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CONSERVING SHOREBIRDS ON DEPARTMENT OF DEFENSE LANDS

BY: BRIAN HARRINGTON
PARTNERS IN FLIGHT

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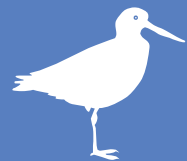
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Conserving Shorebirds on Department of Defense Lands



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By Brian Harrington



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Conserving Shorebirds on Department of Defense Lands

Brian Harrington¹

Introduction

Shorebirds are some of the most highly migratory animals known, and some species routinely travel between the most northern and southern lands of the earth. Although the name suggests all are birds of shorelines, in North America the term is more narrowly applied to roughly 50 kinds of sandpipers, plovers and their allies (Fig. 1), some of which live in upland habitats.

To complete their amazing migrations, many kinds of shorebirds make nonstop flights spanning a thousand or more miles without stopping for food or water. These ‘marathons’ require that they visit migration stopover areas, typically wetlands of one kind or another, where they feed intensively to add large amounts of fat crucial for the ensuing long-distance flight. Some shorebirds, such as those in the interior of the continent, have more dispersed migrations. These species depend on small wetlands interspersed along migration routes. Preferred habitats vary among species and times of year, as do migration routes and schedules.

Unfortunately, more than half of the wetlands that once existed in the United States are now gone, and in some regions strategic to shorebirds more than 90 percent of the wetlands have been lost. Well-focused management initiatives can help provide wetland and other habitats needed by shorebirds and other biota. Along with other large land managers in the U.S., Department of Defense biologists have a unique opportunity to manage wetland and upland habitat in ways that benefit wildlife populations and help to reverse the rapid population declines we are witnessing.

Today increasing numbers of wildlife managers use management practices to provide suitable wetland and other habitats for migratory shorebirds. To help elucidate the best opportunities, The Western Hemisphere Shorebird Reserve Network (WHSRN) provides shorebird management training



American Avocet, *Recurvirostra americana*

workshops for professional managers. The *Shorebird Management Manual*, by Douglas L. Helmers, provides a variety of management recommendations and has assisted managers across the country with ideas for developing specific plans for their sites. The present booklet serves as a companion to the *Manual* by showing when management initiatives can be timed for targeted species or guilds of shorebirds.

Each of the 50 species of shorebirds common in North America has its own unique life history, including migration ‘style.’ For managers seeking to focus on a particular type of wetland and/or a particular species of shorebird, it is essential to know when management opportunities can be coordinated to properly coincide with targeted bird migration schedules. This booklet will assist Department of Defense resource managers in identifying important shorebird management opportunities by providing (1) information on **migration timing** of various ‘habitat guilds,’ and (2) information on the **relative abundance** of different species of shorebirds in different regions of the country during spring and autumn migrations.

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Shorebird Guilds

Shorebirds can be grouped into guilds using a variety of characters such as bill shapes and sizes, habitat preferences, or foraging methods. The guilds used here are based on habitat characteristics that are biologically important to shorebirds but which also can be managed by wildlife and land stewards to benefit targeted types of shorebirds. Thus the guilds we use are based on a combination of management practicality and bird habitat preferences.

Most North American shorebirds use wetland habitats, especially during migration and wintering seasons (Fig. 2). In this manual we consider wetlands to be damp or shallowly flooded land, including permanently or temporarily flooded terrestrial areas as well as intertidal zones. Certain other shorebirds, discussed below, use uplands or ocean beaches.

Some of the most important characteristics of wetlands that directly affect foraging shorebirds are the type of substrate, the water depth and the vegetation cover (Fig. 2). Wetland shorebirds generally use water less than 20 cm deep, and most species use depths less than 5 cm. In addition, the majority of species prefer habitats with less than 25% vegetative cover; none use thickly vegetated wetlands unless the vegetation is short and visibility of surrounding horizons is not obscured. Forested wetlands are not used extensively except by woodcocks and the occasional Solitary or Spotted Sandpiper.

The size of wetlands (or other shorebird habitats) affects the variety of shorebirds that use them. Some species, for example Solitary Sandpiper, favor small wetlands whereas others, for example Dunlin, prefer broad expanses of suitable habitat (see Appendix 1).

Shorebirds find food either by spying it (or some clue to its presence) or by probing with the bill to find prey buried in the substrate. Some, for example most of the plovers, hunt largely by visual means; others, for example dowitchers, hunt almost entirely by probing. When probing, most kinds of shorebirds detect prey by touch and/or by pressure sensitivity, but some use chemo-detection. For many species, especially among the various sandpiper groups, the hunting method (visual, probing) varies with the location, habitat conditions, the penetrability of the substrate, food densities, visibility conditions, and so forth. In general, best probing conditions are when the substrate has a high water content, i.e. is covered by shallow water and/or has recently been dewatered.

Water depth and vegetation are frequently managed for wildlife. Because both are key habitat elements for most kinds of shorebirds, we have used both factors in defining guilds. The guilds are “mud shorebirds”, “wading shorebirds”, “upland shorebirds” and “coastal shorebirds” (Fig. 3). Some species use more than one guild. They are included here with the guild they use most frequently.

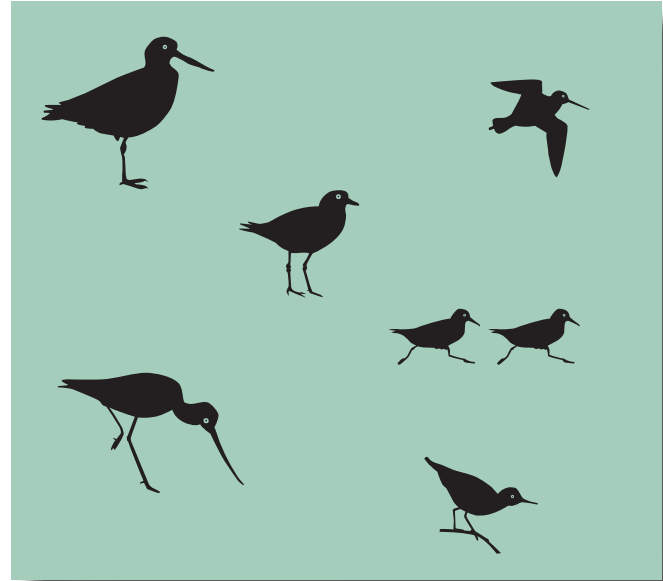
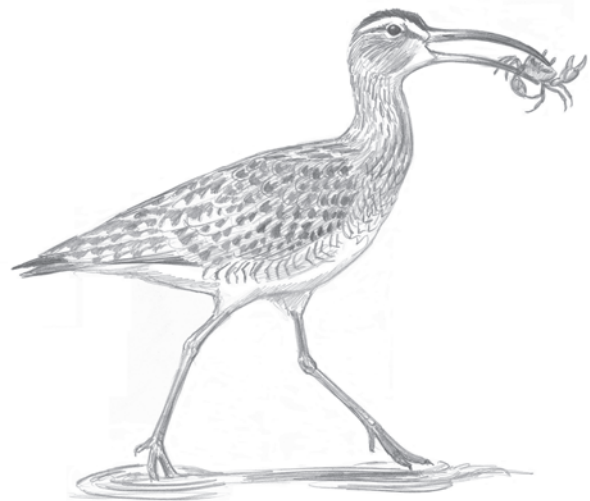


Fig. 1. Shorebird Silhouettes.

Mud Shorebirds



Whimbrel, *Numenius phaeopus*

Mud shorebirds (Fig. 3 and Appendix 2) commonly use unconsolidated muddy or sandy substrates at tidal and nontidal sites. Most species prefer open, sparsely vegetated flats. Some kinds, such as the plovers, prefer recently dewatered flats where they hunt visually for invertebrates including insects and spiders (nonmarine sites) or marine crustaceans and polychaete worms (marine habitats). Other shorebirds use or sometimes prefer (especially at nonmarine sites) shallowly flooded (< 1 cm deep) mud or sand flats where they hunt insects on top of, or just beneath the mud surface. Some, such as Whimbrel, occur in other habitats and could be found in any

of the 4 categories listed in Fig. 1. Spotted Sandpiper favors hunting for insects along placid river and stream edges, but are also common along features such as lake shores and borrow ditches.

Most of the mud shorebirds are relatively intolerant of vegetation growth or other features that obscure their view of surrounding horizons. Least Sandpiper is somewhat more tolerant of vegetation in this regard. Species from other guilds will sometimes use mud habitats. Notable among these are Baird's, Buff-breasted, Pectoral and Solitary Sandpipers.

Soil moisture conditions most conducive to attracting mud shorebirds generally are achieved by slow drawdown, which results in a relatively extended period of moist substrate. Once the mud dries, it is of low value for probing, even though it may still have a high density of buried invertebrates. Managers considering drawdown as a technique to attract shorebirds should take into account various aspects of water and soil chemistry, such as salinity and heavy metal concentration. Also, the area's predisposition to diseases such as botulism is an important consideration.

Wading Shorebirds

Wading shorebirds (Fig. 3 and Appendix 2) forage mostly by wading in water. Some (e.g. phalaropes, yellowlegs and stilts) hunt prey living mostly within the water column, for example insects, crustaceans or small fish. Others hunt mostly on or close to the bottom surface (e.g. American Avocet, Stilt and Western Sandpipers) or by probing into muddy bottom substrates (e.g. snipes and dowitchers). For obvious reasons, leg length restricts most wading shorebirds to shallow water depths (Fig. 1) commensurate with the length of their legs (except for phalaropes, which typically forage while swimming).

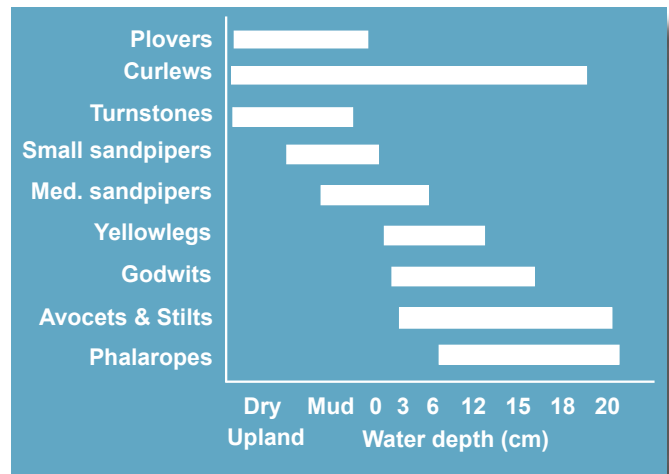
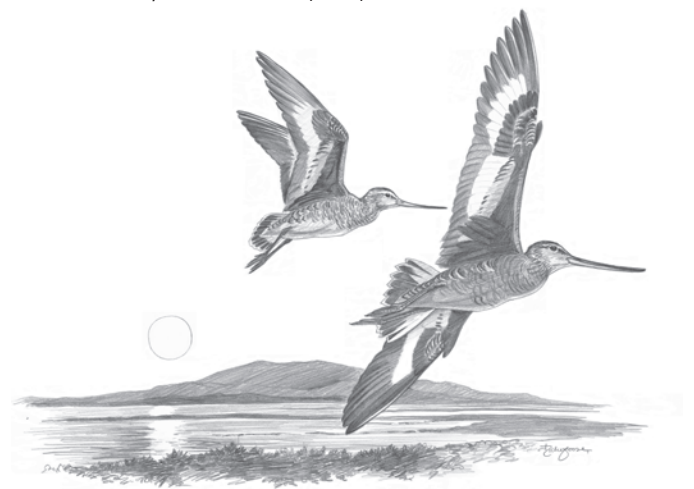


Fig. 2. Habitats and water depths used by North American shorebirds, after Helmers (1992).



Hudsonian Godwit, *Limosa haemastica*



Fig. 3. Shorebird habitat guilds.

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Some wading shorebirds principally use nonmarine habitats (e.g. Killdeer, American Golden-Plover, Solitary and Pectoral Sandpipers, Wilson's Snipe and Wilson's Phalarope) whereas others are principally marine during the nonbreeding season (e.g. Sanderling, Red Knot, oystercatchers, Red and Red-necked Phalaropes). Some species occur broadly across both marine and nonmarine habitats during both migration and winter seasons (e.g. Greater and Lesser Yellowlegs and many of the plovers and sandpipers). Others favor either marine or nonmarine habitats at different seasons (e.g. Hudsonian Godwit in the U.S. uses nonmarine habitats during spring but marine habitats during fall).

As with mud shorebirds, water level manipulation which results in the proper water depth and vegetation density probably is the most appropriate management action for wading shorebirds.

Upland Shorebirds

Most of North America's upland shorebirds (Fig. 3 and Appendix 2) are essentially grassland inhabitants that historically frequented short- or tall-grass habitats. Others depend upon special situations such as coastal moors, blueberry barrens, second-growth woods, or riverine bars. Many of North America's grassland shorebirds, especially those which breed in short-grass habitats, have substantially less habitat than was available before the extensive agricultural development of North and South American grasslands. Because of this, Eskimo Curlew is extinct or nearly so, numbers of Mountain Plover are rapidly declining, and American Golden-Plover is substantially less common than was historically the case.

Most upland shorebirds require winter habitats similar to breeding habitats. Habitat alteration by agricultural development in South American grasslands has affected wintering American Golden-Plover, Upland and Buff-breasted Sandpipers, and Eskimo Curlew, just as habitat degradation in North America has affected their breeding and migration habitats (Fig. 4). Long-billed Curlew, which winters in coastal habitats as well as in agriculture fields, is an exception. Killdeer,



American Woodcock, *Scolopax minor*



Most upland shorebirds that breed in the U.S. are found in grassland habitats; in some regions grassland has become scarce, and much of what remains is in manicured areas such as mown areas next to airport runways, sodfarms or agriculture areas. Grassland shorebirds that can benefit from focused, locally-tailored management include Long-billed Curlew (highly imperiled), Bristle-thighed Curlew on tropical Pacific Islands (species of high concern), and Upland Sandpiper.

Fig. 4. Upland shorebirds.

which frequents disturbed habitats such as gravel roadsides, gravel rooftops, and parking lots, probably has benefited from western 'development' of the New World. Upland Sandpiper, typically found in tall grass habitats, extensively uses agricultural habitats such as hay or alfalfa fields, especially in the eastern half of North America.

Relatively little attention has been given by wildlife managers to manipulating habitat for upland shorebirds, except second-growth woodlands for American Woodcock. Management for grassland shorebirds include use of fire (for preserving and/or emulating short-grass conditions and for preserving coastal heath moors), controlled cattle grazing in appropriate habitats to emulate conditions that probably were historically maintained by buffalo herds and restrictions on mowing to dates outside nesting seasons.

Coastal Shorebirds

Shorebirds in this category (Fig. 3 and Appendix 2) favor oceanfront habitats during breeding and/or nonbreeding seasons. The group can be divided into 2 categories: rocky and sandy intertidal species (Fig. 5).

All of the rocky intertidal species, except Purple Sandpiper, are Pacific coast shorebirds. The sand-beach species, except Snowy Plover, tend to be more abundant on Atlantic than Pacific coasts, but also (except for Piping Plover) occur on Pacific coasts where suitable habitats exist.

There are few options for managing intertidal habitat for foraging shorebirds except in unusual situations where tidal water flow may be regulated. At some coastal sites managers have reduced effects of mosquito-control on wildlife by using "open marsh water management" practices to restore shorebird habitat. The shorebird management initiative most needed at coastal reserves is control of chronic disturbance and protection of nesting habitat in the case of certain plovers and oystercatchers.



American Oystercatcher, *Haematopus palliatus*

Shorebirds are some of the first birds to begin southward migration from the Northern Hemisphere, arriving on U.S. beaches and tidal flats from Arctic and northern breeding places during July and August. Hence they compete with humans for beach space during the peak outdoor recreation season. The frequency of disturbance is directly related to human accessibility and desirability of coastal habitats (Fig. 6). Flights by shorebirds to avoid chronic disturbance use energy, which can deplete the fat reserves otherwise accumulated for migration or early breeding-season needs. Growing evidence suggests that this may lead to mortality of migrants.

There is not yet adequate information for establishing appropriate setbacks for reducing disturbance on a species-by-species basis. In general, larger shorebirds such as Whimbrel or Black-bellied Plover will begin avoidance flights when humans approach within 100-150 yards. Small shorebirds such as the peep sandpipers will not fly until a pedestrian is 20-30 yards away. Fright distances are greater with dogs than with humans and lower with humans in cars than with humans on foot.

Rocky Intertidal	Sandy Intertidal
Black Oystercatcher	Snowy Plover
Black Turnstone	Wilson's Plover
Wandering Tattler	Piping Plover
Surfbird	American Oystercatcher
Purple Sandpiper	Ruddy Turnstone
Rock Sandpiper	Sanderling
	Red Knot

Fig. 5. Shorebirds of rocky and sandy ocean front habitats.

WHIMBREL CASE HISTORY

Between 100-200 of an estimated 600 or more Whimbrels in eastern Maine stage in intertidal habitats and blueberry lands surrounding the Cutler Navy Station. A count of 200 in July 1998 was the sixth highest among 1,800 survey areas in the lower 48 states for fall. The Cutler count was the second highest in New England and the fourth highest along the East Coast.

Whimbrels in Maine forage on both upland (barrens, coastal headlands, and freshwater bogs) and intertidal habitats. In upland areas they eat low-bush blueberry, crowberry and cloudberry. Within the intertidal zone, they feed primarily on invertebrate animals living in sand and gravel flats, or around rockweed-covered boulders. Whimbrels rest on near-shore ledges, gravel beaches, blueberry barrens, heath-dominated barrens, and crowberry shrublands.

Habitat management. The Navy restored and enhanced about 5 acres of blueberry barrens where Whimbrels historically fed. In addition, the Navy created over 250 additional acres of new habitat by managing vegetation in the VLF field. The new areas include open shrubland-grassland containing lowbush blueberry, crowberry, and mountain cranberry. Cover by these preferred food types has increased annually, and with continued vegetation management through burning and mowing, the Whimbrel population should continue to increase.

Protection from Human Disturbance. Whimbrels are especially sensitive to human disturbance. Controlled public access to the Cutler Navy facility, including a leash law, effectively safeguards key feeding habitat and reduces disturbance to essential roost sites.

Habitat protection provided through the creation of the Department of the Defense's first Ecological Reserve Area (ERA) also promotes controlled access at the DoD's first Watchable Wildlife Area overlooking the most important shorebird and waterfowl feeding sites in Machias Bay.



Whimbrel, *Numenius phaeopus*

CASE STUDY – VANDENBERG AIR FORCE BASE

By Nancy Read Francine, Wildlife Biologist, 30 CES/
CEVFN, Vandenberg Air Force Base

Vandenberg Air Force Base, on the California coast approximately 275 miles south of San Francisco, lies just a few miles north of Point Conception. The 99,492-acre base includes approximately 35 miles of mostly undeveloped shoreline. The base supports a wide variety of habitats, including dune-backed and bluff-backed sandy beaches, rocky shoreline, extensive riparian, estuarine and freshwater marsh, vernal pools, and other permanent and seasonal wetlands. Vandenberg's shoreline has special importance as a zone of ecological transition between northern and southern California.

Nesting shorebirds include the threatened Western Snowy Plover, Killdeer, Black Oystercatcher, American Avocet, and Black-necked Stilt. These and 34 other shorebird species have been recorded during migration.

Vandenberg's coastline is protected from development, and most of it is protected from significant human disturbance. Public access is limited to two areas, Ocean Beach just north and south of the Santa Ynez River mouth, and a 1-mile section of Jalama Beach at the southern base boundary. Because Ocean Beach provides public beach access for the City of Lompoc there is substantial pressure to maintain access. A "linear restriction" prohibits entry into Snowy Plover nesting habitat on Ocean Beach and on one mile of military-only recreational beach to the north.

Smaller coastal estuarine and lagoon habitats receive minimal disturbance. The largest of these, San Antonio Creek, is part of a 7-mile stretch of beach that is seasonally closed to protect nesting Snowy Plover and California Least Tern. Other coastal areas on VAFB remain largely undisturbed except for low-density recreational use. No significant impact of rocket launches on nesting snowy plovers or on general bird abundance or diversity has been detected.

A 3-mile section of rocky coastline on VAFB is designated an Ecological Reserve and protects rocky intertidal habitat for shorebirds such as turnstones and Wandering Tattler. Even the VAFB airfield is shorebird habitat, with Black-bellied Plover, small numbers of Mountain Plover and Pacific Golden-Plover, and other species frequenting each winter. Bird-aircraft strike hazard (BASH) risks are carefully monitored at the airfield, but the hazard is rarely considered severe.

