red Knot, *Calidris canutus*, Red-necked Stint, *Calidris ruficollis*, Curlew Sandpiper, *Calidris ferruginea*, Sharp-tailed Sandpiper, *Calidris acuminata*, Bar-tailed Godwit, *Limosa lapponica*.

Received 3 November 2018, accepted 21 May 2019, published online 8 July 2019

## Introduction

Long-distance migratory shorebirds are among the most charismatic and vulnerable migratory species of birds, due to the great distance between breeding and non-breeding ranges, vulnerability of population concentrations at staging sites to localised threats, and rapid destruction of their habitat in some regions (Myers 1983; Bamford *et al.* 2008; MacKinnon *et al.* 2012; Iwamura *et al.* 2014; Runge *et al.* 2014, 2015; Studds *et al.* 2017). These challenges suggest that the conservation of such species requires extensive cooperation and coordination among

sites that connect the migratory routes. This need has given rise to various cross-boundary networks of sites important for migratory birds to promote the need for a shared conservation approach, as well as to facilitate knowledge and technical exchange and obtain pledges of cooperation in conservation among governments and non-governmental organisations. One example of such a network is the East Asian–Australasian Flyway Partnership (EAAFP), which was established in 2006 to provide a flyway-wide framework to promote collaboration, cooperation, and communication for the conservation of

migratory waterbirds and their habitats in the Asia-Pacific region (EAAFP 2012; Szabo *et al.* 2016). Networks have been developed in other parts of the world, including the Western Hemisphere Shorebird Reserve Network covering most of North, Central, and South America and the Caribbean, and the Agreement on the Conservation of African-Eurasian Migratory Waterbirds that functions in Eurasia and Africa.

Numerous recent analyses point to the high degree of threat and relatively precarious conservation status of migratory shorebirds and other waterbirds that occur in the East Asian–Australasian Flyway (EAAF; MacKinnon *et al.* 2012; Piersma *et al.* 2016, 2017; Studds *et al.* 2017). One of the key roles of the EAAFP is to identify and recognise internationally important sites for migratory waterbirds across the EAAF by formally including them in the EAAFP's Flyway Site Network. Criteria for inclusion in the Network include whether a site meets criteria for designation as a site under the Ramsar Convention on Wetlands of International Importance (modified for migratory waterbirds) or whether it supports a large number of individuals or percentage of individuals of a population, subspecies, or species of waterbird (for shorebirds, the standard reference for determining this percentage is Bamford *et al.* 2008; as amended by Hansen *et al.* 2016) (see EAAFP 2019).

A second objective of the EAAFP is to promote linking of specific sites in order to encourage deeper engagement in information sharing and exchange of technical knowledge and other resources. This program is known as the 'Sister Site Program' under the EAAFP; as of 2018, there were eight such sister site linkages encouraged by EAAFP (EAAFP 2018). However, no specific guidance is given by EAAFP for determining how to select possible sites for linking or partnering and there are very few examples of a process to enable such connections to be found for other flyways (see BirdLife International 2013 for an example). Such guidance could increase the ease of assessing partner site opportunities. We use the Adelaide International Bird Sanctuary (AIBS) in South Australia, a relatively new Flyway Network Site, whose managers were seeking opportunities to partner with other sites in the Flyway, as a case study in how to develop quantitative criteria for choosing potential sites to link with, based on seven important shorebird species that occur at AIBS, and supplement that with additional, more qualitative, information. In this analysis we assume that linkage sites should share as large numbers of as many of the same species as possible to provide an expectation of a positive outcome for these shared species. We then complement this species-level analysis with a more qualitative assessment of practical and political issues that effectively would constrain any functional site partnership.

