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CONSERVATION STATEMENTS FOR NUMENIINI SPECIES

Summary:

This document has been submitted by BirdLife International and the International Wader Study Group as an information document for COP11. It includes conservation statements for the Numeniini group including 13 species of birds in total: 8 curlews, 4 godwits and the Upland Sandpiper (*Bartramia longicauda*). The document provides background information on two species that are being proposed for Concerted and Cooperative Actions in document UNEP/CMS/COP11/Doc.22.4, in particular the Far-eastern Curlew (*Numenius madagascariensis*) and the Bar-tailed Godwit (*Limosa lapponica*). It also provides background information to the Programme of Work on Migratory Birds and Flyways contained in document UNEP/CMS/COP11/Doc.23.1.1.

4-9 NOV 2014
QUITO, ECUADOR
CMS COP 11
TIME FOR ACTION!

Drivers of population change and conservation priorities for the Numeniini populations of the world

Conservation statements for the 13 species and 38 biogeographic populations of curlews, godwits and the upland sandpiper

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BirdLife International
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Contents

Summary
The Numeniini are a taxonomic tribe of shorebirds comprising the world's 13 species of curlew (*Numenius spp.*), godwit (*Limosa spp.*) and the Upland Sandpiper *Bartramia longicauda.* They are one of the most threatened taxonomic groups of migrants in the world, and include two IUCN Critically Endangered species that are likely to have gone functionally extinct in recent decades: the Eskimo Curlew *N. borealis* of the Americas and the Slender-billed Curlew *N. tenuirostris* of Africa-Eurasia. The Far Eastern Curlew *N. madagascariensis* of the East Asian-Australasian Flyway and the Bristle-thighed Curlew *N. tahitiensis* of the Central Pacific Flyway are both listed as Vulnerable to global extinction on the IUCN Red List and the Eurasian Curlew *N. arquata* and Black-tailed Godwit *L. limosa* as Near Threatened. With many of the other species, subspecies and biogeographic populations also in decline, the Numeniini emerge as a group of migratory species in desperate need of concerted conservation action to avoid any other populations or species suffering a similar fate to the Eskimo and Slender-billed Curlews.

This pressing conservation case was the rationale behind undertaking this review, which has been coordinated by the Royal Society for the Protection of Birds (BirdLife in the UK), involving input from over 100 shorebird experts from around the world, including through a dedicated full-day workshop at the 2013 International Wader Studies Group Annual Conference in Wilhelmshaven, Germany, on 30th September 2013.

Populations assessed in this review
The Numeniini comprise 13 species in total; 8 curlews, 4 godwits, and the Upland Sandpiper *Bartramia longicauda.* For many of these 13 species, there are various subspecies and/ or biogeographic populations, owing to highly disjunct breeding areas and migratory patterns. The basis for populations assessed in this review were those listed and assessed in Waterbird Population Estimates: Fifth Edition (Wetlands International 2014). In total, this amounts to 37 populations, whilst the addition of a newly described subspecies of Whimbrel *N. phaeopus rogachevae* (Tomkovich 2008) took that number up to 38 (Table 1).

Data collected
For each of the 38 populations, we sought to capture data and information firstly through collating existing published material, and then seeking expert opinion from around the world to review this data and fill in key knowledge gaps. This review has only been made possible thanks to the contributions of over 100 conservationists, ornithologists and academics from across the world, each with an expertise in shorebird research and conservation, and many on a voluntary basis. We are extremely grateful for their invaluable input. For each population, we sought to capture information on:

- Population size and trend.
- Demographic trends relating to nesting success, fledging success, 1st year survival and adult survival.
- Direct threats to the populations.
- Current conservation work occurring for each population.
- Conservation and research priorities for each population.

Acknowledgements
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Table 1. List of populations assessed as part of this review.

No.	Population Species or subspecies	Population Name from Waterbird Population Estimates 5
1	Upland sandpiper *Bartramia longicauda*	Americas
2	Hudsonian Godwit *Limosa haemastica*	Alaska (breeding)
3	Hudsonian Godwit *Limosa haemastica*	Hudson Bay (breeding)
4	Marbled godwit *Limosa fedoa fedoa*	fedoa, SC Canada & NC USA (breeding)
5	Marbled godwit *Limosa fedoa fedoa*	fedoa, James Bay (breeding)
6	Marbled godwit *Limosa fedoa beringiae*	Beringiae
7	Bar-tailed Godwit *Limosa lapponica baueri*	Baueri
8	Bar-tailed Godwit *Limosa lapponica lapponica*	lapponica, Northern Europe/Western Europe
9	Bar-tailed Godwit *Limosa lapponica taymyrensis*	taymyrensis, Western Siberia/West & South-west Africa
10	Bar-tailed Godwit *Limosa lapponica taymyrensis*	taymyrensis, Central Siberia/South & SW Asia & Eastern Africa
11	Bar-tailed Godwit *Limosa lapponica menzbieri* and *Limosa lapponica anadyrensis*	menzbieri & (anadyrensis)
12	Black-tailed Godwit *Limosa limosa limosa*	limosa, Western Europe/NW & West Africa
13	Black-tailed Godwit *Limosa limosa limosa*	limosa, Eastern Europe/Central & Eastern Africa
14	Black-tailed Godwit *Limosa limosa limosa*	limosa, West-central Asia/SW Asia & Eastern Africa
15	Black-tailed Godwit *Limosa limosa limosa*	limosa, S Asia (non-breeding)
16	Black-tailed Godwit *Limosa limosa islandica*	islandica, Iceland/Western Europe
17	Black-tailed Godwit *Limosa limosa melanuroides*	melanuroides
18	Long-billed Curlew *Numenius americanus*	americanus
19	Long-billed Curlew *Numenius americanus*	parvus
20	Bristle-thighed Curlew *Numenius tahitiensis*	W Alaska (breeding)
21	Eurasian Curlew *Numenius arquata arquata*	arquata, Europe/Europe North & West Africa
22	Eurasian Curlew *Numenius arquata orientalis*	orientalis, Western Siberia/SW Asia E & S Africa
23	Eurasian Curlew *Numenius arquata orientalis*	orientalis, S Asia (non-breeding)
24	Eurasian Curlew *Numenius arquata orientalis*	orientalis, E & SE Asia (non-breeding)
25	Eurasian Curlew *Numenius arquata suschkini*	suschkini, South-east Europe & South-west Asia (breeding)
26	Little Curlew *Numenius minutus*	N Siberia (breeding)
27	Slender-billed Curlew *Numenius tenuirostris*	Central Siberia/Mediterranean & SW Asia
28	Far Eastern Curlew *Numenius madagascariensis*	C & E Asia (breeding)
29	Eskimo Curlew *Numenius borealis*	N Canada (breeding)

30	Whimbrel *Numenius phaeopus hudsonicus*	hudsonicus
31	Whimbrel *Numenius phaeopus rufiventris*	rufiventris
32	Whimbrel *Numenius phaeopus alboaxillaris*	alboaxillaris, South-west Asia/Eastern Africa
33	Whimbrel *Numenius phaeopus islandicus*	islandicus, Iceland Faeroes & Scotland/West Africa
34	Whimbrel *Numenius phaeopus phaeopus*	phaeopus, Northern Europe/West Africa
35	Whimbrel *Numenius phaeopus phaeopus*	phaeopus, West Siberia/Southern & Eastern Africa
36	Whimbrel *Numenius phaeopus rogachevae*	Not listed in WPE5
37	Whimbrel *Numenius phaeopus variegatus*	variegatus, S Asia (non-breeding)
38	Whimbrel *Numenius phaeopus variegatus*	variegatus, E & SE Asia (non-breeding)

1. Upland Sandpiper
Bartramia longicauda (Bechstein, 1812)

Image courtesy of Sue Johnson

IUCN Status: Least Concern (LC)
The population trend varies geographically: the breeding population in Canada is declining but the U.S. population appears to be stable. The species does not currently approach the IUCN thresholds for Vulnerable[5].

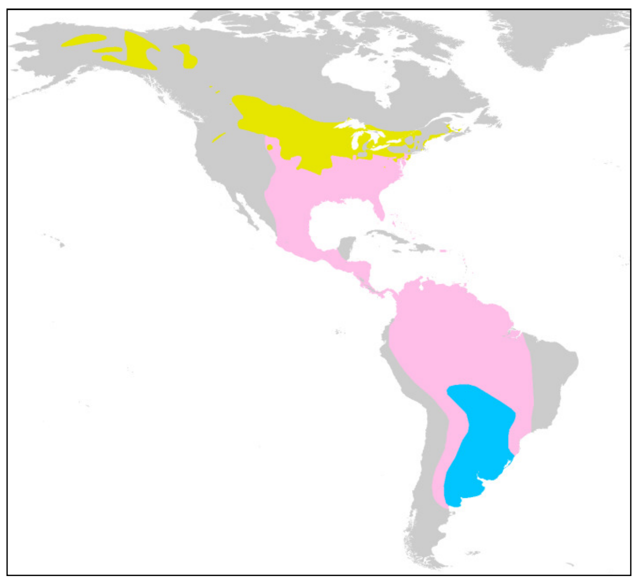
CMS Status: Appendix II

Taxonomy: Monotypic species.

Life cycle, distribution and ecology
Breeding: across northwestern and central North America, including eastern Alaska, the Canadian prairie provinces and east of the Rocky Mountains in the U.S. Also in eastern U.S. and Canada, but here they are rare and locally distributed. Breeding habitat includes a range of short grassland habitats within large, open landscapes, such as native prairies, pastures, hayfields and short-grass savannas.

Non-breeding: departs breeding grounds in July and August, with stopovers in various agricultural habitats including ploughed fields and shrub-grass in the U.S. Little is known about habitat use as the species migrates further through South America, although it is known to use high Andes grasslands and agricultural grasslands. Northbound migration starts in February.

Spends the boreal winter in South America, making use of natural grasslands, grazed pastures, saline steppes, alfalfa fields and cultivated land. Upland Sandpipers do not congregate in very large numbers on either their breeding or non-breeding grounds; flocks are mostly in the tens of birds, although maximum counts of several hundred or even over a thousand birds have been recorded at a handful of non-breeding sites[87].



Key[232]: Breeding Season, Non-breeding Season, Passage

POPULATION ESTIMATES

Size	750,000[88]
Trend	**STABLE**[101,131]

DEMOGRAPHIC TRENDS

Nesting success	**DECLINING**[131]
Fledging success	**UNKNOWN**
1st Year survival	**STABLE**[131]
Adult survival	**STABLE**[131]

INTERNATIONAL RESPONSIBILITIES

Breeding	Canada & U.S.
Non-breeding	Argentina, Barbados, Bolivia, Brazil, Colombia, Ecuador, French Guiana, Mexico, Paraguay, Peru, Suriname, Uruguay & U.S.

THREATS ON BREEDING GROUNDS

North America

The **intensification of cattle production** in Kansas, particularly prescribed burning and heavy grazing pressure, negatively impacts on nest survival[131]. In Canada, the **abandonment of marginal farmland** can lead to scrub encroachment and the natural regeneration of woodlands when not actively managed, replacing breeding habitats[103]. Potential threats, which are not yet fully understood, include the **loss of native grasslands** to agriculture in parts of the prairie range[103], the increasing abundance and distribution of **invasive non-native plant species** within intact tallgrass prairie ecosystems[103,131], the wider impacts of **agricultural chemicals** on grassland birds[89], and expanding **oil, gas and wind farm developments**[131] that fragment breeding grounds.

THREATS DURING MIGRATION

South America

Many threats face this species during migration, including habitat fragmentation caused by increasing **urbanization** along the migration route in South America, the conversion of grassland habitats to **grain crops,** and the **intensification of livestock ranching** (with associated overgrazing, frequent fires, conversion to non-native pastures, etc)[132]. Increasing **energy** developments are also likely to be having an impact, such as **mining** in the Andean region, **oil and gas drilling** in the Llanos, and increasing numbers of **wind farms** along the migration corridor[132]. Upland sandpipers are still **hunted** in parts of the Caribbean, especially in Barbados[132]. Additional threats likely to be having an impact include the frequent **burning** of grassland habitats, the use of **insecticides** and other agrochemicals on soy and rice crops, and increased light pollution in urban areas, which can cause confusion amongst migratory species[132].

THREATS ON NON-BREEDING GROUNDS

South America

The loss and fragmentation of non-breeding habitats as a result of increasing **urbanization** is also occurring on the pampas[132]. Additional habitat loss is occurring due to the conversion of grasslands to grain crops, primarily soy. Also an issue is the **intensification of grassland management**, which is resulting in less fallow areas[132]. **Plantations** of non-native pines and Eucalyptus replace and fragment non-breeding habitats, as does **intensive cattle ranching** and its associated practices of high livestock densities, frequent burning and conversion to non-native pastures[132,131]. Human **disturbance** due to recreational pursuits is increasing in some areas, such as the use of off-road vehicles in Paraguay[132].

CONSERVATION

Current conservation

A Western Hemisphere Shorebird Reserve Network (WHSRN) conservation plan for the Upland Sandpiper was produced in 2010[87]. Appropriate burning and grazing regimes for managing pampas grasslands have been identified.

Conservation priorities

1. **Maintain traditional Pampas grassland management practices** on wintering grounds to prevent conversion to crops such as sugar cane and soy.

2. On breeding grounds, **undertake beneficial burning regimes** in line with current conservation advice where it is used to improve the quality of spring forage for cattle (e.g. Flint Hills, eastern Kansas). This management can benefit Upland Sandpiper through improving foraging conditions, but it can also reduce vegetative cover needed for nesting.

3. Recommend habitat management practices that **maintain landscape heterogeneity.**

RESEARCH

Research priorities

1. **Satellite tag (or GPS tag)** birds from different breeding localities to address several key knowledge gaps relating to migratory routes and timings, important non-breeding sites/ regions, habitat use on non-breeding grounds (including of agricultural crops), whether Upland Sandpipers are faithful to non-breeding sites, and whether they nest only once or breed at separate latitudes in the same breeding season.

2. **Assess key threats during the non-breeding season** (i.e. mortality through drowning and associated mass mortality events that occur during southbound migration in the Andes, habitat loss and degradation in the Pampas, Humid Chaco and Beni Savannas, impact of pesticides and herbicides).

3. **Study breeding populations** to obtain basic data on site fidelity, productivity, age of first breeding, longevity, lifetime reproductive success and potential differences between disjunct breeding populations (e.g. genetic structure and vocalisations).

4. **Improve understanding of migration** (e.g. time and energy budgets, physiology of migration, aerodynamic factors, flight adaptations, and molt period and patterns so birds can be sexed and aged more efficiently).

2. Bristle-thighed Curlew
Numenius tahitiensis (Gmelin, 1789)

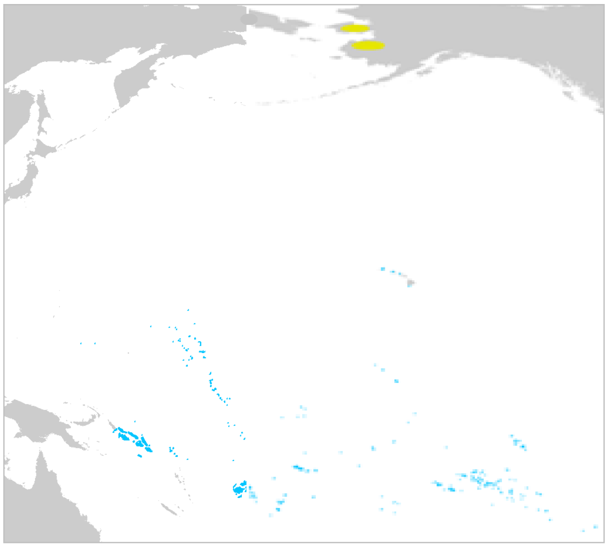
Image courtesy of Kristine Sowl

IUCN Status: Vulnerable (VU)
The population trend is unknown but the population is now small, probably as a result of predation by introduced mammals and hunting on non-breeding grounds, when perhaps more than 50% of adults are flightless during the autumn moult[5].

CMS Status: Appendix I

Taxonomy
Monotypic species.

Life cycle, distribution and ecology
Breeding: Breeds from May to July on dwarf-shrub tundra in western Alaska, U.S.[125,126]. The entire population breeds within two small, disjunct areas separated by approximately 300 km: the lower Yukon River and the central Seward Peninsula[127,128]. Recent DNA analysis has found that the two breeding populations are genetically distinct, but that both populations mix together on non-breeding grounds[61].



Key[232]: Breeding Season, Non-breeding Season, Passage

Non-breeding: In August, birds stage from the central Yukon-Kuskokwim delta south to the northwest coast of the Alaskan Peninsula, typically within 100 km of the coast[128]. By mid-August, most birds have left Alaska. Less is understood about northward migration, but birds are back on breeding grounds by the third week of May, with a few birds using the same staging sites used during southbound migration[128]. Birds spend the non-breeding season on oceanic islands in the tropical and subtropical Pacific Ocean[215], where they use coral reefs, sandy beaches, intertidal mudflats, rocky shores and palm forests with densely vegetated understory. Some individuals move between islands during this period[61].

POPULATION ESTIMATES

Size	10,000[100]
Trend	UNKNOWN

DEMOGRAPHIC TRENDS

Nesting success	UNKNOWN
Fledging success	UNKNOWN
1st Year survival	UNKNOWN

Adult survival	UNKNOWN

INTERNATIONAL RESPONSIBILITIES

Breeding	U.S.
Non-breeding	American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Northern Mariana Islands (to USA), Pitcairn Islands, Republic of the Marshall Islands, Samoa, Tonga, Tuvalu, US Minor Outlying Islands & U.S.[129,130].

THREATS ON BREEDING GROUNDS

Alaska, U.S. The southern breeding area is located almost entirely within the boundaries of the Andreafsky Wilderness Area of the Yukon Delta National Wildlife Refuge, and is thus protected from most threats, except those associated with **climate change** or elevated levels of **predators** in breeding areas[128]. Nest predation can be high during certain years[212] and so the expansion of towns near breeding areas, which can attract and sustain nest and chick predators at artificially high levels (e.g. Common Ravens *Corvus corax*) is a threat[128]. The impacts of **climate change** have recently been observed, as the process of shrubification and advancement of the treeline into sub-arctic tundra has starting to occur in breeding areas[128]. Other anticipated impacts from climate change include changes in the timing and abundance of peak invertebrate and berry food sources, as a consequence of altered temperature and snow melt regimes[128] (see Hudsonian Godwit species account for the potentially serious impacts of such processes). The cumulative effect of **small-scale gold-mining operations** and **seasonal roads** on the Seward Peninsula is likely to be fragmenting breeding habitat whilst also creating localised disturbance[128]. **Mercury bioaccumulation** is also likely to be having an impact, whereby atmospheric mercury from industrial activities in Asia is deposited or released via melting of the permafrost and ice fields. The Alaskan climate is favourable for methylation of mercury, resulting in mercury becoming bio-available[128].

THREATS DURING STAGING

Alaska, U.S. Spring staging occurs mostly on a vast roadless area, with human residents travelling by snowmobile (during spring staging) and in boats along river and sloughs (summer and fall staging). Much of the area is included in the USFWS National Wildlife Refuge (NWR) system, specifically within the Yukon Delta NWR and Togiak NWR[128]. Threats include the expansion of human settlements and the expansion of wind turbines along the coast of Western Alaska near villages[128]. **Subsistence hunting** of large shorebirds occurs during fall migration on the Yukon-Kuskokwim Delta, whilst increased **human disturbance** results from off-road vehicles and oil being transported along river corridors to fuel town generators[128]. The impacts of climate change include: sea level rise; increases in the frequency and intensity of storms; and altered wind, temperature and snow melt regimes. All could negatively impact on habitats, food resources and behavioural responses[128]. Potential/future threats include proposals for large-scale mining projects across south-west Alaska (e.g. Pebble Mine, the Donlin Gold project), a proposed hydroelectric plant near Wood-Tchichik State Park with powerlines to Bethel and the proposal for a road between the Yukon and Kuskokwim Rivers, which would cross the Bristle-thighed Curlew staging range[128].