No vehicles are permitted on any of VAFB's beaches except for mission-essential base personnel.

A limited number of off-highway vehicles (OHV) is managed by VAFB's Fish and Wildlife wardens, a division of the 30th Security Forces Squadron. Restrictions include 10 mph speed limits, few access trails, and use of horses in preference to OHV's whenever possible.

VAFB has also planned to ensure that sensitive coastal areas are disturbed as little as possible. This includes using established routes for flight training that minimize the potential for disturbance, maintaining minimum altitudes of 1000 feet over most areas, and conducting environmental review of new programs to ensure that impacts are minimized or avoided.

Because of the extensive amount and high quality of shorebird habitat on VAFB, management is focused on passive protection rather than active manipulation of habitats. An exception is control of introduced iceplant (*Carpobrotus* spp.) and European beach grass (*Aimophila arenaria*) which have reduced habitat for Snowy Plover and rare plants.

In 1998, researchers from the University of California began a 3-year study of shorebird distribution and abundance on sandy beaches including several sites on Vandenberg. These surveys will be the first systematic studies of all shorebirds on Vandenberg beaches.

Because Vandenberg supports both disturbed (public access and high-use military access) and undisturbed beaches, the base serves as an excellent "outdoor laboratory" for study of the potential impacts of human disturbance. Ongoing monitoring of snowy plovers has shown that reproductive success is higher on closed versus public access beaches. These results challenge Vandenberg, the U.S. Fish and Wildlife Service, and the California Coastal Commission to find more effective ways to protect and recover threatened and endangered species in the face of heavy demand for public access.



Pacific Golden-Plover, *Pluvialis fulva*

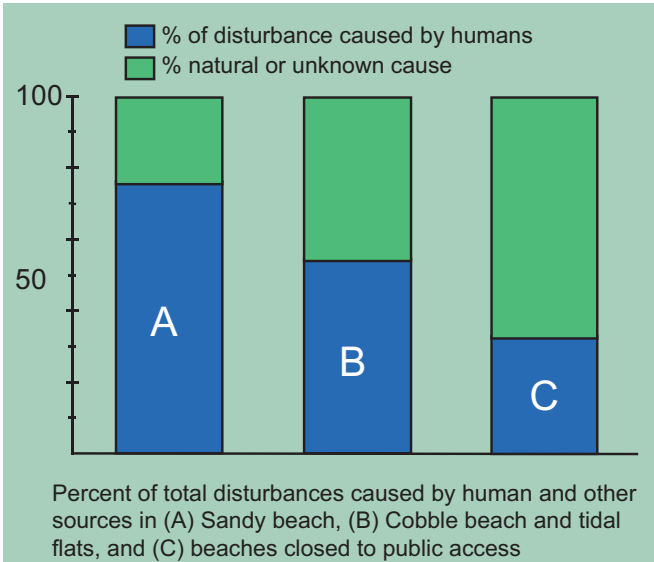


Fig. 6. Effect of disturbances on shorebirds.



Dunlins, *Calidris alpina*

Although usually it is best to manage for maximum diversity, sometimes managers considering habitat manipulations for shorebirds may want to focus upon a particular species rather than a habitat guild. Appendices 2 and 3 show relative abundance of shorebird guilds and common shorebirds in 9 regions across the continental United States. The analysis is based on information from more than 33,000 censuses made at 872 sites during spring and autumn migrations by cooperators of the International Shorebird Surveys (ISS), including Department of Defense lands, National Wildlife Refuges, state wildlife areas, and other federal and privately owned lands. We used information only from sites where there was complete census coverage, *i.e.* at least one census in each 10 days during the appropriate migration period of each species. We also have drawn from work of individuals in areas where the ISS has not traditionally focused (states west of the 105th Meridian, roughly the Rocky Mountains).

Sites were grouped by region (Fig. 7). The mean value of all counts was then calculated separately for each species at marine and nonmarine sites in each region (2 of the regions—4A and 5A—had no marine sites). The results are shown in Appendix 3. In one region (3B) we had relatively sparse coverage (491 and 368 censuses, respectively). Until rigorous statistical comparisons are done, we have low confidence in the mean values shown for this region. Although we believe available data reasonably portray reality, readers should understand that differences shown could be an artifact of sampling as well as a consequence of differences in numbers of birds. Comparisons of occurrence by one species against another species or group of species should help with interpretation of the graphs, especially for the regions with lower census coverage.

Common Shorebirds in Different Regions of the United States

In summary, understanding habitat use and migration chronology of shorebirds guilds is essential to national and international shorebird conservation. The following appendices provide regional information by species and guild. With the appendices and the suggested readings, resource managers can investigate to what extent potential shorebird habitat (both natural and managed) exists on and near their installation. They can then seek partners to join in developing an integrated approach for providing or protecting key shorebird habitat along migration routes.

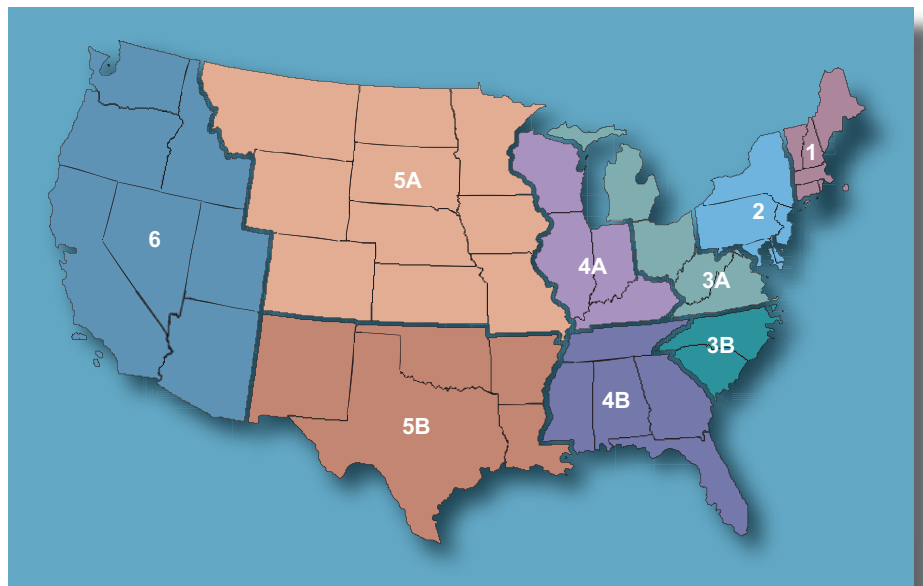


Fig. 7. Regions used in this report (from the International Shorebird Survey).

CASE STUDY – SHOREBIRD MANAGEMENT AT THE NAVAL COMPUTER TELECOMMUNICATION STATION, CUTLER, MAINE

By Norman Famous, Wildlife Biologist

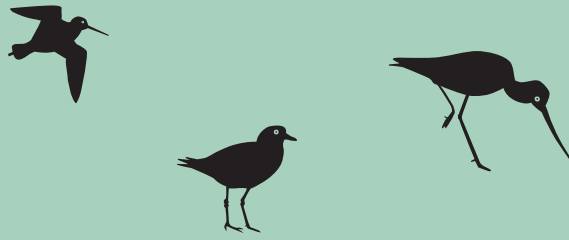
The U.S. Navy recognized that Sprague Neck and its surrounds have a special importance to migratory shorebirds, particularly during the southward migration (July-October). Shorebird stewardship is significant because nationally important numbers of Semipalmated Sandpiper and Whimbrel uses local habitats. The facility is among the most important shorebird roost sites for 7 species in Maine, and has one of the most diverse shorebird communities in the state. Shorebird protection, habitat restoration, enhancement and creation, population monitoring, and migration research have been conducted since 1960.

Located near the eastern-most point in the US, the former Cutler, NCTS occupies a narrow 4-mile long by 1-mile wide peninsula in the SE corner of Machias Bay. The 3,000 acre facility is divided into 3 units: (1) a grassy and shrubby very-low-frequency (VLF) antenna field (2,200 acres), (2) Sprague Neck (175 acres, a forested peninsula with a ¼ mile long sand and gravel spit); and (3) a 200 acre administrative area. The Navy's shorebird management focuses on the VLF field and Sprague Neck. The transmitter is underground and extends into the intertidal zone; 26 above-ground towers (800 to 1,000 feet tall) support receiving antennas.

Thirty-three species of shorebirds have been observed at Sprague Neck Bar between 1978 and 1998. Although some shorebirds are present during winter and spring, the major use is as a fall migration stopover site. The feeding and roosting areas under Department of Defense stewardship include the largest and most stable sites in Machias and Little Machias Bays for 9 species. During winter, between 100 and 300 Purple Sandpipers are residents of the rocky intertidal shorelines.

The Cutler NCTS has the 6th highest count for fall migrating Whimbrel in the lower 48 states; It is second highest count in New England. In addition, Sprague Neck Bar has the second highest recorded count for White-rumped Sandpiper in the U.S. as well as some of the highest counts in Maine for Semipalmated Sandpiper, Semipalmated Plover, Short-billed Dowitcher and Black-bellied Plover.

Other nearby public and privately owned lands coinhabited by NCTS shorebirds include Hog Island Wildlife Management Area (state owned) located ½ mile



north of Sprague Neck and the Cross Island National Wildlife Refuge (CINWR) located 1.4 mile SSE of the VLF field. Sprague Neck Bar and Hog Island form the most important high tide roost in Machias Bay for 9 shorebird species. CINWR is used for roosting during the fall migration by smaller shorebirds such as Semipalmated, Least and White-rumped Sandpipers, and Semipalmated Plover, and for feeding by larger shorebirds such as Whimbrel, Black-bellied Plover, and Ruddy Turnstone.

Management. Management at the Cutler facility involves protecting about 40% of Little Machias Bay and a significant portion of Machias Bay. Passive management includes population monitoring and protection from chronic human disturbance.

Through the Department of Defense Legacy Resource Management Program, the Navy monitored shorebird populations for 5 years during the late 1990's to assess shorebird use, potential risks, and for use in developing local management. Protection has included designation of key feeding and roosting areas as an Ecological Reserve.

Active management has involved the restoration, creation, and enhancement of upland Whimbrel feeding and resting habitat in former low-bush blueberry barrens. Additional plans calls for enhancing roost sites, including creation of resting areas above highest spring tide levels that usually flood local roosting spots.



Black-bellied Plover, *Pluvialis squatarola*

Acknowledgements

Much of this booklet is based upon more than 45,000 censuses made since 1975 by 800 volunteers working with the International Shorebird Surveys; hats off to all of them! The ISS has been largely supported by members and friends of Manomet Center for Conservation Sciences (Manomet), with additional support from the U.S. Fish & Wildlife Service and the National Fish and Wildlife Foundation. The booklet also has benefited from advice of Chris Eberly (Department of Defense Partners in Flight), Jonathan Bart (USGS), Jim Corven, and others.

The ISS effort in the United States was concentrated in states east of the 105th Meridian (roughly the Rocky Mountains). Supplementary census information has been generously provided by PRBO Conservation Science (formerly Point Reyes Bird Observatory) and by Audubon Canyon Ranch.

Additional Readings

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Baird's Sandpiper on nest, *Calidris bairdii*

Appendix 1

Shorebird Names and Natural History

Common and scientific names, major prey, habitats and foraging methods, and nationally significant numbers of regularly occurring shorebirds in the United States.

Common Name	Scientific Name	Major Prey Type ¹	Principal Foraging Method ²	Primary Foraging Habitats ³	Preferred Habitat Acreage ⁴	Important Numbers ⁵
Black-bellied Plover	<i>Pluvialis squatarola</i>	E	V	om ou vu vs	L	2000
American Golden-Plover	<i>Pluvialis dominica</i>	E	V	om vu ou	L	175
Pacific Golden-Plover	<i>Pluvialis fulva</i>	E	V	om vu ou	L	?
Snowy Plover	<i>Charadrius alexandrinus</i>	E	V	om os	M, L	75
Wilson's Plover	<i>Charadrius wilsonia</i>	E	V	os om	M,L	35
Semipalmated Plover	<i>Charadrius semipalmatus</i>	E	V	om os vs	M,L	1800
Piping Plover	<i>Charadrius melodus</i>	E	V	om os	M,L	75
Killdeer	<i>Charadrius vociferus</i>	E	V	ou om vu vs	S,M,L	1200
Mountain Plover	<i>Charadrius montanus</i>	E	V	ou	L	?
American Oystercatcher	<i>Haematopus palliatus</i>	Ei	Vt	om os	L	100
Black Oystercatcher	<i>Haematopus bachmani</i>	E	V	rs	L	?
Black-necked Stilt	<i>Himantopus mexicanus</i>	Es	V	os vs	M,L	200
American Avocet	<i>Recurvirostra americana</i>	Es	T	os ow vs om	L	1000
Spotted Sandpiper	<i>Actitis macularius</i>	E	V	os vs rs	M,L	150
Solitary Sandpiper	<i>Tringa solitaria</i>	E	V	os vs	S,M	60
Wandering Tattler	<i>Tringa incana</i>	E	V	rs	L	?
Greater Yellowlegs	<i>Tringa melanoleuca</i>	Es	V	vs os ow om	M,L	700
Willet	<i>Tringa semipalmata</i>	Ie	Vt	os vs om	L	400
Lesser Yellowlegs	<i>Tringa flavipes</i>	Es	V	vs os om	M,L	5000
Upland Sandpiper	<i>Bartramia longicauda</i>	E	V	vu	L	75
Whimbrel	<i>Numenius phaeopus</i>	Ie	Tv	os om vs vu	L	100
Long-billed Curlew	<i>Numenius americanus</i>	Ie	Vt	vu om	M,L	100
Hudsonian Godwit	<i>Limosa haemastica</i>	I	I	os om	L	60
Marbled Godwit	<i>Limosa fedoa</i>	I	I	vs os	M,L	50
Ruddy Turnstone	<i>Arenaria interpres</i>	Ei	V	rs om os	L	1100
Black Turnstone	<i>Arenaria melanocephala</i>	E	V	rs	L	?
Surfbird	<i>Aphriza virgata</i>	V	Vt	rs, os	M,L	?
Red Knot	<i>Calidris canutus</i>	Ie	Tv	om os	L	1500
Sanderling	<i>Calidris alba</i>	Ie	Tv	om os	L	3500
Semipalmated Sandpiper	<i>Calidris pusilla</i>	Ie	Tv	om os vs	M,L	15,000
Western Sandpiper	<i>Calidris mauri</i>	Ie	Tv	om os vs	M,L	3500
Least Sandpiper	<i>Calidris minutilla</i>	Ei	Vt	vs om os vm	S,M,L	12,000
White-rumped Sandpiper	<i>Calidris fuscicollis</i>	Ei	Tv	om os	M,L	10,000
Baird's Sandpiper	<i>Calidris bairdii</i>	Ei	Vt	om os vu	M,L	3500
Pectoral Sandpiper	<i>Calidris melanotos</i>	Ie	Tv	vs os om vu	M,L	2700
Purple Sandpiper	<i>Calidris maritima</i>	EI	Vt	rs	L	15
Rock Sandpiper	<i>Calidris ptilocnemis</i>	E	V	rs	L	?

Shorebird Names and Natural History—continued

Common Name	Scientific Name	Major Prey Type ¹	Principal Foraging Method ²	Primary Foraging Habitats ³	Preferred Habitat Acreage ⁴	Important Numbers ⁵
Dunlin	<i>Calidris alpina</i>	I	T	om os vs	L	3000
Stilt Sandpiper	<i>Calidris himantopus</i>	I	T	om vs	M,L	2500
Buff-breasted Sandpiper	<i>Tryngites subruficollis</i>	E	V	vu ou om	L	?
Short-billed Dowitcher	<i>Limnodromus griseus</i>	I	T	om os vs	M,L	2500
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>	I	T	vs	M,L	10,000
Wilson’s Snipe	<i>Gallinago delicata</i>	I	T	vm vs vu	S,M,L	150
American Woodcock	<i>Scolopax minor</i>	I	T			?
Wilson’s Phalarope	<i>Phalaropus tricolor</i>	S	V	ow os om vs	M,L	8000
Red-necked Phalarope	<i>Phalaropus lobatus</i>	S	V	ow os vs	L	?
Red Phalarope	<i>Phalaropus fulicarius</i>	S	V	ow os vs	L	?

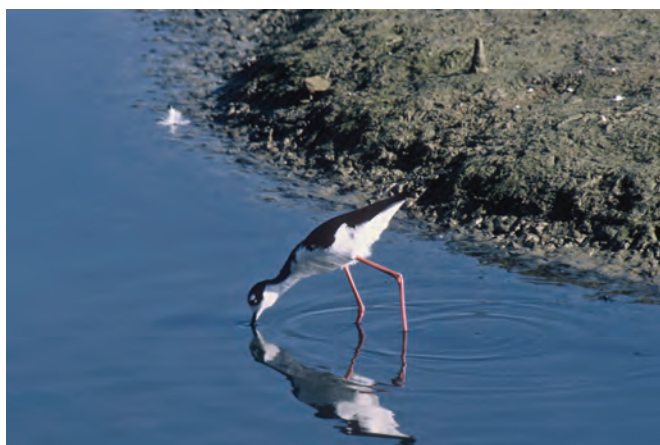
¹ Capital letters represent primary method, small letters represent secondary methods. E = Epifauna (invertebrates living on bottom surface), I = Infauna (invertebrates living in bottom mud/sand), S = Surface (animals living on water surface or in water column)

² V = Visual, i.e. catching spied prey, T = Tactile, i.e. catching prey sensed by touch or chemical cues. Rarely used methods are not shown.

³ om = open, unvegetated or sparsely vegetated habitats, vu = vegetated uplands, ou = open or sparsely vegetated upland, os = open or sparsely vegetated shores or salt flats, vs = vegetated shores and wetlands, rs = rocky shores.

⁴ L = Large (e.g. habitat expanses > 10 acres), M = Medium (e.g. 2-10 acres), S = Small (< 2 acres).

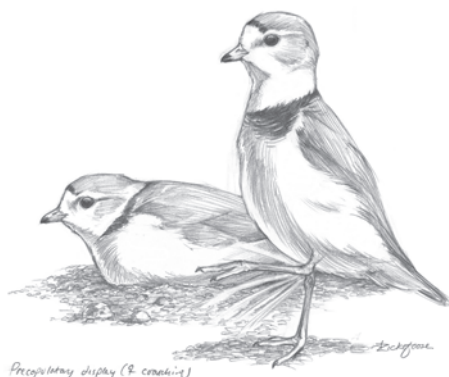
⁵ Numbers equaling or exceeding these values are considered nationally significant according to index standards of the International Shorebird Surveys.