## Materials and methods

The AIBS is located in south-eastern South Australia, Australia. It is a key terminal site in the East Asian–Australasian Flyway and is known to harbour up to 20 000 individual shorebirds of 52 species (DEWNR 2018a). At its proclamation in 2014, the AIBS initially spanned over 50 km of coastline from Adelaide's port and industrial centre, to low density agricultural land in the north along the Gulf St Vincent (DEWNR 2018a). It eventually expanded through its declaration as an EAAFP site (site #131) in

December 2016 to incorporate all of the important sites to the top of the Gulf and around to Yorke Peninsula totalling 37 069 ha (EAAFP 2016). The EAAFP site includes several existing protected areas and the Adelaide International Bird Sanctuary National Park–Winaityinaityi Pangkara (the latter part of the national park name meaning 'country for all birds' in the language of the Kaurna people, the traditional owners/custodians of the land). The national park was specifically created to achieve the policy goals of the AIBS through major land acquisitions and targeting significant holdings of government land (including coastal land). The national park's first stages were proclaimed in 2016 and 2017, with more land being incorporated over the coming 2 years, and currently consists of 14 633 ha – an important achievement in securing land use for conservation in a metropolitan centre (DEWNR 2018a). Several other protected areas occur in the Flyway Network Site, which complement the goals of the AIBS as critical feeding and roosting sites for waterbirds.

The criteria for including AIBS in the EAAFP included the presence of nationally significant numbers of Eastern Curlew (*Numenius madagascariensis*) and Great Knot (*Calidris tenuirostris*), two species listed as globally Endangered on the IUCN Red List (<https://www.iucnredlist.org/>) and nationally Critically Endangered under Australia's *Environment Protection and Biodiversity Conservation Act 1999*; nationally significant numbers of Bar-tailed Godwit (*Limosa lapponica*), Curlew Sandpiper (*Calidris ferruginea*), and Sharp-tailed Sandpiper (*Calidris acuminata*); and internationally significant numbers of Red Knot (*Calidris canutus*) and Red-necked Stint (*Calidris ruficollis*) (see for example counts at or adjoining AIBS over time including Purnell *et al.* 2012, 2015, 2017; Rogers and Cox 2018). These seven species have been targeted by AIBS for their conservation status and their representation across several bird guilds (DEWNR 2018b) and are the focal species for this analysis.

To provide an overview of the options for sister sites for AIBS based on shared shorebird species, we compiled a list of all sites in Bamford *et al.* (2008) outside of Australia and New Zealand (to exclude terminal sites) that contained at least the 1% threshold of the population estimate for the flyway for at least one of the seven long-distance migratory species of shorebird listed above that qualify AIBS as an EAAFP site. For each site, we extracted the maximum count for any of the seven species which occurred there. Since these data were based on published and unpublished sources from ~1986 to the mid-2000s, we updated the counts with more recent count data available in Conklin *et al.* (2014) and Bai *et al.* (2015) for any site for which there was a more recent, higher count. To this list, we also added sites listed in Xia *et al.* (2016) to expand the list of potentially important sites in coastal China. These additional Chinese sites were then cross-checked against Bamford *et al.* (2008), Conklin *et al.* (2014) and Bai *et al.* (2015) to extract any additional count information for the seven species contained in these latter references. The wide temporal range in data availability across so many sites poses a challenge, but it reflects the reality that most sites are not surveyed at regular intervals, much less at the same time. Furthermore, we suggest that extracting the maximum species count over time provides an indicator of what numbers a site could hold, which we propose is an indicator of its relative (potential) linkage importance.

For each site, we then calculated a scaled abundance for each of the seven species at each site by dividing the maximum count at a site by the maximum for that species across all sites. The scaled abundances were then added across species to compute a site ‘importance’ score, ranging from zero (if a site had none of the species) to a theoretical maximum of seven (if a site had the highest count for all seven species). In this methodology, a higher score indicates more of the focal species occurring at higher abundances at a site than a lower score; hence, a higher score could be considered as a more ‘important’ shared site for hosting the focal species. Due to the skewed nature of the importance scores (few high values and many low values) and coarseness of the data, we also assigned an importance rank of high, medium, or low to each site by partitioning the sites into three roughly equivalent size bins.

Establishing effective, productive, and long-lasting partner relationships requires more than the known presence of shared shorebird species. Such a relationship should consider other factors, such as identification of the site as important by regional or global entities, existence of an established protected area (or conservation zone), presence of a managing entity, and existence of already functioning partnership support. These additional factors plus the identification of shared shorebird species should both be used to identify potential partner sites. Therefore, the shorebird importance analysis was complemented with an extensive review of a variety of regional, national, or flyway-wide assessments of existing or potential waterbird conservation sites conducted by several scientific teams from various organisations. Our goal was to obtain relevant information on as many sites as possible to document their importance with a variety of criteria, including importance for the EAAF, importance for other conservation values (e.g. Ramsar designation, Important Bird and Biodiversity Area (IBA) status), and overall region-wide conservation value. These assessments included: MacKinnon *et al.* (2012), Conklin *et al.* (2014), Bai *et al.* (2015), Hua *et al.* (2015), Paulson Institute (2016), Xia *et al.* (2016), Ramsar Convention (<http://www.ramsar.org/>), EAAFP Flyway Site Network (<http://www.eaaflyway.net/>), and BirdLife International’s IBA program (<http://datazone.birdlife.org/site/search>).

