Review

Lines in the mud; revisiting the boundaries of important shorebird areas

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A B S T R A C T

Many shorebird populations are declining throughout the world, concurrent with declines and degradation of wetland habitats. Such declines necessitate a more consistent approach towards conserving habitats used by shorebird populations. Individuals of many shorebird species congregate in specific areas during their non-breeding season. Worldwide, non-breeding areas are designated as 'important' for shorebird conservation based primarily on the abundance of birds found in an area. However, the boundaries of any area are often defined with incomplete information regarding how shorebirds use that habitat. This paper discusses examples in Australia where improved knowledge of shorebird habitat use led to the identification of very different boundaries of important shorebird areas than those identified originally. We highlight how simple questioning of those who count shorebirds in an area, led to an improved understanding of which areas were apparently used by the same local population of non-breeding shorebirds. Subsequent analysis of available count, recapture and/or home range data of particular shorebird species is needed to verify expert opinion regarding most of these boundaries. We review how enhanced boundaries improve the ability of shorebird monitoring to detect population changes; allow management of shorebird habitats at relevant spatial scales; and lead to appropriate designations of important areas. While the kinds of approaches to boundary setting described here are not new, they are not consistently applied worldwide. We suggest additional guidelines to those produced under the Ramsar Convention in regard to designating important areas. We also call for more studies on the movements of migratory shorebirds during the non-breeding season to direct more consistent boundary setting around important non-breeding habitats used by local populations of migratory shorebirds.

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Introduction

Migratory shorebirds are a group of birds showing one of the largest and most widespread population declines (International Wader Study Group 2003; Piersma 2007; Stroud et al. 2006), and these declines are becoming especially acute in the East-Asian Australasian flyway (Amano et al. 2010; Minton et al. 2012; Nebel et al. 2008; Wilson et al. 2011). This is largely attributed to loss or degradation of habitats that hold high numbers of shorebirds (Baker et al. 2004; Moores et al. 2008) and the continuing loss of wetland habitats is of increasing conservation concern for these birds globally (Hagemeijer 2006). Further deleterious impacts are expected as the climate warms (Finlayson et al. 2005; Junk et al. 2013).

Shorebirds are incredibly diverse and some species in Australia often occur in non-wetland habitats such as Oriental Plover *Charadrius veredus* and Oriental Pratincole *Glareola maldivarum*, are found in very low concentrations like Latham's Snipe *Gallinago hardwickii*, or occupy a variety of wetlands such as river edges, flooded pastures or artificial habitats (ARKive 2013; Cardilini et al. 2013; Higgins & Davies 1996; Marchant & Higgins 1993; Weston et al. 2009). However, one of the unique traits many species of shorebird share, is their tendency to concentrate in large numbers at some non-breeding habitats, something that results in large proportions of species' populations being supported in relatively few areas (Brown et al. 2001). A key approach to conserving shorebirds has been to identify 'important areas' for species that concentrate in large numbers in their non-breeding distribution, and to manage these appropriately to ensure shorebird populations are maintained (Kuijken 2006; Mundkur 2006). The current set of identified important shorebird areas is the cornerstone of migratory shorebird conservation in Australia (Bamford et al. 2008; DEH 2006;

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Table 1
Summary of the kinds of criteria used to identify significant shorebird areas throughout the world. Note that many approaches involve a hierarchy of classifications.

