Bar-tailed Godwits *Limosa lapponica* in Alaska: a population estimate from the staging grounds

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Bar-tailed Godwits *Limosa lapponica* were surveyed on their staging grounds in Alaska during September 1995 and 1997. The single high count of 94,000 birds closely matched that of counts from New Zealand and south-eastern Australia, the known non-breeding area for most of the *baueri* subspecies. Numbers recorded on the southern Yukon-Kuskokwim River Delta and at Egegik Bay, a small estuary along the Alaska Peninsula, qualify both areas as Hemispheric Reserves under the Western Hemisphere Shorebird Reserve Network, as sites within the East Asian-Australian Shorebird Reserve Network, and as Ramsar sites. The breeding origins, destinations, and taxonomic affinities of Bar-tailed Godwits staging on the coast of south-west Alaska need further assessment.

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INTRODUCTION

An understanding of basic life-history characteristics is fundamental to effective conservation of migratory birds. Knowledge of the areas birds use throughout their annual cycle (breeding, stopover, and non-breeding), their rates of survival, and the size and trend of their population is needed when formulating and advocating conservation measures (Piersma *et al.* 1996, Piersma & van Gils 1997).

The Bar-tailed Godwit *Limosa lapponica* is one of the best known shorebirds and one for which conservation measures have proven effective. Indeed, the base of knowledge is such that conservation actions have been addressed at the subspecies level and even for populations therein (Watkins 1993, Piersma *et al.* 1996, Riegen 1996, Watkins *et al.* 1996, Wells & Mundkur 1996). Three subspecies of Bar-tailed Godwit are currently recognised (del Hoyo *et al.* 1996, Higgins & Davies 1996), but as many as five have recently been proposed (Engelmoer & Roselaar 1998). This paper focuses on the subspecies *L. l. baueri*, which reportedly nests from the Kolyma River in Russia east to western Alaska (AOU 1983, del Hoyo *et al.* 1996) and spends the austral summer in New Zealand and eastern Australia (Higgins & Davies 1996). At least one authority, however, considers *baueri* to be exclusively New World and godwits in the Anadyr Plain of Chukotka to show characteristics intermediate between *baueri* and the eastern Siberian race *L. l. menzbieri* (P. Tomkovich in litt.; see also Engelmoer & Roselaar 1998).

Here we present results of a co-ordinated effort to document the site-specific occurrence of Bar-tailed Godwits on their staging grounds in western Alaska and to derive an overall estimate of the size of the population. This information will a) help identify important sites for godwits that can be included within the East Asian-Australasian Shorebird Reserve Network (EAASRN) (Gill 1996, Gill and Senner 1996, in Higgins & Davies 1996, Riegen 1996, Watkins *et al.* 1996); b) aid the nomination process of several Alaska sites for the Western Hemisphere Shorebird Reserve Network (WHSRN) (Gill *et al* 1994, Harrington & Perry 1995); and c) help focus questions concerning the taxonomic status and distribution of godwits that breed and stage in Beringia and spend the non-breeding season in New Zealand and eastern Australia.

A PERSPECTIVE ON ALASKA GODWIT INFORMATION

Biometric comparisons of specimens and captured birds, as well as sightings and recoveries of marked birds, have linked godwits breeding in Alaska to nonbreeding areas in northern New Zealand and along the coast of eastern Australia (DeLong & Thompson 1968, Barter 1989, Higgins & Davies 1996; P. Driscoll, A. Riegen, Gill and McCaffery unpubl. data). Gabrielson & Lincoln's (1959) and Kessel's (1989) accounts remain the most authoritative in terms of general breeding biology and seasonal chronology of godwits in Alaska. Information about the species in Alaska outside the nesting period can be found in both regional (Gill & Handel 1981) and site-specific assessments of distribution and timing of occurrence (Gill & Jorgensen 1979, Shields & Peyton 1979, Gill *et al.* 1981, Woodby & Divoky 1983, Gill & Handel 1990, Gill 1996).