## Results

The resulting site database contained 81 potentially important shorebird sites from 14 countries (China 30, Republic of Korea 14, Russia 10, Japan 6, USA (Alaska) 6, Malaysia 4, Indonesia 3, Papua New Guinea 2, Bangladesh 1, Myanmar 1, Democratic People’s Republic of Korea 1, Philippines 1, Singapore 1, Thailand 1) with an average ‘importance’ score of 0.37 and a range of 0.00 (Sungei Buloh Wetland Reserve, Singapore, and Qupaluk, USA) to 2.89 (Yalu Jiang National Nature Reserve, China) (Appendix 1). There were seven sites ranked as High (importance score  $\geq 1.00$ ), 22 sites ranked as Medium (importance score  $< 1.00$  and  $> 0.25$ ), and 52 sites ranked as Low (importance score  $\leq 0.25$ ).

Combining the shorebird importance of sites with the results of the regional, national, or flyway-wide assessments yielded several tiers of sites for AIBS to consider for exploring potential partnerships. The first tier consisted of sites that had shorebird importance of high or medium and that have been designated as

either an EAAFP Flyway Network Site, Ramsar site, or identified IBA. This tier contained 20 sites and can be regarded as the highest priority or of highest interest for exploring partnerships (Table 1). The second tier of sites included those with a high or medium importance for shorebirds but without any EAAFP, Ramsar, nor IBA designation. This tier contained nine sites and deserves additional research by AIBS to consider partnership development, particularly as to whether any of the sites are in process of or could be designated by either EAAFP, Ramsar, or the IBA program (Table 2). The third tier of sites consisted 32 sites of low shorebird importance that have been designated by either EAAFP, Ramsar, or the IBA program; we consider these of lower importance for partnership consideration as the abundance of the focal shorebird species is relatively low (even though the designation indicates their broader importance for conservation) (Table 3). A fourth tier, which included 20 sites, were those of low shorebird importance with no additional designation. Although we do not recommend these sites be considered further for partnerships with AIBS, they are listed in Appendix 1.

## Discussion

The preliminary, realm of potential partnerships for a site like AIBS is large, as shown by the 61 combined sites in Tables 1, 2 and 3. However, filtering the list of sites to begin the work of narrowing choices to help establish an effective conservation partnership requires assessing more qualitative variables, in addition to the presence of species-level connections. To do this, we reviewed published and unpublished literature to assess the capacity of each partner site in terms of existing or potential for ecotourism based on the birds or other natural values of the site, habitat management capability, and the presence of existing or potential for international partnerships with governments or civil society. We recognise that this assessment was preliminary in nature and based on accessible literature; review of these qualitative variables should be part of the partnership evaluation process. This review narrowed the list of recommended sites for AIBS to consider for partnership exploration to 20 (Fig. 1; Table 4) and our criteria for inclusion in this short list of top partnership recommendations included designation of the site by either EAAFP, Ramsar, or the IBA program (with one exception) and classification of the potential for ecotourism or habitat management or existing protected area as either medium or high (with six exceptions). The one non-designated site we included was Luannan Coast, Hebei Province, in China. The importance of this area for shorebird conservation has emerged in recent years and consideration for protected area designation is a possibility (Rogers *et al.* 2010; Yang *et al.* 2011; Murray *et al.* 2014; Murray and Fuller 2015; Piersma *et al.* 2016, 2017; Paulson Institute 2016, 2017; Szabo *et al.* 2016; Hassell *et al.* 2017; Studds *et al.* 2017). The six exceptions for ecotourism, habitat management, or protected area classification (Shuangtaihekou National Nature Reserve, China; Song Do Tidal Flat, Republic of Korea; Mundok Migratory Bird Wetland Reserve, Democratic People’s Republic of Korea; Sonadia and Moheshkhali Island, Bangladesh; Inner Gulf of Thailand; Moroshechnaya River Estuary, Russia) were included on the list to enhance the geographic array of potential partner sites throughout the Flyway.

