Conservation of North Pacific Shorebirds

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Introduction

In his introduction to the 1979 Symposium proceedings entitled "Shorebirds in Marine Environments," Frank Pitelka stressed the need for studies and conservation programs that spanned the western hemisphere (Pitelka 1979). In the 15 years since Pitelka's call to arms, the locations of many important migratory and wintering sites for shorebirds have been identified in the Americas (Senner and Howe 1984, Morrison and Ross 1989, Morrison and Butler 1994) and in the East Asian-Australasian flyway (Lane and Parish 1991, Mundkur 1993, Watkins 1993). However, assessments for Central America, the Russian Far East and most of Oceania remain incomplete or lacking.

The recognition that shorebird conservation required the protection of habitats throughout the birds' range (e.g., Morrison 1984, Davidson and Evans 1989 *in* Ens et al. 1990) prompted the establishment of the Western Hemisphere Shorebird Reserve Network (WHSRN) in the Americas in 1985 (Joyce 1986). This program complemented the 1971 Convention on Wetlands of International Importance Especially for Waterbirds (Ramsar Convention, Smart 1987), recognized by more that 50 countries world-wide.

Our purpose for writing this paper is to: (1) describe the distribution of North Pacific shorebirds throughout their annual cycle; (2) review the locations of and threats to important sites used by North Pacific shorebirds during the breeding,

migration and wintering periods; and (3) outline a program for international conservation of Pacific shorebirds.

Distribution in the North Pacific

The North Pacific region is the area bounded by British Columbia, Alaska and the Russian Far East. The status, distribution and scientific names of the 93 species and subspecies of shorebirds that occur in this region are shown in Table 1.

Breeding

The North Pacific region represents a relatively small portion of the Holarctic landmass, but it is one of the world's most important breeding areas for shorebirds. The region not only supports a disproportionately large assemblage of species with a high degree of endemism, but also hosts the majority of the global populations for many other more widespread taxa. Compared to the world's shorebird fauna, the portion breeding in the North Pacific is represented by 4 of 12 families, 22 of 55 genera and 75 of 212 species (Table 1). This region, more so than anywhere else in the world, is characterized by the Scolopacidae, the largest and most diverse of the shorebird families. Within the North Pacific, the Scolopacidae are represented by 17 of 22 genera (77 percent) and 65 of 87 species (75 percent). The polytypic genera within this family are especially well represented within the region. All species of godwits, shanks, phalaropes, dowitchers and turnstones (genera *Limosa, Tringa, Phalaropus, Limnodromus* and *Arenaria*, respectively), 7 of 9 species of curlews (Tribe Numeniini), and 17 of 19 species of typical sandpipers (genus *Calidris*) breed in the North Pacific. Lastly, several of the genera and many of the species in this family largely are endemic to the region or the majority of their populations occur there. These include the monotypic genera *Eurynorhynchus* (spoon-billed sandpiper) and *Aphriza* (surfbird), both species of tattlers (*Heteroscelus incanus* and *H. brevipes*), black turnstone (*Arenaria melanocephala*), bristle-thighed curlew (*Numenius tahitiensis*), western sandpiper (*Calidris mauri*), all five races of rock sandpiper (*C. ptilocnemis*), great knot (*C. tenuirostris*), American black oystercatcher (*Haematopus bachmani*), and the endangered spotted or Nordmann's greenshank (*Totanus guttifer*).

The biogeographic distribution of shorebirds breeding within the North Pacific is depicted in Figure 1. Fifty-eight species or races nest within the Russian Far East, including 37 that occur only within the Palearctic (*see* Table 1). Compared to the Russian Far East, Alaska has slightly fewer overall breeding taxa (48) and only a third as many taxa restricted to its region (13). The 21 taxa that breed both in the Russian Far East and in Alaska are dominated by no single group, but include a mixture of plovers, godwits, curlews, phalaropes and sandpipers. Seventeen species breed in British Columbia, 16 of which also breed in Alaska. Only one species, the red-necked phalarope (*Phalaropus lobatus*), breeds commonly throughout the entire region.

Migration

Shorebirds breeding in the region migrate over a vast area of the globe, including at least 40 different countries throughout North, Central and South America, Oceania, Asia, Australasia, and Africa (Figure 2). Although the migration corridors along

Table 1. Status of shorebirds within the North Pacific Region.