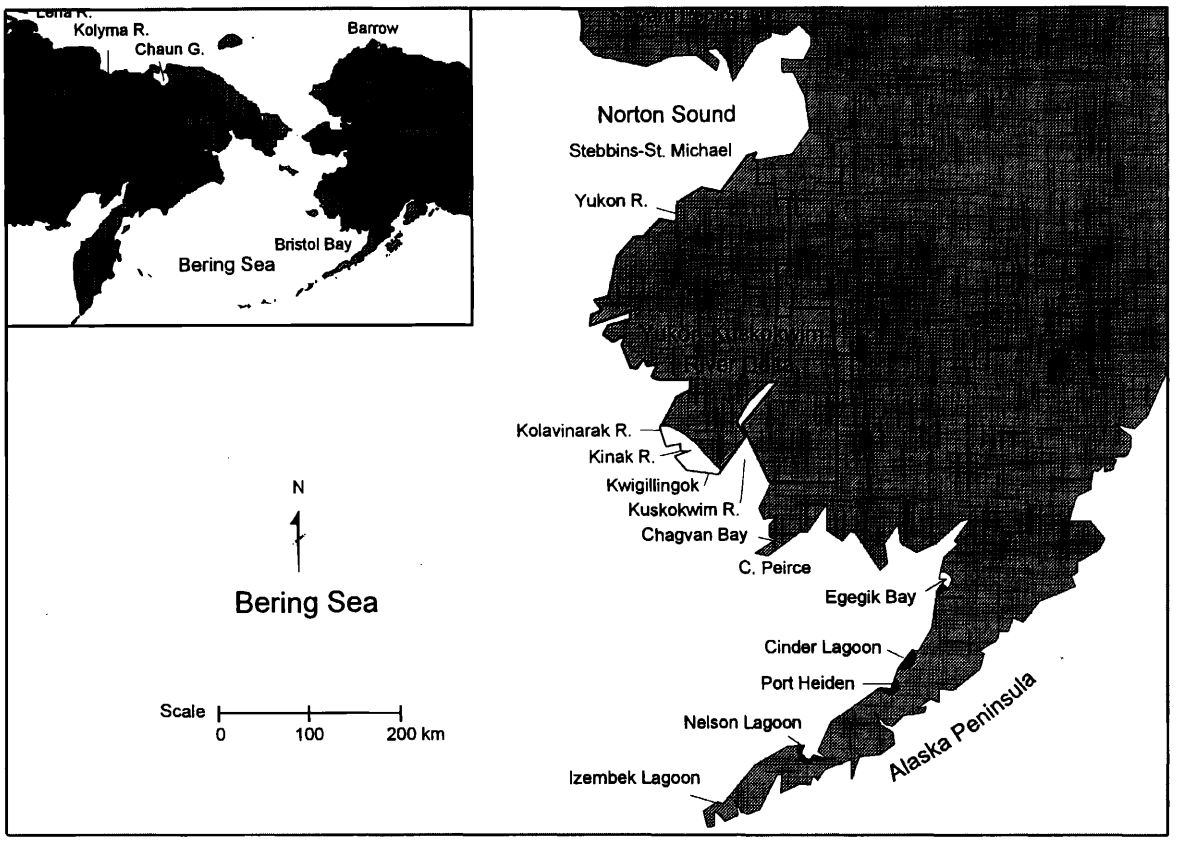

Figure 1. Map of Beringia showing placenames and the survey area of western Alaska. State Critical Habitat are shown in black; potential Hemispheric sites within the Western Hemisphere Shorebird Reserve Network are shown in white (see text). The boundary of the Yukon Delta National Wildlife Refuge is outlined in black.