**Table 1. List of potential partner sites for the Adelaide International Bird Sanctuary that have high or medium importance for the seven focal shorebird species and that have been designated by one or more of the EAAFP, Ramsar Convention, or Important Bird and Biodiversity Area program**  
Sites are listed alphabetically by country and site name. Importance rank is shorebird importance (H = high, M = medium). EAAFP indicates if the site is a Flyway Network Site and, if so, its identifying number. Ramsar indicates if the site is a designated Ramsar site and, if so, its identifying number. IBA indicates if the site is a recognised Important Bird and Biodiversity Area by BirdLife International and, if so, its identifying code

Site name	Country	Importance rank	Importance score	EAAFP	Ramsar	IBA
Chongming Dongtan National Nature Reserve <sup>A</sup>	China	M	0.34	#002	#1144	CN375
Huang He Delta National Nature Reserve <sup>A</sup>	China	M	0.52	#006	#2187	CN327
Laizhou Wan <sup>A</sup>	China	M	0.38			CN328
Lianyungang Coast (Linhongkou and Liezikou) <sup>A</sup>	China	H	1.22			CN365
Shuangtaihekou National Nature Reserve <sup>A</sup>	China	H	1.44	#004	#1441	CN052
Yalujiang Estuary National Nature Reserve <sup>A</sup>	China	H	2.89	#043		CN062
Yancheng National Nature Reserve <sup>A</sup>	China	M	0.92	#005	#1156	CN367
Zhuanghe Wan <sup>A</sup>	China	M	0.57			CN059
Mundok Migratory Bird Wetland Reserve <sup>A</sup>	DPRK	M	0.39	#045		KP019
Asan Bay <sup>A</sup>	ROK	M	0.59			KR017
Ganghwa Island <sup>A</sup>	ROK	M	0.47			KR005
Geum Estuary <sup>A</sup>	ROK	M	0.92	#100	#1925	KR019
Nakdong Estuary	ROK	M	0.55	#097		KR037
Namyang Bay <sup>A</sup>	ROK	M	0.47			KR010
Saemangeum Area <sup>A,B</sup>	ROK	H	1.73			KR021, KR022
Yeongjong Island <sup>A</sup>	ROK	M	0.41			KR006
Daursky Nature Reserve	Russia	M	0.33	#020		
Moroshechnaya River Estuary	Russia	H	2.85	#001	Yes	RU3114
Egegik Bay	USA	M	0.44			Yes
Yukon-Kuskokwim Delta	USA	H	1.27	#109		Yes

<sup>A</sup>Site located in the Yellow Sea.

<sup>B</sup>Most current shorebird value lost due to land reclamation (Moore *et al.* 2008, 2016).

**Table 2. List of potential partner sites for the Adelaide International Bird Sanctuary that have high or medium importance for the seven focal shorebird species but are not designated by either EAAFP, Ramsar, or Important Bird and Biodiversity Area program**

Sites are listed alphabetically by country and site name within shorebird importance rank. Importance rank is shorebird importance (H = high, M = medium)

Site name	Country	Importance rank	Importance score
Luannan Coast and Saltworks <sup>A</sup>	China	H	2.64
Dandong Port East <sup>A</sup>	China	M	0.98
Daqing He and Shi Jiu Tuo <sup>A</sup>	China	M	0.33
Dongsha Islands <sup>A</sup>	China	M	0.56
Huanghua Coast <sup>A</sup>	China	M	0.52
North Bo Hai Wan <sup>A</sup>	China	M	0.30
North-west Bohai Bay <sup>A</sup>	China	M	0.98
Tianjin Coast <sup>A</sup>	China	M	0.92
Banyuasin Delta	Indonesia	M	0.60

<sup>A</sup>Site located in the Yellow Sea.