Black-necked Stilt, *Himantopus mexicanus*



American Golden-Plover, *Pluvialis dominica*



Piping Plover, *Charadrius melodus*



Greater Yellowlegs, *Tringa flavipes*

Appendix 2

Seasonal Occurrence of Shorebirds

ISS Region 1

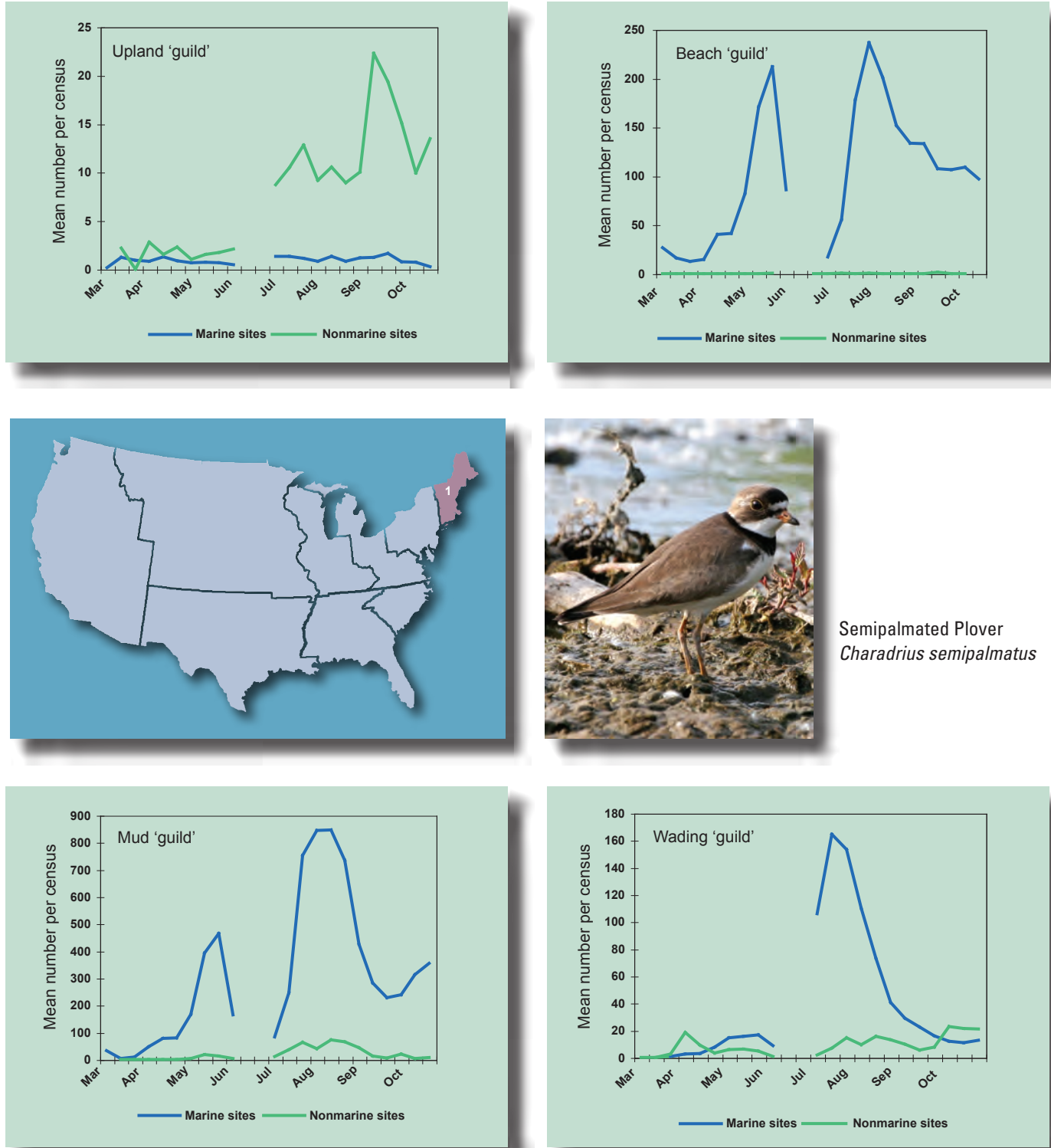
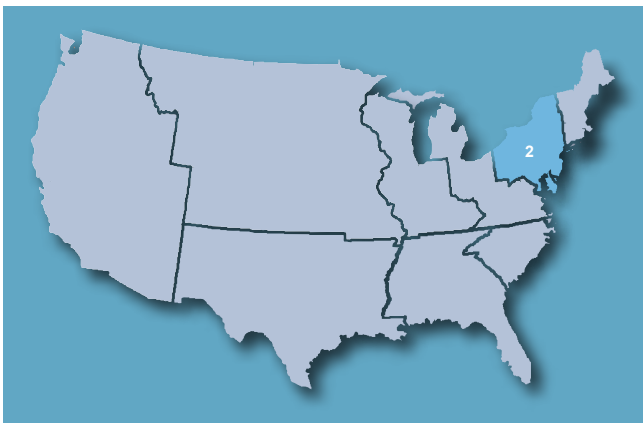
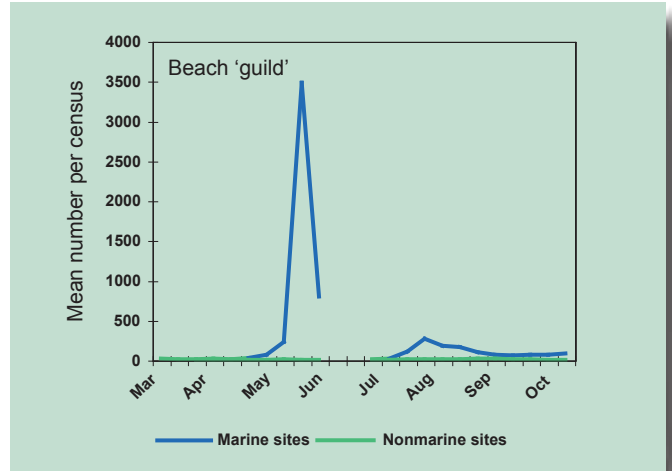
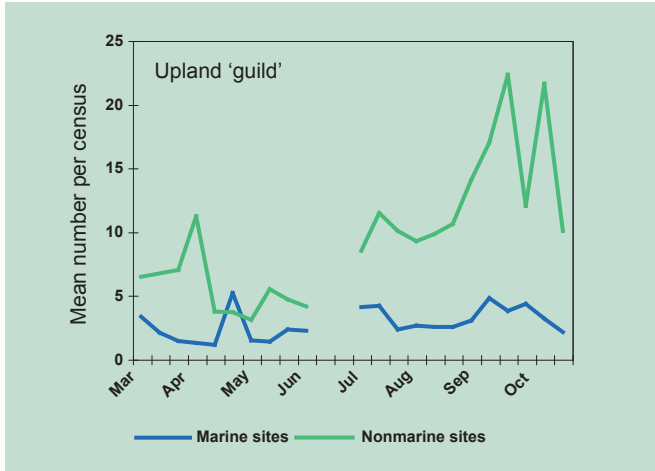


Fig. A2.1. Migration dates of 4 shorebird 'guilds' at marine and nonmarine sites.

Seasonal Occurrence of Shorebirds—continued

ISS Region 2



Lesser Yellowlegs, *Tringa flavipes*

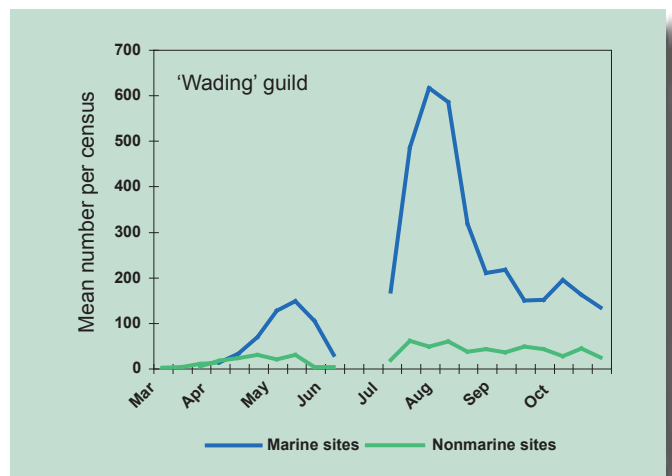
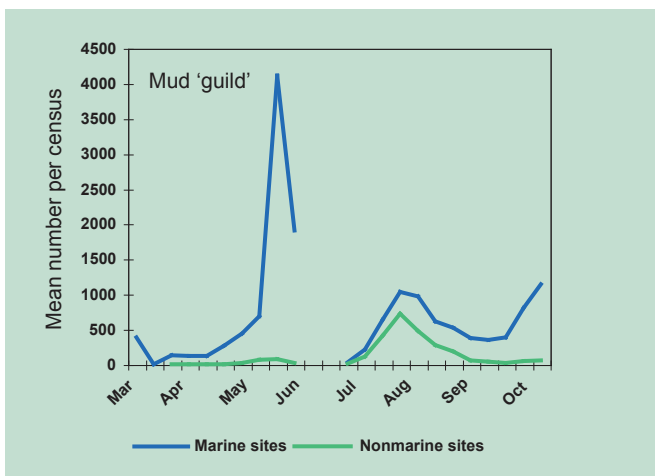
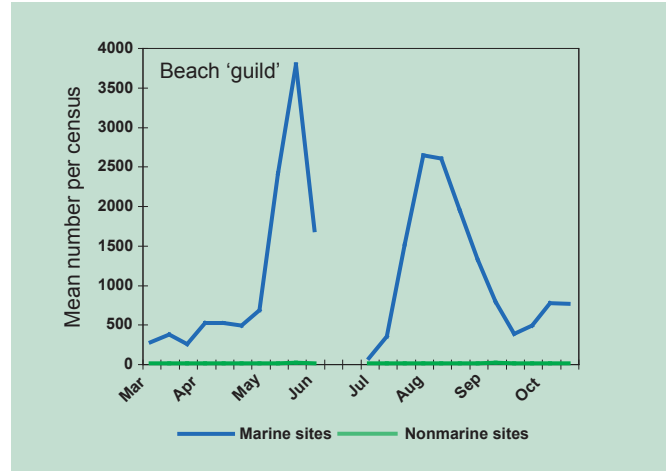
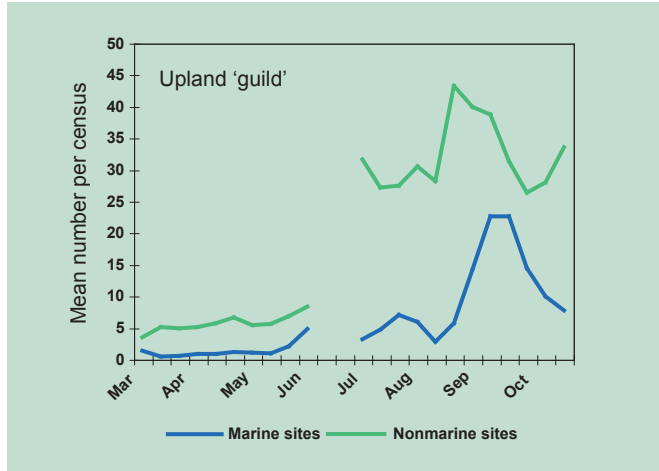


Fig. A2.1.—continued

Seasonal Occurrence of Shorebirds—continued

ISS Region 3A



Least Sandpiper, *Calidris minutilla*

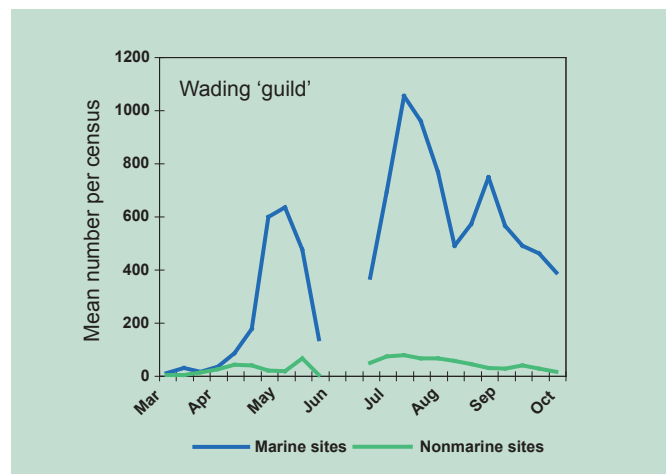
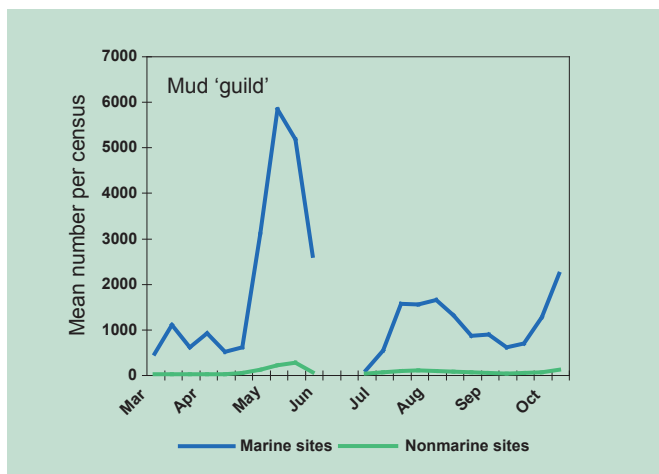
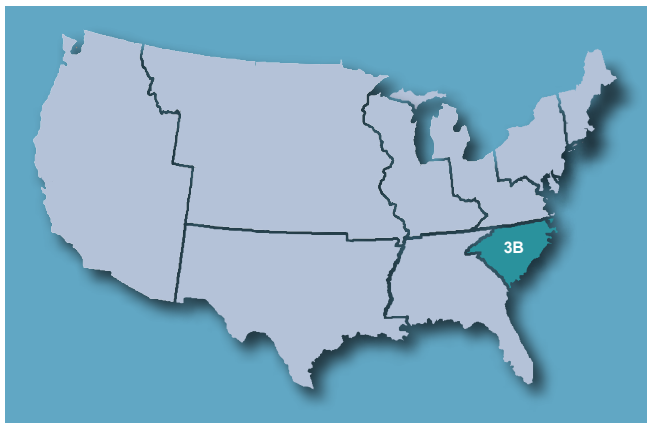
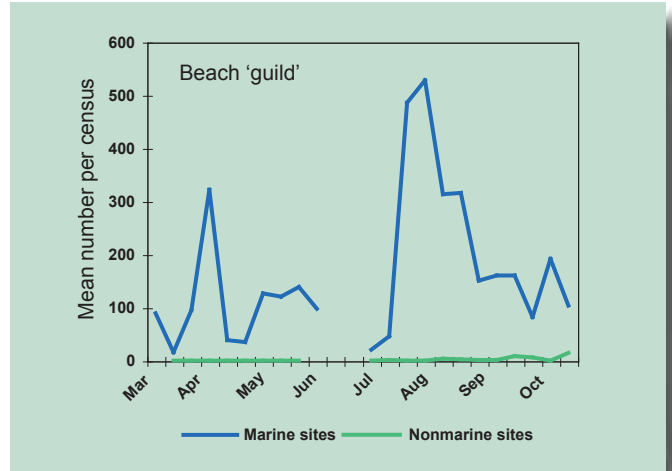
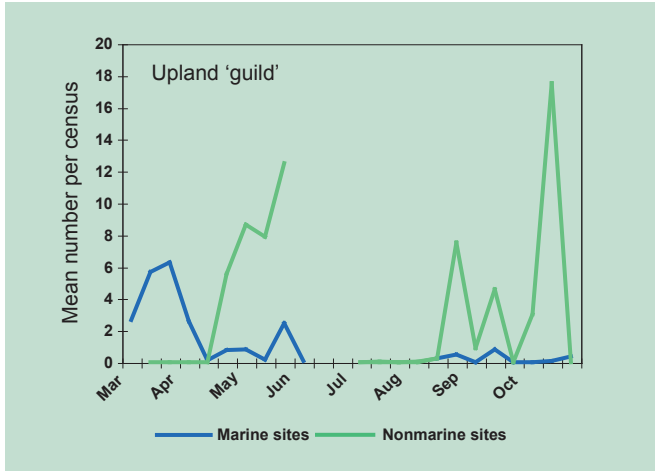


Fig. A2.1.—continued

Seasonal Occurrence of Shorebirds—continued

ISS Region 3B



Willet, *Tringa semipalmata*

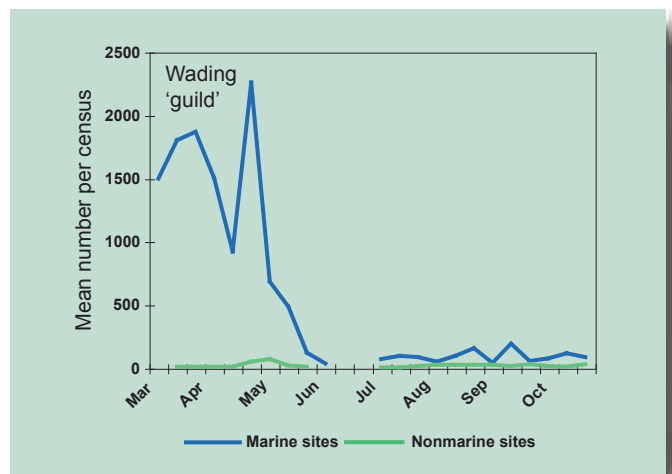
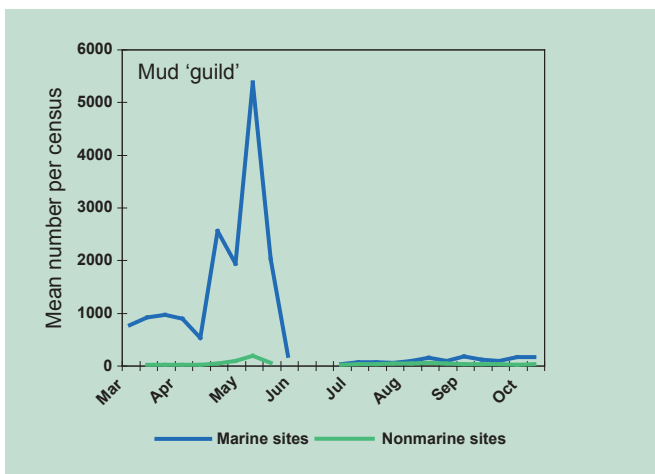
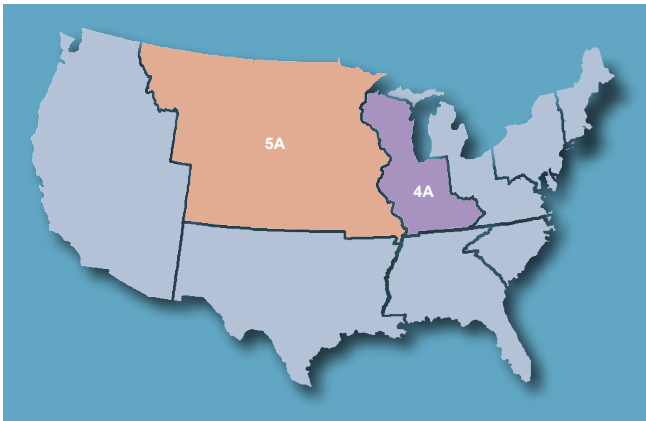
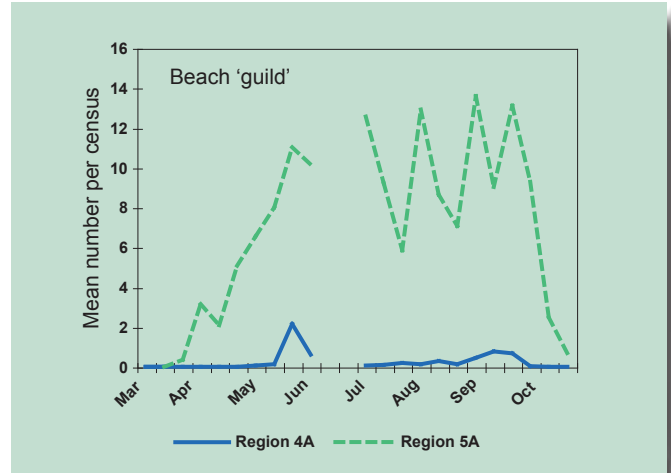
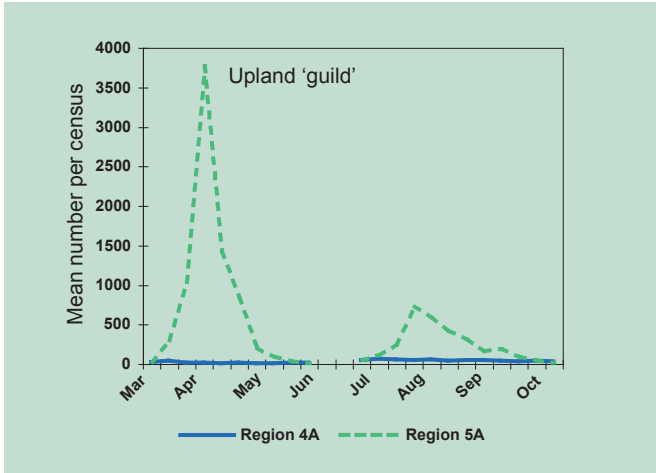