Species[a]	Breeding			Migration			Wintering		
	Russian Far East	Alaska	British Columbia	Russian Far East	Alaska	British Columbia	Russian Far East	Alaska	British Columbia
Haematopodidae									
Eurasian oystercatcher (*Haematopus ostralegus osculans*)	xE[b]			xE					
American black oystercatcher (*Haematopus bachmani*)		x	x		x	x		x	x
Recurvirostridae									
Black-winged (black-necked) stilt (*Himantopus himantopus*)	+			+					
Charadriidae									
Pacific golden plover (*Pluvialis fulva*)	x	x		x	x	x		+	x
American golden plover (*Pluvialis dominica*)	?	x	+	+	x				
Grey (black-bellied) plover (*Pluvialis squatarola*)	x	x		x	x	x		+	x
Ringed plover (*Charadrius hiaticula tundrae*)	x	+		+					
Semipalmated plover (*Charadrius semipalmatus*)	+	x	+		x	x		+	x
Long-billed plover (*Charadrius placidus*)	+T			+T					
Little ringed plover (*Charadrius dubius curonicus*)	x			x					
Killdeer (*Charadrius vociferus*)		x	x		+	x		+	x
Kentish (snowy) plover (*Charadrius alexandrinus*)	+			+		x			x
Lesser sandplover (*Charadrius mongolus stegmanni*)	x	+		x	+				
Eurasian dotterel (*Charadrius morinellus*)	+	+		+	+				
Northern lapwing (*Vanellus vanellus*)	x			x					
Scolopacidae									
Black-tailed godwit (*Limosa limosa melanuroides*)	x			x	+				
Hudsonian godwit (*Limosa haemastica*)		x	+		x	+			
Bar-tailed godwit (*Limosa lapponica baueri*)	x	x		x	x				
(*L. l. menzbieri*)				x					
Marbled godwit (*Limosa fedoa*)		x			x	x			x
Little curlew (*Numenius minutus*)				+					
Eskimo curlew (*Numenius borealis*)		+E[c]			+E[c]				
Whimbrel (*Numenius phaeopus variegatus*)	x			x					

Table 1. *Continued.*

Species[a]	Breeding			Migration			Wintering		
	Russian Far East	Alaska	British Columbia	Russian Far East	Alaska	British Columbia	Russian Far East	Alaska	British Columbia
(*Numenius p. hudsonicus*)		x			x	x			x
Bristle-thighed curlew (*Numenius tahitiensis*)		x			x				
Eurasian curlew (*Numenius aquarta*)				+					
Far eastern curlew (*Numenius madagascariensis*)	x			x					
Long-billed curlew (*Numenius americanus*)			x			x			+
Upland sandpiper (*Bartramia longicauda*)		x	x		+	+			
Spotted redshank (*Tringa erythropus*)	x			x					
Redshank (*Tringa totanus ussuriensis*)	x			+					
Greenshank (*Tringa nebularia*)	x			x					
Marsh sandpiper (*Tringa stagnatilis*)	+			+					
Spotted (Nordmann's) greenshank (*Tringa guttifer*)	xE			xE					
Greater yellowlegs (*Tringa melanoleuca*)		x	x		x	x			x
Lesser yellowlegs (*Tringa flavipes*)		x	x		x	x			x
Green sandpiper (*Tringa ochropus*)	x			x					
Solitary sandpiper (*Tringa solitaria*)		x	x		x	x			
Wood sandpiper (*Tringa glareola*)	x	+		x	+				
Willet (*Catoptrophorus semipalmatus*)						x			+
Terek sandpiper (*Xenus cinereus*)	x			x					
Common sandpiper (*Actitis hypoleucos*)	x			x					
Spotted sandpiper (*Actitis macularia*)		x	x		x	x		+	x
Grey-tailed tattler (*Heteroscelus brevipes*)	x			x	+				
Wandering tattler (*Heteroscelus incanus*)		x	x	+	x	x			+
Ruddy turnstone (*Arenaria interpres*)	x	x		x	x	x			x
Black turnstone (*Arenaria melanocephala*)		x			x	x		x	x
Wilson's phalarope (*Phalaropus tricolor*)		+	x		+	x			
Red-necked phalarope (*Phalaropus lobatus*)	x	x	x	x	x	x			x
Grey (red) phalarope (*Phalaropus fulicarius*)	x	x		x	x	x			x