As part of this analysis of potential partnership sites for AIBS, we highlight one specific geographic area that contains consistently high concentrations of the focal shorebird species for AIBS: the coast of the Yellow Sea of China, Democratic People's Republic of Korea, and Republic of Korea. The importance of this area for avian and wetland conservation is confirmed by Flyway-wide analyses such as MacKinnon *et al.* (2012) and Conklin *et al.* (2014). This geographic area has the highest known density of important sites and individual shorebirds, a fact known since at least the publication of Barter (2002) and most recently

highlighted by Hua *et al.* (2015). Habitat degradation is the main threat to shorebird areas of the Yellow Sea and the extent of wetland losses in the region are well documented by many sources (e.g. Yang *et al.* 2011; Ma *et al.* 2013; Murray *et al.* 2014; Murray and Fuller 2015; Piersma *et al.* 2017). Shorebird species which use the Yellow Sea for stopover have been shown to be severely declining and that the rate of decline is correlated with the degree of reliance on the Yellow Sea as a stopover site (Piersma *et al.* 2016; Studds *et al.* 2017). Of the 61 sites listed in Table 1, 2 and 3, 30 (49.2%) are in the Yellow Sea region in the



**Table 3. List of potential partner sites for the Adelaide International Bird Sanctuary that have low importance for the seven focal shorebird species and that have been designated by one or more of the EAAFP, Ramsar, or Important Bird and Biodiversity Area program**

Sites are listed by country and then alphabetically by site name. EAAFP indicates if the site is a Flyway Network Site and, if so, its identifying number. Ramsar indicates if the site is a designated Ramsar site and, if so, its identifying number. IBA indicates if the site is a recognised Important Bird and Biodiversity Area by BirdLife International

Site name	Country	EAAFP	Ramsar	IBA
Sonadia and Moheskhal Island	Bangladesh	#103		
Inner Deep Bay (Mai Po and Futian Nature Reserves)	China, Hong Kong	#003	#750	HK001, CN496
Ganyu Coast <sup>A</sup>	China			Yes
Jiaozhou Wan <sup>A</sup>	China			Yes
Wudi Zhanhua Coast <sup>A</sup>	China			Yes
Nanhuidongtan <sup>A</sup>	China			CN377
Pesisir Timur Pantai Sumatera Utara	Indonesia			ID007
Sone Higata	Japan			JP135
Mukawa Kako	Japan			JP027
Fukiagehama Kaigan	Japan			JP153
Arao Kaigan	Japan			JP140
Isahaya Higata	Japan			JP141
Daijugarami	Japan			JP140
Bako-Buntal Bay	Malaysia	#112		MY037
Pulau Bruit	Malaysia			MY042
North-central Selangor Coast	Malaysia			MY011
Inner Gulf of Martaban	Myanmar			MM056
Manila Bay	Philippines			PH010
Khairyuzova Bay	Russia			RU3113
Schastiya Bay	Russia			RU3146
Lososei Bay	Russia			RU3167
Terpeniya Bay	Russia			RU3165
Sungei Buloh Wetland Reserve	Singapore	#073		SG001
Suncheon Bay	ROK	#079	#1594	KR031
Cheonsu Bay <sup>A</sup>	ROK	#046		KR018
Han-Imjin Estuary <sup>A</sup>	ROK			KR004
Song Do tidal flat <sup>A</sup>	ROK		#2209	
Inner Gulf of Thailand	Thailand		#1099	TH032
Cinder Lagoon	USA			Yes
Port Heiden	USA			Yes
Port Moller/Nelson Lagoon/Mud Bay	USA			Yes
Qupaluk	USA	#133		

<sup>A</sup>Site located in the Yellow Sea.

coastal provinces of China (Liaoning, Hebei, Tianjin, Shandong, Jiangsu, Shanghai), Democratic People's Republic of Korea, or Republic of Korea. The Yellow Sea is a priority for shorebird conservation in the entire Flyway and deserves attention as an area to look for partner sites for AIBS.

Several sites outside the Yellow Sea region in several countries emerge from this analysis as potential areas for partnerships. Of these, only two emerged as having documented high to medium use by the seven focal shorebird species: Moroshechnaya River Estuary, Russia, and Yukon-Kuskowim Delta, USA. Several other sites seem worthy of exploration of partnerships in various countries but had low use by the seven focal shorebird species, possibly because of limited or incomplete data. Note that many of these sites are important for shorebirds more broadly, just not for the seven focal species. However, all sites are of documented importance as wetlands by one or more of the regional designation schemes, and seem to have some form of current protected status and a viable management entity. These include the Mai Po Nature Reserve,

Hong Kong; Bako-Buntal Bay, Malaysia; Inner Gulf of Thailand; and Sungei Buloh Wetland Reserve, Singapore.