THREATS ON NON-BREEDING GROUNDS

Pacific Ocean

The Bristle-thighed Curlew is the only migratory shorebird that spends the non-breeding season exclusively on oceanic islands[215]. Prior to the arrival of humans, such islands would have been free of terrestrial predators, which most likely explains their unusual moult (unique amongst shorebirds) whereby the prebasic moult renders 50% of adults flightless for approximately two weeks[138,184]. During this flightless period they are extremely secretive, hiding in vegetation and seldom appearing in the open,[215] and are subsequently vulnerable. A suite of non-native mammals have been introduced to the region over previous decades. Feral cats *Felis* catus and dogs *Canus familiaris* are now present throughout much of Oceania, and probably pose the greatest threat in terms of direct predation, especially during the moult[215]. Other mammals degrade and destroy foraging habitat; free-range and feral pigs *Sus scrofa* create disturbance and destroy native vegetation, which alters food resources[215]. Loss of vegetative cover could also render birds more susceptible to predators during the winter moult, or result in curlews avoiding such areas[215]. Copra (coconut) plantations replace native vegetation, reduce biodiversity on atolls and islands, and are often the source of introduced mammals. Invasive non-native plants, which in some cases can cover entire islands e.g. *Verbesinia enceliodes* in Midway Atoll, reduce the extent of roosting habitat and degrade foraging habitat[128]. **Sea level rise** represents a very real future threat to the fragile network of remote, uninhabited islands and atolls on which the species is increasingly dependant as a result of the above threats: the predicted **loss of intertidal habitat**, due to a combination of **sea level rise and increased inundation events**, could result in birds being forced to seek refuge on less-suitable islands inhabited by humans and invasive non-native species. Loss, degradation and fragmentation of roosting and feeding habitat occurs across the region due to **residential and commercial developments** and associated **infrastructure**. Roads on islands and atolls are often prominent features since these islands can be quite small, and they can destroy or degrade habitat, create disturbance, and provide avenues for invasive plants[128]. A wide range of pollutants may also locally be affecting curlews, both directly (e.g. oil spills, ingestion of toxicant pellets used during rat *Rattus spp.* eradication, ingestion of ubiquitous plastic garbage) and indirectly (radioactive waste, lead contamination)[128]. The expansion of wind farms across Oceania, especially on high islands, could provide a further threat[128]. Lastly, alteration of wind regimes due to **climate change** could have significant impacts on the migration capabilities of the Bristle-thighed Curlew; it undertakes very long, non-stop migratory flights to non-breeding areas, and probably uses wind-assisted migration to accomplish this feat[128].

CONSERVATION

Current conservation

No flyway conservation plan is available for this species, however a working group has been established. The creation of shrimp farms with predator exclusion fences has protected curlews at some non-breeding sites. The Hawaiian Islands NWR protects several non-breeding sites; protection and management of habitat at Kahuku on O'ahu has facilitated an increase in the local population.

Conservation priorities

1. Identify key refugia on Pacific islands that will withstand sea level rise.

2. Control non-native predators of adults during moult period when adults become flightless.

RESEARCH

Research priorities

1. Identify best management practices for non-breeding areas.

2. Investigate the biological and physiological impacts of both direct (i.e. plastic garbage ingestion) and indirect (i.e. lead contamination, radioactive waste) forms of pollution on Bristle-thighed Curlews.

3. Obtain more data on adult survival for demographic modelling purposes.

3. **Whimbrel**
Numenius phaeopus ***(Linnaeus, 1758)***

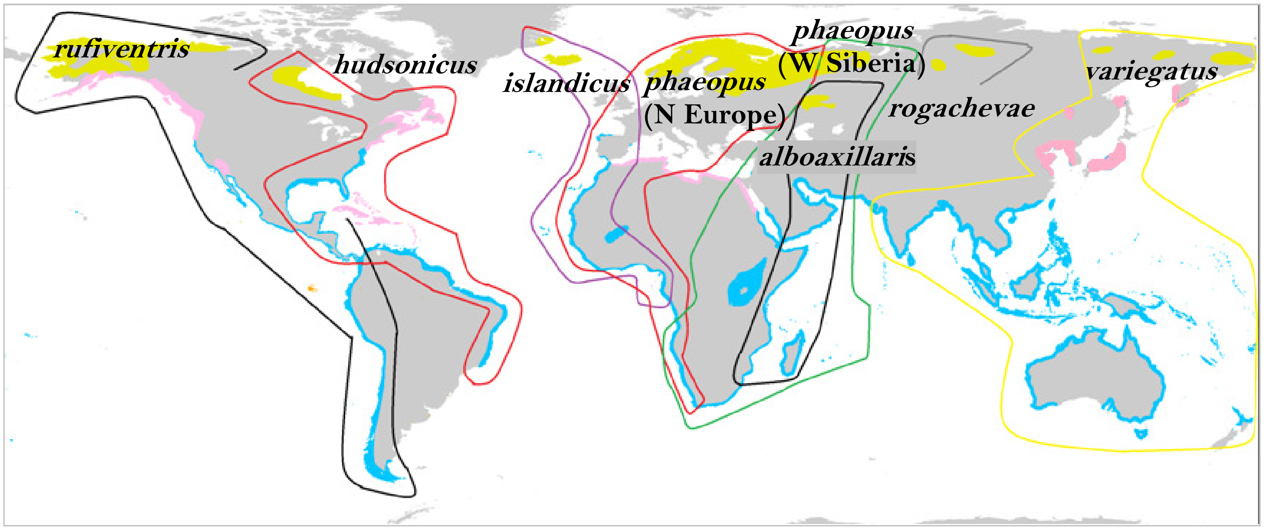
Steve Knell (rspb-images.com)

IUCN Status: Least Concern (LC)
The Whimbrel has an extremely large range, much the largest of any of the Numeniini, and population trends appear to vary across this geographical range[5].

CMS Status: Appendix II

Taxonomy
Seven subspecies are recognised in total:

- *N. p. hudsonicus* breeds in Eastern and Central Canada;
- *N. p. rufiventris* breeds in Alaska and Western Canada. Recent satellite tracking suggests this subspecies comprises two segregated populations. Tracked birds from MacKenzie Delta, Canada stage along the Atlantic coast of Canada and the U.S. before spending the non-breeding season in the Caribbean and South America (predominately Brazil). The non-breeding range differs from Alaskan breeding birds.
- *N. p. islandicus* breeds in Iceland, the Faroe Isles and the UK. Though not conclusive, the small population breeding in Greenland are most likely to be *islandicus* birds. Spends the non-breeding season mostly in West Africa, where it mixes with *phaeopus* birds.
- *N. p. phaeopus* breeds across Fennoscandia, the Baltic States and across to West Siberia. The western portion of the breeding population spends the non-breeding season in West Africa, where it mixes with *islandicus* birds. A separate eastern population migrates down into the Middle East and East Africa.
- *N. p. alboaxillaris* breeds in the lower Volga steppes to the south-east of the Urals;
- *N. p. variegatus* breeds in Central and Eastern Siberia;
- *N. p. rogachevae* has only recently been described and breeds in Southern Siberia.



Key[232]: Breeding Season, Non-breeding Season, Passage

								POPULATION ESTIMATES
Population	***rufiventris***	***hudsonicus***	***islandicus***	***phaeopus* (Europe)**	***phaeopus* (Siberia)**	***alboaxillaris***	***rogachevae***	***variegatus***
Size	**40,000**[171,88]	**40,000**[88,100]	**600,000 – 750,000**[2,116]	**190,000 – 340,000**[2,116]	**100,000 – 1,000,000**[172,12]	**1 – 100**[116,165]	**?**	**100,000**[173,3]
Trend	**POSSIBLY STABLE**	**DEC.**[88,191]	**STABLE**[113]	**DEC.**[38]	**STABLE**[182]	**DEC.**[165]	**?**	**DEC.**[3]
								DEMOGRAPHIC TRENDS
Nest success	**?**[103]	**DEC.**[37]	**VAR.**[174,175]	**DEC.**	**?**	**?**[181]	**?**	**?**
Fledging success	**?**[103]	**?**[103]	**VAR.**[174,175]	**STABLE**	**?**	**?**[181]	**?**	**?**
1st-year survival	**?**[103]	**?**[103]	**VAR.**[174,175]	**?**	**?**	**?**[181]	**?**	**?**
Adult survival	**?**[103]	**?**[103]	**VAR.**[174,175]	**DEC.**	**?**	**?**[181]	**?**	**?**
								INTERNATIONAL RESPONSIBILITY
Breeding	Canada & U.S.	Canada.	Faroe Islands, Greenland, Iceland & UK	Belarus, Estonia Finland, Latvia Norway, Russia & Sweden.	Russia.	Russia.	Russia.	China & Russia.
Non-breeding	Canada, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala Mexico, Nicaragua, Panama, Peru & U.S.	Bermuda, Brazil, Canada, Chile, Columbia, Dominican Republic, Dutch Antilles, French Antilles, French Guiana, Guyana, Haiti, Jamaica, Malvinas/Falklands Mexico, Panama, Suriname, Trinidad, Tobago, Uruguay, U.S. & Venezuela.	Belgium, Benin, Cameroon, France, Gabon, Gambia, Ghana, Guinea-Bissau, Guinea, Ireland, Ivory Coast, Liberia, Mauritania, Morocco, Netherlands, Nigeria, Germany, Portugal, Senegal, Sierra Leone, Spain, Togo, Tunisia, & U.K.	Belgium, Benin, Cameroon, France, Gabon, Gambia, Ghana, Guinea-Bissau, Guinea, Ivory Coast, Liberia, Mauritania, Morocco, Netherlands, Nigeria, Germany, Portugal, Senegal, Sierra Leone, Spain, Togo, Tunisia, & U.K.	*Eastern and Southern Africa, Madagascar (via Caspian Sea).* *Migratory routes unclear. There could be a western and eastern route.	*Islands and coasts of the West Indian Ocean.*	Kazakhstan *Non-breeding area not currently known but thought to involve SW migration route to Caspian Sea[58,189].	Australia, Bangladesh, China, India, Indonesia, Japan, Malaysia, Mongolia, Myanmar, North Korea, Philippines, Russia, South Korea, Thailand & Vietnam.

Life cycle, distribution and ecology

Breeding: breeds from May to August[8] across the boreal, subarctic and subalpine zones[9,11] . Breeds in a wide variety of habitats, including: dry scrub heathland[166], moss and lichen tundra with stunted bushes, sedge meadows[9], wet moorland[11,166] and mossy hummock bogs or heaths[9,10,167,168] in open areas, river valleys and floodplains[11,165], along the shores of tundra lakes[10], in birch forest near the Arctic treeline[11], burned areas of forest[10] and open montane forest[11] and steppes and arable land[165]. Important feeding habitats for adults and broods also include pastures, ploughed fields and mires[169,170].

Non-breeding: migrates southwards from July onwards[8] with the return passage to the breeding grounds occurring chiefly between March and May[8]. Different migration strategies exist, with satellite-tracking of islandicus birds showing one bird fly direct from breeding grounds in Iceland straight to Guinea-Bissau[54]. On passage Whimbrel frequent wetlands, tidal flats[11], short-sward wet and dry grasslands[8,11], farmland[8] and heathland. Whimbrel have a circumpolar range during the non-breeding season, where they mostly use coastal habitats including muddy, rocky or sandy beaches[11], coral shores[164], exposed reefs, tidal mudflats[11], sandflats[164], mangrove swamps[11], tidal marshes[9] and lagoons[164].

THREATS ON BREEDING GROUNDS

Iceland and U.K.

In Iceland, breeding grounds are being fragmented due to the expansion of **summer cottages** and **roads.** They bring with them increased rates of predation and disturbance from **domestic pets,** and increased **disturbance** from humans[174]**. Commercial forestry** has also increased, and is planned to increase further, and further replaces and fragments open breeding habitats[174,42]. Lastly, increased hay production and arable cropping in Iceland has required the **drainage of wetlands** and **conversion of natural habitats**[174]; 55-75% of Icelandic wetlands have been drained to some extent over the last 100 years[238].

On the Shetland Isles, **climate-induced** reductions in food availability for avian predators (skuas & gulls) in the marine environment has led to **increased predation** of nests, chicks and even adults[175]. Fishing practices may also have an influence, with predators such as Great Skuas *Stercorarius skua* having increased due to discards from fishing boats[175]. Emerging threats include large-scale **wind farm developments** in core breeding areas[175].

North America

Increasing drilling for **oil and gas** in western **Canada**, with associated increases in **roads, service corridors** and **disturbance levels,** is fragmenting core *rufiventris* breeding grounds[103]. Whilst **hunting pressure** has reduced in recent years, **subsistence harvesting** continues in North America (illegally in the case of Alaska)[103,171]. **Problematic native species** are also presenting conservation challenges. Native predators, such as Ravens *Corvus corax* and Red Foxes *Vulpes vulpes*, are thought to be impacting on *hudsonicus* breeding success through nest and chick predation[37]. The Lesser Snow Goose *Chen c. caerulescens* population has increased significantly at an important staging site in eastern Canada, degrading the habitat through grazing and attracting predators including Grizzly Bears *Ursus arctos spp*., which subsequently depredate nest and chicks[103]. Many **climate change-**related threats may exist, and some are beginning to become apparent, such as the **northward progression of scrub and woodland** habitat within the *hudsonicus* breeding range[103]. Other possible threats related to climate change include the increasing frequency and intensity of **extreme weather events,** and **alterations to key invertebrate prey** life cycles[103]. Research on other species highlights the very serious implications of the latter (see Hudsonian Godwit species account).

Russia Expansion of cropping is occurring on *alboaxillaris* breeding grounds in the **Lower Volga Steppe**[42], as too is **commercial forestry**. Both forms of land use can replace, degrade and fragment open breeding habitats[174,42]. The scale and intensity of **livestock farming** is increasing in parts of **Western Siberia** (e.g. domestic reindeer *Rangifer tarandus* herds) and the **Lower Volga Steppe**, deteriorating breeding habitats and increasing nest tramping[42]. Further fragmentation is thought to be occurring due to increasing transportation and service corridors in the region, which is also occurring in **Western Siberia**[42,174]. There are potentially unintentional side effects from the hunting of other species. **Hunting of Arctic Foxes** *Vulpes lagopus* for fur in **Russia** has declined in recent decades, potentially increasing fox densities across the breeding ranges of *rogachevae*, *variegatus* and *alboaxillaris*[42]. However, the impact is uncertain; foxes undergo large natural population fluctuations (primarily in response to lemming population fluctuations[236]) and with the end of hunting came the end of fox population estimates (they were derived from hunting bags) so there is no data to support these supposed increases[58]. D**isturbance** by humans is thought to be increasing in several breeding areas, and impacting on *alboaxillaris* birds in the **Lower Volga Steppe**[42]. Lastly, a proposed hydroelectric dam in the **Tunguska River** area in Russia could result in direct loss of *rogachevae* lowland breeding grounds[42].

Europe The scale and intensity of **livestock farming** is increasing in many parts of **Eastern and Northern Europe. Intensification of grassland** management practices (e.g. drainage, reseeding, frequent and earlier mowing of grasslands) degrades nesting habitat and can increase nest tramping[42]. Future threats include large-scale **wind farm developments** in core *phaeopus* breeding areas in northern Europe[175].

THREATS ON NON-BREEDING GROUNDS

Asia For *variegatus* birds, the widespread loss, degradation and fragmentation of coastal habitats in the Yellow Sea is the key threat on their non-breeding grounds. For full details on coastal habitat loss in the region, please see the Bar-tailed Godwit species account. Hunting of *variegatus* birds is thought to be declining at the Inner Gulf of Thailand, a site of international importance[149].

Europe, North and West Africa *Phaeopus* and *islandicus* birds are **legally harvested** on migration through France and on non-breeding grounds in West Africa, where the threat is currently limited, but this may increase in future. Whilst estimates are available for the annual harvest in France[239], the overall impact of **hunting** along the flyway is largely unknown[38]. Coastal habitats in West Africa are under pressure, particularly intertidal flats and adjacent mangroves near urban areas, where **disturbance** on mudflats and roost sites may be more important than actual habitat loss at present[178]. At some important staging sites in the U.K., foraging pastures have been ploughed out whilst many more have been affected by drainage and the addition of fertiliser during the early spring period. Whimbrel usage of such fields has markedly declined. Possible reasons include a direct **reduction in invertebrate prey**, difficulties in accessing prey due to dense, tall swards, or invertebrate prey occurring at soil depths outwith the reach of foraging whimbrel (i.e. before the drainage higher water tables kept invertebrates nearer the surface)[179]. Important pastures for foraging have been lost to similar changing agricultural practices in the Netherlands, namely the shift from grassland foraging habitat to maize[177,178] and possibly through the spraying of insecticides, which may reduce important invertebrate prey[178]. **Invasive non-native species** are impacting on the quality of *phaeopus* and *islandicus* wintering habitat: in the German Wadden Sea, Pacific Oysters *Crassostrea gigas* are overgrowing on Blue Mussel *Mytilus edulis* beds, altering food resources for mussel-feeding birds[40]. Drilling for **oil and gas drilling** can impact on sites in several ways: **natural gas extraction** in Germany has been shown to cause soil subsidence and subsequently reduce wader foraging habitat, whilst **oil spills** are always a potential threat[40]. Loss of coastal habitats to **urban development** is also occurring at staging sites in the German Wadden Sea[40]. Pollution of intertidal ecosystems is occurring across the non-breeding range in West Africa. Potential **climate change**-related threats include **changing water regimes**, the loss of intertidal and supratidal habitats due to **sea level rise** in places such as the Wadden Sea[40], and the flooding out of roost sites, already occurring in some areas[179]. The impact of ocean acidification may impact on prey communities, which has implications for all species that use intertidal habitats[176,203,204,205,206,207,208] and indeed all Numeniini species.

Americas **Hunting** is a major threat to both American subspecies during migration**.** *Hudsonicus* birds are illegally shot in Canada to protect Blueberry *Vaccinium corymbosum* and Partridge Berry *Mitchella repens* crops[103]. With recent satellite-tagging studies confirming they migrate to stage in Atlantic Canada, this threat equally applies to *rufiventris* birds[103]. Hunting also occurs in the **Caribbean** and in **Mexico**[37]. Loss and fragmentation of coastal habitats due to expanding **urban developments** is occurring along coastal sites in Central and South America (e.g. Chiloe Island and adjacent mainland, **Chile**)[176] as well as on *hudsonicus* staging sites in Canada[103]. Further loss and fragmentation is being caused by expanding **marine and freshwater aquaculture** developments, with their associated onshore infrastructure and increased levels of disturbance[176]. **Fishing and harvesting** of aquatic resources (e.g. farming and harvesting of agar-producing algae species in Chile) can deplete prey resources and increase **disturbance** by humans, vehicles and dogs[176]. However, benefits can also accrue: *rufiventris* birds roost on shellfish floats off Chiloé Island[180] and increased algae cover may increase important invertebrate prey[176]. **Invasive non-native species** and **pollution** of intertidal habitats are degrading the quality of non-breeding sites by altering abundance of, and access to, food resources[40]. Feral dogs *Canis lupus familiaris* are considered to be disturbing *hudsonicus* birds at certain non-breeding sites[37]. **Wind and solar farms** are increasing along the *rufiventris* and *variegatus* migration corridor; work in other regions has suggested wind farms can impact through both direct collision and the 'barrier' effect[40].

CONSERVATION

Current conservation A Western Hemisphere Shorebird Reserve Network (WSHRN) plan for the American subspecies has been produced. Satellite tracking of *rufiventris* birds is currently being undertaken by the Centre for Conservation Biology, USA.