In Alaska, godwits move from tundra breeding grounds to coastal staging areas beginning in late June. Godwits occur in coastal western Alaska from Barrow south to the western end of the Alaska Peninsula (Figure 1), a shoreline distance of over 5,000 km, much of it including soft sediment substrates (see, e.g., Gill & Handel 1981, 1990, Piersma & Gill 1998, McCaffery 1998). Over this area large flocks of godwits are generally found only from Norton Sound south throughout the Yukon-Kuskokwim River Delta (hereafter YKD) to Nelson Lagoon along the central Alaska Peninsula. Based on the timing of their occurrence at several sites within this region and repeated observations of passage migrants along the coast of the YKD during July and August (McCaffery unpubl. data), it appears that godwits exhibit a pronounced but gradual southward movement along the Alaskan coast prior to their migration to the south-west Pacific. In Norton Sound (64°N) godwits are common through August, but are absent by September (Shields & Peyton 1979, Woodby & Divoky 1983). On the central YKD (61°N) godwits are common from early July through mid-September, but are rare by the end of September (Gill & Handel 1990). Farther south on Alaska Peninsula lagoons (56°N), numbers of godwits build rapidly beginning in mid-September and peak in late September or early October (Gill & Jorgensen 1979, Gill & Handel 1981, Gill *et al.* 1981). Departure of birds from Alaska occurs mostly during September, but may extend into late October (Higgins & Davies 1996, Piersma & Gill 1998, Gill unpubl. data). It appears that adults and juveniles migrate together, but late departing flocks are comprised mostly of juveniles (Piersma & Gill 1998, Gill unpubl. data).

METHODS

Surveys flown in 1995 focused on the southern YKD, while 1997 surveys included almost the entire coast of western Alaska from the central YKD to Nelson Lagoon on the north-central Alaska Peninsula (Figure 1). We excluded two areas from the 1997 survey: 1) Izembek Lagoon at the western end of the Alaska Peninsula because recent information (Tibbitts *et al.* 1997) indicated little use of this area by godwits, and 2) a small portion of north-eastern Bristol Bay because of potential disturbance to Walrus *Odobenus rosmarus* from low-flying aircraft.

Surveys were conducted in single-engine floatplanes (Cessna 185 and 206, and C1A-1 Husky) flown at about 60 m above ground and at an average ground speed of 160-185 km/h. Godwits on the YKD were counted by BJM; those throughout Bristol Bay and at Alaska Peninsula estuaries were counted by REG. Both observers have several hundred hours of experience surveying shorebirds and other waterbirds from the air.

In order to obtain information that was as thorough and accurate as possible, we designed our surveys around three elements. Firstly, we wanted to survey the entire coast of western Alaska over which godwits are known to stage in early September; secondly, over this area we wanted to survey the YKD portion immediately after the Bristol Bay and the Alaska Peninsula portions to eliminate the possibility that birds moving south from the YKD to the Alaska Peninsula would be counted twice; and thirdly, since at high tides godwits roost and feed in vegetated habitats (McCaffery 1998) where they

Table 1. Numbers of Bar-tailed Godwit recorded during aerial surveys of coastal western Alaska in autumn 1995 and 1997.

	1995				1997				
Area	**1 Sept**	**2 Sept**	**8 Sept**	**26 Sept**	**2 Sept**	**3 Sept**	**4 Sept**	**5 Sept**	**11 Sept**
Central YKD				3,300				6,333	
South YKD	38,835	38,220	54,427	13,704				54,142	34,651
North Bristol Bay					45		42		
Alaska Peninsula						33,365[2]			

[1]Numbers presented only for areas surveyed for a particular date. See Figure 1 for location and extent of each area.
[2]Total includes higher of two (28,215 and 32,188) counts at Egegik Bay.

are often difficult to census, and at low tides they may be dispersed across vast mudflats, we wanted to census at intermediate tide levels (usually within 1-3 hours either side of high tide) to maximise the number of birds visible. The timing of these surveys relative to the stage of the tide, in all but a few instances, precluded our having to search for birds that may have been widely dispersed over the expansive intertidal flats common to these areas (see, e.g., Gill & Handel 1990). During the few occasions that surveys coincided with low or rising tides (e.g. portions of the 11 September 1997 survey), we focused our effort near the tide line since our previous experience indicated that godwits, even at the lowest stages of the tide, still tended to concentrate within a few hundred metres of the water line. During the 1997 survey several detours landward of the survey route to inspect inner mudflats confirmed the virtual absence of Bar-tailed Godwits away from the immediate tide line.

