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INTRODUCTION: THE PACIFIC COAST SHOREBIRD SCENE

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Let me begin by welcoming you all to the Pacific Seabird Group meeting, of which the first part is a shorebird symposium that will occupy this afternoon and all day tomorrow [6–7 January 1977]. The more formal opening of the PSG meeting will be handled tomorrow morning, by Chairman George Divoky and other officers of the organization. I am the first speaker on the symposium and will offer you some introductory comments which I hope will be useful in our thinking about the presentations that follow.

But before that, let me give you what I think are the objectives of this symposium. There are two, and they interlock critically. First, we are looking at current work on the distribution, migration and ecology of shorebirds in marine and coastal environments from the standpoint of basic information and the moving front of knowledge about them. Second, we are also looking at these topics from the standpoint of conservation and management of coastal wetlands that are important to the welfare of shorebirds and, indeed, of all other maritime birds as well. In particular, how can shorebird-habitat interrelationships sharpen our sense of responsibility toward habitat—that is, how can shorebirds help us to assess, select and preserve coastal wetlands? Attending our meeting are representatives of federal and state agencies, and it is a particularly strong desire on the part of all of us who have been involved in getting this symposium organized to emphasize this applied side of our symposium subject. The papers following mine will be addressing themselves to our two objectives, singly or in combination.

For my introductory comments, I have chosen to look at shorebird biology and distribution along the Pacific Coast from a fairly global point of view. Such a view is forced upon us when, for example, we think about the relative importance of different sectors of the coast and the degree to which they must figure in any efforts to select and preserve coastal wetlands that will be not only representative, but also really adequate. After all, shorebirds are long-distance migrants, and this larger view of the coast as an eco-geographic system is necessary and, indeed, inescapable for an understanding of shorebird migrational dynamics and the habitats they need to complete their annual cycles. In the remaining time, for me to pursue that idea seriously would be to presume that we have all sorts of information available, which, as we sadly must admit, is for the most part not true. Nevertheless, this global view is the background for the two parts of my talk: First, I will summarize shorebird distributions along the entire Pacific Coast, and second, I will discuss briefly several biological and geographic factors that figure in that global view.

First, let us look at the world shorebird fauna in order to extract from it the fraction occurring on the Pacific Coast. In Figure 1 are listed the six charadrioid families with species totals. The New World shorebirds consist of four groups—those that are strictly New World (52 species), those that spill over additionally into Asia (5 species), those that are Holarctic (11 species), and those that are Old World *and* spill over additionally into North America (3 species). The total is 71 species (Table 1), of which 57 or 80% are maritime—that is, they figure in the

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TABLE 1
NEW WORLD SHOREBIRDS[a]

KEY TO SYMBOLS:

A	Asiatic breeding in Alaska	Non-m	Non-maritime (absent from maritime habitats)
b	Breeding	Non-PC	Non-Pacific Coast
H	Holarctic	PC	Pacific Coast
NA	North American	SA	South American
NA-A	North American spilling into Asia	SH	Southern hemisphere
NH	Northern hemisphere	T	Transequatorial
Non-b	Non-breeding	w	Western
Non-c	Non-coastal (absent from coastal lowlands)		

Family	Distributional class[b]	Genus and Species	Vernacular name	Comments
ROSTRATULIDAE	SA	*Nycticryphyes semi-collaris*	Painted Snipe	Resident
HAEMATOPODIDAE		*Haematopus palliatus,*	American oystercatcher	Resident
	T	including *H. p. bachmani*	North American Black Oyster-catcher	Resident
	SA	*H. leucopodus*	Magellanic Oystercatcher	Resident
	SA	*H. ater*	South American Black Oyster-catcher	Resident
CHARADRIIDAE	SA	*Vanellus chilensis*	Southern Lapwing	Only local movements
		Vanellus resplendens	Andean Lapwing	Non-c
		Hoploxypterus cayanus	Pied Plover	Non-PC
	NA	*Pluvialis squatarola*	Black-bellied Plover	Migrant
	H	*Pluvialis dominica*	American Golden Plover	In non-b seasons, rare to casual on PC
		Charadrius hiaticula	Ringed Plover	Non-PC
	NA	*C. semipalmatus*	Semipalmated Plover	Migrant
		C. melodus	Piping Plover	Non-PC
	T	*C. alexandrinus*	Snowy Plover	Weakly migrant in NH; resident in SH
	SA	*C. falklandicus*	Two-banded Plover	Weakly migrant
		C. alticola	Puna Plover	Non-c
	T	*C. collaris*	Collared Plover	Resident
	T	*C. vociferus*	Killdeer	Migrant; SH race resident
	T	*C. wilsonia*	Wilson's Plover	Resident
		C. montanus	Mountain Plover	Non-c
		Oreopholus ruficollis	Tawny-throated Dotterel	Non-m