Population	*rufiventris*	*hudsonicus*	*islandicus*	*phaeopus*	*alboaxillaris, variegatus* & *rogachevae*
Conservation priorities	1. **Maintain 'bird-friendly' agricultural habitats** in Central Valley and Imperial Valley, California, USA. 2. **Protect important mangroves** used as staging and wintering sites 3. **Maintain coastal wetlands** in Peru. 4. Work to **preserve intertidal and roost areas** on Isla Chiloé, Chile. 5. **Reduce hunting** during migration (e.g. in Atlantic Canada, Mexico, French Guiana, Saint-Pierre et Miquelon and the French Antilles)	1. **Reduce hunting** on breeding and staging grounds. 2. **Protect and manage** important staging/stopover sites along mid-Atlantic wetlands. 3. **Protect important mangroves** used as staging and wintering sites.	1. Ensure **landscape planning** reduces the impact of **development** on important breeding grounds e.g. afforestation, summer house construction. 2. Ensure adequate **site protection** of breeding sites in UK.	1. Ensure adequate **protection of spring passage sites** (also breeding sites for curlew and continental black-tailed godwit).	1. **Save and protect the key staging sites** – likely to be Yellow River (Huang He) delta, China and Asan Bay, South Korea. 2. **Limit/stop hunting** at key sites along the migration route, once they have been identified (poisoned crabs are put out on tidal flats in China for all curlew species). 3. These subspecies will likely benefit from the **improved fisheries management** suggested for other species in the review.

Population	***rufiventris***	***hudsonicus***	***islandicus***	***phaeopus***	***alboaxillaris, variegatus* & *rogachevae***
Research priorities	1. Implement **enhanced monitoring** program on non-breeding grounds. 2. **Identify subspecies** in Colombia and Venezuela. 3. Undertake **connectivity studies** of central Canadian arctic breeding areas.	1. **Identify** and maintain non-breeding grounds.	The research priorities for ***islandicus*** and European ***phaeopus*** birds are considered together, as they refer to shared non-breeding habitat: 1. Work towards gaining a more **reliable estimate of the *islandicus* population size** (by improved estimates of breeding population in Iceland and non-breeding population in mangroves in West Africa[225]) and *phaeopus.* 2. Analyse **the impact of hunting in France** on juvenile and adult survival for both subspecies. 3. Enhance understanding of **habitat use at stopover sites and migratory routes** through tracking studies. 4. Enhance understanding of **spring passage dynamics and trends in Western Europe**, and underlying causes for decline. 5. Investigate **habitat use** in Africa, specifically change in food resources and exploitability (including role of disturbance).		1. Gain more accurate **information on population numbers and trends.** 2. Undertake **migration studies**, especially through satellite-tagging, to **identify migratory routes** and **key stop-over sites**. 3. Undertake **basic ecological research** to identify the drivers of population decline.

4. Little Curlew
Numenius minutus (Gould, 1841)

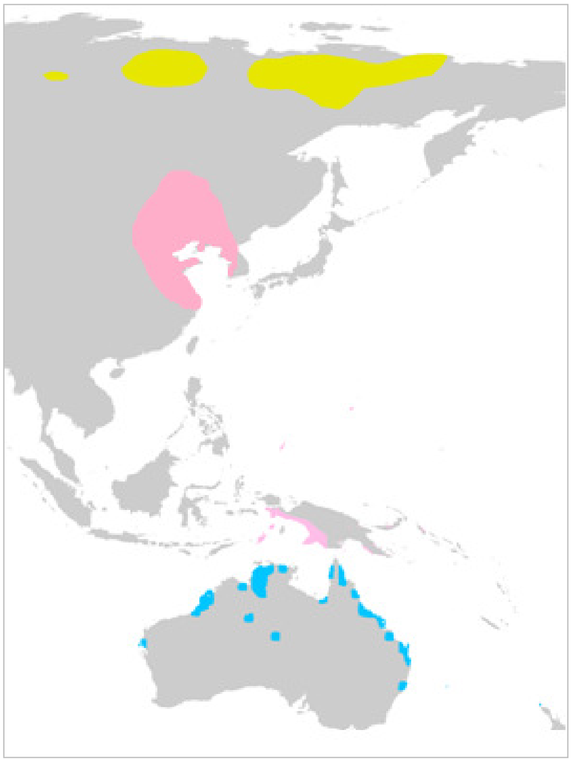
Image courtesy of Richard Porter

IUCN Status: Least Concern (LC)
The population trend for this species is largely unknown, but expert opinion is that it may be declining, but there is insufficient data to verify this[5]. Little Curlew are endemic to the East Asian Australasian Flyway (EAAF).

CMS Status: Appendix II

Taxonomy
Monotypic species. Little Curlew are closely related to the Eskimo Curlew and share considerable morphological (and probably behavioural) traits.

Life cycle, distribution and ecology
Breeding breeds from late-May to early August in Eastern Siberia, in loose colonies which are scattered and separated by hundreds of kilometres[57]. Breeding sites are chiefly along river valleys[8,11] or on well-drained[57] southward-facing mountain slopes[10], within secondary vegetation growth in open burnt areas or in grassy clearing within northern montane larch and dwarf birch woodland[57].



Key[232]: Breeding Season, Non-breeding Season, Passage

Non-breeding: southbound migration is initially overland across Siberian steppes in Transbaikalia, Russia, northern China and eastern Mongolia[58,59] where flocks of 4-300 birds forage for terrestrial invertebrates in dry steppe and aquatic invertebrates on lake shores and riverbanks[220]. An important staging region appears to be the marshlands that span the border of Russia, China and Mongolia; emerging data from three satellite-tagged birds found all three staged in this region for some weeks. Two of these birds subsequently flew non-stop to Australia during southbound migration[74]. However, birds are also known to migrate further overland through the steppes of Mongolia and China, onwards towards the west coast of the Yellow and East China Seas[60,62] before reaching Australia.

During northward migration, most birds depart Australia during late-March/early-April[65,66,67]. Migration routes are not well understood, however they have been recorded in Lombok, Japan[68], the Philippines and Indonesia[69] and large numbers have been recorded at Yellow River (Huang He) delta[70,62,72], the Chongming Dao (an island in the Yangtze estuary[66]) and the Luan He region[66], all in China. Satellite transmitters suggest that passage birds use agricultural lands in the Philippines and

China when making stopovers[74], and short grasslands appear to be a key habitat. On passage they also use swampy meadows near lakes and along river valleys[10], reed (*Phragmites*) farms with stubble or short new growth in spring, arable farmland such as maize stubbles and recently planted maize, and airfields[153]. They also utilise urban grasslands[75,78,67].

There is little information from other non-breeding areas, so it is unclear whether the Australian population constitutes 100% of population or, as is more likely, the majority of the wintering population[74]. Habitats include a variety of grasslands, including dry floodplains[76,77,78,65] as well as swamps, meadows, mudflats and drying and dry lakebeds[79], cultivated soils, dry mudflats[11], coastal plains of black soil[9] with scattered shallow pools of freshwater[69]. Occasionally, dry saltmarshes, coastal swamps, mudflats or sandflats in estuaries and beaches of sheltered coasts are used[69]. They are known to make erratic movements in response to rainfall[11].

POPULATION ESTIMATES

Size **180,000**[1,80,81,82]

Trend **POSSIBLY DECLINING**[42]

DEMOGRAPHIC TRENDS

Nesting success **UNKNOWN**

Fledging success **UNKNOWN**

1st Year survival **UNKNOWN**

Adult survival **UNKNOWN**

INTERNATIONAL RESPONSIBILITY

Breeding Russia.

Non-breeding Australia, China, East Timor, Mongolia, New Guinea & Philippines.

THREATS ON BREEDING GROUNDS

Russia Relatively little is known about threats on breeding grounds, but for a species that breeds relatively close to human settlements, increased levels of hunting are likely to be having an impact, as has been reported in the Daursky Reserve region in Russia[83]. The possibility of future oil and gas exploration in the region is a potential threat[42].

THREATS DURING MIGRATION

East Asia **Changing agricultural practices** could impact on this species. Little Curlew appear highly dependent on short swards typically found on grazed pastures and stubble fields. Therefore any expansion of polytunnels could replace, fragment and degrade stopover sites[74,83] whilst increased planting of winter wheat in areas where maize stubbles would previously have been left until late spring could have implications for foraging habitat during migration[153]. Other threats to stopover sites include increasing **residential and commercial** developments, **oil, gas and renewable** energy developments, drainage and water abstraction, and increasing levels of **human disturbance** at roosting and feeding sites[42]. Another potential/future threat is the **drying out of important stopover sites** in Mongolia, as a result of climate change[219].

THREATS ON NON-BREEDING GROUNDS

Australia A rapidly increasing threat to native grasslands and freshwater wetlands in Queensland and parts of the Northern Territory, Australia is the encroachment of **invasive non-native species**[75] and 'woody weeds'[83] which are modifying Little Curlew habitats. Kakadu National Park is particularly vulnerable to the impacts of **climate change**, with freshwater wetlands at serious risk from saltwater intrusion resulting from rising sea levels[84]. Ephemeral wetlands are an important habitat in the Channel Country, Queensland, Australia[79] being used for drinking and temperature control[65,76] and loss of shallow wetlands due to climate change is a threat[64]. Loss of freshwater habitats will also have an impact on plant communities, such as wild rice which Little Curlew feed on[85]. In recent decades, changes in burning regimes impacted on the composition of plant communities within the floodplains of Kakadu National Park[86]. It is likely these impacted on the quality of Little Curlew foraging habitat. However, the floodplains are now being managed again by centuries-old traditional practices. Long-term maintenance of these practices is essential[64]. Increased **grazing pressure** on native grasslands where Little Curlew forage e.g. Barkly Tableland, Northern Territory, Australia[77] may change the composition of plant and invertebrate communities that Little Curlew feed on[64].

CONSERVATION

Current conservation There are no conservation plans currently published for this species. In the past 30 years, the Australasian Wader Studies Group has caught over 1,400 Little Curlew, of which over 1,100 have been flagged. There have been no overseas sightings or recoveries, suggesting the species must migrate away from inhabited areas[74]. A small number of sightings/recoveries in north-west Australia have shown movements of up to 250km[74]. A satellite-tagging project has commenced (see 'Non-breeding' section for details).

Conservation priorities

1. **Save and protect as much of the Yellow River (Huang He) delta, China as possible** and ensure appropriate management for the waterbird assemblages is being undertaken.

2. Undertake **grassland management interventions**, informed by research (see below).

3. Undertake survey work to assess the marshlands used for staging on the Russian, Mongolian and Chinese border. This should include identifying habitat use, management practices in the area and an assessment of threats (e.g. hunting).

RESEARCH

Research priorities

1. Develop an **effective monitoring method** for what is a widely dispersed species on both its breeding and non-breeding grounds. This will assist towards obtaining reliable population and trend estimates.

2. Deploy further **satellite-tagging** technology so as to better understand migratory routes and important stopover and staging sites.

3. Informed by the satellite-tagging, undertake research on **habitat**

requirements, with an emphasis on grassland management in China and eastern Mongolia, and implications for breeding and post-breeding distribution. Identify best management practices for non-breeding areas.

5. Eskimo Curlew
Numenius borealis *(Forster, 1772)*

One of four known photographs of a living Eskimo Curlew, taken by Don Bleitz on Galveston Island, Texas in 1962

IUCN Status: Critically Endangered (Possibly Extinct) CR(PE)

Eskimo Curlews have not been recorded with certainty since 1963; and none have been confirmed on their non-breeding grounds since 1939. It was formally abundant, but declined rapidly over a century ago as a result of hunting and habitat loss. The latter included the near total loss of the prairies to agriculture, compounded by the suppression of prairie wildfires which provided preferred foraging habitats. However, it cannot yet be presumed extinct until all potential breeding areas have been surveyed, and the series of occasional unconfirmed sightings ceases [5,103].

CMS Status: Appendix I

Taxonomy

Monotypic species.

Life Cycle, distribution and ecology

Breeding: historically bred at Bathurst peninsula and Point Lake in the Northwest Territories, Canada[111] and possibly also in treeless arctic tundra habitat in Alaska.

Key[232]: Breeding Season, Non-breeding Season Passage

Non-breeding: birds migrated between July and October, crossing Hudson Bay to Labrador, Canada and New England, U.S., where it fed on ericaceous heath, pastures and intertidal mudflats. Birds then migrated through the Caribbean, onwards towards their non-breeding grounds. Their return migration took place between March and May, and likely involved flying along the Pacific Coast, through Central America, across the Gulf of Mexico to the Texas coast and then northwards to stage in the prairies of the Rocky Mountains, U.S. where it favoured burnt areas in tall grass and mixed-grass prairie. The now extinct Rocky Mountain locust *Melanoplus spretus* was a key food source[111].

Birds migrated south to Argentina, where the majority of birds were found in the pampas. They may also have spent the non-breeding season in Uruguay, Paraguay, southernmost Brazil and Chile.

POPULATION ESTIMATES

Size Any remaining population is assumed to be tiny, numbering fewer than 50 individuals. It probably numbered hundreds of thousands, but declined rapidly in the 1870s-1890s to become very rare in the 20th century[111,142]. The last irrefutable record was of a specimen collected in Barbados in 1963[143]. Since then there have been no confirmed records, and none from the non-breeding grounds in South America since 1939[111].

Trend Not applicable.

DEMOGRAPHIC TRENDS

Nesting success Not applicable.

Fledging success Not applicable.

1st Year survival Not applicable.

Adult survival Not applicable.

INTERNATIONAL RESPONSIBILITIES

Breeding Canada & (possibly) U.S.

Non-breeding Argentina, Barbados, Brazil, Canada, Chile, Mexico, Paraguay, Uruguay & U.S.

MAJOR THREATS

Across the historic range Current threats were not assessed in detail for Eskimo Curlew due to the high likelihood that the species is extinct. Historic threats included the large-scale spring hunting in North America, which at least partially explains the species' catastrophic population decline. However, there was no population recovery after hunting was outlawed and abandoned around 1916, suggesting other population-level threats were present[111]. The main cause is most likely to have been the near total loss of the prairies to agriculture, compounded by the suppression of prairie wildfires, a preferred foraging habitat, and the extinction of the Rocky Mountain Grasshopper *Melanoplus spretus*[111]. The widespread conversion of the pampas to agriculture began after the main decline, but likely hindered any possible recovery[111].

CONSERVATION AND RESEARCH

Current conservation In Canada, the Eskimo Curlew is designated as Endangered and listed on Schedule 1 of the *Species at Risk Act*. An Environment Canada species recovery plan recommends that no recovery action be undertaken other than continued monitoring of reported sightings[112]

In Canada, the Eskimo Curlew is designated as Endangered and listed on Schedule 1 of the *Species at Risk Act*. An Environment Canada species recovery plan recommends that no recovery action be undertaken other than continued monitoring of reported sightings[112].

Conservation priorities There are no conservation priorities for this species.

Research priorities There are no research priorities for this species.

6. Slender-billed Curlew
Numenius tenuirostris (*Vieillot, 1817*)

M. Brosselin

IUCN Status: Critically Endangered (CR)

In the 19th century, the Slender-billed Curlew was regarded as a very common bird in its Mediterranean non-breeding range, occurring in large flocks during migration and on its wintering grounds. However, by the 20th century it was already regarded as a rare bird. The reasons for this sharp decline are unclear, but a combination of habitat loss and hunting are likely to have been important. Sightings have become increasingly infrequent, and the last undisputed record was in Morocco in February 1995. No regular breeding, passage or wintering population are now known, and the population of any remaining individuals must be tiny. For these reasons the species qualifies as Critically Endangered[5].

Key[232]: Breeding Season, Non-breeding Season, Passage

CMS Status: Appendix I

Taxonomy

Monotypic species.

Life Cycle, Distribution and Ecology

Breeding: between 1909 and 1925, Slender-billed Curlews were recorded breeding near Tara, north of Omsk in southwest Siberia. These remain the only known records of the bird on its breeding grounds. Nests were observed in May, within bog-forest transition zones on the northern limit of the forest-steppe zone; within habitat more typical of taiga marsh[104,5]. It is unsure whether this area represented a highly specialised breeding habitat, or whether this was atypical breeding habitat at the limit of its breeding range[104].

Non-breeding: it is thought they migrated west-south-west from their breeding grounds, through central and eastern Europe before arriving on their wintering grounds, which have historically included southern Europe (Greece, Italy and Turkey) as well as North Africa (Algeria, Morocco and Tunisia). It has also been recorded in the Middle East. On migration and on its wintering grounds, it has been recorded in a variety of habitats, including saltmarsh, steppe grasslands, fishponds, saltpans, brackish lagoons, tidal mudflats, semi-desert and sandy farmland next to lagoons. Many wintering records came from large coastal wetland complexes, and these may be especially characteristic of its preferred wintering habitat[105].

POPULATION ESTIMATES

Size	Estimated at 1-49 individuals in 2012[5]
Trend	**STEEP DECLINE**

DEMOGRAPHIC TRENDS

Nesting success	**UNKNOWN**
Fledging success	**UNKNOWN**
1st Year survival	**UNKNOWN**
Adult survival	**UNKNOWN**

INTERNATIONAL RESPONSIBILITIES

Breeding Russia.

Non-breeding Albania, Algeria, Azerbaijan, Bulgaria, Croatia, Greece, Hungary, Iran, Iraq, Italy, Kazakhstan, Libya*, Macedonia, Montenegro, Morocco, Romania, Russia, Saudi Arabia, Serbia, Sudan*, Tunisia, Turkey, Ukraine, Uzbekistan & Yemen.

*unclear whether historic records of curlews in these countries were vagrants or not.

THREATS ON BREEDING GROUNDS

Russia **Shooting and trapping** are prevalent in the previously-known breeding range and have increased in recent years. **The impact of other** threats on potentially remaining breeding birds are not well understood, due to knowledge gaps in the species' breeding ecology. However it is known that large-scale **drainage and intensification of agriculture** have occurred in the area (though much apparently suitable breeding habitat remains).

THREATS ON NON-BREEDING GROUNDS

Europe, Africa and the Middle East **Hunting,** especially **accidental hunting** through confusion with other species, is a potential threat to any remaining birds, as too is the loss and degradation of wetlands and associated grasslands in the European Steppes, Mediterranean, North Africa and Middle East[141]. **Spraying of locusts** across Europe and North Africa may have reduced an important food source.

CONSERVATION & RESEARCH

Current conservation A Convention on Migratory Species (CMS) Memorandum of Understanding for the species came into effect in 1994, a working group was established in 1998[134] and an international action plan was published in 1996. National action plans are in place in Italy[135], Bulgaria and Ukraine. The most recent of several initiatives to locate the bird undertook surveys 2009-11 across the potential non-breeding range with a particular focus on wintering and potential moult sites[136,137,139,140].

Conservation Actions Proposed

Finding and confirming individuals of this species is a priority. A leaflet has been developed to assist people to identify and report Slender-billed Curlews in the field (available at: www.slenderbilledcurlew.net). The Slender-billed Curlew Working Group continues to receive reports of possible birds. If any potential birds are found, international teams remain in place to confirm identification, and to seek to catch and satellite tag any individuals that are confirmed.

Conservation priorities

1. Continue to solicit and react to reports of potential Slender-billed Curlews

2. Provide reactive advice to any future ornithological surveys or expeditions that include potential breeding, staging or non-breeding habitats.

3. Use the **functional extinction of the Slender-billed curlew** as a flagship to raise awareness of the pressing **conservation issues along the Black Sea – Mediterranean Flyway** and the wider **extinction potential of migratory waders,** and especially Numeniini species.

Research priorities

No research priorities were identified for this species - see above.

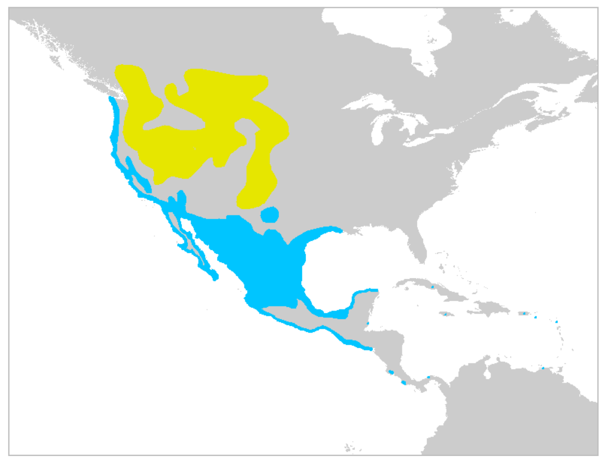
7. Long-billed Curlew
Numenius americanus (*Bechstein, 1812*)

The population appeared to have declined though the 1970s, with range contraction occurring throughout the 20th century leading to local extinction from Kansas, Michigan, Iowa, Minnesota, Wisconsin, eastern Nebraska, Illinois, Manitoba and south-east Saskatchewan[154]. In recent decades, Christmas Bird Count and Breeding Bird Survey data in Canada and the US indicate the population is stable[88], although regional declines (e.g. Idaho) have been recorded.