We highlight two sites that have low value for shared shorebird species with AIBS but are very high on the list for their existing ecotourism facilities and opportunities and for their wetlands and shorebird habitat management capabilities: Mai Po Nature Reserve, Hong Kong, and Sungei Buloh Wetland Reserve, Singapore. Both sites have outstanding reputations in the Flyway for the ease with which visitors can see the sites; for being centres for nature-based tourism for local, regional, and international wildlife watchers; and for being models for wetland management and training. Despite their relatively low value specifically for the seven AIBS focal species of shorebirds, both sites harbour a large diversity of wetland birds and would make for strong partnership opportunities. We note that although Sungei Buloh Wetland Reserve is listed by EAAFP as being part of an existing sister site linkage, we see no reason why multiple linkages should not be considered as part of the evaluation process.



**Fig. 1.** Recommended sites for partnership exploration for the Adelaide International Bird Sanctuary. Shown are 18 of the 20 recommended sites, with two sites in Alaska, USA, excluded due to map size constraints. Sites shown are those that have been designated as an East Asian–Australasian Flyway Network Site, Ramsar Wetland of International Importance, or Important Bird and Biodiversity Area and have high or medium potential for ecotourism, habitat management, or are an existing or potential declared protected area.

We suggest that a framework such as that employed above which combines a method for determining sites that share species with an assessment of conservation partnership capacity is needed for developing partnerships across broad regions such as a flyway. The framework could be augmented by global positioning system (GPS) satellite tracking and/or colour

marking and resight data to determine with greater specificity the geographical links between specific sites for individual shorebirds. However, for many sites, this could be limited: for example we are only aware of very limited such data from the AIBS, with the exception of several Bar-tailed Godwit (Purnell *et al.* 2015), which provide limited sample size for analysis, and

**Table 4. Summary of sites recommended for partnership consideration for Adelaide International Bird Sanctuary with selection criteria.**

Importance Rank is shorebird importance (H = high, M = medium, L = low). Site recognition indicates if the site is designated by either the EAAFP, Ramsar, or IBA program. Ecotourism gives our assessment of the scale of the ecotourism industry at the site (high, medium, low). Management capability gives our assessment of the capacity for shorebird and/or shorebird habitat management at the site (high, medium, low). Partnerships gives our assessment of the current or existing potential to establish a partnership

Site name	Country	Importance rank	Site recognition	Ecotourism (current or potential)	Management capability	Partnerships, existing or potential
Sonadia and Moheshkhali Island	Bangladesh	L	EAAFP	Low	Low	Low
Chongming Dongtan National Nature Reserve	China	M	EAAFP, Ramsar, IBA	Good	Medium	Medium
Huang He (Yellow River) Delta National Nature Reserve	China	M	EAAFP, Ramsar, IBA	Medium	Low	Low
Luannan Coast	China	H	None	Low	Low	High
Shuangtaihekou National Nature Reserve	China	L	EAAFP, Ramsar, IBA	Low	Low	Low
Yalu Jiang National Nature Reserve	China	L	EAAFP, IBA	Medium	Low	High
Yancheng National Nature Reserve	China	M	EAAFP, Ramsar, IBA	Medium	Low	Medium
Mundok Migratory Bird Wetland Reserve	DPRK	M	EAAFP, IBA	Low	Low	Low
Mai Po Nature Reserve	Hong Kong	L	EAAFP, Ramsar, IBA	High	High	High
Bako-Buntal Bay	Malaysia	L	EAAFP, IBA	Medium	Medium	Low
Cheonsu Bay	ROK	L	EAAFP, IBA	Medium	Medium	Low
Geum Estuary	ROK	M	EAAFP, IBA	Medium	Medium	Medium
Nakdong Estuary	ROK	M	EAAFP, IBA	Medium	Low	Low
Song Do Tidal Flat	ROK	L	Ramsar	Low	Low	Low
Suncheon Bay	ROK	L	EAAFP, Ramsar, IBA	Medium	Low	Low
Moroshechnaya River Estuary	Russia	H	EAAFP, Ramsar, IBA	Low	Low	Low
Sungei Buloh Wetland Reserve	Singapore	L	EAAFP, IBA	High	High	High
Inner Gulf of Thailand	Thailand	L	Ramsar, IBA	Low	Low	Low
Qupaluk	USA	L	EAAFP	Low	High	Medium
Yukon Delta National Wildlife Refuge	USA	H	EAAFP, IBA	Medium	High	High

Grey Plover (<http://www.vwsg.org.au/Grey-Plover-tracking.html>) which is not a focal species for this analysis.