TABLE 1. (CONTINUED)

Family	Distributional class[b]	Genus and Species	Vernacular name	Comments
	SA	*Zonibyx modestus*	Rufous-chested Dotterel	Migrant
		Pluvianellus socialis	Magellanic Plover	Non-PC; only local movements
		Phegornis mitchelli	Diademed Sandpiper-plover	Non-c
SCOLOPACIDAE				
Tringinae		*Bartramia longicauda*	Upland Sandpiper	Non-m
		Numenius borealis	Eskimo Curlew	Probably extinct (or = *N. minuta*)
	H	*Numenius phaeopus*	Whimbrel	Migrant
	NA	*N. tahitiensis*	Bristle-thighed Curlew	Migrant; winters on Pacific islands
	NA	*N. americanus*	Long-billed Curlew	Migrant; b non-m
	NA	*Limosa haemastica*	Hudsonian Godwit	Migrant; not along NA PC
	A	*L. lapponica*	Bar-tailed Godwit	Migrant thru Aleutians; winters in SW Pacific region
	NA	*L. fedoa*	Marbled Godwit	Migrant; b non-m
	NA	*Tringa flavipes*	Lesser Yellowlegs	Migrant; b non-m
	NA	*T. melanoleuca*	Greater Yellowlegs	Migrant; b non-m
		T. solitaria	Solitary Sandpiper	Non-m; inland migrant
	NA	*Actitis macularia*	Spotted Sandpiper	Migrant; b non-m
	NA	*Catoptrophorus semipalmatus*	Willet	Migrant; b non-m
	NA	*Heteroscelus incanus*	Wandering Tattler	Migrant; also winters on Pacific islands
Arenariinae	H	*Arenaria interpres*	Ruddy Turnstone	Migrant
	NA	*A. melanocephala*	Black Turnstone	Migrant
Scolopacinae	NA-A	*Limnodromus scolopaceus*	Long-billed Dowitcher	Migrant; chiefly non-m
	NA	*L. griseus*	Short-billed Dowitcher	Migrant
	H	*Capella gallinago*	Common Snipe	Migrant
	SA	*C. paraguaiae*	South American Snipe	Resident; southernmost population migrates
		C. nobilis	Noble Snipe	Non-c
		C. undulata	Giant Snipe	Non-c
		Chubbia imperialis	Bogota Snipe	Non-c (Bogota, Col.; rare)
		C. Jamesoni	Andean Snipe	Non-c
		C. stricklandi	Cordilleran Snipe	Non-c
		Philohela minor	American Woodcock	Non-m

TABLE 1. (CONTINUED)

Family	Distributional class[b]	Genus and Species	Vernacular name	Comments
Calidridinae	NA	*Aphriza virgata*	Surfbird	Migrant
	H	*Calidris canutus*	Red Knot	Migrant; uncommon on w SA coast
	H	*C. alba*	Sanderling	Migrant
	NA	*C. pusillus*	Semipalmated Sandpiper	Migrant; not along NA PC
	NA-A	*C. mauri*	Western Sandpiper	Migrant
	A	*C. ruficollis*	Rufous-necked Sandpiper	Migrant; winters in SE Asia and Australia
	NA	*C. minutilla*	Least Sandpiper	Migrant
	NA	*C. fuscicollis*	White-rumped Sandpiper	Migrant; not along NA PC
	NA-A	*C. bairdi*	Baird's Sandpiper	Migrant; occurs on PC in SA
	NA-A	*C. melanotos*	Pectoral Sandpiper	Migrant; rare along NA PC
		C. maritima	Purple Sandpiper	Non-PC
	NA-A	*C. ptilocnemis*	Rock Sandpiper	Migrant
	H	*C. alpina*	Dunlin	Migrant
	A	*C. ferruginea*	Curlew Sandpiper	Migrant; breeds in northern Alaska; winters in Old World SH
		Micropalama himantopus	Stilt Sandpiper	Non-PC
	NA	*Tryngites subruficollis*	Buff-breasted Sandpiper	Non-PC except arctic Alaska; non-m on wintering range
RECURVIROSTRIDAE	T	*Himantopus mexicanus*	Black-necked Stilt	Migrant; northern SA population resident
	NA	*Recurvirostra americana*	American Avocet	Migrant
		R. andina	Andean Avocet	Non-c; resident
PHALAROPODIDAE	H	*Phalaropus fulicarius*	Red Phalarope	Migrant
	H	*Lobipes lobatus*	Northern Phalarope	Migrant
	NA	*Steganopus tricolor*	Wilson's Phalarope	Migrant; b non-m