Table 1. *Continued.*

Species[a]	Breeding			Migration			Wintering		
	Russian Far East	Alaska	British Columbia	Russian Far East	Alaska	British Columbia	Russian Far East	Alaska	British Columbia
Eurasian woodcock (*Scolopax rusticola*)	x			+					
Solitary snipe (*Gallinago solitaria japonica*)	x			+			x		
Japanese snipe (*Gallinago hardwickii*)	x			+					
Pintail snipe (*Gallinago stenura*)	+			x					
Swinhoe's snipe (*Gallinago megala*)	x			x					
Common snipe (*Gallinago g. gallinago*)	x			x					
(*Gallinago g. delicata*)		x	x		x	x		x	x
Short-billed dowitcher (*Limnodromus griseus caurinus*)		x	x		x	x		x	x
Long-billed dowitcher (*Limnodromus scolopaceus*)	x	x		x	x	x		+	x
Asiatic dowitcher (*Limnodromus semipalmatus*)	+			+					
Surfbird (*Aphriza virgata*)		x			x	x		x	x
Red knot (*Calidris c. canutus*)				x					
(*Calidris c. roselaari*)	x	x		+	x	x			x
(*Calidris c. rogersi*)	x			x					
Great knot (*Calidris tenuirostris*)	x			x					
Sanderling (*Calidris alba*)		x		x	x	x		x	x
Semipalmated sandpiper (*Calidris pusilla*)	+	x			x	x			
Western sandpiper (*Calidris mauri*)	x	x		+	x	x			x
Red-necked (rufous-necked) stint (*Calidris ruficollis*)	x			x	+				
Little stint (*Calidris minuta*)	+			+	+				
Temminck's stint (*Calidris temminckii*)	x			+	+				
Long-toed stint (*Calidris subminuta*)	x			x	+				
Least sandpiper (*Calidris minutilla*)		x	x		x	x			+
White-rumped sandpiper (*Calidris fuscicollis*)		x			+	+			
Baird's sandpiper (*Calidris bairdii*)	x	x		+	x	x			
Pectoral sandpiper (*Calidris melanotos*)	x	x		x	x	x			
Sharp-tailed sandpiper (*Calidris acuminata*)				x	x	+			

Table 1. *Continued.*

Species[a]	Breeding			Migration			Wintering		
	Russian Far East	Alaska	British Columbia	Russian Far East	Alaska	British Columbia	Russian Far East	Alaska	British Columbia
Rock sandpiper (*Calidris ptilocnemis couesi*)		x			x			x	
(*Calidris p. tschuktschorum*)	x	x		+	x	x		x	x
(*Calidris p. ptilocnemis*)		x			x			x	
(*Calidris p. quarta*)	x			x			x		
(*Calidris p. kurilensis*)	xT			xT			xT		
Dunlin (*Calidris alpina pacifica*)		x		+	x	x		x	x
(*Calidris a. articola*)		x		x	x				
(*Calidris a. sakhalina*)	x			x	?				
(*Calidris a. kistchinski*)	x			x					
(*Calidris a. actites*)	xT			xT					
Curlew sandpiper (*Calidris ferruginea*)	+	+		+					
Stilt sandpiper (*Calidris himantopus*)		x			+	+			
Broad-billed sandpiper (*Limicola falcinellus sibirica*)				x					
Spoon-billed sandpiper (*Eurynorhynchus pygmaeus*)	x			x					
Buff-breasted sandpiper (*Tryngites subruficollis*)	+	x		+	+	+			
Ruff (*Philomachus pugnax*)	x	+		+	+	+			

[a]Taxonomic and vernacular names from Hayman et al. (1986), except we do not recognize *Calidris paramelanotus* as a species, and we include stilt sandpiper within *Calidris*.
[b]Breeding (May–June): (x) = significant portion of a population of a species or subspecies breeds within this region; (+) = breeds in low numbers within a region. Migration (July–October and March–May): (x) = occurs in significant numbers within the region, primarily on coastal or intertidal habitats; (+) = occurs regularly but in small numbers within the region; (?) = status uncertain. Wintering (November–March): (x) = relatively large numbers occur within the region, primarily on coastal or intertidal habitats; (+) = occurs regularly but in small numbers within the region. E = endangered, T = Threatened. Source: Brazil (1991), Campbell et al. (1990), Flint et al. (1984), Gabrielson and Lincoln (1959), R. Gill (unpublished data), Gochfield et al. (1984), Hayman et al. (1986), Kessel and Gibson (1978), Lane (1987), Paulson (1993), Stepanyan (1990), Stishov et al. (1991), Tomkovich (1986, 1992a, 1992b, 1992c, unpublished data), Vaurie (1965), Watkins (1993).
[c]Inclusion for region based on historical accounts. There has been no substantiated record for the curlew in Alaska since 1899 and the species now may be extinct (Gollop et al. 1986).