Fig. A2.1.—continued

Seasonal Occurrence of Shorebirds—continued

ISS Regions 4A & 5A



American Golden-Plover, *Pluvialis dominica*

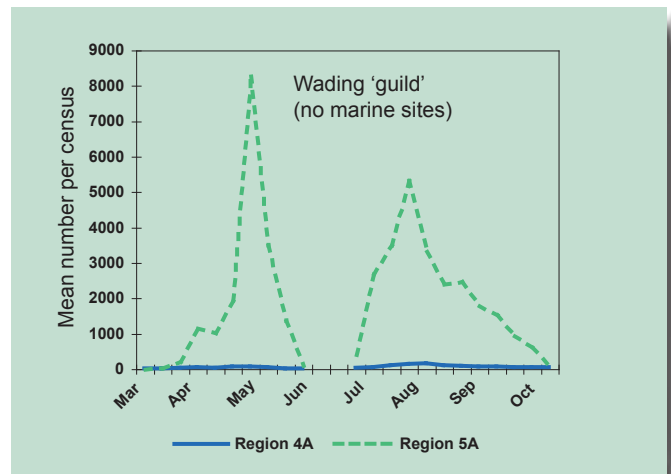
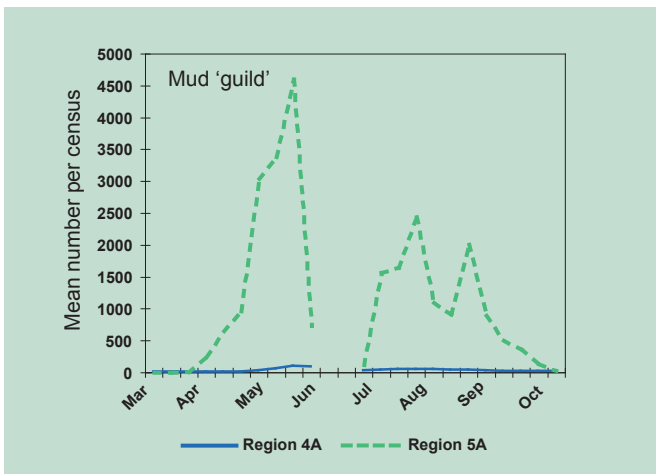
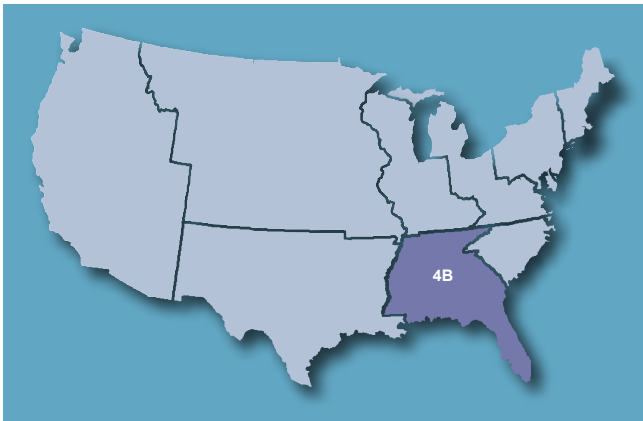
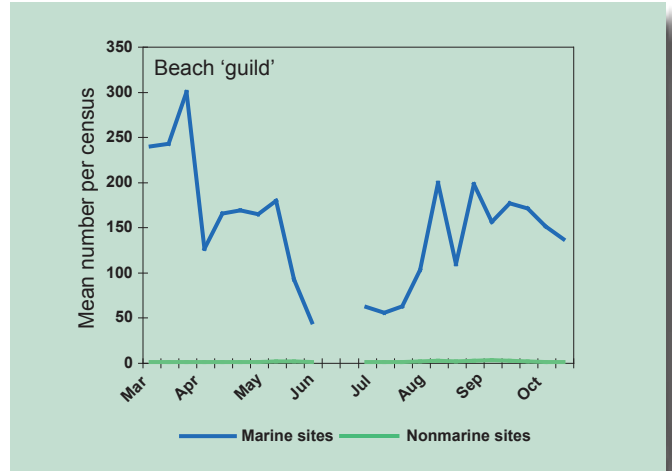
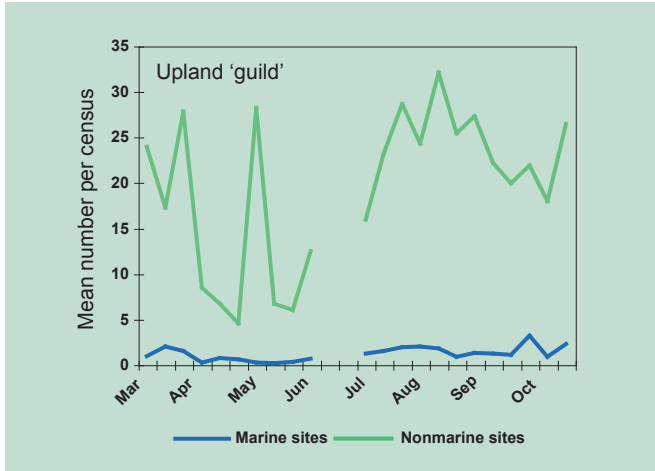


Fig. A2.1.—continued

Seasonal Occurrence of Shorebirds—continued

ISS Region 4B



Western Sandpiper, *Calidris mauri*

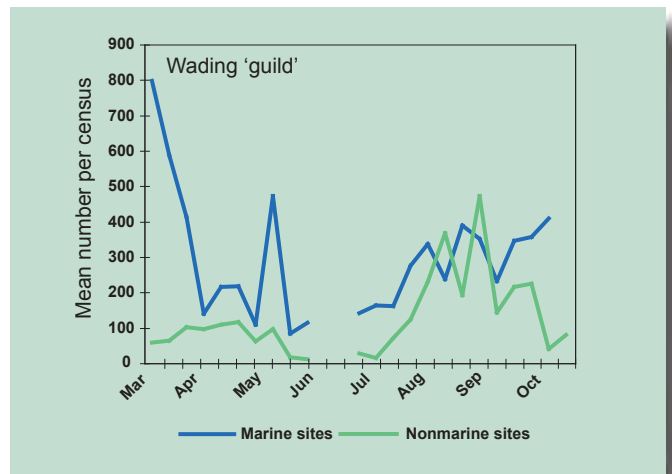
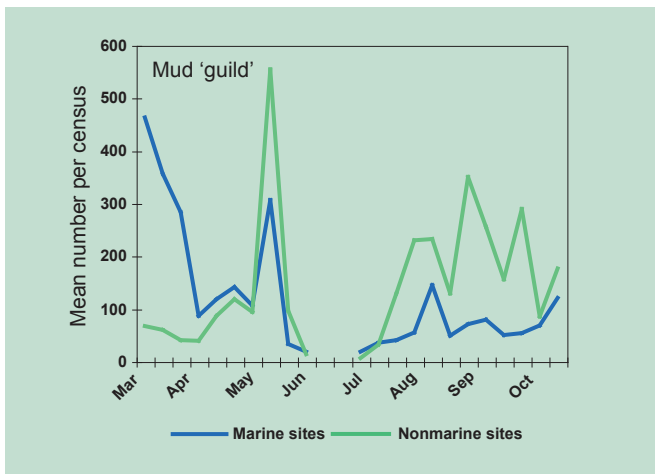
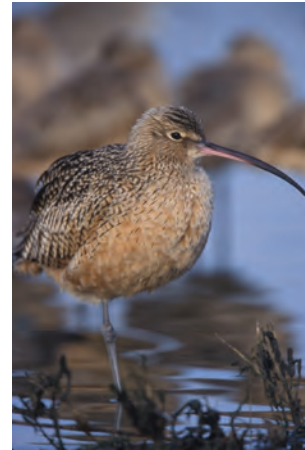
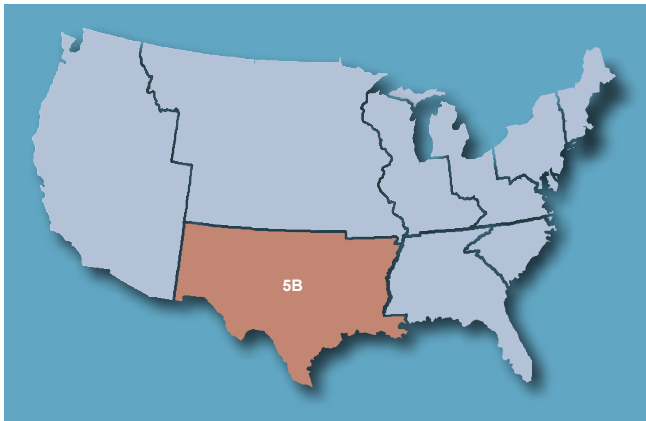
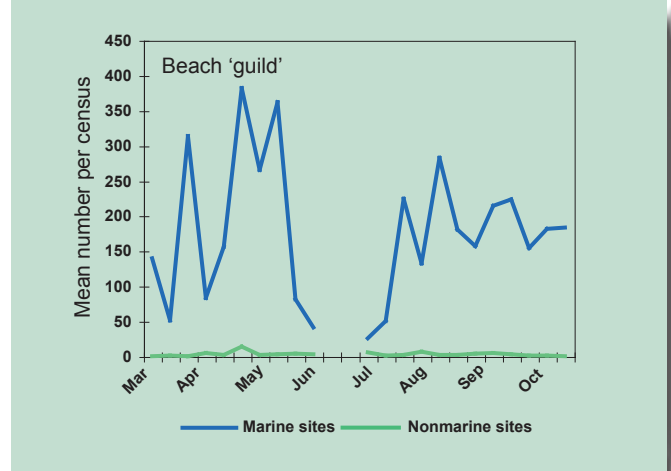
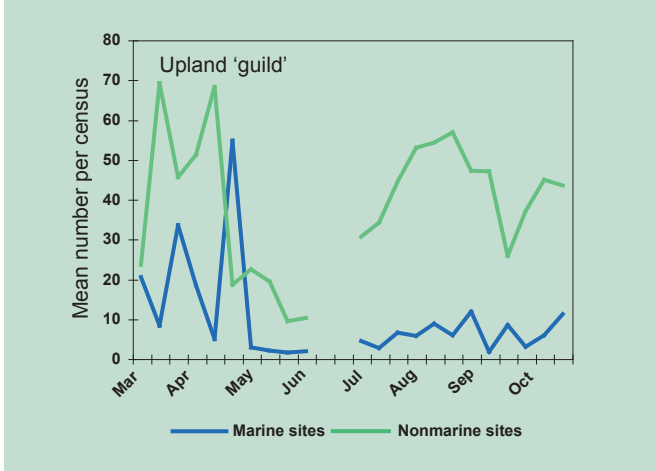


Fig. A2.1.—continued

Seasonal Occurrence of Shorebirds—continued

ISS Region 5B



Long-billed Curlew
Numenius americanus

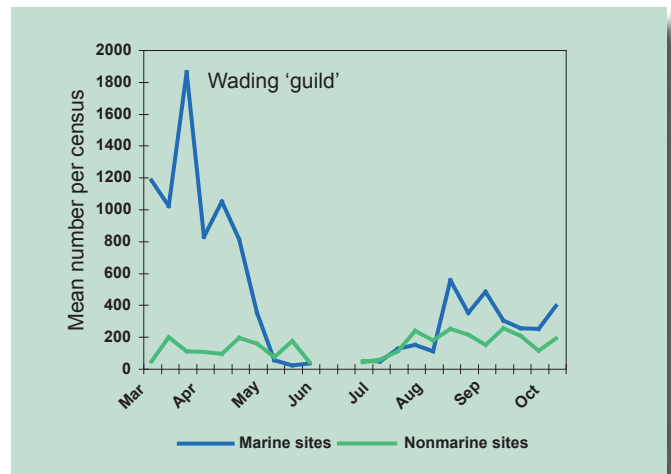
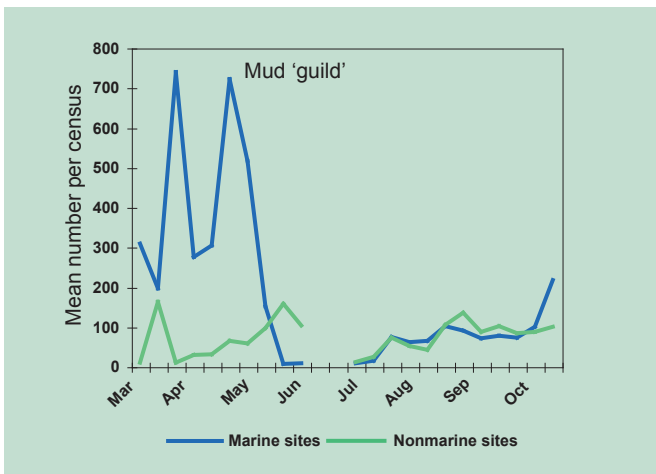
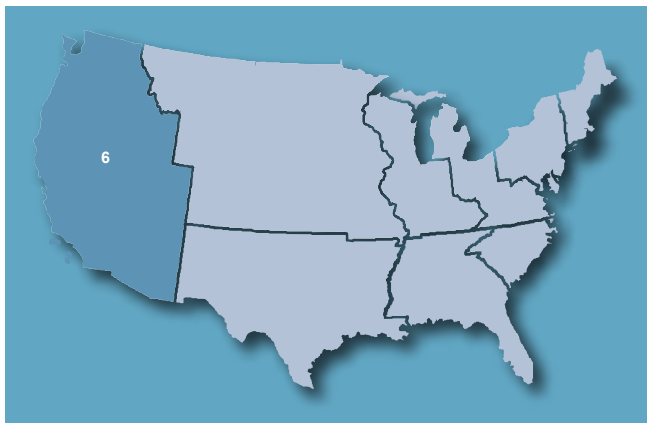
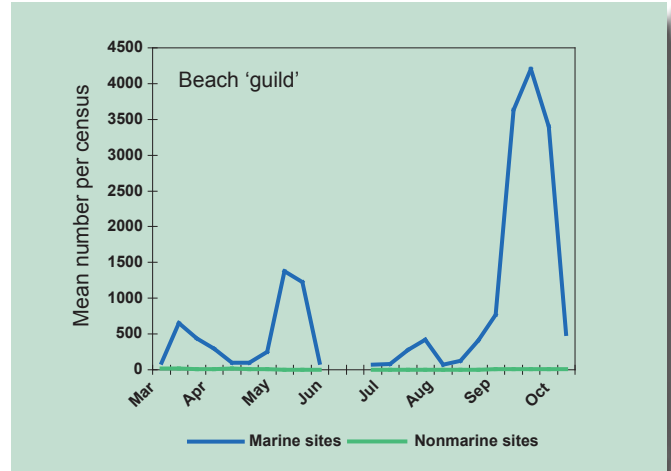
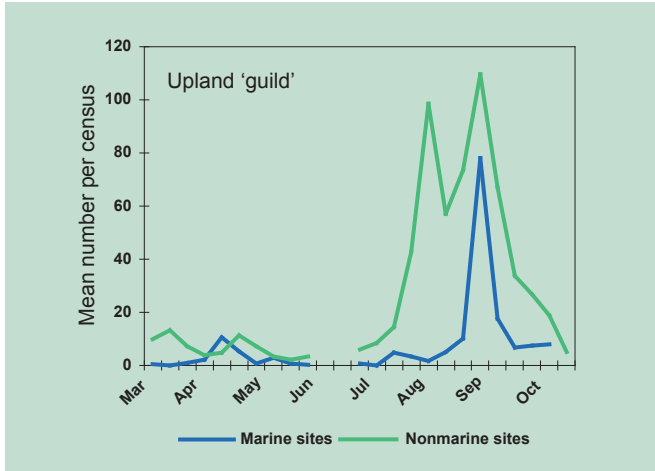


Fig. A2.1.—continued

Seasonal Occurrence of Shorebirds—continued

ISS Region 6



Black Oystercatcher, *Haematopus bachmani*

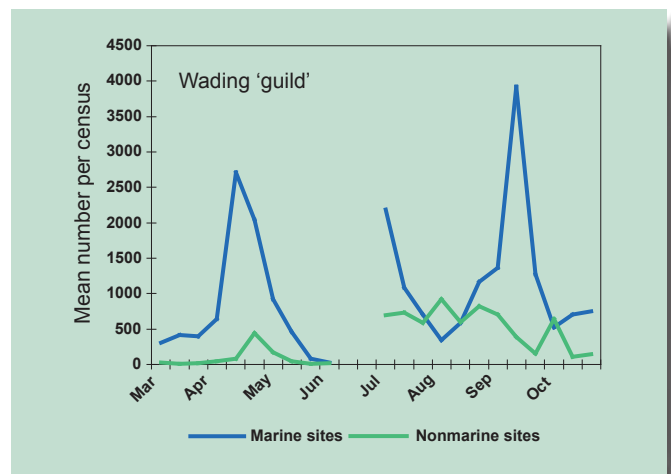
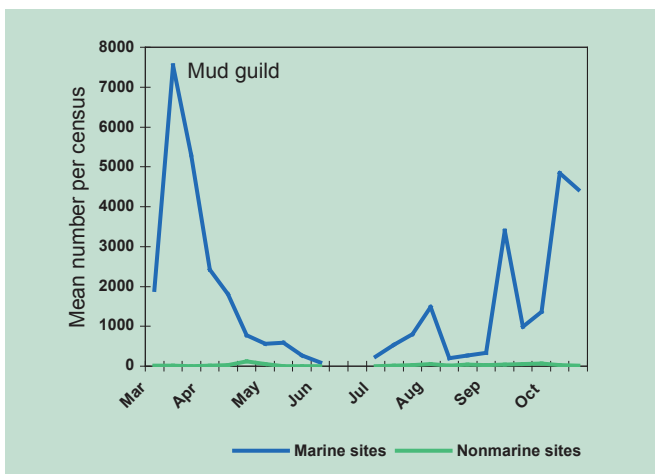


Fig. A2.1.—continued

Appendix 3

Regional Abundance of Shorebirds

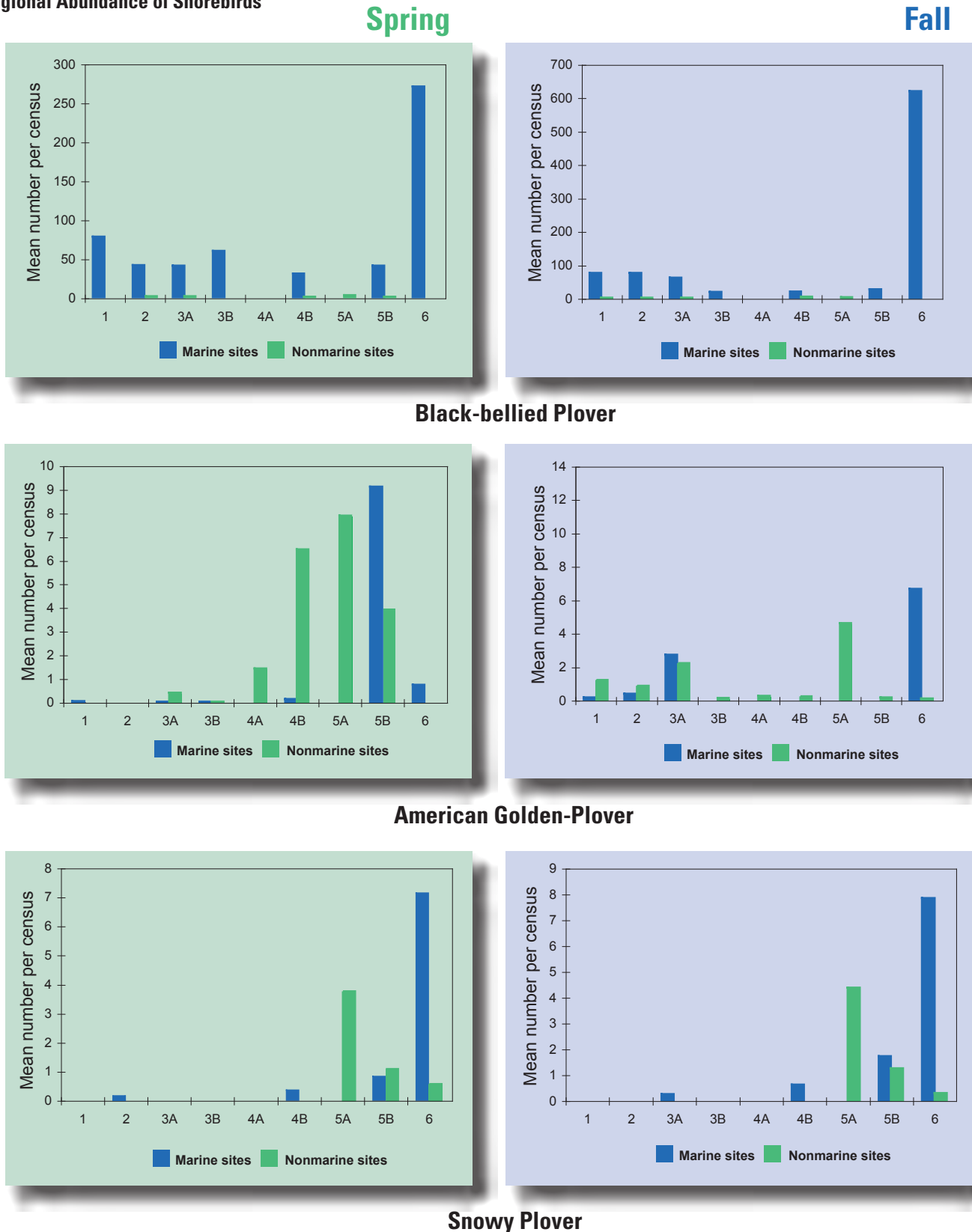
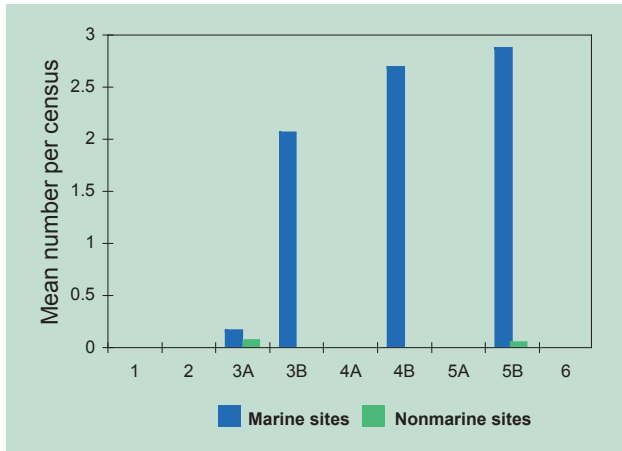


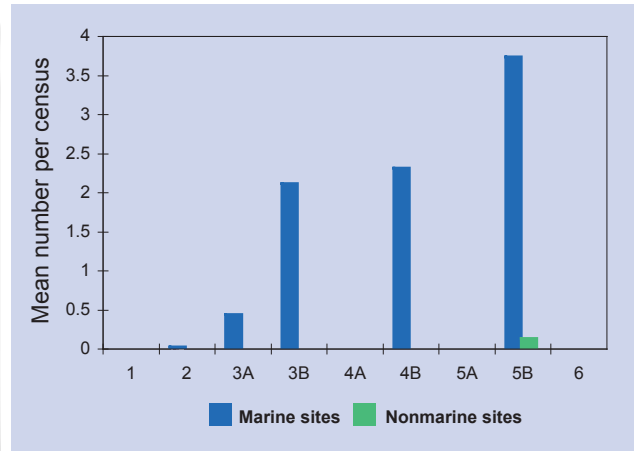
Fig. A3.1. Relative abundance by season, species, and region.