Accomplishing the stated conservation goals for wide-ranging groups of species such as shorebirds in initiatives such as EAAFP will happen only if partners work together on the same species at different sites. However, we recognise that practical political and social constraints will restrict the partnering options and we attempt to address the latter with our qualitative conservation capacity assessments. This framework for developing potential partnership sites for AIBS could be extended to other sites that wish to establish partnerships for migratory shorebirds. One example of establishing and implementing such a partnership is the work done by the Pukorokoro Miranda Naturalists' Trust (PMNT), New Zealand, to build conservation relationships with the Yalujiang Estuary National Natural Reserve (YJNNR), China (Riegen *et al.* 2014). This partnership has accomplished many elements that should be considered by AIBS (and others) in establishing a relationship, including developing a memorandum of understanding signed by both parties, conducting shorebird surveys with participants from both PMNT and YJNNR, upgrading the management, research techniques, and educational activities at YJNNR, and ensuring the lasting contribution and participation of both PMNT and YJNNR to the EAAFP. As site-based international

partnerships based on shared species and conservation capacity become more common, our framework could be modified to explicitly incorporate and assess the specific elements pioneered by PMNT and YJNNR as a way of both assessing the accomplishments of the partnership and establishing new ones.

We note in this analysis that the Bamford *et al.* (2008) compilation is not up-to-date, with many individual site counts being three or more decades old, some sites are known to be unviable for shorebird conservation due to development occurring after they were surveyed (e.g. Saemangeum, Republic of Korea; Moores *et al.* 2008, 2016), and sites identified after the publication of Bamford *et al.* (2008) need to be included. Nevertheless, combining quantitative shorebird abundance data with more qualitative aspects of site conservation allows partnerships to be explored that both have some hope of biological reality and some potential for conservation partnership success.

### Conflicts of interest

The authors declare no conflicts of interest.

### Acknowledgements

Thanks to the South Australia Department for Environment and Water for funding this work under an agreement with The Nature Conservancy.

Helpful advice and comments on various aspects of this project were received from Mark Carey, Tony Flaherty, Rich Fuller, Michaela Heinson, Micha Jackson, Spike Millington, Chris Purnell, Phil Straw, Connie Warren, Doug Watkins and Dan Weller. Helpful comments on a draft of the manuscript were received from three anonymous reviewers.

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**Appendix 1. List of shorebird sites outside of Australia and New Zealand with counts greater than or equal to the 1% threshold of the population estimate for the East Asian-Australasian Flyway of one or more of the seven focal shorebird species for the Adelaide International Bird Sanctuary (Eastern Curlew, Great Knot, Red Knot, Red-necked Stint, Curlew Sandpiper, Sharp-tailed Sandpiper, Bar-tailed Godwit), ranked in descending order of ‘importance’ score, based on data in Bamford *et al.* (2008), updated with data in Conklin *et al.* (2014), Bai *et al.* (2015) and Hassell *et al.* (2017) for the same site**

Where multiple counts were available for a species the same site, the highest available count was used to calculate the importance score. Methodology as described in text