Protocol	Shorebird trigger criteria for site recognition as 'important'
Ramsar Convention (1971)	Any shorebird area on the globe can be identified as being internationally significant if it regularly supports: • at least 20,000 waterbirds, or • at least 1% of the individuals in a population of one species or sub-species of waterbird These areas are flagged as internationally important in Australia
East Asian-Australasian Shorebird Site Network (1996)	Two categories of site importance: (1) "Internationally significant sites" (same criteria as used for Ramsar above except that waterbirds has been replaced with "shorebirds"): (2) "Nationally important sites" were recommended as: • areas with 10,000 or more shorebirds, or • areas that support 1% or more of the individuals of the Australian population of a species or sub-species
Western Hemisphere Shorebird Reserve Network (1985)	Three categories of site importance: (1) "Hemispheric Sites" hold at least 500,000 shorebirds annually or 30% of the biogeographic population for a species (2) "International Sites" hold at least 100,000 shorebirds annually or 10% of the biogeographic population for a species, and (3) "Regional Sites" hold at least 20,000 shorebirds annually or 1% of the species biogeographic population for a species
Second tier of nationally important sites (UK): Sites of Special Scientific Interest	Nationally important sites are: • where 1% or more of the national population of a non-breeding species or sub-species has been recorded, or • where semi-natural habitats hold at least 70 breeding species, 90 non-breeding species, or 150 transient species, or • where pre-set index thresholds for different habitat types are exceeded by cumulative scores of the species present that related to the national breeding population
Australia's draft national significant impact guidelines under the EPBC Act	Nationally important shorebird areas are: • identified as internationally important, or • support at least 0.1% of the flyway population of a single species, or • support at least 2000 migratory shorebirds, or • support at least 15 shorebird species

DEWHA 2009; Watkins 1993). In Australia, like much of the globe, during the non-breeding season wetlands support extremely high numbers of waterbirds (Boere & Stroud 2006), and internationally important areas for shorebirds are designated if the area supports over 20,000 waterbirds, or over 1% of the flyway population of any species (Ramsar Convention Secretariat 2010; Table 1). The Australian Federal Government also recognises any area with over 2000 shorebirds or 0.1% of the flyway population as being nationally important (DEWHA 2009; Table 1). The Ramsar criteria have been used to help define boundaries of important habitat in Australia, including the preference to include wetland 'complexes' or clusters of sites that are linked either hydrologically or through their use by a common population of animal (Ramsar Convention Secretariat 2010).

During the non-breeding season, one common way in which spatially separated shorebird habitats remain "ecologically linked" (Wright et al. 2010) is through the foraging and roosting behaviour of shorebirds. Shorebirds that forage across expansive tidal flats are forced to other areas when the flats become regularly inaccessible as they are covered by water during higher tides. At these times many shorebirds seek out relatively open and undisturbed roosting locations where they can rest and remain vigilant for predators (Colwell 2010). Shorebird conservation has long recognised the need to protect these linked habitats to conserve the birds in an area, and growing evidence demonstrates the importance of roosting habitats that are close to foraging habitats, which reduce energetic expenditures of travelling between roosting and foraging locations (Rogers et al. 2006).

Ecologically linked wetlands can also include separate wetlands within the home range of non-breeding shorebirds between which shorebirds regularly move for other reasons. These

between-wetland movements are thought to be triggered largely by dynamic food availability, changes in water levels at inland wetlands, avoidance of predators or disturbance, or different habitat requirements in different weather conditions, tide heights, or time of day. Increasingly, these kinds of considerations are being used to determine appropriate boundaries around important shorebird habitats (EGA-RAC/SPA 2012; Wright et al. 2010), and we would suggest such considerations have often been followed in areas where well developed local shorebird expertise was sought out when establishing boundaries.

In Australia, the boundaries around important shorebird habitat attempt to include separate but ecologically linked habitats. At most tidal habitats, coarse boundaries define large areas while attempting to encompass most of the separate habitats used for foraging and roosting by groups of shorebirds within estuaries or other tidal areas. There are a few cases where officially mapped boundaries do not include nearby roosts that are within 100 m of the boundary, but generally, interpretation of the boundary has not excluded such a roost from planning or management decisions. More distant roosts such as nocturnal or alternate roosts used during large spring tides may require expansion of boundaries if they are to be included. However, when looking at separate wetlands well outside the relatively contiguous habitat in which most roosts and adjacent feeding areas occur, the boundaries around important habitats like Ramsar sites have tended to combine separate wetlands based on them being relatively close together provided they are being used by similar species. There was little information on the way in which shorebirds used these clustered wetlands within or between years, or whether they were ecologically linked when boundaries were originally formed. In the decades after many of these areas were designated as important, our understanding