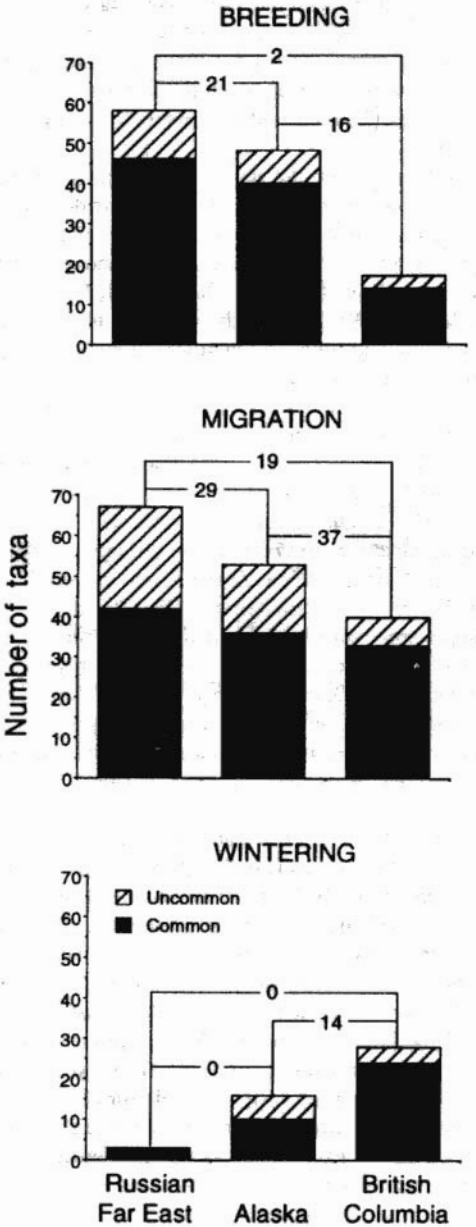

Figure 1. Biogeographic distribution of shorebirds within three areas of the North Pacific region during the breeding, migration and wintering periods. Solid portion of bars indicates the number of taxa (species and subspecies) occurring in significant numbers within each area; cross-hatching shows those occurring regularly but in small numbers (*see* Table 1). Connections between bars show the number of taxa shared between areas.

which North Pacific shorebirds travel are fairly well known, specific links between different breeding and wintering populations within broad-ranging species are virtually unknown. The routes taken are as varied as the species and the migration strategies they employ. Migrations entail distances ranging from only a few hundred kilometers (*e.g.*, rock sandpiper) to several thousand kilometers in a single flight (*e.g.*, bristle-thighed curlew).

Shorebirds traveling to and from the region use a number of migration corridors which sometimes differ between spring and autumn. Corridors used during spring or autumn within the western hemisphere have been summarized by Morrison and Myers (1987). Those used during autumn throughout Oceania and during autumn and spring in east Asia also are generally well known (Baker 1951, Parish et al. 1987, Weishu and Purchase 1987, Parish 1989). Most birds migrating to the region in spring from western hemisphere wintering grounds follow routes along the east coast of the Pacific Ocean or pass through the interior of North America (Morrison and Myers 1987). Shorebirds migrating to the Russian Far East from eastern hemisphere wintering areas primarily follow the west coast of the Pacific Ocean (Parish 1989), but also use several interior routes. The termini of both the Pacific and Central flyways of the western hemisphere and the East Asian flyway overlap in Beringia (Hopkins 1982) and result in considerable interchange of species between Asia and North America (Figure 2). The third major migration corridor to the region is a transoceanic route from over-winter sites in Australia, New Zealand, and the myriad atolls and islands of southern Oceania (Baker 1951, Parish et al. 1987, Parish 1989).

In general, the major southward migration routes of shorebirds from the North Pacific are the reverse of those used in spring. The autumn migration period, however, is much more protracted (June–October) than in spring (March–May) and birds use more stopover sites, many that differ from those used in spring (Page and Gill 1994). These differences are mainly attributable to age- and sex-related differences in the timing of postbreeding movements (*e.g.*, Gill and Handel 1981, 1990, Butler et al. 1987).