Regional Abundance of Shorebirds—continued

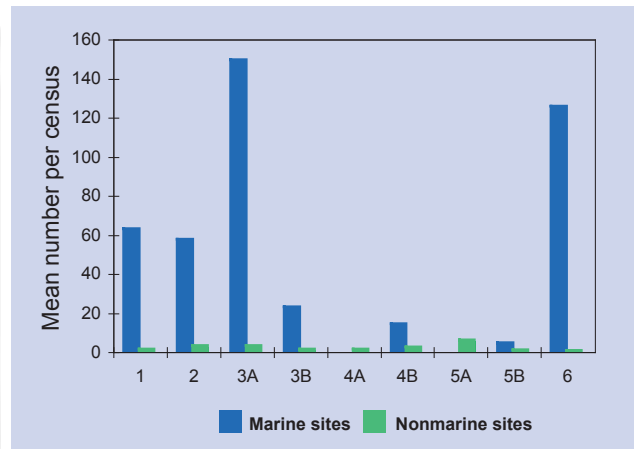
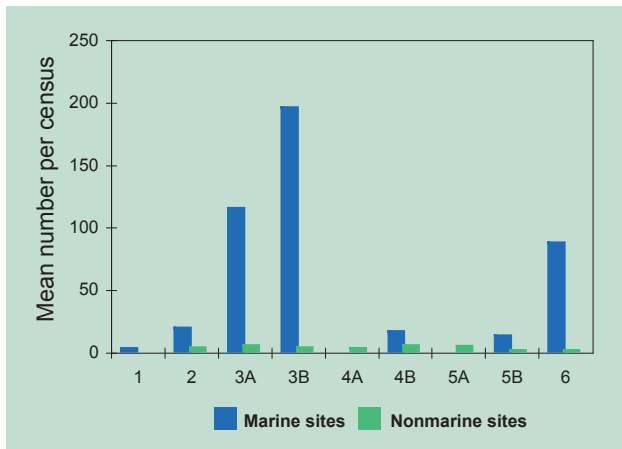
Spring



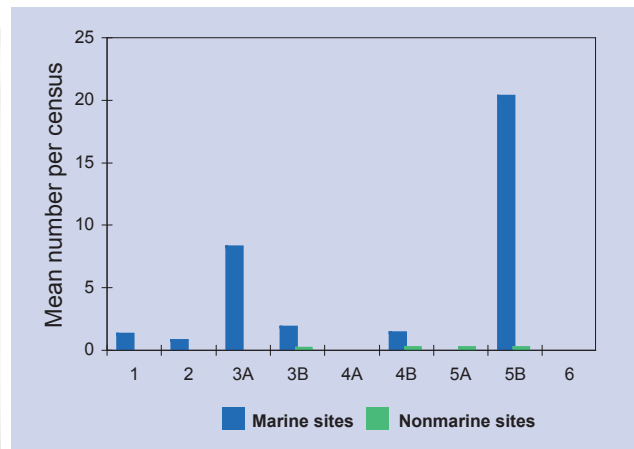
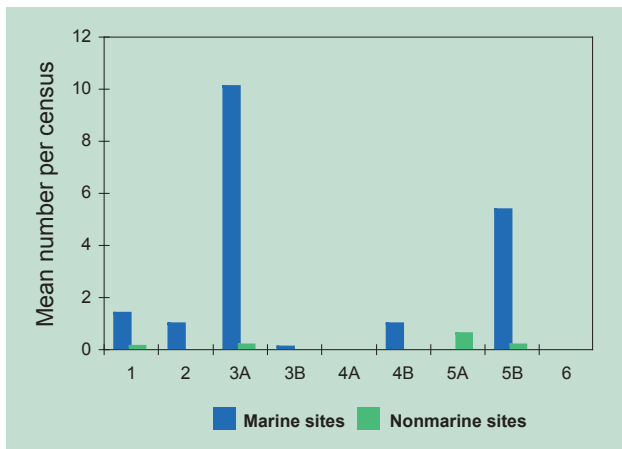
Fall



Wilson's Plover



Semipalmated Plover



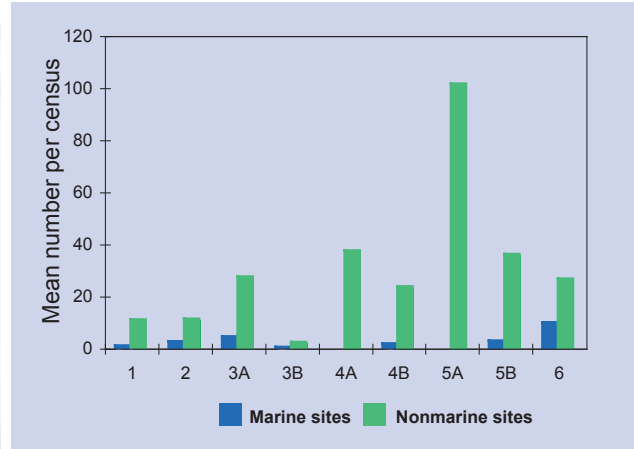
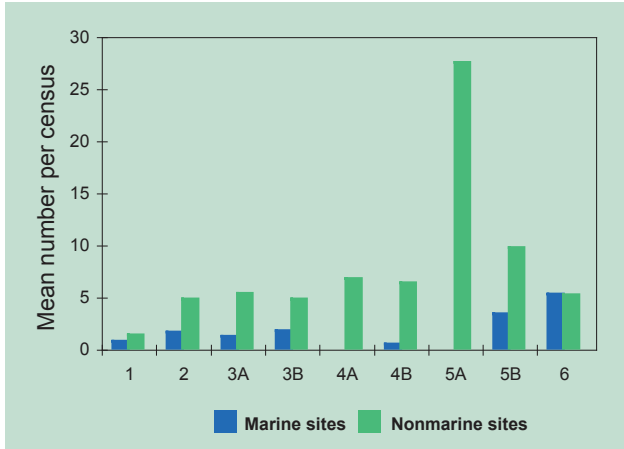
Piping Plover

Fig. A3.1.—continued

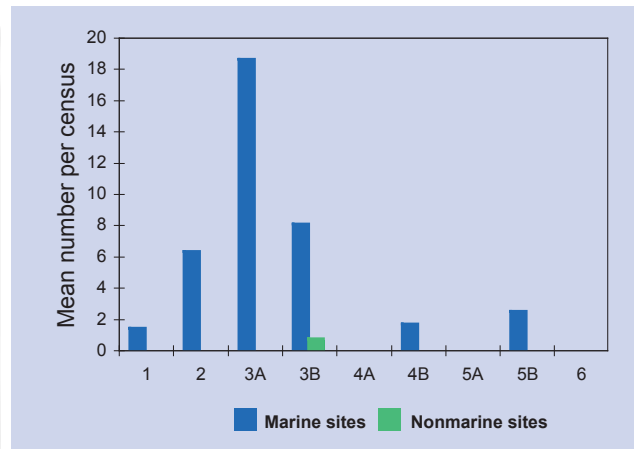
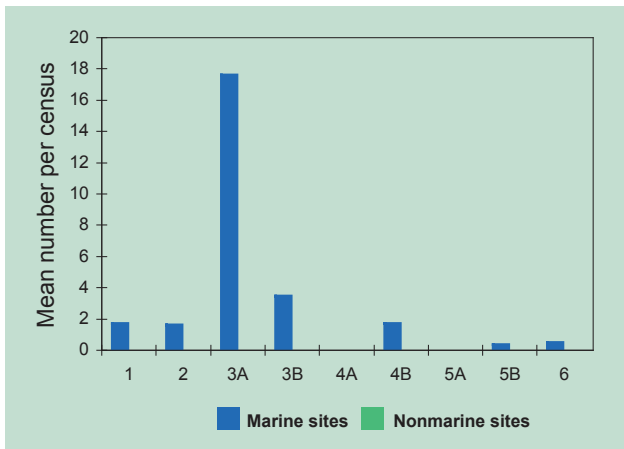
Regional Abundance of Shorebirds—continued

Spring

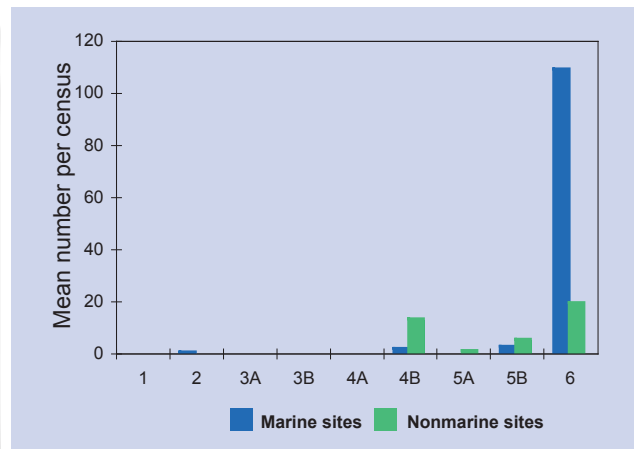
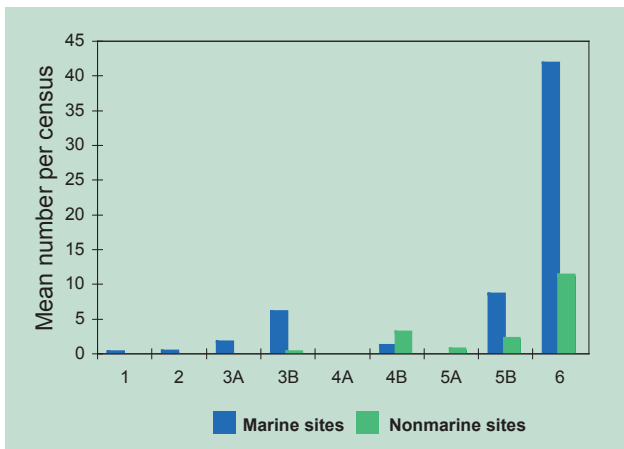
Fall



Killdeer



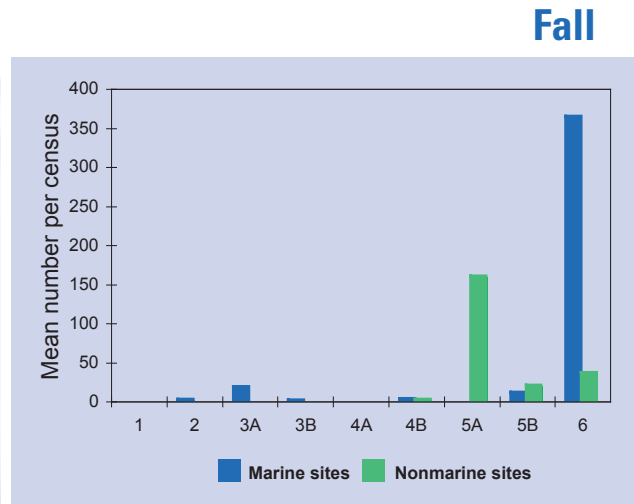
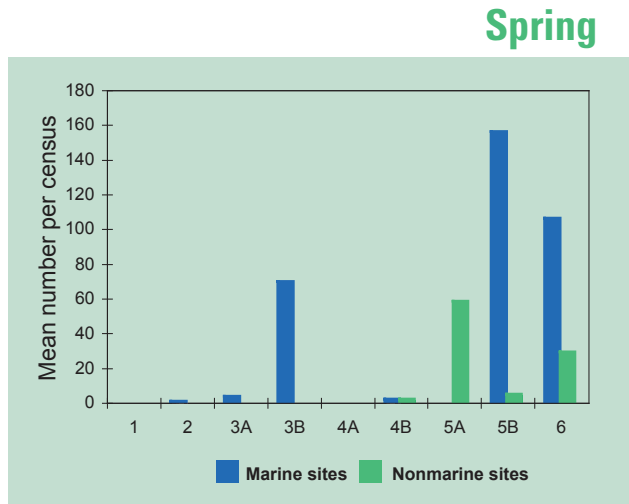
Oystercatchers



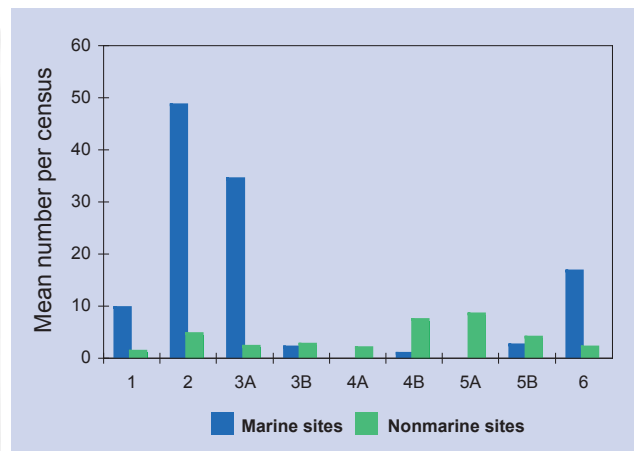
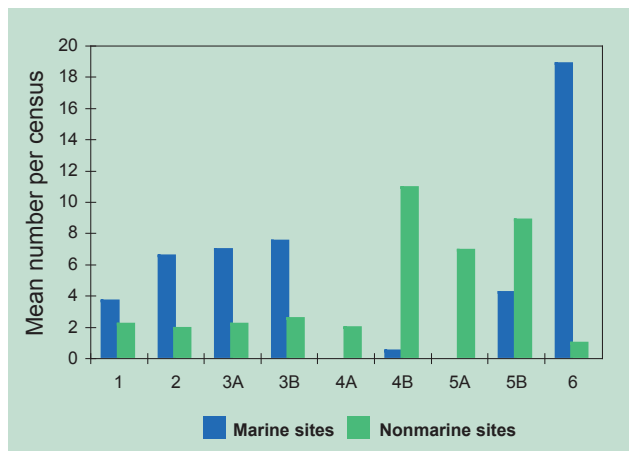
Black-necked Stilt

Fig. A3.1.—continued

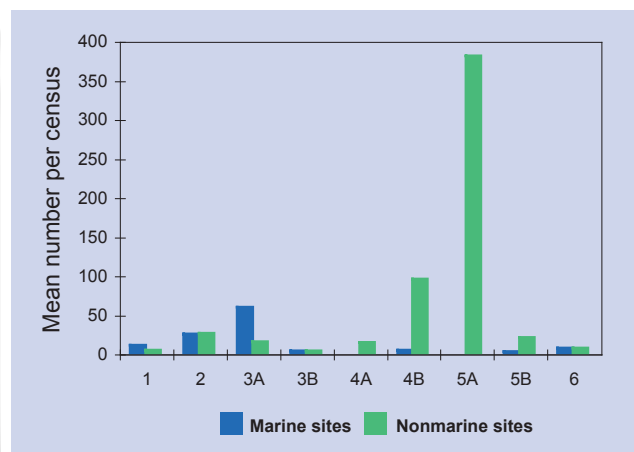
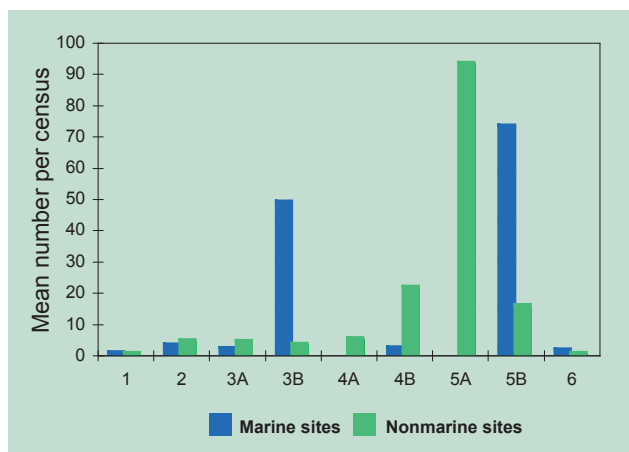
Regional Abundance of Shorebirds—continued



American Avocet



Greater Yellowlegs



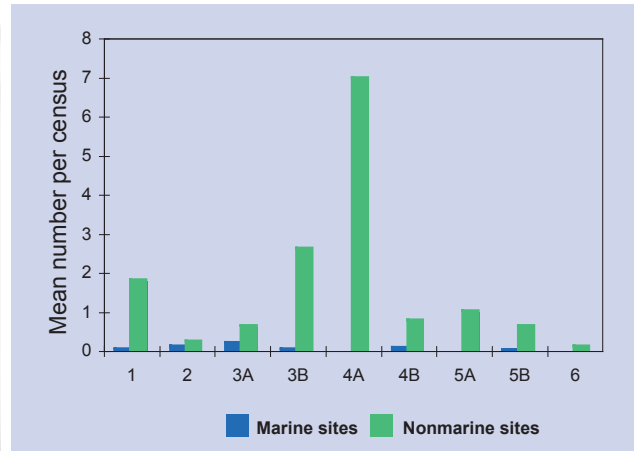
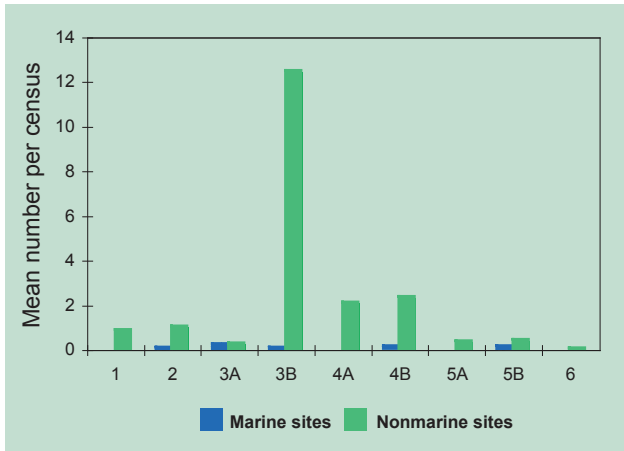
Lesser Yellowlegs