[a] Limited to the super family Charadrioidea; taxonomy based on Peters (1934) and Hellmayr and Conover (1948) revised to agree with the A. O. U. check-list (1957) and its supplements; distributional data drawn from these sources and from de Schauensee (1964), Friedmann et al. (1950), Gabrielson and Jewett (1940), Gabrielson and Lincoln (1959), Grinnell and Miller (1944), Humphrey et al. (1970), Jehl and Rumboll (1976), Jewett et al. (1953), Johnson and Goodall (1965), Land (1970), Olrog (1968), Salo (1975), Saunders et al. (1950), and Wetmore (1965).

[b] Species assigned to distributional classes are those entering into compilations for Figures 3 and 4. All others are dismissed under 'Comments' as not occurring on or near the Pacific Coast (non-PC), or if present on Pacific drainage slopes at whatever elevations, they are non-coastal (non-c), or if coastal, they are non-maritime (non-m). Note that some species occurring along the Pacific Coast as migrants and winter residents breed inland (b non-m), to distinguish them from species which utilize maritime (and inland) habitats during the breeding season.

WORLD SHOREBIRD FAUNA

	OLD WORLD	and Alaska →	BOTH	← and Siberia	NEW WORLD	TOTALS
Rostratulidae Painted Snipe	1				1	2
Haematopodidae Oyster catchers	2				3	5
Charadriidae Plovers	44		2		17	63
Scolopacidae Sandpipers	41	3	7	5	27	83
Recurvirostridae Avocets, etc.	5				3	8
Phalaropodidae Phalaropes			2		1	3
	93	3	11	5	52	164
	112 (93 + 3 + 11 + 5)			71 (3 + 11 + 5 + 52)		
MARITIME	?			57 (80%)		

FIGURE 1. An analysis of the world shorebird fauna (superfamily Charadrioidea) giving species totals by family subdivided according to New World and Old World occurrences. The New World total is 71 species of which 19 are shared with the Old World, and of which 57 (or 80 percent) utilize maritime habitats in any phase of their annual cycles.

ecology of coastal wetlands, many importantly, some negligibly. Of these 57, however, only 49 occur on or near the Pacific Coast. We reduce that figure by four species (three Asiatic species in Table 1 plus *Numenius tahitiensis*) breeding in northern latitudes of America, but taking off for Asia and the Pacific islands in migration, so that only 45 occur along the Pacific Coast south of the Alaska Peninsula. Of these, 33 are North American breeders, six are trans-equatorial, and six are South American. There is some play in these figures due mainly to the fact that information for Central and South America is poor.

In order to reduce details of distribution to a graphic, compact picture, I divided the Pacific Coast into 5-degree latitudinal belts (Fig. 2) and plotted occurrences in these belts. For purposes of this analysis, the Pacific Coast is the entire coastline from Cape Horn up to and beyond Bering Strait to Point Barrow. By this extention to Point Barrow, we manage to include a fraction of the breeding range (and exclude none) of high arctic species that occur along Pacific Coast.