CMS Status: Appendix II

Image courtesy of Tom Grey

Taxonomy
Monotypic. 2 subspecies have previously been reported: *N. a. americanus* and *N. a. parvus.* Whilst *Waterbird Population Estimates 5* assesses them as separate populations, they are increasingly addressed together[88,154,155] and they have been assessed together in this review.



Key[232]: Breeding Season, Non-breeding Season, Passage

Life cycle, distribution and ecology
Breeding: breeds in the prairies of the Great Plains, the desert grasslands of the Great Basins and Columbia River Plateau, and the intermountain valleys of the Rocky Mountains and British Columbia[156]. Breeding habitat can vary from shortgrass to mixed-grass prairie, encompassing moist meadows to very dry grasslands[156,154,157].

Non-breeding: overwinters along the Pacific Coast, from California south through Central America, throughout Baja California, along the Gulf of Mexico and the interior of northern and central Mexico, especially within the Mexican Plateau[154]. There are casual records of wintering birds along the Atlantic coast of the U.S.[154]. Non-breeding habitats include agricultural lands (both dry grasslands and flooded fields)· as well as coastal and inland mudflats[158].

POPULATION ESTIMATES

Size	160,000[155]
Trend	**STABLE**[88,159,160]

DEMOGRAPHIC TRENDS

Nesting success	**UNKNOWN/ VARIABLE**[161]
Fledging success	**UNKNOWN**
1st Year survival	**UNKNOWN**
Adult survival	**UNKNOWN**

INTERNATIONAL RESPONSIBILITIES

Breeding Canada & U.S.

Non-breeding Canada, Costa Rica, El Salvador, Guatemala, Honduras, Mexico & U.S.

MAJOR THREATS ON BREEDING GROUNDS

Canada & U.S. In the absence of native large herbivores, **livestock farming and ranching** are critical in maintaining short-grass prairie breeding habitat[162]. The conversion of native prairie to cropping (especially corn production) and financial cuts to the Conservation Reserve Program (CRP) are therefore large threats[161,162,103]. New and expanding **suburban settlements, wind farms, strip mining for coal, oil wells and gas developments** are fragmenting breeding areas[161,103]**.** Degradation of breeding habitats also occurs, as many of these developments act as a source of **invasive non-native plant species**[161,103]. Additional fragmentation occurs due to an expanding network of **roads and powerlines,** which act as perches for avian predators[161]. **Human disturbance** is increasing, predominately through the large-scale oil and gas developments[161]. **Illegal hunting** on breeding grounds in Idaho has been recorded[161]. **Water diversion** for cities is a potential problem in areas where urban populations are increasing, such as in Las Vegas, U.S.[161]. An increasing number of pollutants are entering breeding habitats, including **pesticides** used for grasshopper control and toxins from mining, however their impact is not known[162,103]. Climate change represents an increasingly important potential/future threat, with the anticipated changes to natural weather patterns i.e. increasing frequency and severity of floods, droughts and temperature extremes[161].

THREATS ON NON-BREEDING GROUNDS

U.S. & Central America Increases in **residential and commercial developments** have occurred across staging and wintering regions in both coastal and inland areas[162] and are leading to increased levels of disturbance. **Oil and gas production**, including fracking, have increased at stopover sites, including the front range of the Rockies[162]. The recent expansion of **solar and wind farms** along migratory routes are likely to be having an impact[162]. Increasing **transportation corridors** are further fragmenting habitats[162]. **Invasive non-native plant species** (e.g. *Spartina alternaflora*) are encroaching on a range of non-breeding habitats, including interior grasslands and estuarine sites[162]. **Rising sea levels**, as a consequence of climate change, threaten coastal wintering areas[162] whilst increasing **droughts** in western U.S. and Mexico could alter the landscape features favored by curlews e.g. water becoming less available for flooded rice and alfalfa fields[162].

CONSERVATION

Current conservation A conservation plan has been produced[154]. The conservation plan includes a conservation action plan, available as a standalone document[163].

Conservation priorities 1. On breeding grounds, **manage shortgrass prairie** through appropriate management techniques.

2. On wintering grounds, **protect grassland in northern Mexico** high plateau through maintenance of 'bird-friendly' agricultural systems.

3. Maintain 'bird-friendly' agricultural techniques that create important habitat used during staging and overwintering in Central Valley, California, the Texas Panhandle and in Mexico.

RESEARCH

Research priorities

1. Identify optimum **habitat management practices on breeding grounds.**

2. Assess the taxonomic status of the two populations (which were previously regarded as subspecies *N. a. americanus* and *N. a. parvus*).

8. Eurasian Curlew
Numenius arquata (Linnaeus, 1758)

Niall Benvie (rspb-images.com

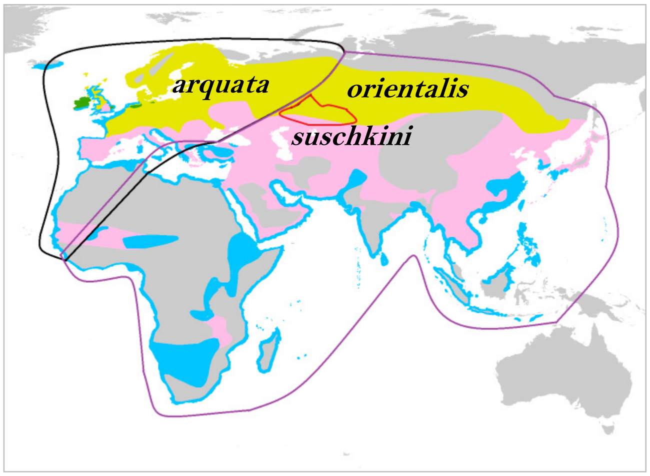
IUCN Status: Near Threatened (NT)
The population is declining: breeding population and range declines have now been recorded in several important countries. Overall, a moderately rapid global decline is estimated[5].

CMS Status: Appendix II

Taxonomy
Three subspecies are recognised:

- *N. a. arquata* is the most numerous subspecies and breeds across northern Europe as far east as the Ural Mountains, Russia. It spends the non-breeding season in Northwest Europe, the Mediterranean and West Africa.

- *N. a. orientalis* breeds from the Ural Mountains to east of Lake Baikal, Russia. The breeding range overlaps with *arquata*, and there is probably a broad zone of inter-gradation between the two subspecies across the Urals[113]. Three populations are listed in Waterbird Population Estimates 5, but for the purposes of this review they are assessed together, as a) the divide between breeding birds that migrate west/south-west and those that migrate east/south-east is not well known.
- *N. a. suschkini* has a breeding range confined to the steppes of Kazakhstan and Russia[113]. It's non-breeding range is poorly understood.



Key[232]: Resident, Breeding Season, Non-breeding Season, Passage

Life cycle, distribution and ecology
Breeding: breeds from April to August in a variety of habitats including upland moors and adjacent enclosed grasslands, peat bogs, swampy and dry heathlands, fens, open grassy or boggy areas in forests, damp grasslands, meadows[11], lowland wet grasslands, dune valleys and coastal marshlands[11].

Non-breeding: Migration starts in July. Large populations congregate along the coasts of the Wadden Sea, the British Isles, France, the Mediterranean coast, NW Africa and the Middle East. A variety of coastal habitats are used, including intertidal mudflats and coastal farmland. Some populations also overwinter at inland sites.

POPULATION ESTIMATES

Population	*arquata*	*orientalis*	*suschkini*
Size	700,000 – 1,000,000[116,2]	25,000 – 100,000[48,114]	1 – 10,000[22]
Trend	DECLINING[123,124]	DECLINE?	UNKNOWN

DEMOGRAPHIC TRENDS

Nesting success	DECLINING[117,118,119,120]	?	?
Fledging success	DECLINING[117,118,119,120]	?	?
1st Year survival	INCREASING[121]	?	?
Adult survival	INCREASING[121]	?	?

INTERNATIONAL RESPONSIBILITIES

Breeding	Austria, Belarus, Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Lithuania, Netherlands, Norway, Poland, Russia, Sweden & U.K.	Russia & Mongolia.	Kazakhstan & Russia.
Non-breeding	Austria, Belgium, Denmark, France, Germany, Greece, Guinea-Bissau, Hungary, Iceland, Ireland, Italy, Mauritania, Netherlands, Norway, Portugal, Romania, Spain, Switzerland, Tunisia & U.K.	China, Cyprus, Greece, India, Indonesia, Iran, Iraq, Japan, Kuwait, Malaysia, North Korea, Oman, Philippines, Russia, Saudi Arabia, South Korea, Taiwan, Thailand, UAE & Vietnam.	The non-breeding range of *suschkini* is largely unknown, but is thought to include Africa. Birds have also been recorded in Sri Lanka[235] and the Netherlands[234].

THREATS ON BREEDING GROUNDS

Eurasia

On *arquata* breeding grounds in Europe, several studies have shown high levels of nest and chick predation by native predators are the proximate cause of population declines, whilst **introduced mammals** (e.g. Racoon *Procyon lotor*, Racoon Dog *Nyctereutes procyonoides*) are also having an impact in some areas[117,118, 119,120]. Changes to pastoral farming systems, including the large-scale **drainage** and **intensification of grassland management** across many parts of Europe, has led to the loss, degradation and fragmentation of breeding habitats, whilst farming operations (e.g. rolling and cutting of grasslands, trampling by livestock) can destroy nests and chicks during the breeding season[117,119]. **Land abandonment** is leading to rank grassland and scrub formation in parts of eastern Europe, northern European Russia and Siberia, and can lead to direct loss of previously suitable breeding habitat[123]. **Afforestation** of predominately open landscapes has been shown to have an impact on some important *arquata* populations (e.g. UK) [122] and may also pose a future threat in parts of the *orientalis* and *suschkini* breeding range. The scale and intensity of **arable crop management** is increasing in the *suschkini* breeding range and is thought to be having a detrimental impact here, and in other areas where curlews nest in arable crops[38,42]. Increasing **residential and commercial developments** are likely to be impacting on *orientalis* breeding populations in parts of Siberia, whilst so too is the expansion of **oil and gas drilling** in western Siberia[42]. Increasing **transportation and service corridors,** though local**,** are occurring in many breeding areas and are likely to be having a cumulative impact[42]. **Human disturbance,** again though local, is impacting on all subspecies and is likely to be having a cumulative population-level impact. Increased levels of **hunting** in Russia are likely to impact on *orientalis* and *suschkini* breeding populations. Prescribed burning of grasslands to improve foraging conditions for livestock is thought to be increasing on *orientalis* and *suschkini* breeding grounds, and this could be having a negative impact if undertaken on a sufficient scale during the breeding season[42]. Inappropriately-sited **wind farms** can reduce the suitability of breeding habitat: research from an upland site in Scotland, U.K. found that curlews demonstrated clear turbine avoidance[213], whilst research at a lowland site in Germany found no evidence of **wind turbines** on the population trend of the study population, concluding that site fidelity and agricultural practices were more important factors (but there was weak evidence suggesting turbines had a displacement effect up to 100 metres[214]). Projected increases in the frequency and intensity of extreme weather events, arising from **climate change,** are poorly understood but likely to pose a future threat.

THREATS ON NON-BREEDING GROUNDS

Europe & Africa

For *arquata*, key threats include changes to **agricultural grasslands** which provide important foraging habitats when near to roost sites. **Shellfisheries** have been shown to have a negative impact on foraging grounds due to **disturbance** and, in the case of **dredging** activities, disrupting key food resources i.e. invertebrate communities[121]. **Sea level rise**, as a result of **climate change**, is a potential threat in important wintering areas, where successionary intertidal habitats cannot be created due to existing flood defence infrastructure. **Oil and gas drilling** represents a threat, particularly should oil spills occur near important wintering grounds. The impact of pollution on wintering grounds in North Africa is not well understood.

Middle East

Coastal sites in the Middle East are also under threat from fragmentation due to increasing residential and commercial development, drilling for oil and gas and associated inshore infrastructure, and aquaculture developments. All are leading to increased levels of disturbance of feeding and roosting birds at coastal sites[42].

East Asia

For the *orientalis* population that winters in East and South-East Asia, the widespread loss, degradation and fragmentation of coastal habitats represents the largest threat. This is particularly the case along the coast of the Yellow Sea where large numbers of curlew use certain key sites[153] e.g. 13% of the flyway population at Yalu Jiang National Nature Reserve, Liaoning, China[201]. For full details on habitat loss in the region, please refer to the Bar-tailed Godwit species account.

CONSERVATION

Current conservation

An international conservation plan is being developed under the African-Eurasian Waterbird Agreement (AEWA)[123].

CONSERVATION

Population	*arquata*	*orientalis*	*suschkini*
Conservation priorities	1. **Protect nature reserves** and **restore wetlands** for the establishment and protection of breeding populations (through hydrological and grazing management) 2. Ensure wider countryside management policy delivers for the species e.g. the EU Common Agricultural Policy, Agri-Environment Schemes (e.g. through the reduction of fertiliser inputs, stop vaccinating Red Fox *Vulpes vulpes* for rabies, keep cattle outdoors) 3. Ensure landscape planning is co-ordinated and strategic to **safeguard important breeding grounds** (e.g. avoid new forestry or wind farms in core breeding areas through awareness raising with landowners, planners, etc.)	1. Protect staging and other important non-breeding sites from **further reclamation** and other threats, and appropriately manage as much as possible of the remaining habitat at Yalu Jiang, National Nature Reserve, Liaoning, China. 2. **Effective management of shellfish fisheries** at key sites for the benefit of all shorebirds. 3. **Limit/stop hunting** at key sites along the migration route (e.g. poisoned crabs are put out on tidal flats in China for all curlew species).	1. **Effective management of shellfish fisheries** at key sites for the benefit of all shorebirds. 2. **Limit/stop hunting** at key sites along the migration route.

RESEARCH

Research priorities	1. Improve impact of **agri-environment scheme delivery** (through tailored management options for curlew, targeting options in important breeding populations, and improving uptake. The latter includes wider socio-economic research about drivers of agri-environment scheme uptake) 2. **Identify methods of reducing the impact of predation** (e.g. habitat management to reduce predator densities, disease, the impact of apex predator on mesopredators). 3. Investigate the **effects of pollution on breeding grounds and on non-breeding grounds.**	Research priorities for ***orientalis*** and ***suschkini*** are considered together: 1. **Identify population numbers** and trends. 2. Undertake **migration studies using satellite-tagging** to identify routes and key stop-over sites. 3. Undertake **basic ecological research** to identify the drivers of population decline. 4. Undertake basic biological and taxonomic studies to further knowledge of the status of the *suschkini* subspecies.

9. Far Eastern Curlew
Numenius madagascariensis
(Linnaeus, 1766)

Image courtesy of Richard Porter

IUCN Status: Vulnerable (VU)
The population is undergoing a rapid population decline, which is suspected to have been primarily driven by habitat loss and deterioration in its Yellow Sea staging areas. Further proposed reclamation projects are predicted to cause additional declines in the future[5]. Far Eastern Curlew is endemic to the East Asian-Australasian Flyway. There are concerns that the small population size is an overestimate, and its IUCN status may warrant uplisting to Endangered in the near future[3].

CMS Status: Appendix I

Taxonomy
Monotypic species. There appear to be several disjunct breeding populations.

Life cycle, distribution and ecology
Breeding: Largest migratory shorebird in the world. Breeds from the upper reaches of the Nizhnyaya Tunguska river east though the Verkhoyarsk mountains to Kamchatka, and south to Primorye. Small colonies breed from early May to late June in open mossy or transitional bogs, moss-lichen bogs, wet meadows and swampy shores of small lakes.

Key[232]: Breeding Season, Non-breeding Season, Passage

Non-breeding: Recent analysis of band recoveries and flag resightings[229] and from geolocators[216] suggest quite consistent migration strategies from southern Australia, including direct flights from southern Australia to the Yellow Sea on northwards migration, and direct flights from the Yellow Sea to Australia on southwards migration, with some birds staging on the shores of northern Australia. The Yellow Sea of North Korea, South Korea and China is a particularly important staging site, with the greatest numbers occurring at Yalu Jiang National Nature Reserve, Liaoning, China; where 34% of the population stage[201].

The vast majority (>70%) of the population migrate onwards into Australia, with smaller numbers (~25%) in the Philippines, Indonesia, Papua New Guinea. Smaller numbers still visit New Zealand. Immature birds may remain year-round on non-breeding grounds until their third year[74]. During the non-breeding season it is essentially a coastal wader, occurring at estuaries, mangrove swamps, saltmarshes and intertidal mudflats, especially those with extensive seagrass *Zosteraceae spp.* meadows[11].

POPULATION ESTIMATES

Size 32,000 individuals[107]. There are concerns that this is an overestimate, and the population may not exceed 20,000[3].

Trend **DECLINING**[15,108,73,186,187,228.]

DEMOGRAPHIC TRENDS

Nesting success UNKNOWN

Fledging success UNKNOWN

1st Year survival UNKNOWN

Adult survival UNKNOWN

INTERNATIONAL RESPONSIBILITIES

Breeding China & Russia.

Non-breeding Australia, China, Indonesia, Japan, Malaysia, New Zealand, North Korea, Papua New Guinea, Philippines, South Korea & Thailand.

THREATS ON BREEDING GROUNDS

Russia and China In southern parts of the breeding range, both **arable and livestock farming** are increasing, and this thought to be degrading breeding habitats[42]. The burning of grasslands is an important land management practice in this area too. Anecdotal evidence at one breeding site suggests curlews preferentially nest within recently-burned grasslands, with high nest success recorded. After nesting, chicks are frequently observed foraging in nearby swamps and sedge meadows, suggesting a mosaic of unburnt grassland, burnt grasslands and wetlands is important. However, burning can also have a devastating impact on breeding success if undertaken during the nesting period: one study to the south of the Amur region recorded 28% of nests destroyed by fires[233]. The timing of burning is therefore of critical importance. The impact of regular burning on invertebrate food resources is not well understood[224]. In several breeding areas, increasing levels of **human disturbance**[42] could reduce breeding success; Far Eastern Curlews are extremely 'wary' birds and are particularly susceptible to human disturbance[231]. In the Amur River basin, there are examples of hydroelectric scheme dams inundating nesting areas e.g. the Zea reservoir in the 1970s[224] and further dams in the future could destroy other breeding areas. The impacts of **climate change** may have an impact on breeding grounds in the future e.g. more regular drying out of wetlands used for foraging[42]. Lastly, **hunting,** including instances of Far Eastern Curlew being mistaken for Whimbrel, occurs at an unknown level but is not thought to be having a population-level impact[110].