Numbers and habitat associations of birds were recorded onto cassette tape and concentrations of birds were noted on maps of the survey areas. The flight line usually occurred about 20-40 m outboard of the tide line if the extent of exposed flats was less than 200-300 m; if the exposed flats were wider, the airplane made two or more parallel passes. Where large concentrations of birds were encountered the aircraft circled so observers could devote more time to estimating flock sizes, and for exceptionally large flocks we obtained at least two counts to get a measure of intra-observer variability. We did not verify the accuracy of our flock size estimates (e.g., via photography or ground counts) primarily because during this inaugural survey we had only single observers who focused on counting birds within a very rigid time schedule.

RESULTS

Numbers

During 1995 we surveyed the southern YKD portion of western Alaska over which a single high count of about 54,500 godwits was obtained on 8 September (Table 1). The week before, 30% fewer godwits had been detected over the same area and were spread uniformly over sub-areas of this region. By late September 1995 total numbers were down to 14,000 birds, but birds remained distributed in similar proportions among the same sub-areas surveyed earlier in the month. During 1997, when the survey was expanded to include all of south-western Alaska, we counted a total of 93,882 godwits between 3 and 5 September (Table 1). A replicate survey of the southern portion of the YKD on 11 September produced a third fewer birds than had occurred there the previous week (Table 1). The overall decrease in numbers was also reflected by decreases in each of the sub-areas surveyed.

Flock size and composition

A total of 182 flocks of godwits (median flock size 80; range 1-4,000) was recorded on the comprehensive survey of 3-5 September 1997. Average flock size (X = 260, n = 362) over the YKD portion of the survey did not vary between replicate surveys on 5 and 11 September (ANOVA, P = 0.52); however, flock sizes were significantly smaller than those recorded at Egegik Bay (X = 520, n = 62) on the Alaska Peninsula on 3 September (ANOVA, P = 0.007). At Egegik Bay light conditions were such that plumage differences between adult and juvenile godwits could be discerned from the air so an effort was made to note the presence or absence (but not total numbers) of juveniles within flocks. For those flocks for which we assessed such age composition (26 of 38), all contained both adults and juveniles.

Important sites

During the comprehensive survey on 3-5 September 1997 most (61,000 or 64%) of the godwits were found on the YKD, but 33,000 (36%) were present along the Alaska Peninsula. On the YKD during both the 1995 and 1997 surveys, godwits concentrated along a 175 km-long portion of the southern YKD from the village of Kwigillingok north to the Kolavinarak River (Figure 1). Along this same area on both 5 and 11 September 1997, the greatest percentage of godwits (38% and 51%, respectively) were found between the Kinak and Kolavinarak Rivers (Figure 1). The same general pattern of distribution was also found during the September 1995 surveys.

Among the six principal estuaries along the Alaska Peninsula, only the relatively small Egegik Bay (54.2 km of unvegetated intertidal flats) supported appreciable numbers of godwits. Between 28,000 and 32,000 birds (totals for two counts on same day) were recorded there, accounting for c. 95% of the total godwits found along the peninsula. Within Egegik Bay, birds were confined entirely to the south and south-eastern portions of the estuary over what appeared to be about half of the intertidal flats available within the bay. Over the vast intertidal flats of upper Bristol Bay (only 50 km north of Egegik Bay), fewer than 100 godwits were recorded.

DISCUSSION

Numbers

These surveys represent the first attempt to estimate the post-breeding population of Bar-tailed Godwits in Alaska. Despite

the geographic extent of the surveys, three classes of godwits may have gone undetected: those that were still north of the YKD during the surveys, those within unsurveyed portions of our study area, and those which had already departed Alaska for non-breeding areas in the south-west Pacific. Previous surveys north of our study area have documented that by late August and early September godwits are rare or absent from Norton Sound (Shields & Peyton 1979, Connors & Connors 1982, Woodby & Divoky 1983), the Stebbins-St. Michael wetlands (McCaffery unpubl. data), and the northern Yukon Delta (R. Ernst pers. comm.). The few areas we failed to survey in our study area, such as from Chagvan Bay to Cape Peirce (Figure 1), have mostly rocky shorelines that are not generally attractive to godwits and historically have hosted only a few dozen birds (Petersen *et al.* 1991; T. & L. Burke in litt.). Finally, based on historical first arrival dates of late August for godwits at most nonbreeding sites in eastern Australia and New Zealand (Higgins & Davies 1996, A. Riegen pers. comm.), an undetermined fraction of godwits may have departed Alaska prior to our early September survey. The number of godwits present at these austral sites prior to mid-September, however, are quite small (Higgins & Davies 1996, Parrish & Lock 1995, 1996), suggesting that relatively few birds had left Alaska before our survey. Therefore, we believe that our estimate of 94,000 approaches the total number of Bar-tailed Godwits that staged in western Alaska in 1997, and that relatively few occurred outside our survey area.