The species occurrences by 5-degree belts during the boreal or northern summer are shown in Figure 3. Species density is strikingly high in the northern latitudes, reaching a peak of 28 in the 60–65° interval, which is the belt roughly running from Seward Peninsula down to the Kuskokwim River. The breeding occurrences of North American species fall off rapidly southward. We then pick

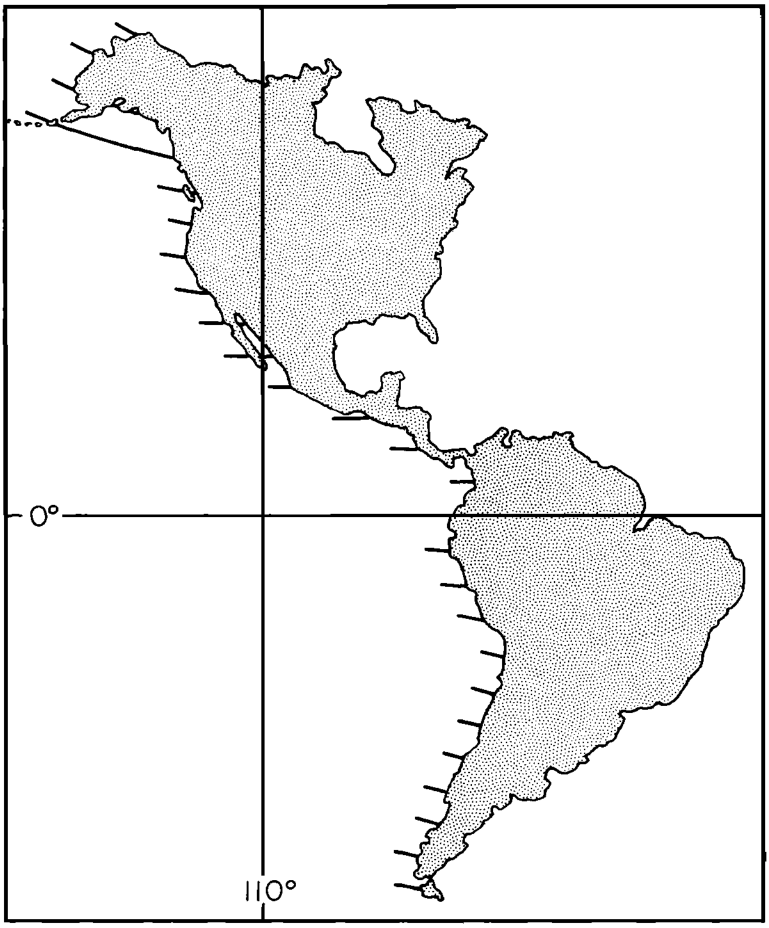

FIGURE 2. The New World showing five-degree intervals along the Pacific Coast used in plotting species densities shown in Figures 3 and 4.

up a trans-equatorial group that occurs through a wide belt, the species most notorious in this respect being the Oystercatcher. Number of species in this group is low, there being only four or five through a 30° belt halved by the equator. And finally we have a small group of South American species, which, with several of the more southern trans-equatorial species, reach a maximum number of nine in the 40–45° interval.

A datum missing from Figure 3 is the number of northern species represented by non-breeding individuals that remain at mid- or southern latitudes through the austral winter (see beyond). The significance of this phenomenon varies from species to species; for some, non-breeding occurrence of first-year individuals at southern, "wintering" latitudes is apparently a regular feature of their annual cycle. But the available distributional data are not only scant, they are too scattered for me to attempt to add the non-breeder component to Figure 3 at this time. But the phenomenon deserves attention, and a synthesis of existing data, limited though they are now, would be worthwhile. [See Bullock 1949 and Eisenmann 1951 for earlier notice of this phenomenon.]