THREATS DURING MIGRATION

East Asia The Yellow Sea is a critical staging area during southward and northward migrations, where Far Eastern Curlew stage for around 5 weeks. These staging areas are threatened from the current loss and fragmentation of intertidal habitats occurring through **land claim** of the intertidal zone to enable the construction of new and expanding **human settlements**, **tidal energy developments**, **oil and gas developments** and **transportation and service corridors**[4,18,19,20,21,22]. The **damming of major rivers**, which combined with upstream **water extraction**, reduces silt discharge to the extent of reversing the process of intertidal mudflat formation: the shoreline is receding in some areas. Changes in the seasonality and quality of freshwater discharge are also occurring[4,18,23,24,25,19]. Expanding **aquaculture** along the intertidal zone (aquaculture cages, fish ponds, seaweed farming on racks and salt farms) further replaces and fragments intertidal habitats[4,26,27] whilst the **harvesting of aquatic resources**, both through the mechanised harvesting of intertidal invertebrates and through harvesting by hand of large polychaetes, is reducing prey abundance[27,4,153]. Poisoned crabs are put out on tidal flats in China for all curlew species[153]. The above developments are associated with increases in a wide range of **pollutants,** including from agricultural run-off (fertiliser, pesticides, herbicides), aquaculture (antibiotics), industry (phosphate, hydrocarbons, heavy metals, DDT in anti-fouling paint[195]), domestic (wastewater, sewage), oil spills and plastics, which can lead to direct mortality, reduced fitness and reduced prey availability[4,28,29,30,31,32,19]. The above threats, combined with recreational activities, result in high levels of **human disturbance** at feeding and roosting sites[27,4]. The **global shipping trade** provides an inadvertent source of **invasive non-native species** (e.g. Zebra Mussels *Dreissena polymorpha*) which combined with deliberately introduced species (e.g. *Spartina spp.*) can outcompete native species and change the composition and structure of intertidal communities and habitats[27,4,33,34]. Many additional threats could arise from **climate change**. Projected sea-level rise could further reduce the extent of intertidal habitats, whilst coastal defences impede the formation of new intertidal zone. Increasing frequency and severity of tropical cyclones and floods could lead to further loss of intertidal zones. Lastly, increasing temperatures could lead to a seasonal mismatch between migration times and peak food abundances[4,35,36], whilst climate change can result in prey items suffering from reduced recruitment[198], reduced growth rates[199] and potential population collapse due to parasites[200].

THREATS ON NON-BREEDING GROUNDS

Australia The sex ratio of curlews in Victoria, Australia is strongly skewed: 63% of the population are female[230]. If the sex ratio is equal, as would be expected in a monogamous species, then it is likely that males predominate at other non-breeding sites[227]. Habitat loss on non-breeding grounds could therefore have disproportionate effects on Eastern Curlew, if they impacted one sex much more than the other[227]. **Disturbance** and **development** near wetland sites in Victoria, Australia may especially impact on females, who typically migrate further south than males[3]. This threat is especially important when considering Eastern Curlew are a notoriously wary wader[231]. Localised **seagrass losses**, due to unknown causes, are associated with local declines in several avian species including Eastern Curlew, but unlikely to impact at population level[110].

CONSERVATION

Current conservation Far Eastern Curlew have been identified as a priority for conservation action species in the WWF Hong Kong East-Asian Australasian flyway prioritisation report, on the basis of small population size, declines and the fact it is endemic to the flyway[3]. Long-term (>30 years) annual monitoring of Eastern Curlew populations occurs at > 20 locations around Australia, organised by the Australasian Wader Studies Group. Eastern Curlew are included in *The Action Plan for Australian Birds 2010*[15]. The Victorian Wader Study Group has deployed geolocators on 23 Far Eastern Curlew. 8 have been retrieved, shedding light on migratory routes and timings[74,216]. Staff at the Kronotsky Nature Reserve, Russia intend to undertake studies relating to breeding ecology, breeding success, breeding density as well as deploying colour rings and geolocators[109].

Conservation priorities

1. **Protection** from further land claim, and other threats, and appropriately manage as much as possible of the remaining habitat at **Yalu Jiang National Nature Reserve, Liaoning, China**.

2. **Protection** from further land claim, and other threats, and appropriately manage as much as possible of the remaining habitat at the Yellow River (Huang He) delta.

3. Ensure effective management of **shellfish fisheries** and polychaetes harvesting at key sites for the benefit of all shorebirds.

4. **Limit/stop hunting** at key sites along the migration route (poisoned crabs are put out on tidal flats in China for all curlew species).

RESEARCH

Research priorities

1. Develop an effective **monitoring** method, for what is a widely dispersed species on both its breeding and non-breeding grounds, to obtain more reliable population and trend estimates.

2. Deploy **further satellite-tagging** technology to identify migratory routes and important stop-over sites.

3. Undertake basic ecological research to **identify the drivers of population decline**.

9. Bar-tailed Godwit
Limosa lapponica (Linnaeus, 1758)

Chris Knights (rspb-images.com)

IUCN Status: Least Concern (LC)
The Bar-tailed Godwit has an extremely large range and population trends vary across this range[2]. However, its status may soon be reviewed and uplisted to Near Threatened or Vulnerable based on observed declines across many parts of its range.

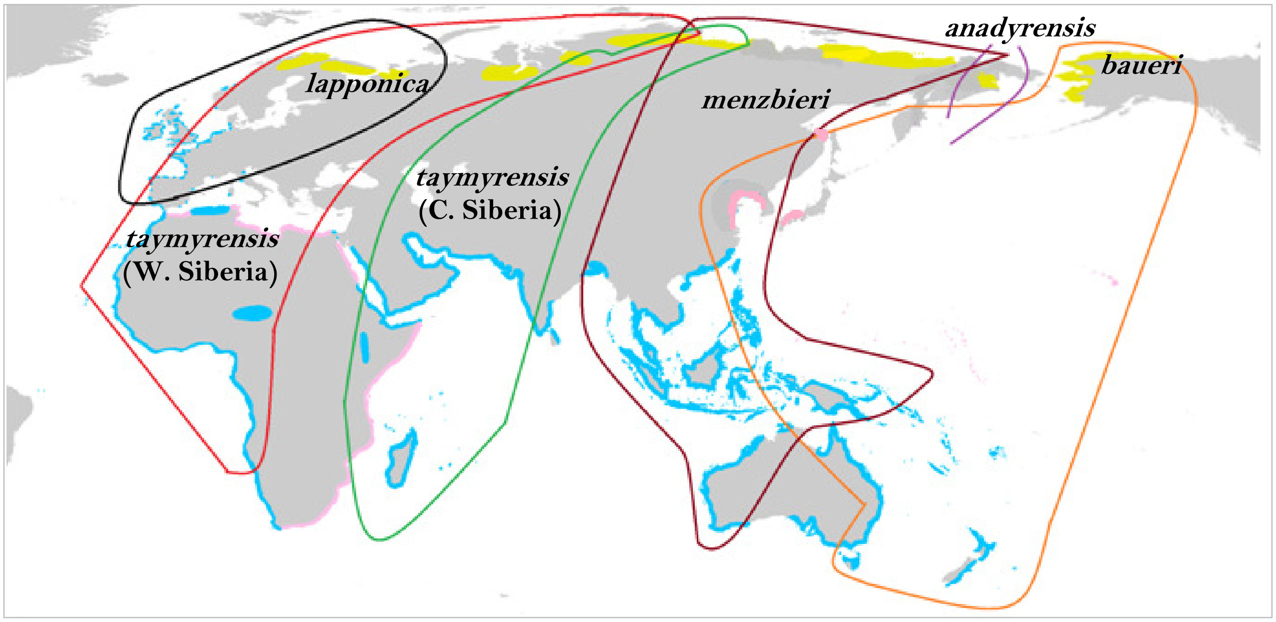
CMS Status: Appendix II

Taxonomy
Four subspecies are currently recognised, and a fifth has been proposed:

- *L. l. lapponica* breeds in northern Fennoscandia and northwest Russia. In winter, the population is concentrated in northwest Europe, but extends as far south as Iberia;
- *L. l. taymyrensis* breeds from the Yamal peninsula to the delta of the Anabar River, in western Siberia, and spends the non-breeding season along the coasts of West Africa, East Africa, the Middle East and northwest India. Birds stage during both northwards and southbound migration in the Wadden Sea[6]. Two biogeographic populations are recognised: one that breeds in Western Siberia and spends the non-breeding season in West & South-West Africa, and another that breeds in Central Siberia and overwinters in South Asia, South-West Asia and Eastern Africa. These are shown on the distribution map, but considered together in the rest of the text.
- *L. l. menzbieri* breeds to the east of the River Kolyma in northeast Siberia. Outwith the breeding season, the majority of birds are found in northwest Australia, but also in South-East Asia. Migrating birds stage for over one month during both southbound and northwards migration in western and northern parts of the Yellow Sea[7,];
- *L. l. baueri* breeds in coastal Alaska and spends the non-breeding season in New Zealand and eastern Australia. Migrating birds stage for over 1 month in the Yellow Sea region (especially the mouth of the Yalu River) during northwards migration. During southwards migration, after staging in southwest Alaska they fly directly to their non-breeding grounds[7];
- *L. l. anadyrensis* has an isolated and restricted breeding range on the Anadyr Lowland in Chukotka, eastern Siberia[183]. It is not widely recognised and its migration and non-breeding range are unknown. For the purposes of this review it is assessed together with *L. l. menzbieri*.

Life cycle, distribution and ecology
Breeding: breeds from early May to August[8] across tundra and northern boreal zones of Eurasia and coastal Alaska. Breeds in a variety of habitats, including marshes in lowland moss and shrub tundra near wet river valleys, lakes and sedge bogs[9,10,11 10], swampy heathlands in the willow and birch zone near the Arctic treeline[9] , in open larch woodlands next to water [11], occasionally on open bogs in the extreme north of the coniferous forest zone[9], and on coastal marshes.

Non-breeding: this long-distance migrant undertakes some exceptionally long non-stop flights (e.g. across the Pacific from Alaska, U.S. to New Zealand). Staging and stopover sites are predominately intertidal habitats but also include some inland wetlands[8,219], short-grass meadows, sandy beaches with pine stands and swampy lowlands near lakes[10]. Birds spend the remainder of the non-breeding season at coastal sites, where they aggregates in large flocks, roosting and feeding on intertidal mudflats, estuaries, inlets, mangrove-fringed lagoons and sheltered bays[11].



Key[232]: Resident, Breeding Season, Non-breeding Season, Passage

				POPULATION ESTIMATES
Population	*lapponica*	*taymyrensis* (both populations)	*menzbieri*	*baueri*
Size	120,000[12]	725,000[12,13]	146,000[14]	133,000[14]
Trend	**INCREASING**[13]	**DECLINING**	**DECLINING**[15,21]	**DECLINING**[15,16,210]
				DEMOGRAPHIC TRENDS
Nesting success	?	?	?	?
Fledging success	?	?	?	?
1st Year survival	?	?	?	?
Adult survival	?	?	**DECLINING**[17,211]	**DECLINING?**[153,210]
				INTERNATIONAL RESPONSIBILITIES
Breeding	Finland, Norway, Russia & Sweden.	Russia.	Russia.	U.S.
Non-breeding	Denmark, France, Germany, Ireland, Netherlands, Portugal & UK.	Germany, Guinea-Bissau, Denmark, France, Iran, Mauritania, Morocco, Mozambique, Netherlands, Oman, Saudi Arabia, South	Australia, China, Indonesia, Mongolia, North Korea, South Korea & Taiwan.	Australia, China, Japan, New Zealand North Korea & South Korea.

Africa, Sudan
UAE & UK.

THREATS ON BREEDING GROUNDS

U.S. On *baueri* breeding grounds in Alaska, despite the decreasing trend in recent years, legal **subsistence hunting still** poses a threat[27,42]. **Oil and gas exploration** on the Alaskan North Slope is reducing and fragmenting breeding areas; current proposals, such as extraction of copper-gold-molybdenum sulphide deposit in Bristol Bay ('Pebble Mine'), poses a future threat, as does associated pollution[27,42]. The potential impacts of **climate change** include sea level rise and thawing permafrost, which together could reduce the extent of tundra breeding habitat by facilitating a northward progression of shrubs and trees ('scrubification'); the main mechanisms preventing shrubs and trees from colonizing the coastal permafrost zone are shallow, highly acidic soil, which are by-products of permafrost's effects on permanent drainage habitat[27].

Russia In Russia, **oil and gas exploration,** and associated **transportation and service corridors,** are reducing and fragmenting western parts of the *taymyrensis* breeding range. Though localised, oil and gas drilling is also likely to be impacting on *anadyrensis* breeding grounds in northeast Siberia[42]. **Illegal spring hunting** occurs in different areas for all subspecies[42]. The practice of burning grasslands for agricultural purposes is increasing in western parts of the *taymyrensis* breeding range, and this is likely be having a negative impact when carried out during the breeding season[42]. **Trapping of Arctic Fox** *Vulpes lagopus* for fur stopped in Russia in the early 1990s. There are some suggestions that increasing fox densities may have increased predation pressure[42], however foxes undergo large natural population fluctuations (primarily in response to lemming population fluctuations[236]) and with the end of hunting came the end of fox population estimates (they were derived from hunting bags) so there is no data to support these supposed increases[58]. The Wolverine's *Gulo guo* attempt to settle in the tundra may pose a future threat[236]. In northern Yakutia, both domestic herds and wild populations of Reindeer *Rangifer tarandus* where previously believed to have an impact on *menzbieri* breeding success through nest and chick trampling and occasional predation, but numbers in Yukutia alone decreased from 350,000 to 150,000 following the end of the Soviet Union, and no longer poses a threat[58,236].

Europe Threats relating to the *lapponica* breeding range in Europe were not obtained through this review.

THREATS DURING MIGRATION

East Asia *Baueri* and *menzbieri* birds are highly concentrated at a few major staging sites in **East Asia**. For example, 42% of the *baueri* and 19% of the *menzbieri* non-breeding populations stage at Yalu Jiang National Nature Reserve**,** Liaoning, China[193]. The widespread **loss and fragmentation of intertidal habitats**, particularly in the Yellow Sea, is occurring through **land claim** of the intertidal zone to enable the construction of new and expanding **human settlements**, **renewable energy developments**, **oil and gas developments** and **transportation and service corridors**[4,18,19,20,21,22]. Expanding **aquaculture,** especially sea cucumber farming along the intertidal zone, and salt farms, further replaces and fragments intertidal habitats[4,26,27] whilst the **harvesting of aquatic resources**, particularly through the mechanised harvesting of intertidal invertebrates, is reducing prey abundance[27,4]. The **damming of major rivers**, which combined with upstream **water extraction**, reduces silt discharge to the extent of that it reverses the process of intertidal mudflat formation: the shoreline is receding in some areas. Changes in the seasonality and quality of freshwater discharge are also occurring[4,18,23,24,25,19]. The above developments are associated with increases in a wide range of **pollutants,** including from agricultural run-off (fertiliser, pesticides, herbicides), aquaculture (antibiotics), industry (phosphate, hydrocarbons, heavy metals, fire retardants), domestic (wastewater, sewage), fishing (DDT is a component of anti-fouling paint[195]), oil spills and plastics, and DDT (a component of anti-fouling paint and a contaminant within dicofol) which can lead to direct mortality, reduced fitness and reduced prey availability[4,28,29,30,31,32,19]. The use of pesticides on tidal flats to kill potential predators/competitors prior to seeding out spat is also increasingly being practised[153]. The above threats, combined with **recreational activities**, result in high levels of **human disturbance** at feeding and roosting sites[27,4]. The **global shipping trade** provides an inadvertent source of **invasive non-native species** (e.g. Zebra Mussels *Dreissena polymorpha*) which combined with deliberately introduced species (e.g. *Spartina spp.*) can outcompete native species and change the composition and structure of intertidal communities and habitats[27,4,33,34]. *Spartina* is spreading around the Bohai coast and, if left uncontrolled will significantly reduce intertidal foraging[153]. Many additional threats could arise from **climate change**. Projected sea-level rise could further reduce the extent of intertidal habitats[196], whilst coastal defences impede the formation of new intertidal zone. These processes could be exacerbated by **land subsidence**, especially in Bohai, China[196]. Increasing frequency and severity of **tropical cyclones and floods** could lead to further loss of intertidal zones, whilst **changing wind patterns** through the Pacific could impact on migratory flights[197]. **Increasing temperatures** could lead to a seasonal mismatch between migration times and peak food abundances[4,35,36], whilst climate change can result in prey items suffering from reduced recruitment[198], reduced growth rates[199] and potential population collapse due to parasites[200]. Lastly, with populations increasingly concentrated in a smaller number of staging sites, the potential for **stochastic events** to impact on these sites is highlighted by the large-scale disappearance of benthic invertebrates at Yalu Jiang National Nature Reserve**,** Liaoning, China in 2014[194].In Mongolia, inland wetlands used for stopover are being degraded due increased grazing and trampling by livestock and drying out due to changing weather pattners[219].

U.S. Despite decreasing in recent years, subsistence hunting still occurs and poses a threat to *baueri* birds at their staging sites in **Alaska**[27,37]. Sea level rise as a result of climate change could reduce the extent of intertidal foraging habitat, whilst coastal defences impede the formation of new intertidal habitats[27].

THREATS ON NON-BREEDING GROUNDS

New Zealand and Australia On *baueri* non-breeding grounds in **New Zealand** and eastern **Australia**, i**nvasive species**, including from both native (e.g. mangrove) and non-native (seagrass) species, are encroaching into coastal habitats, reducing the extent of intertidal mudflats[27]. Several **pollutants** from upriver agricultural and industrial activities are contaminating estuarine ecosystems[27]. There are currently no immediate threats to *menzbieri* wintering grounds in NW Australia[74].

Africa & the Middle East On *taymyrensis* wintering grounds in Africa and the Middle East, threats include increasing **residential and commercial developments** near important wintering sites, such as the development on the border of Banc d'Arguin National Park, Mauritania, which is resulting in habitat fragmentation[38]. Expanding **aquaculture developments** and increased **harvesting of aquatic resources** near roosting and feeding sites are increasing disturbance and depleting the invertebrate prey base[38]. New **oil and gas developments** are further fragmenting important wintering sites[38]. All of the above developments are associated with increasing **transportation and service corridors** and levels of **human disturbance**[38].

NW Europe For *lapponica* wintering grounds and *taymyrensis* staging grounds in **north-west Europe**, **renewable energy developments**, including coastal and offshore wind farms, are increasing. Bar-tailed Godwits are susceptible to the indirect impacts associated with poorly-sited turbines, namely the increased energy costs associated with altering flight paths to avoid turbines during migration, and displacement at roosting and feeding sites when turbines are situated nearby[39,40]. **Fishing and aquaculture** activities include the dredging of mussel beds, which largely destroy their associated benthic communities and reduce the invertebrate prey base[40]. Most fishing and aquaculture activities result in increased **transport activity** and **disturbance** near feeding and roosting sites. This is exacerbated by high levels of **recreational activities,** many of which take place on the intertidal and supratidal zones (e.g. walking, kite surfing, etc)[41]. Increasing numbers of Peregrine Falcons *Falco peregrinus* are thought to be having a population-level impact[38]. Projected **sea-level rise** combined with **coastal defences** could impede the transition of coastal zones, resulting in so-called 'coastal squeeze' and ultimately leading to loss of both area and diversity of intertidal and supratidal habitats[40]. Lastly, Bar-tailed Godwits are still legally **hunted** throughout the winter period in France[150].

CONSERVATION

Current conservation **Spartina control** at selected sites in **New Zealand** has led to an increase in unvegetated intertidal habitat[185]. **Newly created roost sites** in **South Korea** have resulted in use by a range of shorebirds[42]. Creation of roost sites does not compensate for loss of inter-tidal habitat, but highlights the approach may work and is potentially important around the Yellow Sea. Here, birds usually roost in supra-tidal habitats and these are being lost to land claim[153]. Researchers are currently using New Zealand ringing and re-sighting data to undertake a survival analysis of *baueri*, and to compare with *menzbieri* survival data[27].

Conservation priorities

lapponica

1. **Promote sustainable shellfisheries** in the Wadden Sea and other important European estuaries.

2. Ensure **adequate protection of spring staging sites** in Germany and the Netherlands.

taymyrensis, baueri and menzbieri

1. **Save and protect** as much of the remaining habitat at **Yalu Jiang National Nature Reserve, Liaoning, China** from further **reclamation** and ensure **appropriate management** of this critical staging area.

2. **Save and protect** as much of the remaining habitat at **Nanpu, Bohai Bay, China** from further **reclamation** and ensure **appropriate management** of this critical staging area.

3. Initiate **high-level advocacy** at the earliest possible

opportunity to ensure that **future coastal land-use planning in North Korea is sympathetic to the needs of shorebirds and wider biodiversity**. This is for the protection of all shorebirds dependant on the Yellow Sea.