Before we are able to fully interpret the significance of our findings, however, a number of inter-related questions need to be resolved. Specifically, the geographic origins, destinations, and taxonomic affinities of Bar-tailed Godwits staging on the coast of south-west Alaska need further resolution. The majority of Bar-tailed Godwits staging on the YKD and Bristol Bay shorelines are almost certainly from the Alaska breeding population. With no independent population estimate from the Alaska breeding grounds, however, we are unable to determine what proportion of staging birds are of Alaskan origin. Some Bar-tailed Godwits staging along the coast of south-west Alaska may have come from Russian breeding grounds. Such a pattern has been demonstrated for a number of species of Beringian shorebirds (Tomkovich unpubl. data, Gill 1996, Gill *et al.* 1996), but not for others.

If Russian breeders do stage in Alaska, the geographic origin and taxonomic affinity of such birds are unclear. Among populations of godwits breeding in Russia, those from the Anadyr Plain of the Russian Far East are the most likely to stage in western Alaska. These would either be members of the pan-Beringian form *L. l. baueri*, or, if *baueri* is limited to Alaska as a breeding taxon, a population intermediate between *baueri* and *menzbieri* (P. Tomkovich *in litt.*). It seems unlikely that true *menzbieri* occur in western Alaska (see, e.g. Barter 1996). Godwits are not known to breed on the Chukotsk Peninsula and the few records from there are of migrants (Portenko 1972) and most of these are considered of Alaskan origin (P. Tomkovich *in litt.*). If *menzbieri* do come east to Alaska, as do sympatric nesting Sharp-tailed Sandpiper *Calidris acuminata* each September-October (Tomkovich 1982), then these godwits apparently bypass Chukotka. The likely origin of Asiatic godwits in Alaska (if they at all occur there at all) is from the Anadyr region, recently proposed by Engelmoer & Roselaar (1998) as supporting a separate subspecies.

The geographic origins of, and taxonomic relationships among, populations of Bar-tailed Godwits in Australasia also need to be clarified. Bar-tailed Godwits west of the Gulf of Carpentaria are generally considered to be *menzbieri*, while the vast majority of those from south-east Australia and New Zealand belong to *baueri* (Higgins and Davies 1996, M. Barter pers. comm.). The annual mean count (1983-1992) for New Zealand (both north and south islands) was c. 85,000 (± 7,555 SD) birds (in Higgins & Davies 1996). In south-eastern Australia, populations of c. 8,000 and 5,000 birds are known for Victoria and New South Wales, respectively (Lane 1987). When the Australian data are combined with data from New Zealand, the population of *L. l. baueri* recorded during the austral summer approaches 100,000 birds, or only slightly more than the 94,000 we recorded during our comprehensive survey in Alaska. However, these figures from the nonbreeding grounds also include subadult birds that do not migrate north until at least their third year. In New Zealand c . 4% of the population is subadult (Higgins & Davies 1996) while in Australia the proportion ranges between 7.5% and 16% depending on whether derived from catches or counts (Hewish 1990). Thus, when the proportion of subadults is considered in the overall population figure we find even greater concordance between Alaska and Australasia survey results.

The identity of Queensland birds remains problematic, however. Current population estimates from Queensland total 49,000 birds (Driscoll 1997). Band recoveries and observations of colour-banded birds indicate that at least some of these birds are from Alaska, and therefore assignable to *baueri*. Thus, the post-breeding population of *baueri* is probably somewhere between 100,000 (if *baueri* is primarily limited to New Zealand and south-eastern Australia) and 150,000 (if all of the Queensland birds are *baueri*). Regardless of where the actual numbers fall within this range, our estimate of 94,000 on the Alaska staging grounds comprises a significant fraction of the global population.