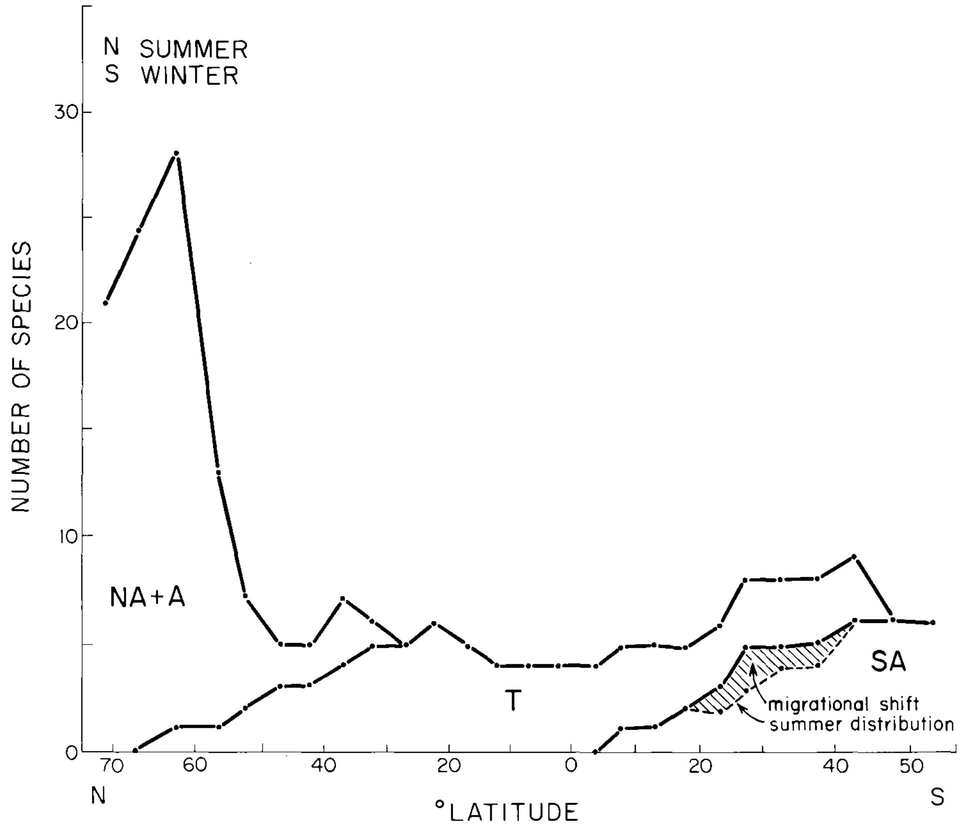

FIGURE 3. The occurrence by five-degree intervals of shorebird species totals during the northern summer (southern winter), subdivided into North American plus Asiatic (NA + A), transequatorial (T), and South American (SA). See text for further explanation.

The distribution of the South American group is shown in Figure 3 for both the southern or austral winter and the southern summer. This brings out the relatively small amount of latitudinal shift of these southern species from a migrational standpoint. The available information on this matter is scant, of course, but the fact remains that migrational distances among these southern species are piddling compared to what we will see it is for the northern species. [However, J. P. Myers tells me that "southern species *pile* into central Argentina during the non-breeding season. This shift is significant."]

The picture in the southern or austral summer is given in Figure 4. As in Figure 3, the numbers in the distributional classes in each latitudinal belt are graphed cumulatively (except for the dashed line; see below). Again, note the summering South American species, the trans-equatorial species, and now the North American species as they spread themselves over Middle and South American latitudes during their 'wintering' residency. Superimposed on this are occurrences in successive 5-degree belts that are strictly transit occurrences of species between their breeding and wintering ranges. For comparison, the boreal summer distributions of North American species are shown by the dashed line.