4. Ensure **effective management** of shellfisheries at key sites for the benefit of all shorebirds.

5. For *taymyrensis*, ensure robust management plans with strong management committees to ensure their implementation for key West Africa non-breeding sites, Banc d'Arguin, Mauritania and Bijagós Archipelago, Guinea-Bissau, and protection from threats associated with oil and gas extraction and shipping.

6. **Eradicate** the limited amount of ***Spartina*** from Bohai, China whilst it is feasible.

RESEARCH

Research priorities

lapponica

1. **Investigate the impacts of climate change in the high Arctic**, with a focus on: the impact of increasing Red Fox *Vulpes vulpes* abundance; changes in lemming population cycles; and the northward encroachment of scrub habitat.

taymyrensis, baueri and menzbieri

1. Develop more effective monitoring methods in order to obtain more reliable population and trend estimates, for example through the promotion of data sharing agreements (this would benefit all shorebirds in the region). This should include an assessment of annual breeding success (e.g. proportion of juveniles on the non-breeding grounds as an index of breeding success).

2. **Investigate the use of intertidal habitats in the Yellow Sea**, with a focus on the relationships between foraging, food resources and fine-scale habitat use, with a view to informing future habitat creation and restoration. Investigate whether current food resources are 'natural' or the result of a disturbed situation, as has recently been found for Red Knot *Calidris canutus* in Bohai Bay, China (unpublished study by Beijing Normal University and the University of Groningen).

3. **Investigate the effects of pollutants** within highly polluted intertidal habitats of the Yellow Sea and other key sites, with a focus on the accumulation of pollutants and consequences for survival and reproductive success.

11. Marbled Godwit *Limosa fedoa* (Linnaeus, 1758)

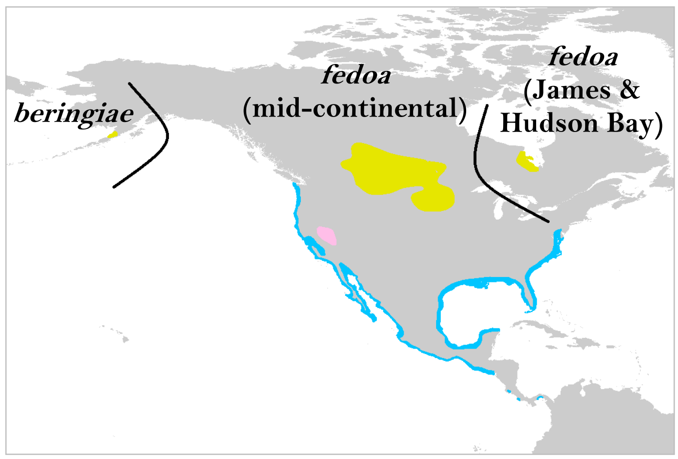
Image courtesy of Dan Ruthrauff

IUCN Status: Least Concern (LC)
The overall population is thought to be largely stable, although breeding declines have been recorded in the Canadian population. Trends for the two smaller populations are unknown, but both populations are small, numbering only around 2,000 individuals each[5].

CMS Status: Appendix II

Taxonomy
Two subspecies containing three biogeographic populations are recognised, owing to the fact they are found in three highly disjunct breeding areas[95,96]:

- *L. f. beringiae* breeds in a small region of the Alaskan Peninsula, U.S. and winters on the U.S. Pacific Coast;
- *L. f. fedoa*, which consists of a mid-continental breeding population and a population breeding around James and Hudson Bays, Canada.



Key[232]: Breeding Season, Non-breeding Season, Passage

Life cycle, distribution and ecology
Breeding: the mid-continental population breeds in the prairies of north-central U.S. and south-central Canada, with the disjunct eastern population breeding along the south-west coast of James Bay in Ontario and Québec, and on Akimiski Island, Nunavut. *Beringiae* birds breed on the northeast coast of the Alaska Peninsula near Ugashik Bay, within a narrow strip of inland lowlands from just north of Pilot Point south to Cinder-Hook Lagoon. The mid-continental population nests in native shortgrass in open landscapes, and occasionally in hayfields and fallow pastures. Taller grass habitats for brood-rearing, and a variety of wetland habitats, are a breeding habitat requirement. The James Bay population nests primarily in open, supratidal grasslands and occasionally wet tundra and taiga habitats. In Alaska they nest in herb bog meadows, fresh herb meadows and sedge bog meadows[97].

Non-breeding: arrives on breeding grounds from late April to late May, with mid-continental birds arriving earlier. Mid-continental birds depart breeding grounds from July through September, with Alaskan and James Bay birds departing late August to late September[97]. James and Hudson Bay birds stage in the mid-continent before wintering along the coast of Sonora, Mexico[88,217]. The mid-continental population winters primarily along the coasts of north-west Mexico and south-east U.S.[98,99,217] with some wintering along the coastline of California[218]. *Beringiae* birds winter at coastal sites from Washington south to central California, U.S.[97]. During the non-breeding season, they forage mostly on intertidal mudflats and sandflats, as well as brackish marshes, brackish mudflats, muddy-edges of mangrove-lined channels and unvegetated inland wetlands, flooded pastures, fields and wet meadows[97].

POPULATION ESTIMATES

Population	mid-continental ***fedoa***	James and Hudson Bay ***fedoa***	***beringiae***
Size	**170,000**[100,88]	**2,000**[88]	**2,000**[100,88]
Trend	**STABLE***[101,88]	**STABLE**[101,88]	**STABLE**[101,88]
	***overall, but declines in Canada**		

DEMOGRAPHIC TRENDS

Nesting success	**STABLE**[103]	**?**	**?**
Fledging success	**STABLE**[103]	**?**	**?**
1st Year survival	**?**	**?**	**?**
Adult survival	**STABLE**[103]	**?**	**?**

INTERNATIONAL RESPONSIBILITIES

Breeding	Canada & U.S.	Canada.	U.S.
Non-breeding	Mexico & U.S.	Canada & U.S.	U.S.

THREATS ON BREEDING GROUNDS

Mid-continental North America

For the mid-continental population, native prairie habitat is being lost to **agricultural conversion** (particularly potatoes and GM soybeans) in core breeding areas, due to insufficient subsidies for ranchers and small dairies[103]. **Increasing strip-mining for coal**, **oil drilling**, **potash mining** and associated increases in **roads and powerlines** are fragmenting breeding habitat as too are **residential** developments and their associated increases in **human disturbance**[103]. **Invasive non-native plants** threaten native grasslands and wetlands. Increasing **drainage and water abstraction for irrigation** is drying out wetlands, when shallow wetlands are already more prone to drying out as a result of **changing weather patterns**[103]. Pollution from pesticides predominantly used for grasshopper control may also be having an impact on food sources[103].

James Bay and Hudson Bay

On the breeding grounds of James and Hudson Bay birds, there is a northward progression of scrub and woodland onto breeding habitats due to **climate change**[103]. **Oil and gas drilling** and associated **transportation** and service corridors are fragmenting habitat, whilst the rapidly expanding **Snow Goose** *Chen caerulescens* population is degrading coastal tundra at important breeding and stopover sites[103]. Subsistence **harvesting** occurs in the region, and whilst the exact impact is unknown it is likely to be having an effect[103]. Increasing levels of human disturbance are also occurring**.**

Alaska

On *beringae* breeding grounds in Alaska, potential future threats include proposals for **large-scale mining operations** and **oil and gas leases** in the Bristol Bay region[102]. Another future/potential threat is from **climate change**. As godwits breed very close to shorelines, rises in **sea level, storm surges** (and associated **coastal erosion)** could inundate nesting and foraging areas: GIS of aerial survey detections indicate most birds occur at low elevation sites (<16 m) in shrub-free freshwater meadows. It is unclear if changes to more salt-tolerant (resulting from inundation) and/or shrubby habitats (birds moving upslope due to sea level rise) would prove detrimental to godwits[102].

THREATS ON NON-BREEDING GROUNDS

Northwest Mexico and Southeast U.S.

For the mid-continental population, many of the threats listed for breeding grounds are also present at mid-continental staging sites. On their wintering grounds in north-west Mexico and south-east U.S., habitat fragmentation is occurring due to increasing oil and gas developments and transportation and service corridors[37]. Intentional hunting occurs on wintering grounds, whilst there are increasing levels of **human disturbance** arising from recreational activities (e.g. boating, fishing). Invasive non-native species of intertidal habitats as well as problematic native species, including Peregrine Falcons *Falco peregrinus*, are also thought to be having a population-level impact. Sea level rise and the expansion of renewable energy projects are potential/ future threats[37].

California and Oregon, U.S.

On *beringae* non-breeding grounds, primarily in northern California and Oregon, U.S. there has been an increase in **reclamation** of intertidal habitats to enable **expanding human settlements,** whilst there has been further loss of intertidal habitats due to the **colonisation** of non-native *Spartina spp.*, which has been documented at bays and estuaries throughout the Pacific northwest[102]. The expansion of **wind farms** is also likely to be having an impact, as too are increasing levels of **human and dog disturbance** along beaches and estuaries[102]. Frequent **shipping** along the Pacific coast poses the risk of **oil spills**, as do offshore oil wells[102]. Threats arising from climate change include the loss of intertidal habitats due to **sea-level rise**, whereby dykes and sea walls prevent the formation of new intertidal habitat, and **ocean acidification,** which will have an impact on calcareous-shelled prey including molluscs, which comprise a large part of the diet[102]

CONSERVATION

Current conservation

A Western Hemisphere Shorebird Reserve Network (WHSRN) conservation plan for the Marbled Godwit was produced in 2010[97]. The United States Department of Agriculture's **Conservation Reserve Program** (CRP) and the **Wetland Reserve Program** (WRP) are assisting conservation efforts for this species across some of the breeding range.

Population	**mid-continental *fedoa***	**James and Hudson Bay *fedoa***	***beringiae***
Conservation priorities	1. **Maintain Conservation Reserve Program** (CRP) and **Wetland Reserve Program** (WRP) in the face of funding cuts. 2. **Restore abandoned shrimp farms** in western Mexico. 3. **Ensure sufficient freshwater** input into	1. **Restore abandoned shrimp farms** in western Mexico. 2. **Ensure sufficient freshwater** input into Texas Gulf Coast estuaries. 3. **Maintain mid-continental wetlands** for staging.	1. **Land protection** to allow for sea level rise on wintering grounds.

	Texas Gulf Coast estuaries.		
			RESEARCH
Research priorities	1. Investigate **the impact of fracking** on habitat fragmentation of grassland breeding grounds.	1. **Monitor breeding population** size. 2. Assess **level and impact of subsistence hunting** on breeding grounds.	1. Better **monitoring of breeding populations** and demographic rates. This is needed because the breeding population is currently not monitored and the wintering population is indistinguishable from *L. f. fedoa* birds, which flock together during winter[102].

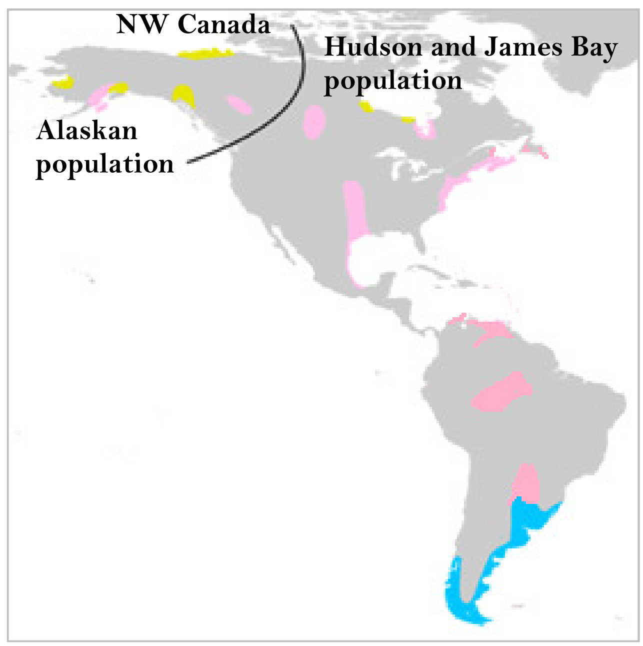
12. Hudsonian Godwit
Limosa haemastica (Linnaeus, 1758)

Image courtesy of Andrew S. Johnson

IUCN Status: Least Concern (LC)
The overall population trend appears to be declining, as a result of declines in the James and Hudson Bay population in Canada[5].

CMS Status: Appendix II

Taxonomy
Monotypic species. Two biogeographic populations have previously been recognised: breeders from the **Hudson Bay and James Bay** regions of northeast Canada; and an '**Alaskan population**' which referred to not only birds breeding in scattered pockets of suitable habitat in southcentral and western Alaska, U.S.[90] , but also included breeding from the Mackenzie and Anderson river deltas in northwest Canada. However, as new geolocator studies shed light on the migratory connectivity of these populations, it is increasingly apparent that breeding birds from NW Canada do not mix with Alaskan-breeding birds on their on-breeding grounds, and yet do mix, to a certain extent, with Hudson and James Bay birds during the annual cycle. It is therefore recommended that three biogeographic populations are recognised: (1) **Alaska**, (2) **NW Canada**, (3) **Hudson and James Bay**.



Key[232]: Breeding Season, Non-breeding Season, Passage

Life cycle, distribution and ecology
Breeding: They breed in open sedge meadows containing small ponds, often in landscapes interspersed with small trees. The sedge meadows are often in close to tundra, taiga and intertidal mudflats[90].

Non-breeding: Departs breeding grounds in mid-July and may stage for several weeks before undertaking non-stop, 5-day flights to South America[71]. Recent geolocation studies have vastly improved our understanding of the migratory strategies of the three breeding populations:

On southbound migration, **Alaskan** birds stage in central Saskatchewan, Canada before a stopover site in the Amazon Basin in Colombia. Following a further stopover, in Buenos Aires province, Argentina, they then arrive in Isla Chiloé and the adjacent mainland, Chile. Their northward migration sees them move through mid-continental U.S., staging in central Kansas and Nebraska before returning to Alaska.

Hudson and James Bay birds stage at James Bay, before flying non-stop to stopover sites in Buenos

Aires province. They then migrate onwards to their non-breeding sites: Tierra del Fuego and the Argentinean mainland. They also migrate through mid-continental U.S. during northbound migration, using frequent stopovers as far north as Winnipeg before returning to their breeding grounds[221,222,223].

The life cycle of the **NW Canada** breeding population is the least well understood. Recent tracking of two Mackenzie Delta birds found they staged in the Hudson and James Bay region (one bird via a Churchill stopover). They then staged for 3-4 weeks in the Amazon (the Orinoco River Basin, Venezuela and the Caribbean coast of Colombia, respectively) before spending a further 3-4 weeks staging sites in the Amazon (Brazil and Bolivia, respectively). Both birds then reached the provinces of Santa Fe and Buenos Aires, Argentina before arriving at Bahía Samborombón in northern Argentina. Their exact northwards migration is currently unclear as no birds have been tracked yet[192], but also involves migrating up through mid-continental U.S.

Despite the differing migratory routes, it is thought that extensive mixing of birds of the two Canadian breeding populations occurs in Buenos Aires province[93]. Meanwhile, whilst it appears they visit different sites at different times, the mid-continental U.S. corridor is likely to be critical for all of three populations[93]. Habitats used in South America mostly comprise large intertidal mudflats, but also inland saline lakes, sewage lagoons, salt marshes, flooded fields and upland grasslands[90]. North American staging and stopover sites are mostly inland, where flooded fields or the beds of lakes and reservoirs with low water tables are preferred feeding habitat. Marshes, sloughs and sewage lagoons are also used[91].

POPULATION ESTIMATES

Population	**Alaska**	**NW Canada**	**James & Hudson Bay**
Size	**21,000**[88] Previously, this estimate was derived from counts in Chile and applied to the Alaskan & NW Canada birds. Tracking studies show that the NW Canada population does not overwinter here, so this now only relates to the Alaskan population.	A combined estimate of **56,000**[100] Previously, this was the estimate solely for the Hudson & James Bay population, and was based on non-breeding population estimates from Tierra del Fuego and the coast of Argentina. Recent tracking studies have shown these estimates comprise birds from both Canadian breeding populations.	
Trend	**STABLE**[88]	**DECLINING**[88]	

DEMOGRAPHIC TRENDS

Nesting success	**STABLE**	**?**	**DECLINING**[92]
Fledging success	**STABLE**	**?**	**DECLINING**[92]
1st Year survival	**?**	**?**	**?**
Adult survival	**STABLE**[133]	**STABLE**[92]	**STABLE**[92]

INTERNATIONAL RESPONSIBILITIES

Breeding	U.S.	Canada	Canada
Non-breeding	Argentina, Brazil, Chile, Colombia, Venezuela & U.S.	Argentina, Brazil, Colombia, Venezuela & U.S.	Argentina, Brazil, Colombia, Venezuela & U.S.

THREATS ON BREEDING GROUNDS

North America

This is one of the first species with evidence highlighting the **impact of climate change**. In the Hudson and James Bay population, a study has shown that climate change (in the form of cooler late springs followed by warmer summers) has imposed a mismatch between the godwit breeding season and peak insect abundance; godwits are raising their young in a resource-poor environment, resulting in **near-complete reproductive failures** in many years[92]. Increasing populations of **problematic native species** (aided by man and chiefly concerning Raven *Corvus corax* and Red Fox *Vulpes vulpes*) pose a significant threat to godwits breeding in proximity of human habitations in the Hudson and James Bay population[93] and to a lesser extent in Alaska[37]. **Human disturbance** is thought to be having an impact on breeding grounds in Alaska[37]. **Potential/future threats** facing Hudsonian Godwit in Alaska include proposed oil and gas drilling, a proposed bridge across Cooke Inlet[93], a proposed gravel mine and a proposed open cast coal mine in the Beluga area, which includes a transportation belt running through important breeding, feeding and staging areas[93].

THREATS DURINGMIGRATION

U.S. and the Amazon

Many threats face both populations during migration, including habitat fragmentation due to increased urbanization along the migration corridor[37] and a decrease in the area of **rice farming**, an important habitat for Hudsonian Godwits during migration. Habitat fragmentation is also likely to be occurring due to increasing **gas and oil drilling** in the Gulf Coast, **fracking,** and the expansion of **wind farm developments** in mid-continental U.S.[37]. Increasing rates of **deforestation** in the Amazon, combined with associated increases in roads is also likely to be having an impact, as too is increasing levels of **human disturbance** across the entire migration corridor[37]. Further threats include the drainage of wetlands, a general reduction in 'wet agriculture', increasing populations of **problematic native species**, particularly Peregrine Falcon *Falco peregrinus*, and the impacts of pollution and climate change at staging sites[37].

THREATS ON NON-BREEDING GROUNDS

Argentina and Chile

At coastal sites in southern South America, recent expansion of **residential and commercial developments** (new harbours, ports and housing) is resulting in a loss of intertidal feeding habitat and supratidal roosting habitat[93,94]. The **salmon and shellfish farming** sectors have grown significantly, resulting in increased **infrastructure, human disturbance** and traffic near intertidal habitat[93,94]. All three areas used by godwits on Isla Chiloé are in close proximity to major **shipping** corridors[93]. Widespread farming and harvesting of agar-producing algae species is a major economic activity on Isla Chiloé and brings **human, pet and vehicular disturbance** into the intertidal zones[93,94]. **Pollution** is present on Isla Chiloé from a variety of sources, including from oil extraction, shipping lanes, urban waste, sewage, household and industrial toxins, and those arising from aquaculture activities[93,94]. There are oil platforms in the mouth of Bahia Lomas, Chile and significant oil tanker traffic throughout the region - oil spills are a constant threat[93]. Potential/future threats include those arising from wind farms and climate change - projected droughts on Isla Chiloé could influence water and nutrient flows into estuarine areas and alter the life-cycles of benthic invertebrates[93]. Further loss of intertidal habitat to sea level rise also poses a significant future threat[93].