Site	Country	Importance score	Importance rank
Yalu Jiang National Nature Reserve	China	2.89	High
Moroshechnaya River Estuary	Russia	2.85	High
Luannan Coast and Saltworks	China	2.64	High
Saemangeum (Dongjin and Mangyeong Estuaries)	Republic of Korea	1.73	High
Shuangtaizihekou National Nature Reserve	China	1.44	High
Yukon-Kuskokwim Delta	USA	1.27	High
Lianyungang Coast	China	1.22	High
Dandong Port East	China	0.98	Medium
North-west Bo Hai Wan	China	0.98	Medium
Tianjin Coast	China	0.92	Medium
Geum River Estuary (incl. Yubu Island)	Republic of Korea	0.92	Medium
Yancheng National Nature Reserve	China	0.91	Medium
Banyuasin Delta	Indonesia	0.60	Medium
Asan Bay	Republic of Korea	0.59	Medium
Zhuanghe Wan	China	0.57	Medium
Dongsha Islands	China	0.56	Medium
Nakdong Estuary	Republic of Korea	0.55	Medium
Huang He (Yellow River) Delta National Nature Reserve	China	0.52	Medium
Huanghua Coast (Cangzhou)	China	0.52	Medium
Namyang Bay	Republic of Korea	0.47	Medium
Ganghwa Island/Tidal Flat	South Korea	0.47	Medium
Egegik Bay	USA	0.44	Medium
Yeongjong Island	Republic of Korea	0.41	Medium
Mundok Migratory Bird Wetland Reserve	Democratic People’s Republic of Korea	0.39	Medium
Laizhou Wan	China	0.38	Medium
Chongming Dongtan National Nature Reserve	China	0.34	Medium
Daqing He and Shi Jiu Tuo	China	0.33	Medium
Daursky Nature Reserve	Russia	0.33	Medium
North Bo Hai Wan	China	0.30	Medium
Pesisir Timur Pantai Sumatera Utara	Indonesia	0.24	Low
Rudong Coast	China	0.23	Low
Song Do Tidal Flat	Republic of Korea	0.23	Low
Linghekou	China	0.23	Low
Inner Deep Bay (Mai Po and Futian Nature Reserves)	China, Hong Kong	0.23	Low
South Bo Hai Wan	China	0.21	Low
Han River Estuary	Republic of Korea	0.19	Low
Odoptu Gulf	Russia	0.15	Low
Cinder Lagoon	USA	0.15	Low
Port Heiden	USA	0.15	Low
Port Moller/Nelson Lagoon/Mud Bay	USA	0.15	Low
North-central Selangor Coast	Malaysia	0.13	Low
Inner Gulf of Thailand	Thailand	0.10	Low
Inner Gulf of Martaban	Myanmar	0.08	Low
Tugurskiy Bay	Russia	0.08	Low
Pulau Bruit	Malaysia	0.08	Low
Bensbach-Bula Coast	Papua New Guinea	0.07	Low
Kikori Delta	Papua New Guinea	0.06	Low
Laobian – Yingkou Coast	China	0.06	Low
Ganyu Coast	China	0.06	Low
Northern Jiangsu Coastline	China	0.06	Low

(Continued)

## (Continued)

Site	Country	Importance score	Importance rank
Wudi-Zhanhua-Hekou Coast	China	0.05	Low
Kuala Samarahan – Kuala Sadong	Malaysia	0.05	Low
Fukiagehama Kaigan	Japan	0.05	Low
Dongling Coast	China	0.04	Low
Schastiya Bay	Russia	0.04	Low
Khairyuzova Bay	Russia	0.04	Low
Aphae Island	Republic of Korea	0.03	Low
Penzhina River mouth	Russia	0.03	Low
Dongtai (Zhou Gang – Qiang Gang Coast)	China	0.03	Low
Seosan	Republic of Korea	0.03	Low
Sone Higata	Japan	0.03	Low
Benoa Bay	Indonesia	0.03	Low
Lososei Bay	Russia	0.03	Low
Suncheon Bay	Republic of Korea	0.03	Low
Baikal Bay	Russia	0.03	Low
Cheonsu Bay	Republic of Korea	0.03	Low
Jiazhou Wan	China	0.03	Low
Nanhuidongtan	China	0.03	Low
Daijugarami	Japan	0.03	Low
Manila Bay	Philippines	0.02	Low
Isahaya Higata	Japan	0.02	Low
Haenam Hwangsan	Republic of Korea	0.02	Low
Mukawa Kako	Japan	0.02	Low
Bako-Buntal Bay	Malaysia	0.02	Low
Terpeniya Bay	Russia	0.01	Low
Arao Kaigan	Japan	0.01	Low
Xuwei Saltworks	China	0.01	Low
Ta-Tu-Hsi, Changhua	China	0.01	Low
Sonadia and Moheskali Island	Bangladesh	0.01	Low
Sungei Buloh Wetland Reserve	Singapore	0.00	Low
Qupaluk	USA	0.00	Low