The continental routes in North America are used mainly by birds that nest at high latitudes and winter in the Neotropics (Pitelka 1979, Boland 1991). The continental flyways in Asia are used primarily by birds migrating from central Siberia to the East Asian coast and from the Russian Far East to the Indian Ocean and Africa (Parish et al. 1987, P. Tomkovich unpublished data). One particular feature of autumn migration, however, is the greater number of species with long, transoceanic migrations. From the North Pacific, these transoceanic migrants include populations of Pacific golden plovers (*Pluvialis fulva*), dunlin (*Calidris alpina*), long-billed dowitchers (*Limnodromus scolopaceus*), bar-tailed godwits (*Limosa lapponica*), whimbrels (*Numenius phaeopus*), bristle-thighed curlews, ruddy turnstones (*Arenaria interpres*) and sanderlings (*Calidris alba*). After breeding, red-necked and grey (red) phalaropes (*Phalaropus fulicarius*) migrate exclusively at sea, the former along the continental shelf and the latter mostly across pelagic waters.

Wintering

The distribution of shorebirds within the North Pacific region during winter is very different from that during breeding. Only three species winter in the Russian Far East, while 16 occur in Alaska and 28 occur in British Columbia during winter (Table

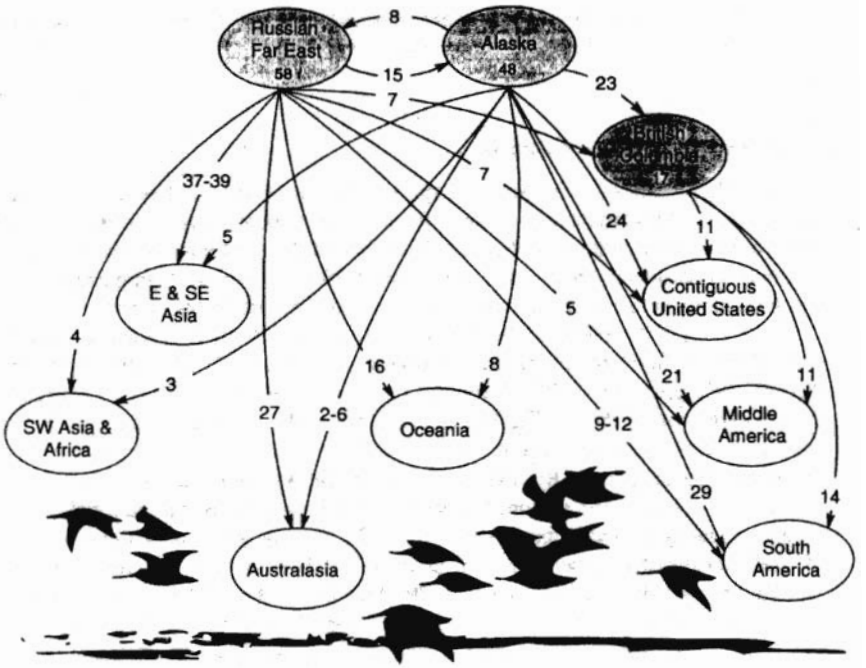

Figure 2. Post-breeding dispersion of shorebirds from the North Pacific region. Number of taxa breeding within each of the three areas is shown inside shaded ovals. Connections between areas within the North Pacific show the number of these taxa exchanging during autumn migration. Connections to other regions of the world (clear ovals) show the number of taxa dispersing to winter in those regions. Many species winter in more than one region, and exact connections between specific breeding and wintering populations are poorly known for most species.

1, Figure 1). Only species associated with rocky intertidal habitats or sandy beaches (*e.g.*, American black oystercatcher, sanderling, rock sandpiper, surfbird and black turnstone) are common in Alaska during winter. Most species breeding in the Russian Far East and about half of those breeding in Alaska and British Columbia spend the boreal winter in tropical or subtropical latitudes encompassing both hemispheres of the globe. The patterns of post-breeding dispersion shown in Figure 2 underscore the need for a truly international perspective for the conservation and management of North Pacific shorebirds.

Important wintering sites in the Pacific region for populations of shorebirds breeding in the North Pacific occur in the Americas from southern Canada to Chile (Morrison and Ross 1989, Morrison et al. 1992, 1993, Page and Gill 1994). These include numerous estuaries along the coast of Washington and California, especially San Francisco Bay (Page et al. 1992), estuaries along the coast of Baja and west coast of mainland Mexico (Morrison et al. 1992, G. Page unpublished data), and the Bay of Panama (Morrison and Butler 1994). In Oceania and Eastern Asia, most North Pacific species winter south of about 30 degrees N (Weishu and Purchase 1987), although large numbers of dunlin and a few other species winter along the coasts of Korea, Japan and China (Long et al. 1988, Brazil 1991). The bristle-thighed curlew

is the only migratory species whose entire population is confined to Oceania during the nonbreeding period (Gill and Redmond 1992).