CONSERVATION

Current conservation

A Western Hemisphere Shorebird Reserve Network (WHSRN) conservation plan for the Hudsonian Godwit was produced in 2010[90]. A conservation plan for Isla Chiloé, Chile, has also been produced[94]. The Center for Conservation Biology have been satellite tagging birds from the Mackenzie Delta breeding population.

Population	Alaska	NW Canada	James and Hudson Bays
Conservation priorities	1. **Maintain the mid-continental wetlands** used during staging. 2. Work to **preserve intertidal habitats** on Isla Chiloé, Chile.	1. **Maintain the mid-continental wetlands** used during staging. 2. Provide permanent **protection for non-breeding estuarine habitat** for the 2 key sites on Tierra del Fuego: Bahía Lomas, Chile and Bahía San Sebastián, Argentina.	1. **Maintain mid-continental wetlands** used during staging. 2. Provide permanent **protection for non-breeding estuarine habitat** for the 2 key sites on Tierra del Fuego: Bahía Lomas, Chile and Bahía San Sebastián, Argentina). 3. **Maintain 'bird-friendly' agricultural management** on rice fields used for staging in Texas, Kansas and Oklahoma, U.S.

RESEARCH

Research priorities	1. **Understand habitat use** in mid-continental wetland staging grounds. 2. **Quantify habitat use** at stopover and staging sites in the Amazon. 3. **Monitor breeding biology** and gain a better understanding of the influence of climate. 4. Undertake updated **DNA analysis** to better understand the genetics of the three populations[237].	1. **Understand habitat use** in mid-continental wetland staging grounds. 2. **Quantify habitat use** at stopover and staging sites in the Amazon. 3. **Quantify the impact of hunting** in James Bay, Canada. 4. **Continue satellite tracking** studies to improve our understanding of migration routes, timings and important non-breeding sites.	1. **Understand habitat use** in mid-continental wetland staging grounds. 2. **Quantify the impact of hunting** in James Bay, Canada. 3. Undertake updated **DNA analysis** to better understand the genetics of the three populations[237].

5. Undertake updated **DNA analysis** to better understand the genetics of the three populations[237].

13. Black-tailed Godwit
Limosa limosa *(Linnaeus, 1758)*


Jeroen Stel (rspb-images.com)

IUCN Status: Near Threatened (NT)
Although widespread and with a large global population, Black-tailed Godwits have declined rapidly in parts of their range owing to changes in agricultural practices. Overall, the global population is estimated to be declining at such a rate that the species qualifies as Near Threatened[5].

CMS Status: Appendix II

Taxonomy
Three subspecies are recognised:

- *L. l. islandica* breeds in NW Europe, predominately Iceland;
- *L. l. limosa* breeds across northern and central Europe and into central Asia (east of the River Yenisei in central Siberia). Three biogeographic populations of *L. l. limosa* are recognised;
- *L. l. melanuroides* breeds in disjunct areas of central & eastern Siberia, north-east Mongolia, north-east China and the far east of Russia.

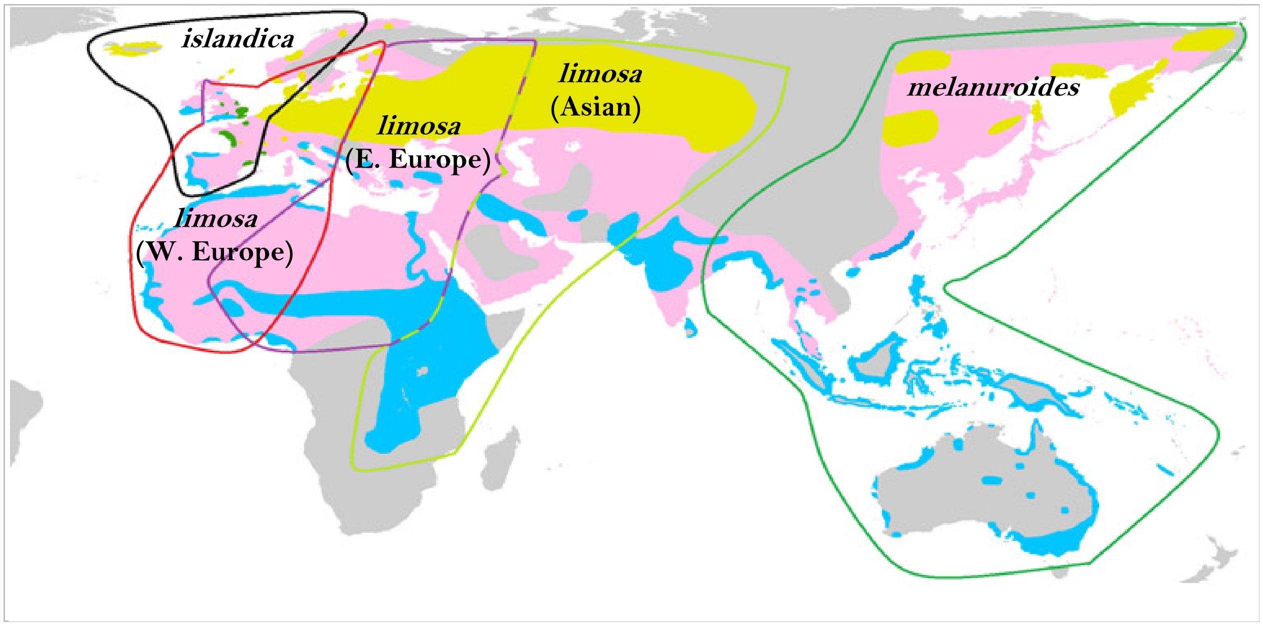
Life cycle, distribution and ecology
Breeding: Breeds from April to mid-June in a variety of habitats including cattle pastures, hayfields[9], lowland wet grasslands, grassy marshland, raised bogs and moorland, lake margins and damp grassy depressions in steppes, coastal marshes, large patches of dwarf-birch bog and marsh, particularly with abundant sedge-pools[11,45].

Non-breeding: migrates from late-June to October, though failed breeders may migrate as early as May. Migrates across a broad front and may roost in flocks of tens of thousands at favoured sites. Northward migration may start as early as December[11,43,44].

Large non-breeding range extends from the British Isles to Australia, encompassing Iberia, the Mediterranean, sub-Saharan Africa and parts of the Middle East, India, Indochina, China, Taiwan, the Philippines, Indonesia, and Melanesia[46]. *Limosa* birds mostly winter in freshwater habitats including swampy lake shores, pools, flooded grassland and irrigated rice fields. *Islandica* and *melanuroides* birds often winter in brackish habitats[11] including sheltered estuaries and lagoons with large intertidal mudflats[9,44], sandy beaches, salt-marshes and salt-flats[11]. Birds on passage in Iberia make much use of rice fields[43]. *Melanuroides* birds in South Korea also stage in large numbers at coastal rice fields during northward migration[108] although they also use feed in large numbers on intertidal mudflats e.g. Laizhou Bay, Bohai, China[153].

POPULATION ESTIMATES

Population	***islandica***	W. Europe ***limosa***	E. Europe ***limosa***	Asian ***limosa***	***melanuroides***
Size	**50,000 – 75,000**[47]	**160,000 – 180,000**[2]	**90,000 – 165,000**[2]	**25,000 – 100,000**[48]	**139,000**[1,14,15]
Trend	**INCREASING**[49]	**DECLINING**[49]	**?**	**?**	**DECLINING**



Key[232]: Resident, Breeding Season, Non-breeding Season, Passage

				DEMOGRAPHIC TRENDS	
Populations	***islandica***	**W. Europe *limosa***	**E. Europe *limosa***	**Asian *limosa***	***melanuroides***
Nesting success	INCREASE[47]	STABLE	?	?	?
Fledging success	INCREASE[47]	DECLINING[144]	?	?	?
1st Year survival	?	STABLE[47]	?	?	?
Adult survival	INCREASE[47]	STABLE[145,146]	?	?	?

			INTERNATIONAL RESPONSIBILITIES		
Breeding	Iceland, Faroe Isles, Norway & UK.	Belgium, France, Germany & Netherlands.	Belarus, Poland, Russia & Ukraine.	Russia	China, Mongolia & Russia.
Non-breeding	France, Morocco, Netherlands, Portugal, Spain & UK.	France, Guinea Bissau, Mali, Mauritania, Morocco, Portugal, Senegal & Spain.	Azerbaijan, Bulgaria, Chad, Cyprus, Greece, Iran, Kazakhstan, Mali, Nigeria, South Sudan, Turkey, Tunisia & Ukraine.	Tbc.	Australia, China Indonesia, Japan, Malaysia, Mongolia, North Korea, Philippines, South Korea, Thailand & Vietnam.

THREATS ON BREEDING GROUNDS

Eurasia Across *limosa* breeding grounds in **Western Europe**, **intensification of grassland management**, namely drainage, reseeding and high fertiliser application rates reduces food resources[49,50,51,52,53] whilst the **early and frequent cutting** of grasslands destroys nests and chicks. Emerging evidence comparing nest survival between semi-natural meadows and intensive grasslands found predation rates are higher in the latter[115]. These threats are likely to be increasing in Eastern Europe, linked to agricultural subsidies. **Drainage** of natural habitat is also occurring in *islandica* breeding habitats in **Iceland** to facilitate hay and barley production[54]. Nest destruction and chick mortality through trampling is an additional threat which is also present in **Eastern Europe**[49,51,52,53]**.**The **ploughing of semi-natural habitats** occurs in Belarus and Ukraine, whilst **dike construction** to reduce spring flooding reduces habitat quality[49]. **Large-scale farmland abandonment,** leading to overgrowth of breeding habitats, is occurring on *limosa* breeding grounds in **Eastern and Central Europe**[49] and western Asia and in northern areas of the *melanuroides* breeding range[42]. In France, **drainage** and **conversion of grasslands** into maize has led to loss of breeding and stopover sites[150,49]. High levels of **nest and chick predation** are occurring across Europe due to increasing populations of native predators including Red Fox *Vulpes vulpes*, Stoat *Mustela erminea*, Common Buzzard *Buteo buteo* and Grey Heron *Ardea cinerea*[49,53], as well as **invasive non-native mammals** such as Racoon Dog *Nyctereutes procyonoides*. Many generalist predator populations are increasing in Europe due to reduced levels of predator control and land use changes which benefit predators e.g. drainage, road construction, loss of 'open' habitats, etc[52]. Throughout continental Europe, increasing **urbanisation** and **transport corridors** are fragmenting breeding grounds[49]. In **Iceland**, summer cottage and associated road construction is fragmenting breeding habitat and increasing disturbance[54]. Increasing transportation and service corridors are also fragmenting *limosa* breeding grounds in Asia[42]. **Spring grassland fires** are increasing in southern parts of *limosa* and *melanuroides* breeding ranges in Asia[42] whilst the burning of grasslands in Eastern Europe also destroys nests and chicks[49]. **Commercial forestry plantations**, including conifers and aspen, are increasing in Iceland and fragmenting breeding grounds[54]. **Increasing disturbance** of breeding habitats in western Europe and Iceland is occurring, due to agricultural activities, road traffic, fishing, recreational activities, cycling, road traffic and walking[55,49]. Disturbance contributes to high nest predation rates, as incubating birds are forced to leave nests[56]. **Pollution** is increasing in *limosa* breeding areas in western Asia[42]. **Climate change** has the potential to shift the breeding range, with evidence of godwits moving northwards in Russia[49]. Warmer temperatures could alter the timings of migration and advance the breeding season, leading to higher nest and chick losses to mowing[51,49]. In Mongolia, marsh and bog breeding habitats near lakes and rivers are being degraded. The drying out of wetlands due to changing weather patterns, coupled with increasing livestock numbers, means that at some sites livestock trample through and rest within wetland breeding habitats as they seek wetlands to drink and cool down[220].

THREATS DURING MIGRATION

East Asia For *melanuroides*, the widespread loss, degradation and fragmentation of coastal habitats along the Chinese coast of the Yellow Sea is the largest threat to non-breeding range. For full details on habitat loss in the region, please refer to the Bar-tailed Godwit species account. In South Korea, *melanuroides* occur in highest numbers in ricefields, or on tidal flats near to rice fields[108]. It is possible that rice fields are now a vital habitat, especially in the context of the widespread loss of intertidal habitat, so changes in land use (e.g. turning over rice-fields to industrialisation or urbanisation) is a threat[227].

THREATS ON NON-BREEDING GROUNDS

Europe and West Africa

Reclamation is also occurring in Eastern Europe and Portugal, with industrial and commercial expansion onto the margins of the largest wetlands (Tagus and Sado estuaries and Ria de Aveiro)[147]. Increasing residential and commercial development is also occurring at some Middle East sites[42]. Increasing **transportation and service corridors** are fragmenting the non-breeding habitats of *limosa* and *melanuroides* birds. Expanding **rice production** creates non-breeding habitat, but increasing numbers of godwits on rice fields has lead to conflict with farmers in West Africa and subsequent **hunting**[152,49]. Capturing of non-target godwits also occurs through **bird netting** in Mali[148]. Hunting has reduced in other parts of the range, including Europe and the Gulf of Thailand[149]. In West Africa, wetlands have been degraded due to canalisation for **flood control and irrigation, energy production** and water retention for low water periods[49]. In Portugal, artisanal **fish and shrimp farming** on deactivated salt-pans is reducing roosting and foraging options, as water levels increase[147]. **Aquaculture developments** are also replacing and fragmenting intertidal staging habitats in the Yellow Sea[42]. **Invasive non-native species** are encroaching on non-breeding sites: Common bulrush *Typha latifolia* is increasing in the Senegal delta due to damming of the river[152], whilst cord-grass *Spartina alternaflora* is invading *melanuroides* staging habitats along China's Yellow Sea coast[42]. **Pollution**, from a variety of industrial, domestic and agricultural sources, is affecting some sites in France[150] and SE Asia[42]. Conversely, in Portugal, reduction of untreated domestic and industrial discharges into estuarine systems has resulted from implementation of the European Union's (EU) **Water Framework Directive** (Directive 2000/60/EC that commits EU Member States to achieve good qualitative and quantitative status of all water bodies by 2015)[147]. **Oil and gas drilling** is increasing at non-breeding sites in parts of the Middle East[42]. Previously not an issue, the economic crisis has seen recent increases in the **harvesting of bivalves and polychaetes** for commercial use, potentially depleting food resources and increasing **disturbance**[147]. Harvesting of aquatic resources is also having an impact on staging sites in SE Asia[42]. Increasing **renewable energy projects** pose an additional threat[148] and **climate change** is predicted to further degrade non-breeding habitats along the African-Eurasian and East-Asian Australasian flyways[38].

CONSERVATION

Current conservation

An African-Eurasian Waterbird Agreement (AEWA) international single species action plan for the conservation of the Black-tailed Godwit was published in 2008[49] and an AEWA Black-tailed Godwit international working group has been set up. The first review of the plan will be in 2018.

Population	*islandica*	W. Europe *limosa*	E. Europe *limosa*	Asian *limosa* & *melanuroides*
Conservation priorities	1. Ensure **landscape planning** reduces the impact of **development** on important breeding grounds e.g. afforestation, summer house construction. 2. **Protect saltpans in Iberia and France** (saltpan abandonment and transformation to commercial aquaculture reduces roosting and foraging habitat availability). 3. **Expand protected area (SPA, SAC) boundaries** to include **coastal grasslands** – (in UK and Ireland, coastal grasslands can be key to supporting estuarine wintering populations).	1. **Protect reserves and restore and create new wetlands** for the establishment and protection of breeding populations. 2. Ensure **wider countryside management policy** delivers for godwits e.g. the EU Common Agricultural Policy, Agri-Environment Schemes (e.g. through the reduction of fertiliser inputs, stop vaccinating foxes for rabies, keeping cattle outdoors). 3. **Protect rice fields** and **restore natural wetlands** used during migration and overwinter. 4. Maintain the **non-hunting status in France** when the current moratorium comes to an end.	1. **Protect existing breeding populations on steppe habitat**, which supports very large populations. 2. **Reduce loss of breeding habitat arising from land abandonment** by promoting compatible agricultural activities and increasing landowner awareness.	1. **Effective management** of shellfish fisheries at key sites for the benefit of all shorebirds. 2. **Eradicate** the limited amount of ***Spartina*** from Bohai, China whilst eradication is feasible. Other conservation measures for these populations will need to be informed by the research findings (see below).

Population	*islandica*	W. Europe *limosa*	E. Europe *limosa*	Asian *limosa* & *melanuroides*
Research priorities	1. Ensure **landscape planning** reduces the impact of **development** on important breeding grounds e.g. afforestation, summer house construction. 2. **Protect saltpans in Iberia and France** (saltpan abandonment and transformation to commercial aquaculture reduces roosting and foraging habitat availability). 3. **Expand protected area (SPA, SAC) boundaries** to include **coastal grasslands** – (in UK and Ireland, coastal grasslands can be key to supporting estuarine wintering populations).	1. Understand **impacts of rice field** distribution and timing of management on godwit distribution 2. Improve impact of **agri-environment scheme delivery** (through tailored management options for godwits, targeting options in important breeding populations, and improving uptake. The latter includes wider socio-economic research about drivers of agri-environment scheme uptake).	1. Improve knowledge of **passage and winter distribution** and **site use.** 2. Explore evidence for **impacts of hunting** and pollution throughout the range.	1. Gain more accurate information on **population numbers and trends.** 2. Undertake **migration studies**, especially through satellite-tagging, to identify migratory routes and key stop-over sites. 3. Undertake **basic ecological research** to identify the drivers of population decline. 4. Evaluate the **taxonomic status of different *melanuroides*** populations, to ascertain whether they should be afforded separate subspecies status or not. 5. Assess the **importance of rice fields** to the *melanuroides* subspecies.

References

1. Bamford, M.J., Watkins, D.G., Bancroft, W., Tischler, G. & Wahl, J. 2008. *Migratory Shorebirds of the East Asian - Australasian Flyway: Population estimates and internationally important sites.* Wetlands International - Oceania. Canberra, Australia.
2. BirdLife International. 2004. *Birds in Europe: population estimates, trends and conservation status.* Cambridge, UK: BirdLife International (Conservation Series No. 12).
3. Conklin, J.R., Verkuil Y.I. & Smith, B. 2014. *Prioritizing migratory shorebirds for conservation action on the East Asian-Australasian Flyway.* WWF-Hong Kong.
4. MacKinnon, J., Verkuil, Y.I. & Murray, N. 2012. *IUCN situation analysis on East and Southeast Asian intertidal habitats, with particular reference to the Yellow Sea (including the Bohai Sea).* Occasional Paper of the IUCN Species Survival Commission No. 47. IUCN, Gland, Switzerland and Cambridge, UK. ii + 70 pp.
5. BirdLife International. 2014. IUCN Red List for birds. Downloaded from http://www.birdlife.org on 24/06/2014
6. Engelmoer, M. 2008. Breeding origins of wader populations utilizing the Dutch Wadden Sea, as deduced from body dimensions, body mass, and primary moult. PhD Thesis, University of Groningen.
7. Battley, P.F., Warnock, N., Tibbitts, T.L., Gill, Jr. R.E., Piersma, T., Hassell, C.J., Douglas, D.C., Mulcahy, D.M., Gartrell, B.D., Schuckard, R., Melville, D. & Riegen, A. 2012. Contrasting extreme long-distance migration patterns in bar-tailed godwits *Limosa lapponica. Journal of Avian Biology 43: 21–32.*
8. Hayman, P., Marchant, J. & Prater, A. J. 1986. *Shorebirds.* Croom Helm, London.
9. Johnsgard, P.A. 1981. *The plovers, sandpipers and snipes of the world.* University of Nebraska Press, Lincoln, USA and London.
10. Flint, V. E., Boehme, R. L., Kostin, Y. V. & Kuznetsov, A. A. 1984. *A field guide to birds of the USSR.* Princeton University Press, Princeton, New Jersey.
11. del Hoyo, J., Elliott, A., & Sargatal, J. 1996. *Handbook of the Birds of the World, vol. 3: Hoatzin to Auks.* Lynx Edicions, Barcelona, Spain.
12. Stroud, D.A., Davidson, N.C., West, R., Scott, D.A., Haanstra, L., Thorup, O., Ganter, B. & Delany, S. (compilers) on behalf of the International Wader Study Group. 2004. Status of migratory wader populations in Africa and Western Eurasia in the 1990s. *International Wader Studies 15: 1-259.*
13. Wetlands International. 2012. Results of trend analysis undertaken for CSR5 2012, presented in Annex 4. http://www.unepaewa.org/meetings/en/mop/mop5_docs/pdf/mop5_14_csr5.pdf
14. Watkins, D., Jaensch, R., Rogers, D. & Gosbell, K. 2012. Unpublished table of preliminary updated estimates of population size of selected shorebird species in the East Asian - Australasian Flyway based on trends in The Action Plan for Australian Birds 2010 (Garnett *et al.* 2010).
15. Garnett, S., Szabo, J. & Dutson, G. 2011. Action Plan for Australian Birds 2010. CSIRO, Collingwood.
16. Southey, I. 2009. *Numbers of waders in New Zealand 1994–2003*. Research & Development Series 308, pp. 1–70. New Zealand Department of Conservation.