Fig. A3.1.—continued

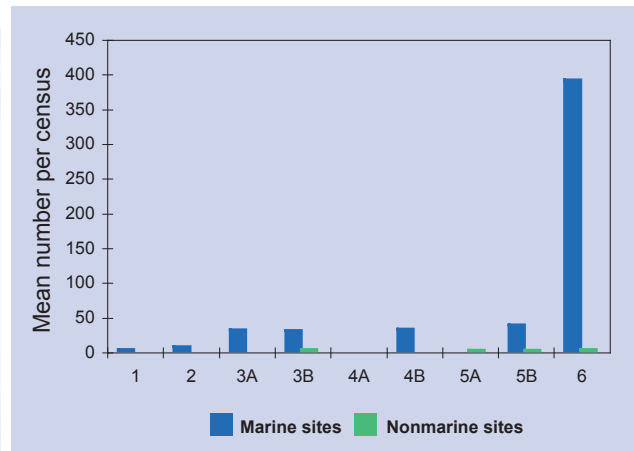
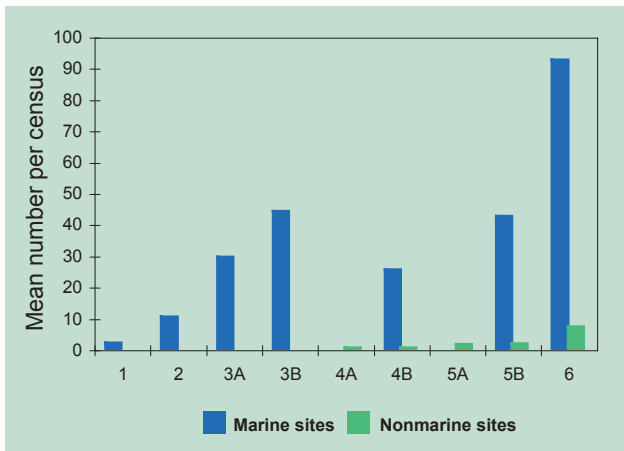
Regional Abundance of Shorebirds—continued

Spring

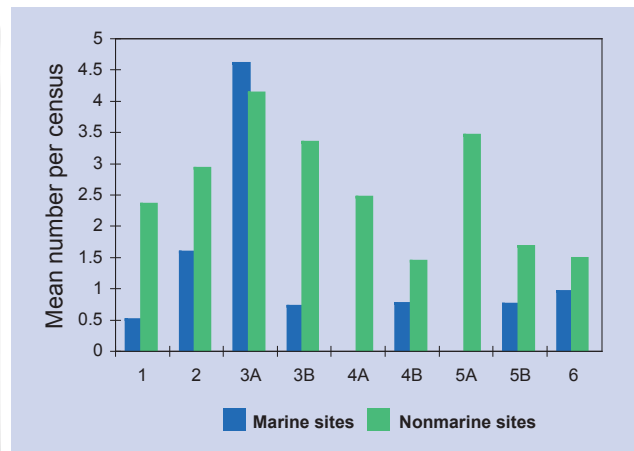
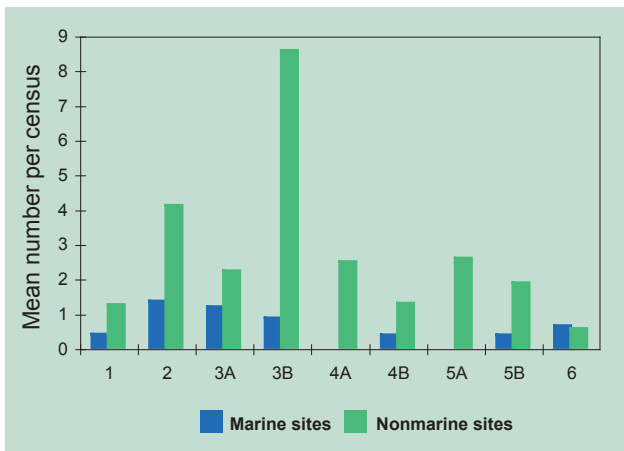
Fall



Solitary Sandpiper



Willet

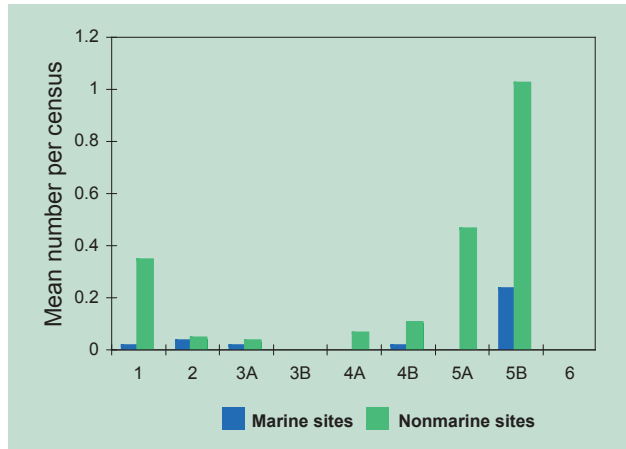


Spotted Sandpiper

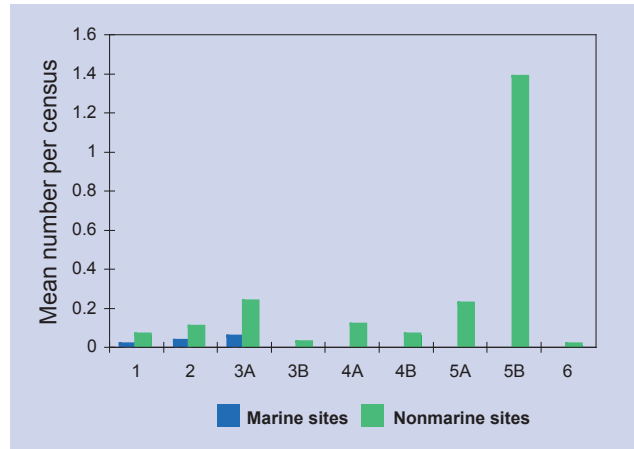
Fig. A3.1.—continued

Regional Abundance of Shorebirds—continued

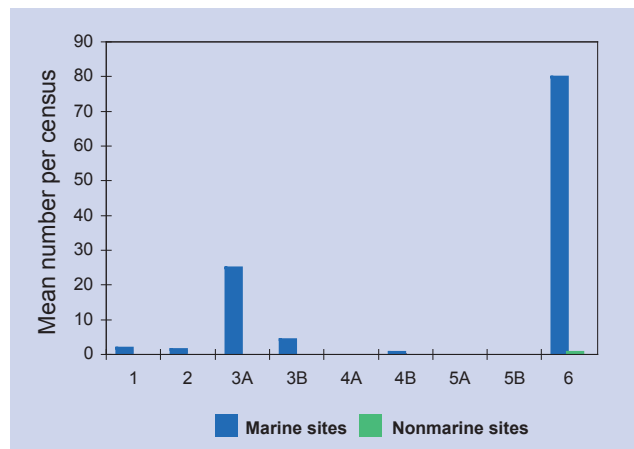
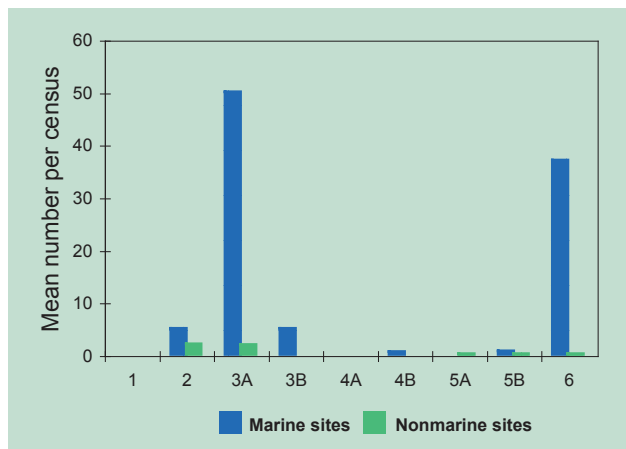
Spring



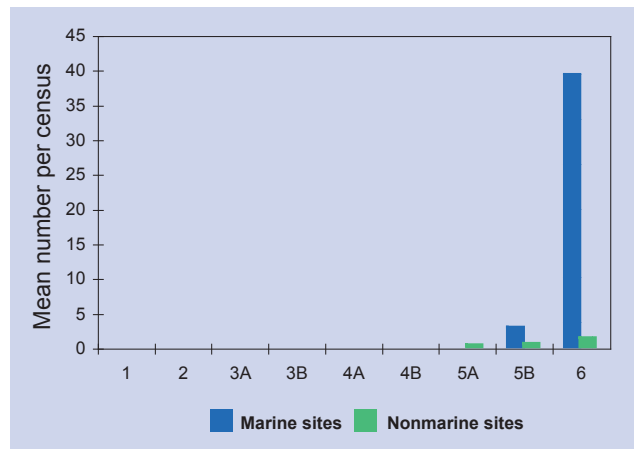
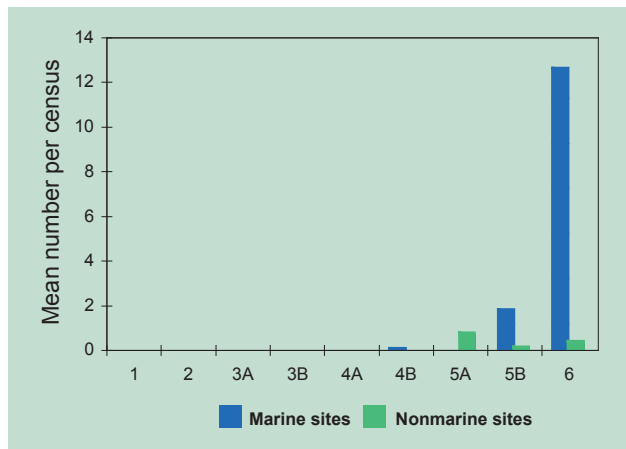
Fall



Upland Sandpiper



Whimbrel

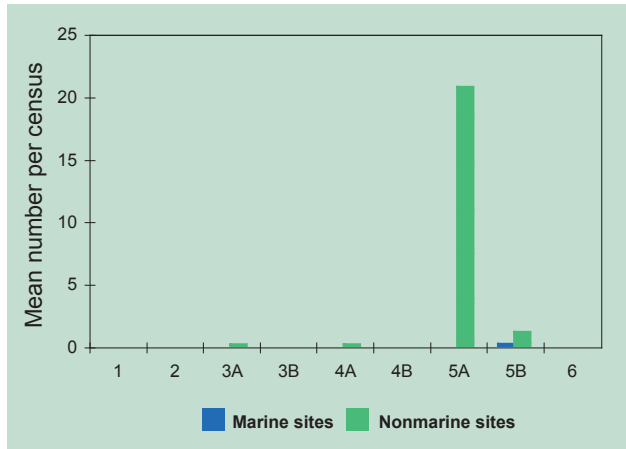


Long-billed Curlew

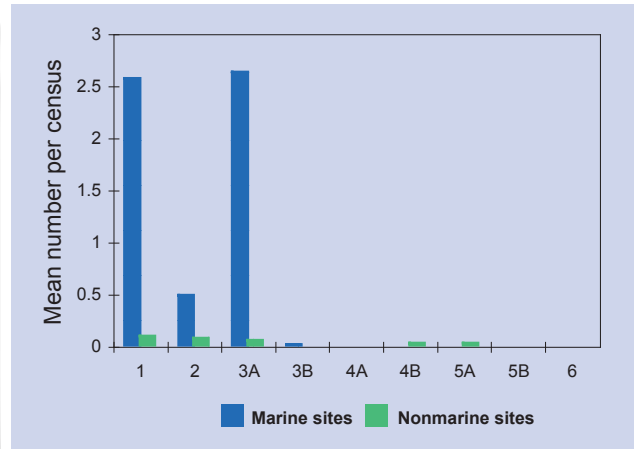
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Regional Abundance of Shorebirds—continued

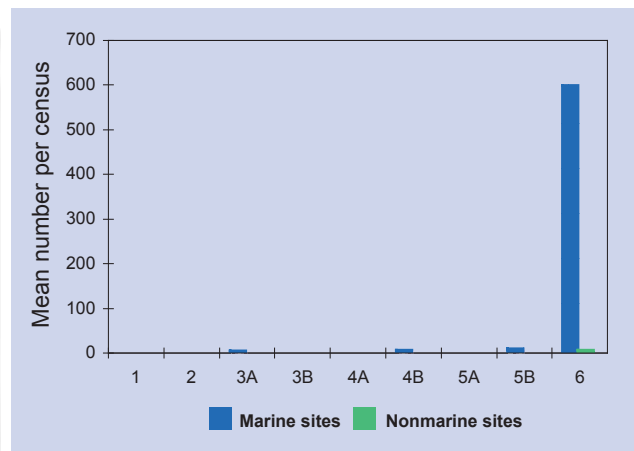
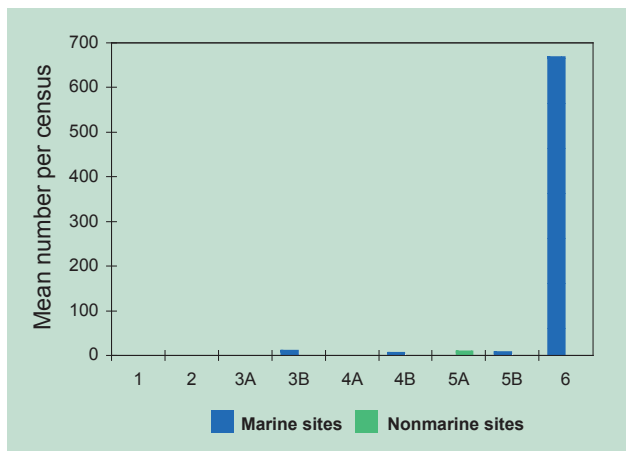
Spring



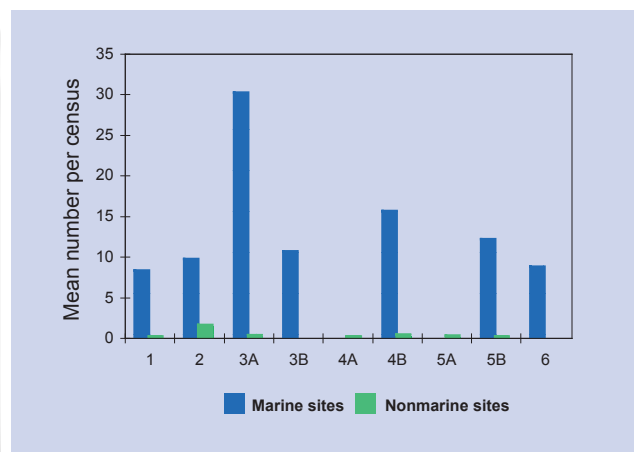
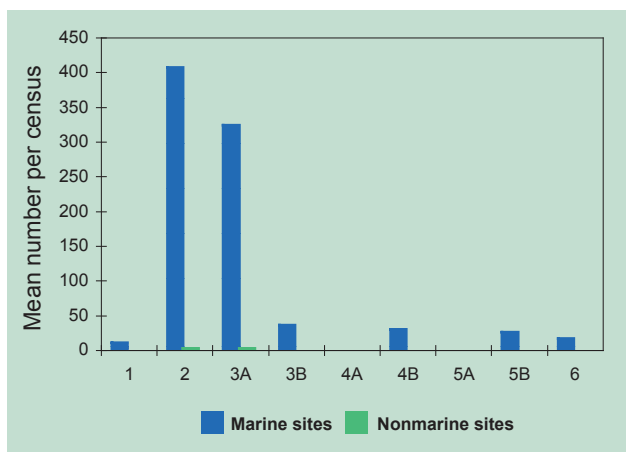
Fall



Hudsonian Godwit



Marbled Godwit

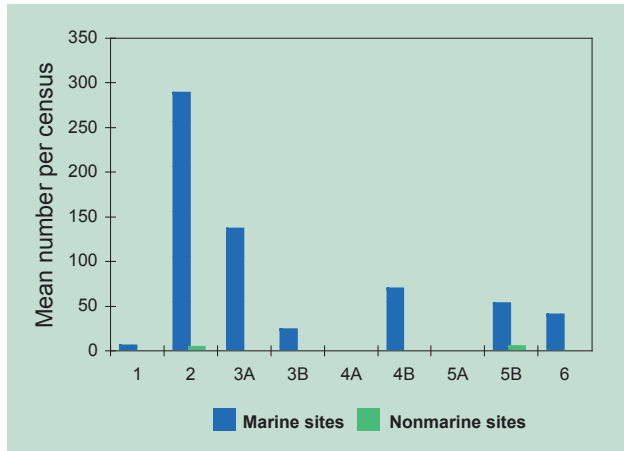


Ruddy Turnstone

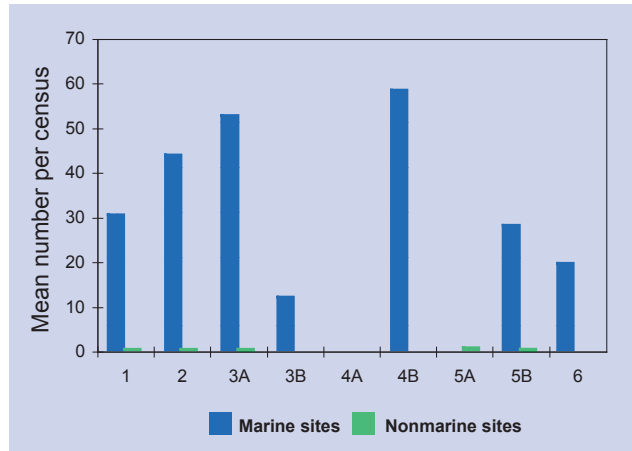
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Regional Abundance of Shorebirds—continued

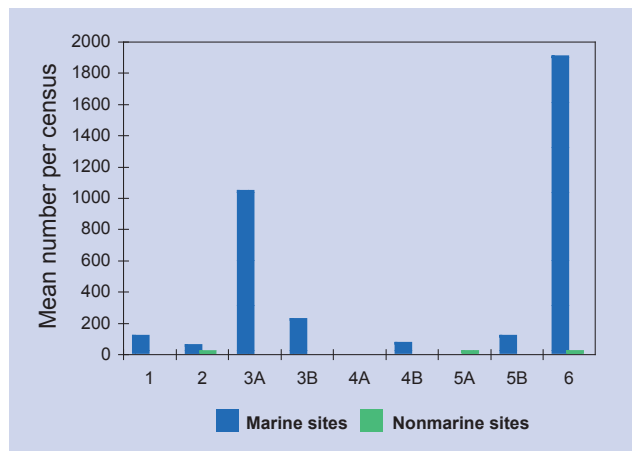
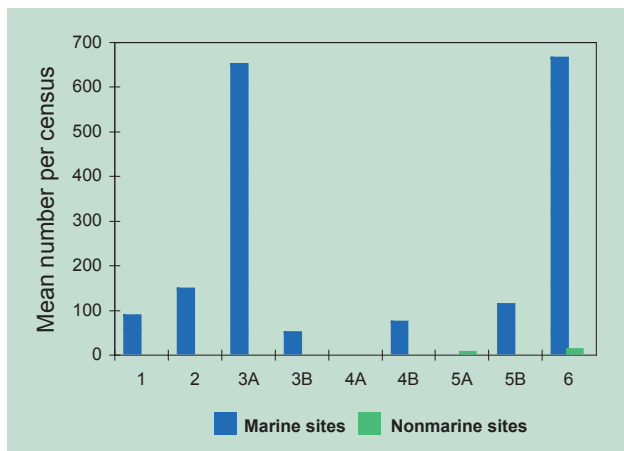
Spring



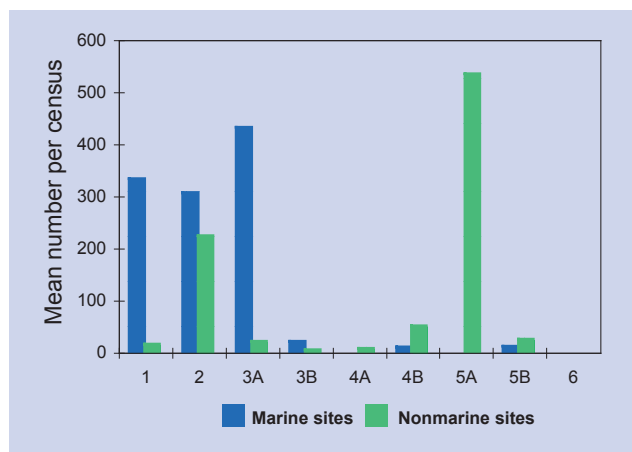
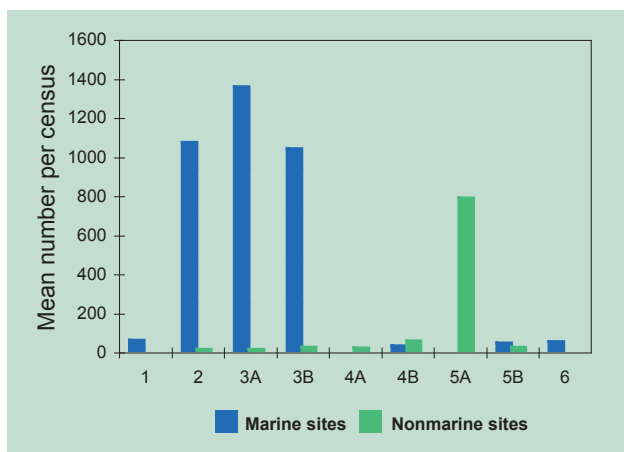
Fall