Critical sites

Based on our surveys and current selection criteria (Harrington & Perry 1995), the YKD from the mouth of the Kuskokwim River north to the Kolavinarak River, and Egegik Bay near the base of the Alaska Peninsula (Figure 1) would both qualify as WHSRN Hemispheric. Further, these areas meet both EAASRN and Ramsar (Ramsar Convention, Smart 1987) criteria by hosting more than 20,000 shorebirds and more than one percent of a known flyway population (Rose & Scott 1994). Portions of Egegik Bay have been designated a Critical Habitat Area by the Alaska Department of Fish and Game, but areas where we detected godwits are not included within these boundaries. All of the intertidal habitats along the YKD are administered by the Alaska Department of Natural Resources and much of the adjacent tundra where godwits often roost and feed at high tide is under jurisdiction of the Yukon Delta National Wildlife Refuge.

These surveys occurred over a relatively small portion of the

time godwits are usually present on staging areas. Previous studies indicate that other embayments are also important to godwits and that in any one season several sites may be used. For example, the central portion of the YKD has hosted concentrations of as many as 20,000 godwits in early September (Gill & Handel 1990; Gill unpubl. data), thus meeting the criteria for both a Ramsar site and a WHSRN site of International importance. Likewise, concentrations of between 3,000 and 10,000 godwits have been noted on several Alaska Peninsula estuaries besides Egegik Bay, including Cinder Lagoon, Port Heiden, and Nelson Lagoon-Mud Bay (Gill & Jorgensen 1979, Gill *et al.* 1983, Gill *et al.* unpubl. data). Use by godwits of these areas qualifies each as both Ramsar and WHSRN sites; each is also designated a Critical Habitat Area by the Alaska Department of Fish and Game.

CONCLUDING REMARKS

Aerial surveys proved a practical and relatively inexpensive means of obtaining population data on Bar-tailed Godwits over their vast staging grounds in western Alaska. We detected a significant fraction of the global population *of L. l. baueri* in early September 1997. Survey totals closely matched those recorded for *baueri* in New Zealand and south-eastern Australia. Because of uncertainty about the taxonomic status of Queensland godwits, however, we cannot determine the overall size of the global population of *baueri*. Future research should include biometric and genetic analyses of godwits from Chukotka and Alaska, as well as from Australia and New Zealand. In addition, a modest effort to mark birds on the breeding grounds and to obtain sightings on the nonbreeding grounds would go far towards answering these unresolved questions. Of potentially greater reward, however, would be to look for Australian and New Zealand marked birds at sites like Egegik Bay or other Alaska estuaries where godwits occur in large concentrations.

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REFERENCES

American Ornithologists Union. 1983. *Check-list of the Birds of North America*. 6th Edition. Am. Ornithol. Union, Washington, D.C.

Barter, M. 1989. Bar-tailed Godwit *Limosa lapponica* in Australia. Part 1: Races, breeding areas and migration routes. *The Stilt* 14: 43-48.

Barter, M. 1989. Bar-tailed Godwit *Limosa lapponica* in Australia. Part 2: Weight, moult and breeding success. *The Stilt* 14: 49-53.

Barter, M. 1996. Wader studies in Australia. Pp. 35-39 In: Tomkovich, P. (Ed.) *Information Materials of the Working Group on Waders*, No. 9. Moscow.

Connors, P.G. & Connors, C.S. 1982. Shorebird littoral zone ecology of the southern Chukchi coast of Alaska. Pp. 1-58 In: *Environmental assessment of the Alaska continental shelf, final reports of principal investigators*. Vol. 23. NOAA Environ. Res. Lab., Boulder, CO.

del Hoyo, J., Elliott, A. & Sargatal, J. (Eds.). 1996. *Handbook of the Birds of the World. Vol. 3. Hoatzin to Auks*. Barcelona: Lynx Edicions.