Two striking things come out of Figure 4: First, the shorebird fauna of South

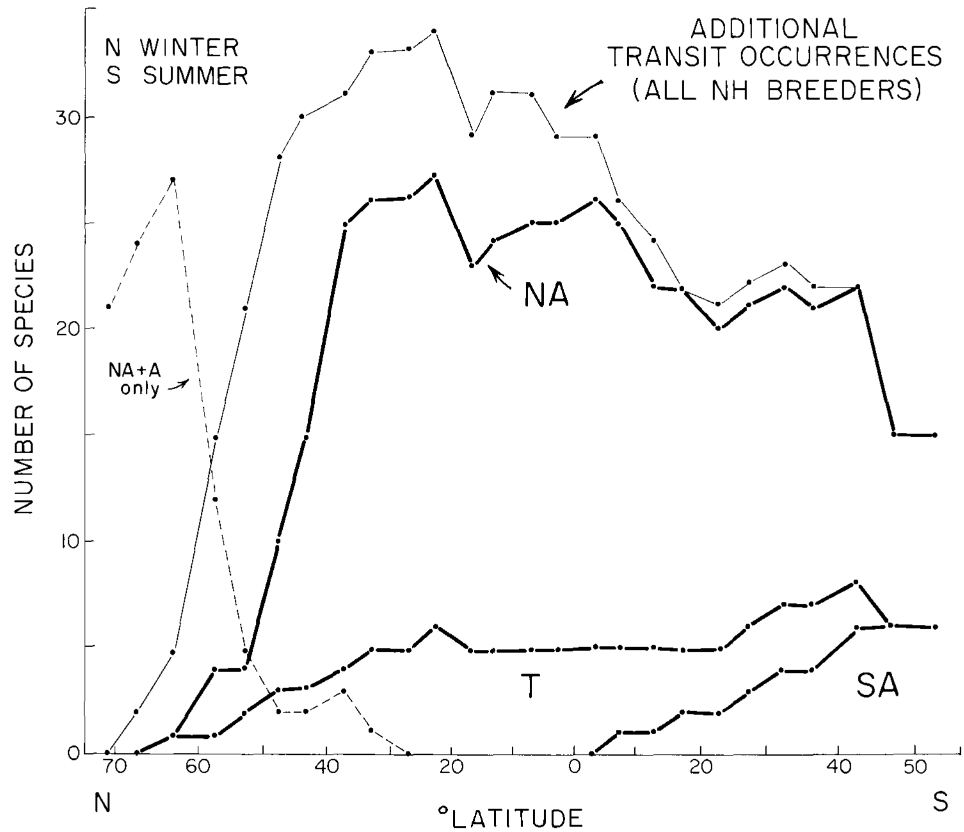

FIGURE 4. The occurrence by five-degree intervals of shorebird species totals during the northern winter (southern summer) subdivided as in Figure 3. Additional occurrences by five-degree interval of species found in each as migrants are also shown. For comparison, totals for North American species during the northern summer are shown by a broken line. See text for further explanation.

America is roughly quadrupled by the influx of North American migrants, and second, the northern species winter in highest species density between 40°N (near Cape Mendocino, northern California) and 40°S (near Valdivia, southern Chile). A fascinating thing about this picture is the degree to which the North American species, heavily concentrated in their breeding distribution, spread out over an enormous latitudinal sector of the bi-hemispheric coastline. Along the Pacific, and in similar manner though of course not in detail along other bi-hemispheric coastlines, the distributions are not continuous, but the significance of discontinuities is almost impossible to assess now on the Pacific Coast due to lack of data on relative abundances along successive sectors of the coast.

Such, briefly, is the distributional picture for shorebirds on the Pacific Coast, and I turn now to several factors that contribute significantly to the need to view the ecology and conservation of shorebirds along a coast such as the Pacific as an eco-geographic system. There is, first of all, the business of staging areas. By 'staging area' I refer to a site where migrating shorebirds ready themselves physiologically for the next migrational leap. We are acutely aware of the importance of staging areas in the latter part of the spring migration, in northern parts of migrational routes, but this does not mean that staging areas may not be important also to the south of the political limits that now tend to confine us in our thinking about the matter. There are some puzzling gaps in the known occurrences of several species along the Pacific Coast that clearly suggest landfall and staging areas of as yet unknown location and importance in Central America and more southern latitudes.

Second, there is the business of tightness of migrational movement. Spring migration is tight in the sense that it is limited temporally more strongly than it is in the fall, and so one might think that staging areas are more important in the spring than they are in the fall. And yet the apparent looseness of fall timing may just be an artefact in our existing information about fall movements. In the first place, there are age differences in the fall; that is, age groups tend to sort out temporally in interesting and critical ways when we have the information. Therefore, the pacing of migration, the occurrence of staging areas, and the intervals between staging areas may be of importance to our knowledge of shoreline habitat in the fall as it is in the spring. Not only that, but the very fact of molt schedule tied to fall migration and to arrival on wintering grounds suggests that there may be critical aspects to the timing of fall migration that we are only now beginning to sense.

Third, there is the evidence from an increasing number of species that wintering populations stay put and return to the same area. This wintering site tenacity again says that with regard to timing of arrival on wintering grounds, and with regard to period of residence there and exploitation of whatever resources are necessary not only to survive, but to molt and prepare for spring migration, we need to improve our knowledge of critical shoreline habitat. This becomes both complicated and urgent because of differences in habitat needs among different species and because of the constraints imposed on the process of identifying and assessing important habitat when the supply is already so limited, at least at heavily populated temperate latitudes.