Red Knot



Sanderling

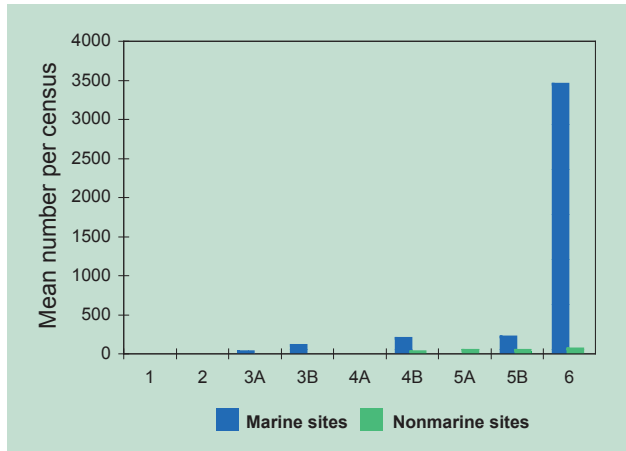


Semipalmated Sandpiper

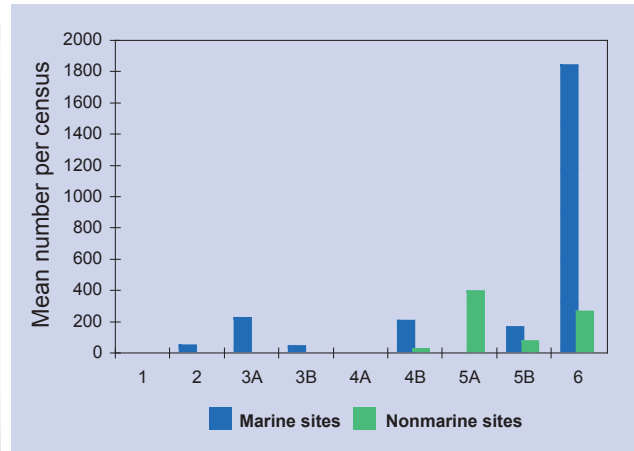
Fig. A3.1.—continued

Regional Abundance of Shorebirds—continued

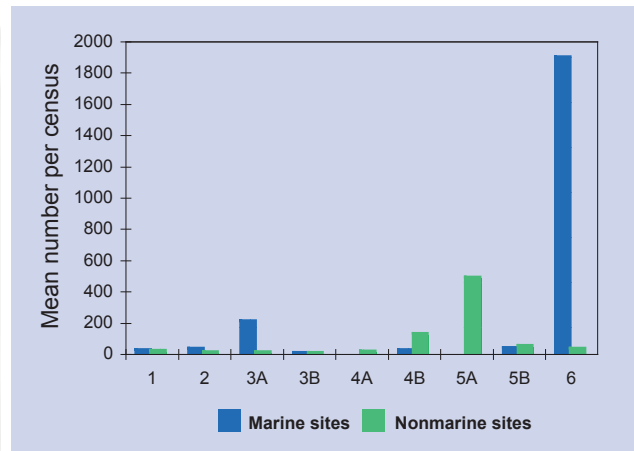
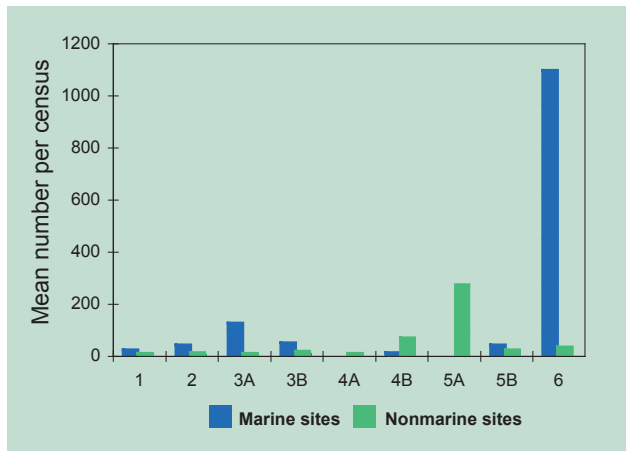
Spring



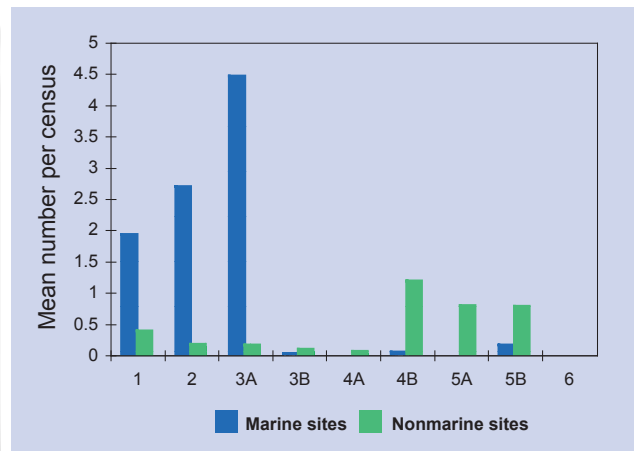
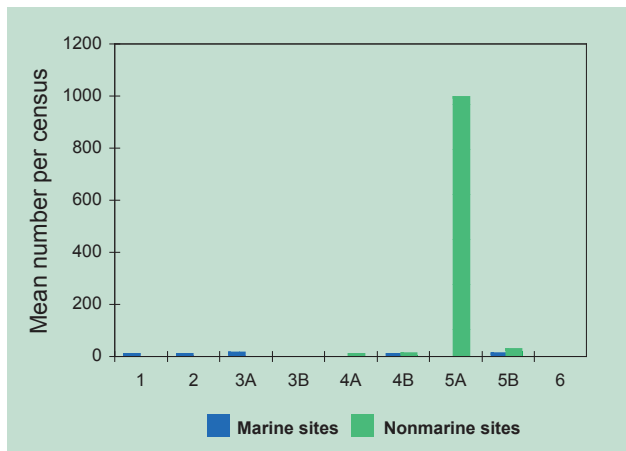
Fall



Western Sandpiper



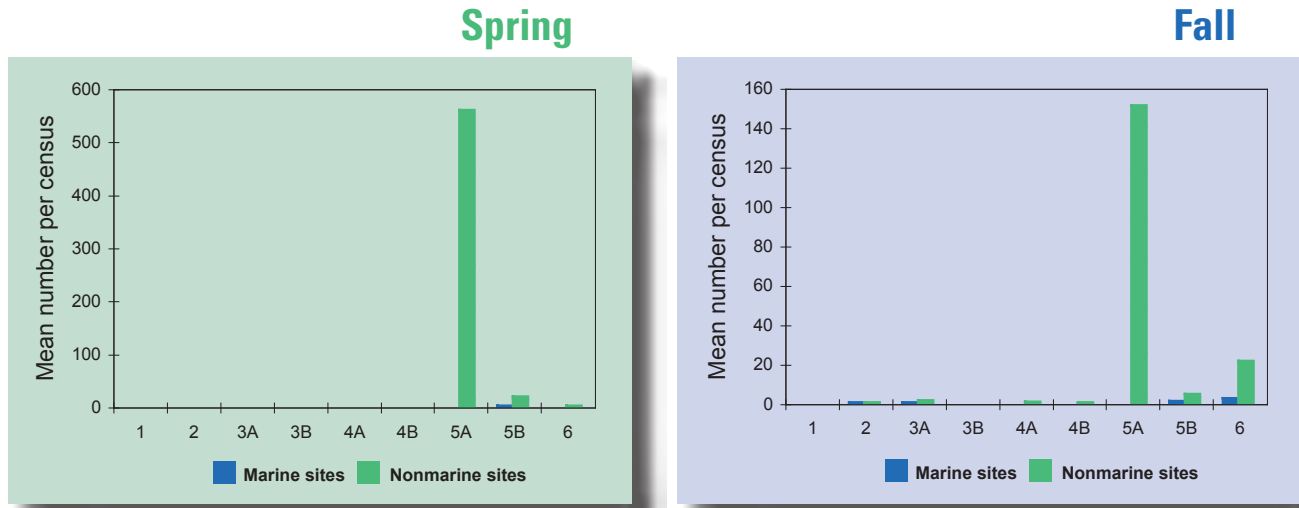
Least Sandpiper



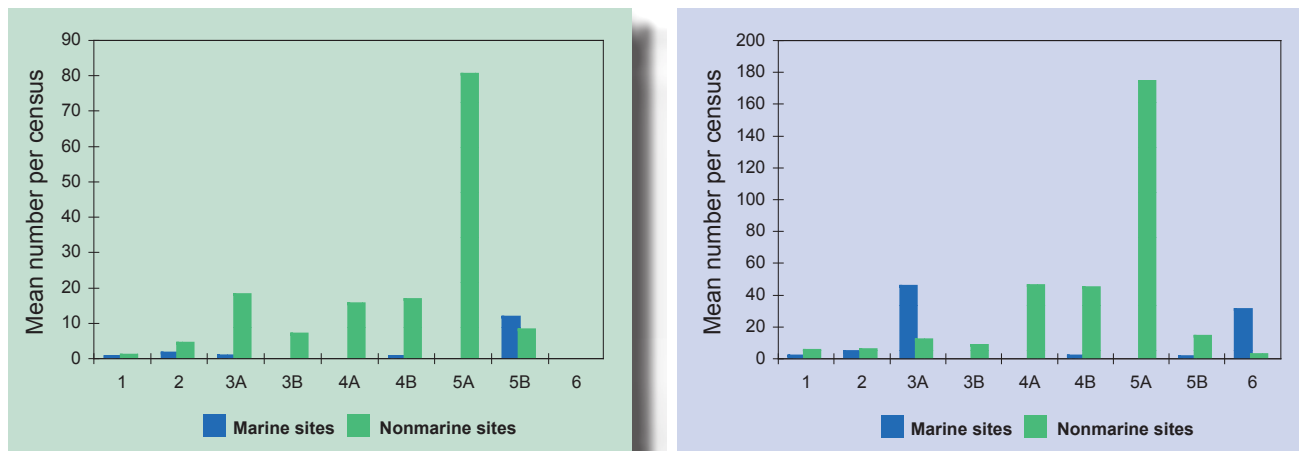
White-rumped Sandpiper

Fig. A3.1.—continued

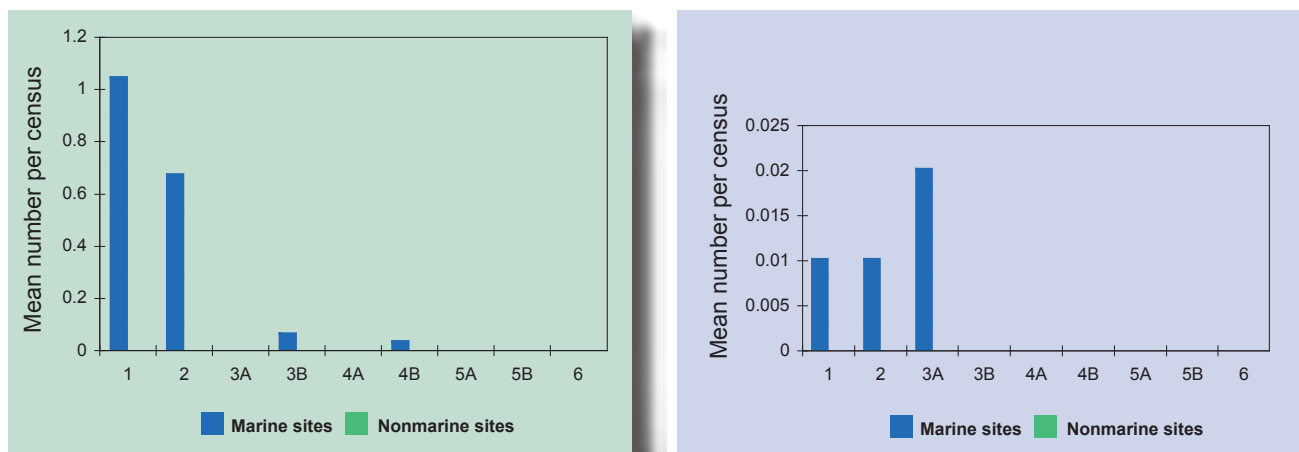
Regional Abundance of Shorebirds—continued



Baird's Sandpiper



Pectoral Sandpiper



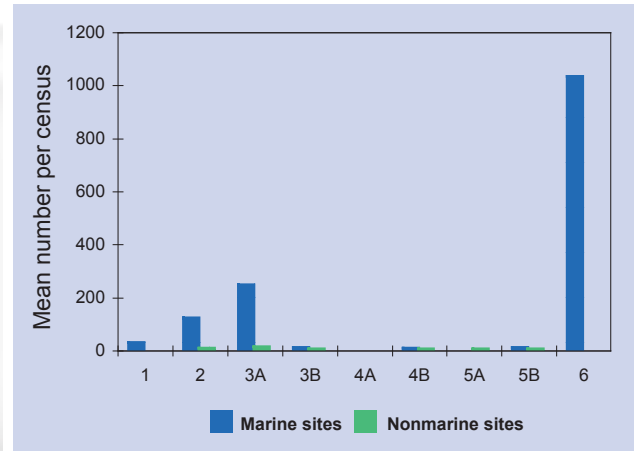
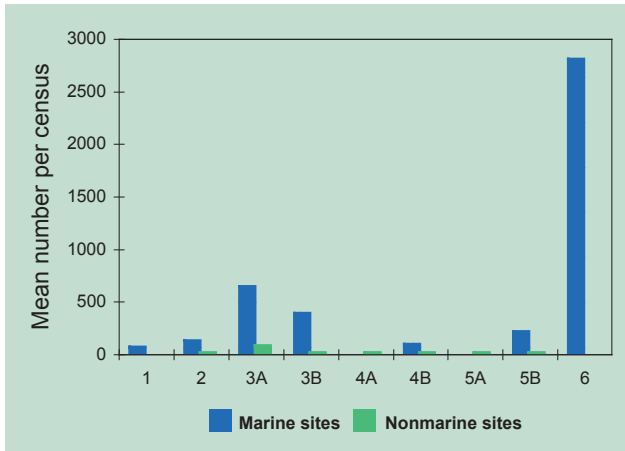
Purple (east coast) and Rock (west coast) Sandpipers

Fig. A3.1.—continued

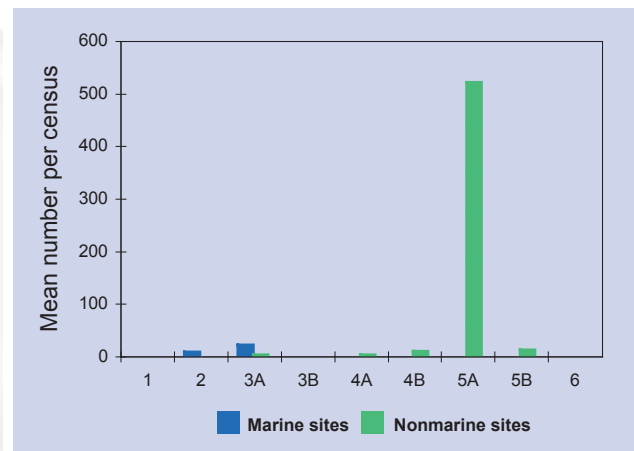
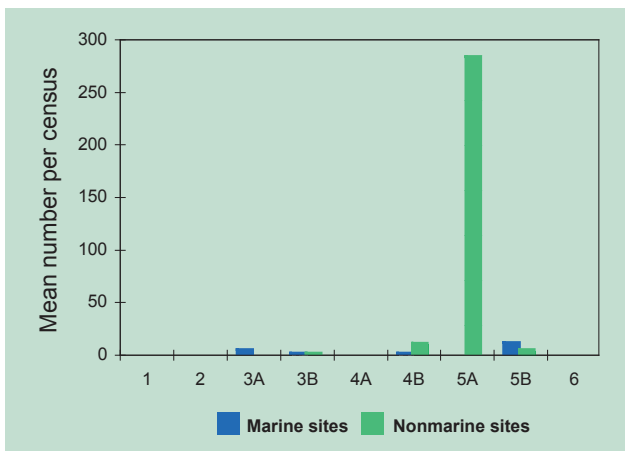
Regional Abundance of Shorebirds—continued

Spring

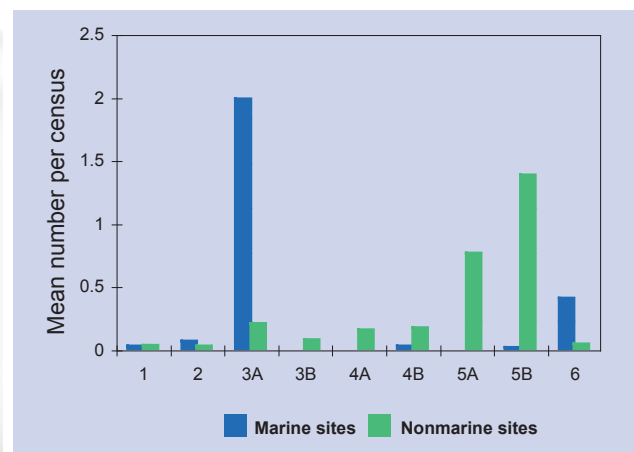
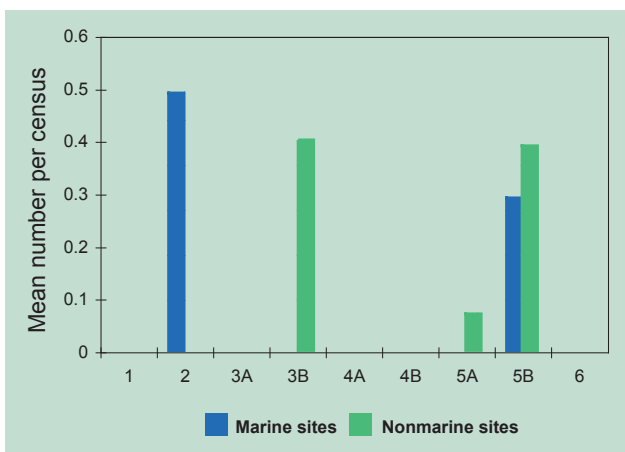
Fall



Dunlin



Stilt Sandpiper

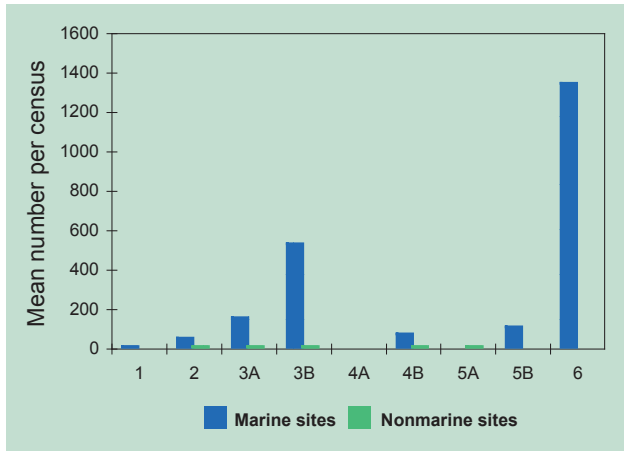


Buff-breasted Sandpiper

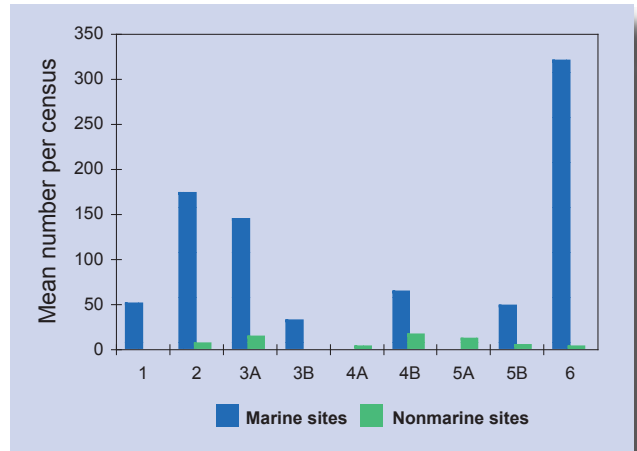
Fig. A3.1.—continued

Regional Abundance of Shorebirds—continued

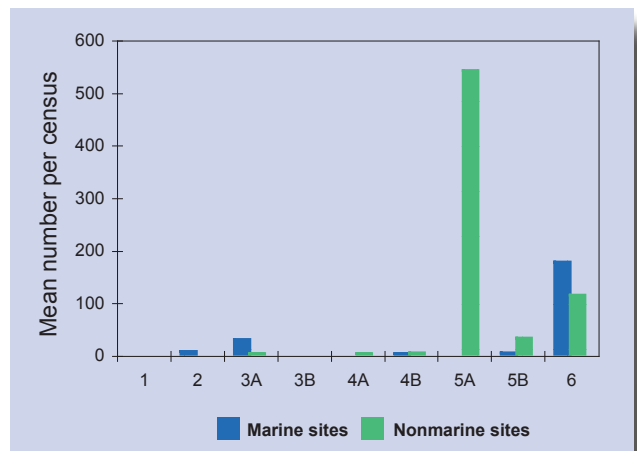
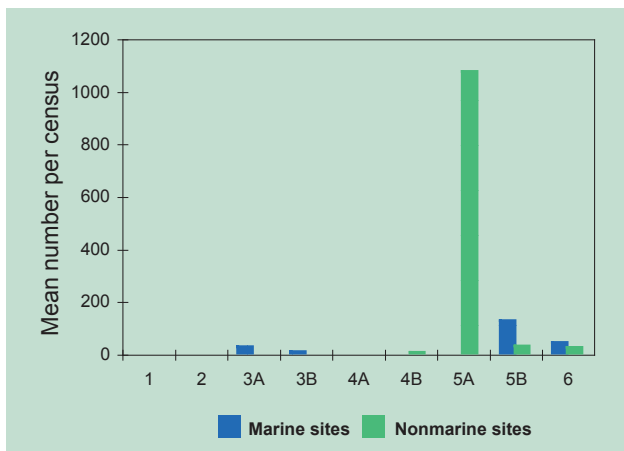
Spring