Conservation of Shorebirds

The high degrees of endemism and species diversity make the North Pacific one of the world's most important regions for shorebirds. The responsibility for their conservation rests on the will for international cooperation. One of the most effective mechanisms for the conservation of shorebirds is the protection of critical breeding, staging and nonbreeding areas along entire flyways, which transcend international boundaries.

Along the Pacific coast of the Americas, there are 26 areas known to qualify as sites of hemispheric or international importance to North Pacific shorebirds under the WHSRN program (Table 2, Figure 3). To date, an additional eight sites along the western rim of the Pacific Ocean have been identified as important to North Pacific shorebirds under these criteria. Identification of critical sites is incomplete, however, especially in the Russian Far East, Central America, East Asia and Oceania. Within the North Pacific region, 5 areas potentially qualify as international sites and 11 areas qualify as hemispheric sites (Table 2). Among these, only three have been officially designated under the Ramsar or WHSRN programs. Izembek Lagoon in Alaska and the Alaksen National Wildlife Area on the Fraser River Delta in British Columbia are official Ramsar sites, and the Copper River Delta, Alaska, is a WHSRN hemispheric site. Elsewhere in the Pacific, 12 areas qualify as international sites and 6 areas qualify as hemispheric sites according to WHSRN criteria (Table 2). Among these, only San Francisco Bay and Grays Harbor have been officially designated as WHSRN sites. In addition to the 26 Pacific Rim sites identified here, numerous other sites are important to North Pacific shorebirds, especially to species with mid-continent or Atlantic migration routes or those wintering along the Atlantic coast of Central and South America. Such sites include Cheyenne Bottoms in Kansas, Laguna Madre along the east coast of Mexico, and Bahia Lomos, Chile (Senner and Howe 1984, Morrison and Ross 1989, Morrison et al. 1992, 1993).

Most sites in Alaska currently are afforded some level of official protection under various land conservation measures (*e.g.*, as National Wildlife Refuges, National Monuments or State Critical Habitat Areas). Boundary Bay in the Fraser River delta, British Columbia, likely will receive official protection as a Provincial Wildlife Management Area in 1994. Conservation efforts in Alaska and British Columbia should be directed primarily at preventing habitat deterioration, especially from oil spills. In the Russian Far East major efforts should be directed at identifying the many important sites that are likely to exist. The effects of hunting that occur locally along the coast also should be assessed, particularly the impacts on populations of Eurasian woodcock (*Scolopax rusticola*), whimbrel, Eurasian oystercatcher (*Haematopus ostralegus*) and the endangered spotted greenshank.

The major threats to North Pacific shorebirds in Central America, South America and the East Asian-Australasian flyway are from destruction of mangrove habitats, hunting, and pollution from oil, mining and pesticides (Delgado 1986, Mundkur 1993, I. Davidson personal communication: 1994). Most shorebird populations are judged to have rebounded from the market hunting that occurred during the past century in North America (Morrison and Harrington 1979, Senner and Howe 1984). The long

Table 2. Coastal wetlands thoughout the Pacific basin that qualify as important sites for North Pacific shorebirds under criteria of the Western Hemisphere Shorebird Reserve Network (WHSRN).[a] Sites referenced by number on Figure 3.