DeLong, R. L. & Thompson, M.C. 1968. Bar-tailed Godwit from Alaska recovered in New Zealand. *Wilson Bull.* 80: 490-491.

Driscoll, P. 1997. The distribution of waders along the Queensland coastline. Pp. 80-122 In: Straw, P. (Ed.) *Shorebird Conservation in the Asia-Pacific Region*. Australasian Wader Studies Group, Melbourne.

Engelmoer, M & Roselaar, C. 1998. *Geographical variation in waders*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Gabrielson, I.N. & Lincoln, F.C. 1959. *The birds of Alaska*. Stackpole Co., Harrisburg, PA.

Gill, R.E., Jr. 1996. Alaska shorebirds: status and conservation measures at a terminus of the East Asian-Australasian flyway. Pp. 21-42 In: Wells, D. & Mundkur, T. (Eds.) *Conservation of migratory waterbirds and their wetland habitats in the East Asian-Australasian Flyway*. Wetlands International-Asia Pacific, Kuala Lumpur, Publ. No. 116, and International Waterfowl and Wetlands Research Bureau-Japan Committee, Tokyo.

Gill, R.E., Jr., Butler, R.W., Tomkovich, P.S., Mundkur, T. & Handel, C.M. 1994. Conservation of North Pacific Shorebirds. *Trans. N. Am. Wildl. Natur. Res. Conf.* 59: 63-78.

Gill, R.E., Jr. & Handel, C.M. 1981. Shorebirds of the eastern Bering Sea. Pp. 719-738 In: Hood, D. & Calder, J. (Eds.) *The eastern Bering Sea shelf: Oceanography and resources*. Vol. 2. Univ. Washington Press, Seattle.

Gill, R.E., Jr. & Handel, C.M. 1990. The importance of subarctic intertidal habitats to shorebirds: a study of the central Yukon-Kuskokwim Delta, Alaska. *Condor* 92: 709-725.

Gill, R.E., Jr. & Jorgensen, P.D. 1979. Preliminary assessment of the timing and migration of shorebirds along the north-central Alaska Peninsula. *Stud. in Avian Biol.* 2: 110-120.

Gill, R.E., Jr., Petersen, M.R. & Jorgensen, P.D. 1981. Birds of the north-central Alaska Peninsula, 1976-1980. *Arctic* 34: 286-306.

Gill, R.E., Jr. & Senner, S.E. 1996. Alaska and its importance to Western Hemisphere shorebirds. *International Wader Studies* 8: 8-14.

Harrington, B. & Perry, E. 1995. *Important shorebird staging sites meeting Hemispheric Shorebird Reserve Network criteria in the United States.* Unpublished report, Manomet Observatory for Conservation Science and U.S. Dept. of Interior. 121 pp.

Hewish, M. 1990. The summer 1989 population monitoring count: increasing numbers of Bar-tailed Godwits at monitored sites in eastern Australia, 1982-1989. *The Stilt* 16: 23-35.

Higgins, P.J. & Davies, S.J.J.F. (Eds.). 1996. *Handbook of Australian, New Zealand and Antarctic Birds. Vol. 3. Snipe to Pigeons.* Oxford Univ. Press, Melbourne.

Kessel, B. 1989. *Birds of the Seward Peninsula, Alaska: Their biogeography, seasonality, and natural history.* Univ. Alaska Press

Lane, B. 1987. *Shorebirds in Australia.* Nelson Publishers, Melbourne.

McCaffery, B.J. 1998. Implications of frequent habitat switches in foraging Bar-tailed Godwits (*Limosa lapponica*). *Auk* 115: 494-497.

Parrish, R.G. & Lock, J.W. 1995. Classified summarized notes, North Island, 1 July 1993 to 30 June 1994. *Notornis* 42: 145-173.

Parrish, R.G. & Lock, J.W. 1996. Classified summarized notes, North Island, 1 July 1993 to 30 June 1994. *Notornis* 43: 117-145.

Petersen, M.R., Weir, D.N., & Dick, M.H. 1991. Birds of the Kilbuck and Akhlun Mountain Region, Alaska. *North Am. Fauna* 76.