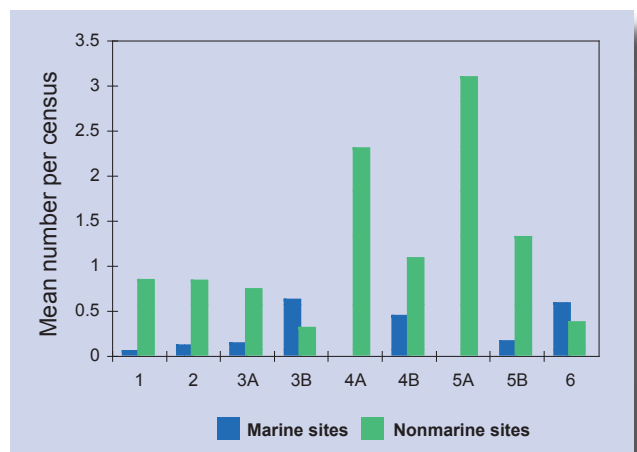
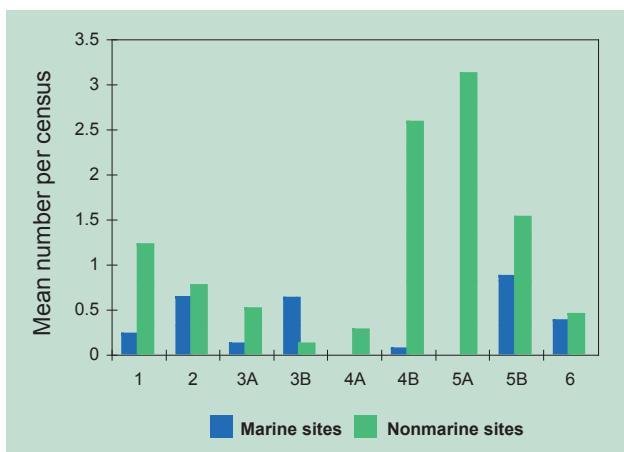
Fall



Short-billed Dowitcher



Long-billed Dowitcher



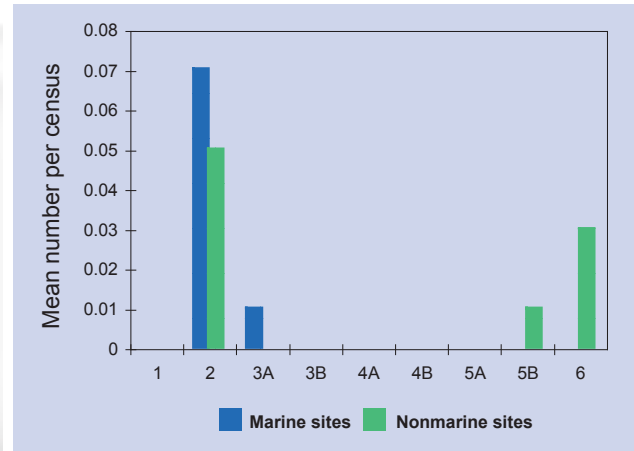
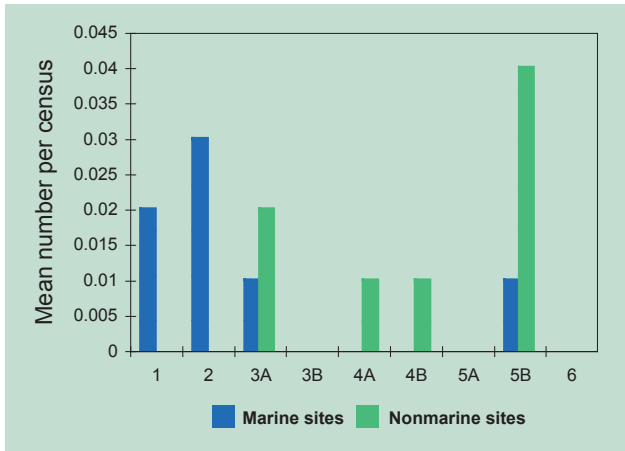
Wilson's Snipe

Fig. A3.1.—continued

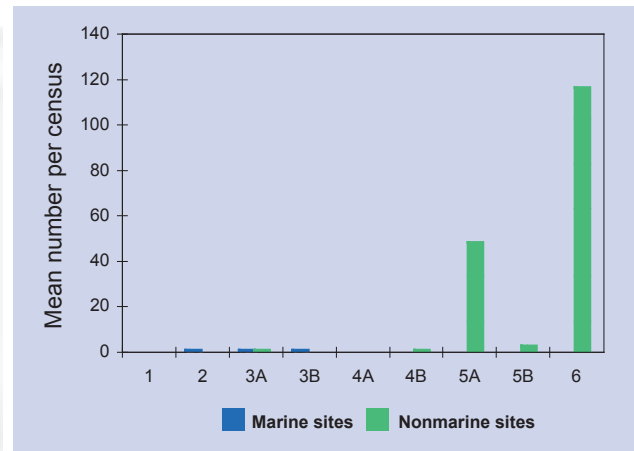
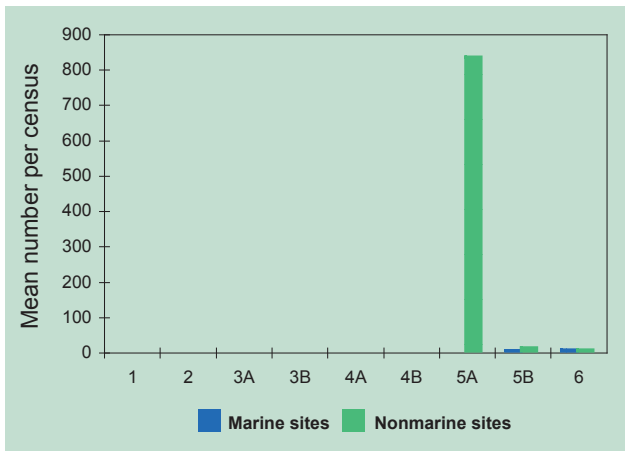
Regional Abundance of Shorebirds—continued

Spring

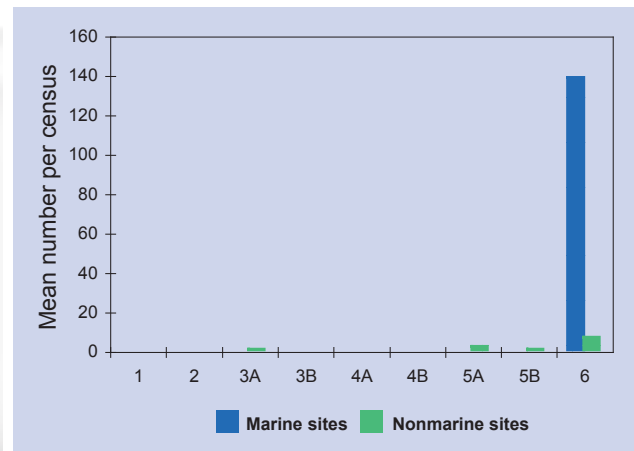
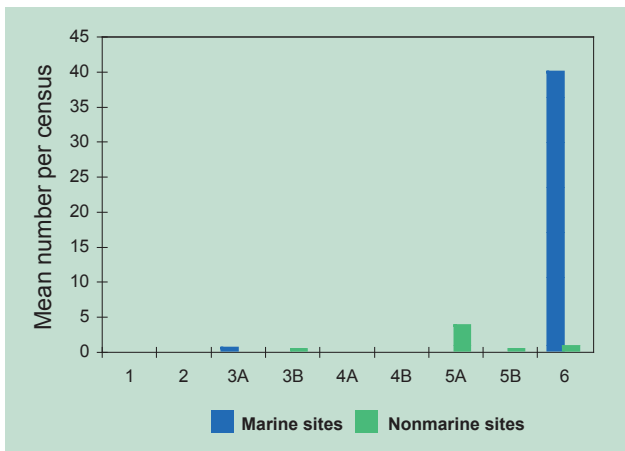
Fall



American Woodcock



Wilson's Phalarope



Red-necked Phalarope

Fig. A3.1.—continued

Regional Abundance of Shorebirds—continued

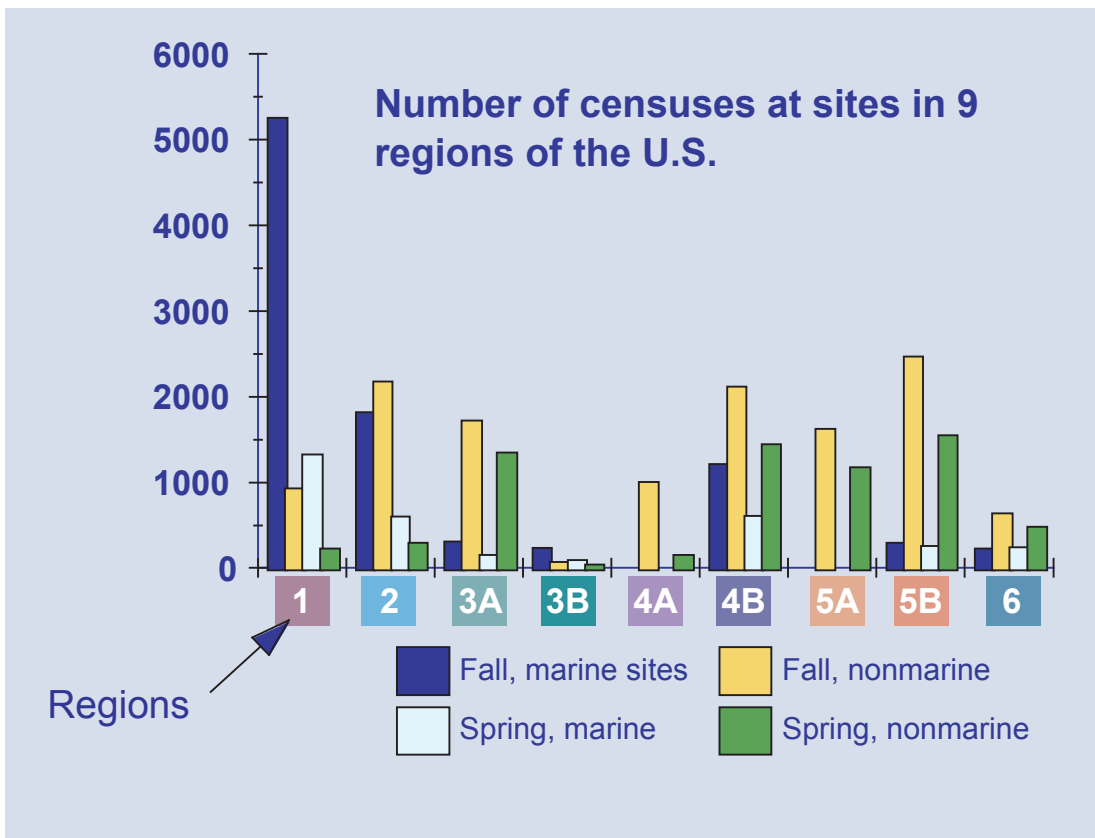
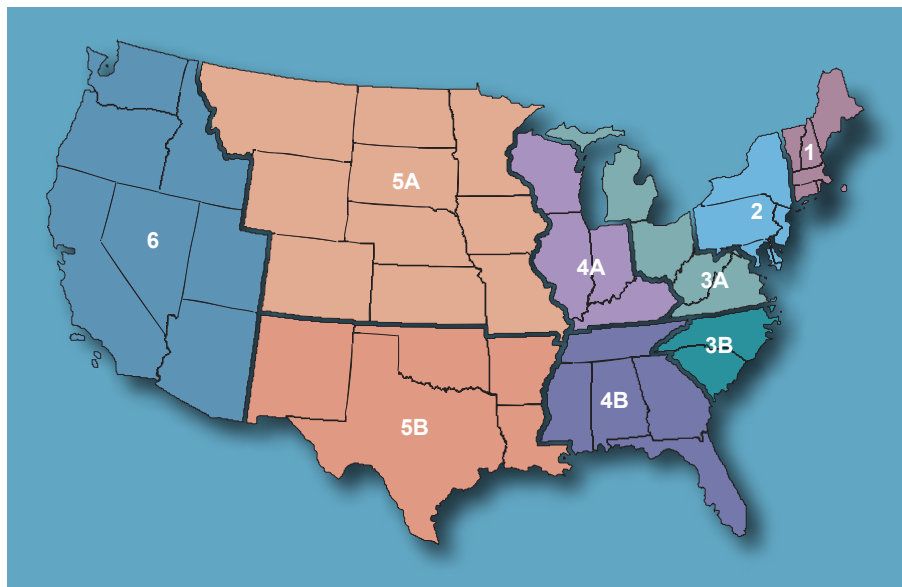


Fig. A3.2. Number of surveys from each region.



Appendix 4

Guilds and Population Trends

Species, guild assignment, and population change ('-' for declining status, '+' for increasing status) in North American shorebirds (Adapted from Our Living Resources. 1995. U.S. Dept. of the Interior, National Biological Service, Washington, D.C.).

Common Name	Scientific Name	Guild	Ref., Status ¹	Significance ^{1,2}	USSCP ³
Black-bellied Plover	<i>Pluvialis squatarola</i>	mud	a-; d+	P<.10(a); ns(d)	3
American Golden-Plover	<i>Pluvialis dominica</i>	upland	d-	ns	4
Pacific Golden-Plover	<i>Pluvialis fulva</i>	upland	unknown		4
Snowy Plover	<i>Charadrius alexandrinus</i>	coastal	g threatened		5
Wilson's Plover	<i>Charadrius wilsonia</i>	coastal	unknown		4
Semipalmated Plover	<i>Charadrius semipalmatus</i>	mud	a-; d+	ns(a); ns(d)	2
Piping Plover	<i>Charadrius melodus</i>	coastal	c threatened		5
Killdeer	<i>Charadrius vociferus</i>	upland	b-	P<.05	3
Mountain Plover	<i>Charadrius montanus</i>	upland	b+	ns	5
American Oystercatcher	<i>Haematopus palliatus</i>	coastal	unknown		4
Black Oystercatcher	<i>Haematopus bachmani</i>	coastal			4
Black-necked Stilt	<i>Himantopus mexicanus</i>	wading	b-	ns	2
American Avocet	<i>Recurvirostra americana</i>	wading	b-	ns	3
Spotted Sandpiper	<i>Actitis macularius</i>	mud	b+	ns	2
Solitary Sandpiper	<i>Tringa solitaria</i>	wading	unknown		4
Wandering Tattler	<i>Tringa incana</i>	coastal	unknown		3
Greater Yellowlegs	<i>Tringa melanoleuca</i>	wading	a-	ns	3
Willet	<i>Tringa semipalmata</i>	wading	a±, b+; d-	ns(a), ns(b), ns(d)	3
Lesser Yellowlegs	<i>Tringa flavipes</i>	wading	a+	ns	3
Upland Sandpiper	<i>Bartramia longicauda</i>	upland	b+	P<.05	4
Whimbrel	<i>Numenius phaeopus</i>	mud	a-; d+	P<.01(a); ns(d)	4
Long-billed Curlew	<i>Numenius americanus</i>	upland	b-	P<.05	5
Hudsonian Godwit	<i>Limosa haemastica</i>	wading	unknown		4
Marbled Godwit	<i>Limosa fedoa</i>	wading	b+	ns	4
Ruddy Turnstone	<i>Arenaria interpres</i>	coastal	a-;d+;e-	ns(a), ns(d), ns(e)	4
Black Turnstone	<i>Arenaria melanocephala</i>	coastal	unknown		4
Surfbird	<i>Aphriza virgata</i>	coastal	unknown		4
Red Knot	<i>Calidris canutus</i>	coastal	a-;d-;e-	ns(a);P<.10(d);ns(e)	4
Sanderling	<i>Calidris alba</i>	coastal	a-;d-;e-	P<.01(a),ns(d); <.01(e)	4
Semipalmated Sandpiper	<i>Calidris pusilla</i>	mud	a-;d-;e-	ns(a);P<.02(d); P<.05(e)	3
Western Sandpiper	<i>Calidris mauri</i>	wading	unknown		4
Least Sandpiper	<i>Calidris minutilla</i>	mud	a+;d-	ns(a);P<.05(d)	3
White-rumped Sandpiper	<i>Calidris fuscicollis</i>	mud	unknown		2
Baird's Sandpiper	<i>Calidris bairdii</i>	upland	unknown		2
Pectoral Sandpiper	<i>Calidris melanotos</i>	wading	unknown		2
Purple Sandpiper	<i>Calidris maritima</i>	coastal	unknown		2
Rock Sandpiper	<i>Calidris ptilocnemis</i>	coastal	unknown		3
Dunlin	<i>Calidris alpina</i>	wading	d-;e±	ns(d);ns(e)	3

Guilds and Population Trends—continued

Common Name	Scientific Name	Guild	Ref., Status ¹	Significance ^{1,2}	USSCP ³
Stilt Sandpiper	<i>Calidris himantopus</i>	wading	unknown		3
Buff-breasted Sandpiper	<i>Tryngites subruficollis</i>	upland	unknown		4
Short-billed Dowitcher	<i>Limnodromus griseus</i>	wading	a-;d-;e+	P<.05(a);P<.08(d); P=.12(e)	4
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>	wading	unknown		2
Wilson's Snipe	<i>Gallinago delicata</i>	wading	b-	P<.05	3
American Woodcock	<i>Scolopax minor</i>	upland	b-;f-	P<.05(b);P<.05(f)	4
Wilson's Phalarope	<i>Phalaropus tricolor</i>	wading	b-	P<.05	4
Red-necked Phalarope	<i>Phalaropus lobatus</i>	wading	unknown		3
Red Phalarope	<i>Phalaropus fulicarius</i>	wading	unknown		3

¹ a=Howe et al. (1989) for the years 1972-1983; b=Peterjohn, unpublished analysis, Breeding Bird Survey, National Biological Survey, 1982-1991; c=Haig and Plissner, 1993; d=Morrison et al, in press for years 1974-1991; e=Clark et al., 1993 for the years 1986-1992; f=Sauer and Bortner, 1991; g=United States Fish & Wildlife Service, Office of Endangered Species, unpublished.

² ns=not statistically significant

³ National conservation category from the U.S. Shorebird Conservation Plan (<http://shorebirdplan.fws.gov>); 5=Highly Imperiled, 4=High Concern, 3=Moderate Concern, 2=Low Concern, 1=Not at Risk.



American Oystercatcher, *Haematopus palliatus*



Wilson's Snipe, *Gallinago delicata*



Killdeer, *Charadrius vociferus*



Ruddy Turnstone, *Arenaria interpres*

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of U. S. Fish and Wildlife Service
Digital Library System (<http://images.fws.gov/>)

Whimbrel, page 5, courtesy of Richard Johnston

Front cover:

Long-billed Curlew

Back cover—top to bottom:

Least Sandpiper

Short-billed Dowitcher flock

Lesser Yellowlegs

Red-necked Phalarope female

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