Site	WHSRN designation	Source
United States—Alaska		
1. St. Lawrence Island	H[b]	Gill and Tibbitts unpublished data
2. St. Matthew Island	I	Gill and Tibbitts unpublished data
3. Pribilof Islands	H[b]	Gill and Tibbitts unpublished data
4. Nunivak Island	I[b]	Gill and Tibbitts unpublished data
5. Central Yukon-Kuskokwim River delta	H	Gill and Handel (1990)
6. Kuskokwim River delta	H	Gill and Tibbitts unpublished data
7. Cinder River lagoon	I	Gill and Tibbitts unpublished data
8. Nelson Lagoon	I–H[c]	Gill and Jorgensen (1979), Gill et al. (1981), Gill and Tibbitts unpublished data
9. Mud Bay	I–H[c]	Gill and Tibbitts unpublished data
10. Redoubt Bay	I	Gill and Tibbitts unpublished data
11. Fox River delta	I	Gill and Tibbitts unpublished data, G. West unpublished data
12. N. Montague Island	H[d]	Gill and Tibbitts unpublished data
13. Copper River delta	H	Senner and Howe (1984)
14. Stikine River delta	H	C. Iverson unpublished data
Canada		
15. Fraser River delta, B.C.	H	Morrison et al. (1992)
United States—contiguous states		
16. Grays Harbor, Washington	H	Senner and Howe (1984), Wilson (1993)
17. Humboldt Bay, California	I	Senner and Howe (1984)
18. San Francisco Bay, California	H	Senner and Howe (1984), Page et al. (1992)
Mexico		
19. Rio Colorado	I	Morrison et al. (1993)
20. Laguna Ojo de Liebre	I	Morrison et al. (1993), G. Page unpublished data
21. Esteros Tobari and Lobos	I	Morrison et al. (1993)
22. Culiacan-Los Mochis	I	Morrison et al. (1993)
Panama		
23. Panama Bay	I	Morrison and Butler (1994)
Peru		
24. Virrila estuary	H[e]	Morrison and Ross (1989)
25. Chiclayo region	H	Morrison and Ross (1989)
Chile		
26. Chiloe region	H[f]	Morrison and Ross (1989)
Russian Far East		
27. Moroshechnaya River delta	H	P. Tomkovich unpublished data
Sumatra		
28. Banyuasin Musi River delta	I	Mundkur (1993)
Australia		
29. Lake McLeod	I	Watkins (1993)
30. Port Hedland Saltworks	I	Watkins (1993)
31. Eighty Mile Beach	H	Watkins (1993)

Table 2. *Continued.*

Site	WHSRN designation	Source
32. Roebuck Bay and Plains	I	Watkins (1993)
33. S. E. Gulf of Carpentaria	I	Watkins (1993)
34. The Coorong	I	Watkins (1993)

[a]Under WHSRN criteria, an international site (I) must annually support at least 100,000 shorebirds or 15 percent of a flyway population; a hemispheric site (H) must support at least 500,000 shorebirds or 30 percent of a flyway population.
[b]Based on percentage of rock sandpiper population using this site.
[c]Site qualifies as (I) based on numbers and as (H) based on percent of flyway population (dunlin and bar-tailed godwit). Additional studies also likely to support (H) designation based on total numbers.
[d]Based on percentage of surfbird population using this site.
[e]Based on percentage of sanderling population using this site.
[f]Based on percentage of Hudsonian godwit and whimbrel populations using this area.

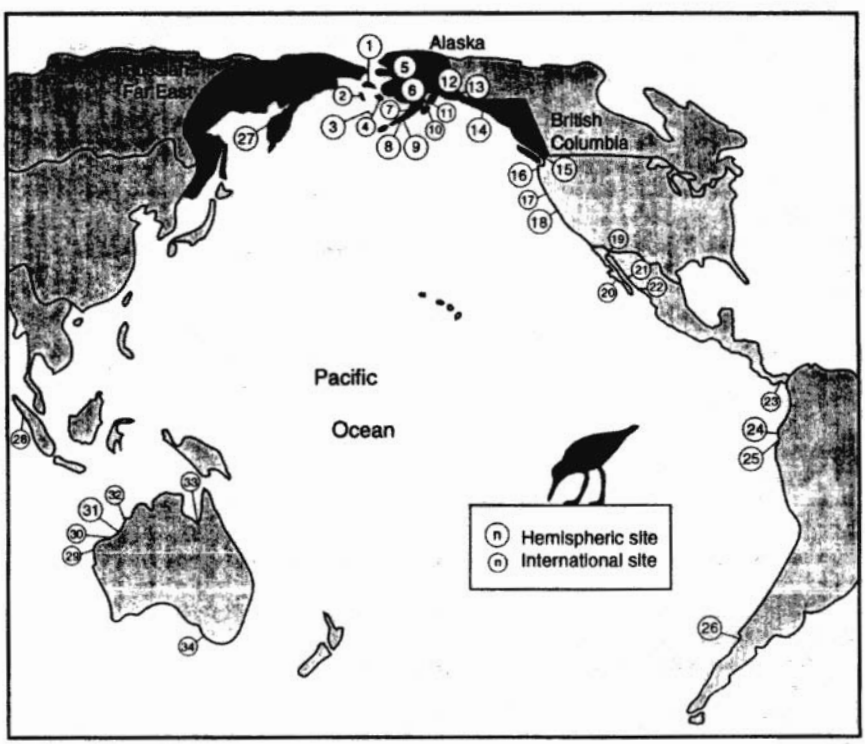

Figure 3. Locations of coastal wetlands throughout the Pacific basin that meet Western Hemisphere Shorebird Reserve Network criteria for sites of international or hemispheric importance (*see* Table 2 for criteria, names and designations).