Piersma, T., van Gils, J. & Wiersma, P. 1996. Family Scolopacidae (sandpipers, snipes, and phalaropes). In: del Hoyo, J., Elliott, A., & Sargatal, J. (Eds.) *Handbook of the Birds of the World. Vol. 3. Hoatzin to Auks*, ed. J., A. Elliott & J. Sargatal, pp. 444-533. Barcelona: Lynx Edicions.

Piersma, T. & van Gils, J. 1997. The many unknowns about plovers and sandpipers of the world: introduction to a wealth of research opportunities highly relevant for shorebird conservation. *Wader Study Group Bull.* 82: 23-33.

Piersma, T. & Gill, R.E. 1998. Guts don't fly: small digestive organs in obese Bar-tailed Godwits. *Auk* 115: 196-203.

Portenko, L.A. 1972. *Ptitsy Chukotskogo poluostrova I ostrova Wrangelya* [Birds of Chukotka peninsula and Wrangel Island]. Leningrad: Nauka. (In Russian).

Riegen, A. 1966. New Zealand: conservation of shorebirds and their wetland habitats. Pp. 218-235 In: Wells, D. & Mundkur, T. (Eds.) *Conservation of migratory waterbirds and their wetland habitats in the East Asian-Australasian Flyway.* Wetlands International-Asia Pacific, Kuala Lumpur, Publ. No. 116, and International Waterfowl and Wetlands Research Bureau-Japan Committee, Tokyo.

Rose, P.M. & Scott, D.A. 1994. *Waterfowl population estimates.* IWRB 29. IWRB, Slimbridge, UK.

Shields, G.F. & Peyton, L.J. 1979. Avian community ecology at the Akulik-Inglutalik River Delta, Norton Bay, Alaska. Pp. 608-710 In: *Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators, Vol. 5.* Outer Continental Shelf Environmental Assessment Program, National Oceanic and Atmospheric Administration, Boulder, Colorado.

Smart, M. 1987. International Conventions. Pp. 114-121 In: Davidson, N. & Pienkowski, M. (Eds.) The conservation of international flyway populations of waders. *Wader Study Group Bull.* 49, Suppl./IWRB Spec. Publ. 7.

Tibbitts, T.L., Gill, R.E., & Dau, C.P. 1996. *Abundance and distribution of shorebirds using intertidal habitats of Izembek National Wildlife Refuge, Alaska.* Unpubl. Final Rpt., U.S. Geological Survey, Alaska Biological Sciences Center, Anchorage, AK. 38 pp.

Tomkovich, P.S. 1982. Peculiarities of the autumn migration of the Sharp-tailed Sandpiper. *Bull. Moscow Society of Naturalists* 87: 56-61. (In Russian).

Watkins, D. 1993. *A national plan for shorebird conservation in Australia.* Australian Wader Studies Group, Royal Australasian Ornithologists Union and World Wide Fund for Nature. RAOU Rpt. No. 90.

Watkins, D., Barter, M. & Weaver, K. 1996. Australia: shorebird conservation. Pp. 203-217 In: Wells, D. & Mundkur, T. (Eds.). *Conservation of migratory waterbirds and their wetland habitats in the East Asian-Australasian Flyway.* Wetlands International-Asia Pacific, Kuala Lumpur, Publ. No. 116, and International Waterfowl and Wetlands Research Bureau-Japan Committee, Tokyo.

Wells, D.R. & Mundkur, T. (Eds.). 1996. *Conservation of migratory waterbirds and their wetland habitats in the East Asian-Australasian Flyway.* Wetlands International-Asia Pacific, Kuala Lumpur, Publ. No. 116, and International Waterfowl and Wetlands Research Bureau-Japan Committee, Tokyo.

Woodby, D. & Divoky, G. 1983. Bird use of coastal habitats in Norton Sound. Pp. 353-704 In: *Environmental assessment of the Alaska continental shelf. Final reports of principal investigators, Vol. 18.* Outer Continental Shelf Environmental Assessment Program, National Oceanic and Atmospheric Administration, Boulder, Colorado.