Fourth, there is variation in sex ratio among populations of one species in different latitudinal sectors of a coastal distribution. We know such between-population differences occur, for example, in many species of ducks, but at the moment, I am not aware of any shorebird species for which we have good data. In the latest issue of Bird-Banding, there is an interesting report of a sampling of Least Sandpipers in Surinam (Spaans 1976) that yielded a sex ratio of 6 females to 1 male. The sample was small, but it is suggestive, and indeed we should expect that latitudinal differences in sex ratio will occur in wintering populations of shorebirds. Again, this has implications with regard to habitat needs of shorebirds. [At the symposium, A. J. Prater commented on evidence of heavily female-weighted sex ratios in the Ruff, *Philomachus pugnax,* in south Africa. For data, see Greenhalgh 1968, Pearson et al. 1970, and Schmidt and Whitehouse 1976. Also, J. V. Remsen has called my attention to data on unequal sex ratios in the Dunlin (Page 1974) and Western Sandpiper (Page et al. 1972).]

There are still other features of shorebird distribution worth noting in this vein—for example, the non-breeding fractions of populations that remain on their wintering or migrational grounds, or the spillover from the Caribbean into the Pacific Coast system at Panamanian latitudes of such species as the American

Golden Plover and Semipalmated Sandpiper. But time is too short to go into any detail.

Finally, I want to mention a couple of geographic factors. Compared to the Atlantic Coast, the Pacific is straighter, and this means that it has considerably fewer miles of shoreline available to shorebirds. Furthermore, it is also climatically less favorable, the most obvious feature in this respect being the desert latitudes—the northern Mexican stretch and the Peruvian-northern Chilean stretch. A more general way of making this point is to observe that there is significantly less flow of fresh water into the Pacific than into the Atlantic, and this means that other things being equal (which they are not, viz. topography), there will be, and is, proportionally less coastal wetland habitat. Beyond the desert latitudes, this problem is most serious in the adjacent Mediterranean latitudes where rainfall can be severely limited, as we are now well aware in California [in 1975–76 and 1976–77]. The consequence of these geographic considerations is that the relative importance of different coastal sectors from the standpoint of shorebird habitat needs is going to vary more critically along the Pacific than it does along the Atlantic. And this means that it becomes more urgent to look at the significance of different sectors of the coast with regard to the welfare of species populations that comprise the fauna.

Another geographic factor is that of tides. I have been mucking around in the intertidal for years, from the subtropics to the arctic, and one impression I have gained is that notwithstanding local factors, there is a general trend from the equator to higher latitudes (although not beyond Bering Strait) of increasing amplitude in the tides. There are of course local complications—form of the coastline, depth and bottom topography of adjacent ocean, and other proximate factors as well as more remote ones such as the long-term cycle of the moon. We have checked tidal amplitudes at different times of the year from Barrow to Cape Horn taking stations at more or less 10-degree intervals of latitude, and in fact, this trend appears to be real. The funny thing is that to date I have not been able to check the matter satisfactorily. I cannot find any consideration of it in the literature notwithstanding the heaps of data from numerous stations of predicted intervals and timing of tides. The actual study of tidal dynamics has progressed most strongly in western Europe, where the scope for latitudinal comparison is of course limited. And other than a few large-scale maps of co-tidal lines in the two main ocean masses, there is nothing of a general, synthetic character that assists us in getting down to the sort of question I am posing for the Pacific Coast as a whole. We have already noted that overall, migrating shorebirds face more variable, more unpredictable conditions on the Pacific Coast than on the Atlantic where climates are wetter and coastal wetlands more extensive. If this is so, the factor of clinal narrowing of tidal amplitude toward the equator augments this contrast, narrowing area of potentially usable intertidal habitats and thus exacerbating questions of critical habitat needs for migrating shorebirds. A prediction one could make from these considerations is that the overall relative incidence of shorebirds occurring as non-breeders on wintering and migrational grounds may be higher on the Pacific than on the Atlantic.

This concludes very quickly—and I'm sorry how necessarily quickly—what I have to say. In these remarks I am anticipating things that will be developed further by the speakers, but my main message to you is that we need to work at acquiring a better sense of system in studying shorebirds in coastal wetlands. Along the Pacific this calls for some sort of systematic monitoring on a grander scale than any attempted to date, going beyond political limits that have confined us to date. We need to think and work on a more global scale.

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