period required for recovery, however, highlights the need for effective protection from severe impacts throughout their range. Humans have devastated the avifauna of Oceania, which is one of the fastest growing human population centers on earth (Holyoak 1973, Moors 1985, Loope et al. 1988, IUCN 1991). There is a particular need for information on the bristle-thighed curlew because of its restricted range on small islands and atolls, where it may be vulnerable to human disturbance and exotic animals, especially during its flightless molt (Marks et al. 1990, Gill and Redmond 1992). Red-necked phalaropes, which winter throughout southern Oceania, may be threatened by ingestion of plastic particles (Connors and Smith 1982) and oil spills. Only international cooperation will ensure that oceanic and coastal habitats remain free of such pollution.

Coordinated International Research and Conservation

Many countries are involved in migratory bird conservation throughout the Pacific. However, conservation information is dispersed, resources are limited and data necessary for conservation actions are not always available. The global scale of shorebird conservation problems requires coordinated efforts to direct results to appropriate decisionmakers. We see this happening at two levels, one involving the hands-on biologists, the other wildlife administrators, but both working jointly through all phases of the program.

In the past two decades numerous organizations have formed to promote the study and conservation of shorebirds, including the Western Hemisphere Section of the Wader Study Group of Europe, the Australasian Wader Studies Group, the Asian Wetland Bureau, Wetlands for the Americas and the Russian Working Group on Waders, to name a few. These groups have been very active in their areas of geographic interest and readily have made information available to others. Recently, they have recognized the need to form partnerships and expand their focus throughout a flyway. For example, the Wader Study Group developed a formal protocol for international cooperation in research efforts in the eastern hemisphere, including the East Asian-Australasian flyway (Wader Study Group 1992). They also developed a formal agreement to provide advice on shorebird research and conservation issues to the International Wetlands Research Bureau (N. Davidson personal communication: 1994). The protocol and agreement are being used as models to establish arrangements between the western hemisphere section of the Wader Study Group and Wetlands for the Americas (Canavari 1993). The Australasian Wader Studies Group, in conjunction with Russian shorebird biologists, recently has supported work on Palearctic nesting species using the East Asian flyway. All of these partnerships are aligned around north-south shorebird migration corridors. We have shown in this paper that shorebirds throughout the Pacific, but especially the North Pacific, involve east-west associations as much as they do those north-south. It is time for the various shorebird groups and national conservation agencies throughout the Pacific Rim nations to recognize this east-west link and begin to work toward new partnerships. Further, these arrangements should extend to include Pacific island nations that individually support many small populations of shorebirds but collectively account for substantial numbers of birds.

What specifically can be done? First, on a regional basis, but through international programs, we need to identify important sites using objective criteria. The Russian

Far East, Central America and Oceania need particular attention. By the nature of habitats and preliminary studies, we know that critical sites exist in these areas, but there is no funding available or programs established to identify them. It is in the interest of all Pacific Rim nations to identify and evaluate the relative importance of critical sites used by North Pacific shorebirds during their annual cycle.

As a second step, we need to establish programs to link each of these sites to the specific populations that use them during various stages of the annual cycle. It is hollow conservation to have identified a critical staging site in Alaska, for example, if sites used by these same birds the other 10 months of the year are not known and if potential threats to the areas are not assessed. These links can be established through large-scale marking and censusing programs that are organized along flyways by core staff in each nation, and that function with mostly volunteer help. New advances in genetics and systematics show much promise as another tool that can be used by research biologists to link populations to specific breeding, staging and wintering sites. If these links can be established, it will be much more cost-effective to initiate international monitoring programs at appropriate sites throughout the annual cycle than to have a single country try to cover all aspects by itself. Such programs, however, will require a strong, long-term commitment by the participating governments to support their portion of such an international monitoring program. It may be in the best interests of some of the nations to assist others, particularly the developing countries, in organizing such programs and developing their own expertise.

Last, once sites have been identified, linked and their threats assessed, they need to be recognized as critical components of an *international* shorebird reserve network. This will require the continued financial and political support of existing programs such as WHSRN, Ramsar, Wetlands for the Americas and the Asian Wetland Bureau. Mostly, it will require a strong commitment from the three North Pacific countries—the United States, Russia and Canada—to expand the scope of such programs and forge partnerships that encompass the entire Pacific basin.

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