17. Piersma, T., Lok, T., Chen, Y., Hassell, C.J., Yang, H.-Y., Boyle, A., Slaymaker, M., Chan, Y.-C., Melville, D.S., Zhang Z.-W., & Ma, Z. 2014. Simultaneous declines in summer survival of three shorebird species signals a flyway at risk. *Manuscript in prep.*

18. Chen, X.Q., Zhang, E.F., Mu, H.Q. & Zong, Y. 2005. A preliminary analysis of human impacts on sediment discharges from the Yangtze, China, into the sea. *Journal of Coastal Research 21: 516–521.*

19. CCICED. 2010. Ecosystem Issues and Policy Options Addressing Sustainable Development of China's Ocean and Coast. Pp. 264–316 in: *Report of Marine Ecosystems Task Force to CCICED AGM.* Beijing.

20. Bi, X., Wang, B. & Lu, Q. 2011. Fragmentation effects of oil wells and roads on the Yellow River Delta, North China. *Ocean & Coastal Management 54: 256–264.*

21. Cheung, C.P.S, Alino, P.M., Uychiaoco, A.J & Arceo, H.O. 2002. *Marine Protected Areas in Southeast Asia.* ARCBC, Philippines.

22. Chen, L., Wang, W., Zhang, Y. & Lin, G. 2009. Recent progresses in mangrove conservation, restoration and research in China. *Journal of Plant Ecology 2: 45–54.*

23. Syvitski, J.P.M., Kettner, A.J., Overeem, I., Hutton, E.W.H., Hannon, M.T., Brakenridge, G.R., Day, J., Vörösmarty, C., Saito, Y., Giosan, L. & Nicholls, R.J. 2009. Sinking deltas due to human activities. *Nature Geoscience 2: 681–686.*

24. Wang, H., Bi, N., Saito, Y., Wang, Y., Sun, X., Zhang, J. & Yang, Z. 2010. Recent changes in sediment delivery by the Huanghe (Yellow River) to the sea: causes and environmental implications in its estuary. *Journal of Hydrology 391: 302–313.*

25. Yang, Z., Ji, Y., Bi, N., Lei, K. & Wang, H. 2011. Sediment transport off the Huanghe (Yellow River) delta and in the adjacent Bohai Sea in winter and seasonal comparison. *Estuarine Coast Shelf Science 93: 173–181.*

26. Naylor, R.L., Goldburg, R.J., Primavera, J.H., Kautsky, N., Beveridge, M.C.M., Clay, J., Folke, C., Lubchenco, J., Mooney, H. & Troell, M. 2000. Effect of aquaculture on world fish supplies. *Nature 405: 1017–1024.*

27. Conklin, J. 2013. Personal communication (questionnaire response).

28. Wang, Y., Wang, T., Li, A., Fu, J., Wang, P., Zhang, Q. & Jiang, G. 2008. Selection of bioindicators of polybrominated diphenyl ethers, polychlorinated biphenyl, and organochlorine pesticides in molluscs in the Chinese Bohai Sea. *Environmental Science and Technology,42: 7159–7165.*

29. Gräslund, S. & Bengtsson, B.E. 2001. Chemicals and biological products used in south-east Asian shrimp farming, and their potential impact on the environment – a review. *Science of the Total Environment 280: 93–131.*

30. Li, D.J. & Daler, D. 2004. Ocean pollution from land-based sources: East China Sea, China. *Ambio 33: 107–113.*

31. Sowana, A., Shrestha, R.P., Parkpian, P. & Pongquan, S. 2011. Influence of coastal land use on soil heavy-metal contamination in Pattani Bay, Thailand. *Journal of Coastal Research 27: 252–262.*

32. Hu, L.M., Zhang, G, Zheng, B.H., Qin, Y.W., Lin, T. & Guo, Z.G. 2009. Occurrence and distribution of organochlorine pesticides (OCPs) in surface sediments of the Bohai Sea, China. *Chemosphere 77: 663– 672.*

33. An, S.Q., Gu, B.H., Zhou, C.F., Wang, Z.S., Deng, Z.F., Zhi, Y.B., Li, H.L., Chen, L., Yu, D.H., & Liu, Y.H. 2007. *Spartina* invasion in China: implications for invasive species management and future research. *Weed Research 47: 183–191.*

34. Li, B., Liao, C.H., Zhang, X.D., Chen, H.L., Wang, Q., Chen, Z.Y., Gan, X.J., Wu, J.H., Zhao, B., Ma, Z.J., Cheng, X.L., Jiang, L.F. & Chen, J.K. 2009. *Spartina alterniflora* invasions in the Yangtze River estuary China: an overview of current status and ecosystem effects. *Ecological Engineering 35: 511–520.*

35. Maclean, I.M.D., Rehfisch, M.M., Delany, S. & Robinson, R.A. 2008. *The Effects of Climate Change on Migratory Waterbirds within the African-Eurasian Flyway.* BTO Research Report 486. BTO, Thetford.

36. Lee, S., Lie, H.J., Song, K.M. & Cho, C.H. 2010. A tale of two coasts; tidal modification in Saemangeum and Isahaya. Pp. 91–109 in: Ishimatsu, A. & Lie, H.-J. (eds.) *Coastal Environmental and Ecosystem Issues of the east China Sea.* TERRAPUB/Nagasaki University.

37. Information received from the Americas workshop at the Numeniini Review.

38. Information received from the African-Eurasian workshop at the Numeniini Review.

39. Exo, K.-M., Hüppop, O. & Garthe, S. 2003. Birds and offshore wind farms: a hot topic in marine ecology. *Wader Study Group Bull. 100: 50-53.*

40. Hötker, H., Schrader, S., Schwemmer, P., Oberdiek, N., Blew, J., Evans, R. & Lass-Evans, S. 2010. Status threats and conservation of birds in the German Wadden Sea. NABU Technical Report, Druckhaus Berlin-Mitte, Berlin.

41. Busch, N. 2013. Personal communication (questionnaire response).

42. Information received from the Asian workshop at the Numeniini Review.

43. Lourenço, O. M., Kentie, R., Schroeder, J., Alves, J.A., Groen, N. M., Hooijmeijer, J. C. E. W. & Piersma, T. 2010. Phenology, stopover dynamics and population size of migrating Black-tailed Godwits *Limosa limosa limosa* in Portuguese rice plantations. *Ardea 98(1): 35-42.*

44. Alves, J.A., Lourenço, P.M., Piersma, T., Sutherland, W.J. & Gill, J.A. 2010. Population overlap and habitat segregation in wintering Black-tailed Godwits. *Bird Study 57: 381-391.*

45. Gunnarsson, T. G., Gill, J. A., Appleton, G. F., Gíslason, H., Gardarsson, A., Watkinson, A. R. & Sutherland, W. J. 2006. Large-scale habitat associations of birds in lowland Iceland: Implications for conservation. *Biological Conservation 128: 265-275.*

46. Dutson, G. 2011. Birds of Melanesia: Bismarcks, Solomons, Vanuatu and New Caledonia. Christopher Helm, London.

47. Gill, J.A., Langston, R.H.W., Alves, J.A., Atkinson, P.W., Bocher, P., Cidraes Vieira, N., Crockford, N.J., Gélinaud, G., Groen, N., Gunnarsson, T.G., Hayhow, B., Hooijmeijer, J., Kentie, R., Kleijn, D., Lourenco, P.M., Masero, J.A., Meunier, F., Potts, P.M., Roodbergen, M., Schekkerman, H., Schroder, J. Wymenga, E. & Piersma, T. 2007. Contrasting trends in two Black-tailed Godwit populations: a review of causes and recommendations. *Wader Study Group Bull. 114: 43-50.*

48. Perennou, C.P., Mundkur, T. & Scott, D.A. 1994. The Asian Waterfowl Census 1987–1991: distribution and status of Asian waterfowl. IWRB Spec. Publ. No. 24, AWB Spec. Publ. 86. Slimbridge, UK and Kuala Lumpur, Malaysia.

49. Jensen, F.P., Béchet, A. & Wymenga, E. (Compilers) 2008. *International Single Species Action Plan for the Conservation of Black-tailed Godwit Limosa l. limosa & L. l. islandica.* AEWA Technical Series No. 37. Bonn, Germany.

50. Verhulst J. 2007. *Meadow bird ecology at different spatial scales.* Responses to environmental conditions and implications for management. PhD thesis Wageningen University.

51. Kleijn, D., Schekkerman, H., Dimmers, W.J., van Kats, R.J.M., Melman, T.C.P. & Teunissen, W.A. 2010. Adverse effects of agricultural intensification and climate change on breeding habitat quality of Black-tailed godwits *Limosa l. limosa* in the Netherlands. *Ibis 152: 475–486.*

52. Schekkerman, H., Teunissen, W. & Oosterveld, E. 2008. The effect of 'Mosaic management' on the demography of black-tailed godwit *Limosa limosa* on farmland. *Journal of Applied Ecology 45: 1067–1075.*

53. Schekkerman, H., Teunissen, W. & Oosterveld, E. 2009. Mortality of shorebird chicks in lowland wet grasslands: interactions between predation and agricultural practice. *Journal of Ornithology 150: 133-145.*

54. Gunnarsson, T.G. 2013. Personal communication (questionnaire response).

55. Holm, T.E. & Laursen, K. 2009. Experimental disturbance by walkers affects behaviour and territory density of nesting Black-tailed Godwit *Limosa limosa. Ibis 151: 77-87.*

56. Höetker, H. 2013. Personal communication (questionnaire response).

57. Labutin, Y. V., Leonovitch, V. V. & Veprintsev, B. N. 1982. The Little Curlew *Numenius minutus* in Siberia. *Ibis 124(3): 302-319.*

58. Tomkovich, P. 2013. Personal communication.

59. Tugarinov, A.Y. 1932. Observations on birds of eastern Mongolia during an expedition of 1928. Proceedings Mongolian commission. USSR Academy of Science 1: 1-46. Leningrad (Russian).

60. la Touche, J. 1931-34. *A Handbook of the Birds of East China.* Vols. I-II. Taylor & Francis, London.

61. Sonsthagen, S.A., Tibbits, T.L., Gill, R.J., Williams, I., Talbot, S.L. 2014. Spatial genetic structure of bristle-thighed curlews (*Numenius tahitiensis)*: breeding area differentiation not reflected on the non-breeding grounds. *Conservation Genetics* - in press.

62. Barter, M.A., Tonkinson, D.A., Lu ,J.Z., Zhu, S.Y., Kong, Y., Wang, T.H., Li, Z.W., Meng, X.M. 1998. Shorebird numbers in the Huang He (Yellow River) delta during the 1997 northward migration. *Stilt 33, 15-26.*

63. Lane, B.A. 1987. *Shorebirds in Australia.* Nelson, Melbourne.

64. Bellio, M. 2013. Personal communication.

65. Garnett, S. & Minton, C. 1985. Notes on the movements and distribution of Little Curlew *Numenius minutus* in Northern Australia. *Australian Bird Watcher 11: 69-73.*

66. Barter, M.A. 2002. Shorebirds of the Yellow Sea: Importance, Threats and Conservation Status. Wetlands International Global Series 9, International Wader Studies 12, Canberra, Australia.

67. Collins, P. & Jessop, R. 2001. Arrival and departure dates and habitat of Little Curlew *Numenius minutus* at Broome, North-Western Australia. *Stilt 39: 10-12.*

68. Asian Wetland Bureau (AWB). 1993. A status overview of shorebirds in the East Asian-Australasian Flyway. Asian Wetland Bureau Internal Report 2.

69. Higgins, P. J. & Davies, S. J. J. F. 1996. *Handbook of Australian, New Zealand and Antarctic birds vol 3: snipe to pigeons.* Oxford University Press, Melbourne.

70. Chen, K.L., Li, Z.W., Barter, M., Watkins, D., Jun, Y. 1997. Shorebirds survey in China (1997). Wetlands International – China Programme, Beijing, China.

71. Centre for Conservation Biology press release http://www.ccbbirds.org/2014/01/07/hudsonian-godwits-go-long/

72. Barter, M.A., Tonkinson, D.A., Wilson, J.R., Li, Z.W., Lu,J.Z., Shan, K. & Zhu, S.Y. 1999. The Huang He delta - an important staging site for Little Curlew *Numenius minutus* on northward migration. *Stilt 34:11-17.*

73. Cooper, R., Clemens, R., Oliveira, N. & Chase, A. 2012. Long-term declines in migratory shorebird adundance in north-eat Tasmania. *Stilt 61: 19-29.*

74. Minton, C. 2013. Personal communication.

75. Bellio, M. G., Bayliss, P., Morton, S. & Chatto, R. 2006. Status and conservation of the Little Curlew *Numenius minutus* on its over-wintering grounds in Australia. In: Boere, G.; Galbraith, C., Stroud, D. (ed.), *Waterbirds around the world*, pp. 346-348. The Stationary Office, Edinburgh, UK.

76. Bamford, M.J. 1988. Kakadu National Park: a preliminary survey of migratory waders October/November 1987. RAOU (Royal Australasian Ornithologists Union) Report No. 60. RAOU, Melbourne, Australia.

77. Bamford, M.J. 1990. RAOU survey of migratory waders in Kakadu National Park: Phase III. RAOU Report No. 70. RAOU, Melbourne, Australia.

78. McKean, J.L., Shurcliff, K.S. & Thompson, H.A.F. 1986. Notes on the status of Little Curlew *Numenius minutus* in the Darwin area, Northern Territory. *Australian Bird Watcher 11: 259-260.*

79. Jaensch, R. 2004. Little Curlew and other migratory shorebirds on floodplains of the Channel Country, arid inland Australia, 1999-2004. *Stilt 46: 15-18.*

80. Bishop, K.D. 2003. A Review of the Avifauna of the TransFly Eco-region: the status, distribution, habitats and conservation of the region's birds. Report to WWF South Pacific Program.

81. Hassell, C. and Piersma, T. 2010. Record numbers of grasshopper-eating shorebirds (Oriental Pratincole, Oriental Plover, Little Curlew) on coastal West-Kimberley grasslands, Western Australia, in mid February 2010. *Stilt 57: 36-38.*

82. Reid, J.R.W., Kingsford, R.T. & Jaensch, R.P. 2009. Waterbird Surveys in the Channel Country Floodplain Wetlands, Autumn 2009. Report by Australian National University, Canberra, University of New South Wales, Sydney, and Wetlands International, Oceania, Brisbane, for the Australian Government Department of Environment, Water, Heritage and the Arts. 81 pp. Also available online at http://www.lebmf.gov.au/publications/pubs/waterbirds-report.pdf

83. Jaensch, R. 2013. Personal communication.

84. Eliot, I., Finlayson, C.M. & Waterman, P. 1999. Predicted climate change, sea-level rise and wetland management in the Australian wet-dry tropics. *Wetland Ecology and Management 7: 63–81.*

85. Boustead, A. 2009. *A review of the potential impacts of climate change upon Kakadu wetlands.* MTEM Thesis, Charles Darwin University.

86. Roberts, S. J. 1995. Fire on the Gapalg (Floodplain): contemporary aboriginal and other burning patterns in Kakadu National Park, Northern Australia, Proceedings 19th Tall Timbers Fire Ecology Conference. Fire in wetlands: a management perspective. Tallahassee, FL. Tall Timbers Research, Inc.,Tallahassee, FL. p. 31-38.

87. Vickery, P.D., Blanco, D.E. & Lopez-Lanus, B. 2010. Conservation plan for the Upland sandpiper (*Bartramia longicauda*). Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts.

88. Andres, B.A., Smith, P.A., Morrison, R.I.G., Gratto-Trevor, C.L., Brown, S.C. & Friis, C.A. 2012. Population estimates of North American shorebirds, 2012. *Wader Study Group Bull. 119(3): 178–194.*

89. Strum, K.M., Hooper, M.J., Johnson, K.A., Lanctot, R.B., Zaccagnini, M.E. & Sandercock, B.K. 2010. Exposure of migratory nonbreeding shorebirds to cholinesterase-inhibiting contaminants in the Western Hemisphere. *Condor 112:15-28.*

90. Senner, N.R. 2010. Conservation Plan for the Hudsonian Godwit. Version 1.1. Manomet Center for Conservation Science, Manomet, Massachusetts.

91. Elphick, C.S. & Klima, J. 2002. Hudsonian Godwit (*Limosa haemastica*). In The birds of North America, no. 629 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

92. Senner and Sandercock. In review.

93. Senner, N. 2013. Personal communication (questionnaire response).

94. Johnson, J. Personal communication (questionnaire response).

95. Gibson, D.D. & Kessel, B. 1989. Geographic variation in the Marbled Godwit and description of an Alaskan subspecies. *Condor 91: 436-443.*

96. Gratto-Trevor, C.L. 2000. Marbled Godwit (*Limosa fedoa*). In A. Poole, and F. Gill (Eds.). The Birds of North America, no. 492. The Birds of North America, Inc. Philadelphia, Pennsylvania.

97. Melcher, C.P., A. Farmer, and G. Fernández. 2010. Version 1.2. Conservation Plan for the Marbled Godwit (*Limosa fedoa*). Manomet Center for Conservation Science, Manomet, Massachusetts.

98. Gratto-Trevor, C.L. 2011. Connectivity in Willets and Marbled Godwits breeding in western Canada. *Wader Study Group Bull.* 118: 55–57.

99. Olson, B.E. 2011. *The biogeography of Marbled Godwit (*Limosa fedoa*) populations in North America.* MSc. thesis, Utah State University, Logan, UT, USA.

100. Morrison, R.I.G., McCaffery, B.J., Gill, R.E., Harrington, B.A., Skagen, S.K., Jones, S.L., Page, G.W., Gratto-Trevor, C.L. & Haig, S.M. 2006. Population estimates of North American shorebirds, 2006. *Wader Study Group Bull. 111: 67-85.*

101. Sauer, J.R., J.E. Hines, J.E. Fallon, K.L. Pardieck, D.J. Ziolkowski, Jr. & W.A. Link. 2011. The North American Breeding Bird Survey, results and analysis 1966–2010, version 12.07.2011. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD, USA.

102. Ruthrauff, D & Tibbitts, L. Personal communication (questionnaire response).

103. Environment Canada. Personal communication (questionnaire response).

104. Gretton, A. 1996. International action plan for the Slender-billed Curlew (*Numenius tenuirostris*). In: Heredia, B., Rose, L., Painter, M. (ed.), Globally threatened birds in Europe: action plans, pp. 271-288. Council of Europe, and BirdLife International, Strasbourg.

105. Buchanan, G., Crockford, N. & Gretton, A. 2010. The Slender-billed Curlew *Numenius tenuirostris* in Africa. *Bulletin of the African Bird Club 17(2): 202-206.*

106. Driscoll, P.V. & Ueta, M. 2002. The migration route and behaviour of Eastern Curlews *Numenius madagascariensis. Ibis 144: E119-E130.*

107. Watkins, D., R. Jaensch, D. Rogers & K. Gosbell. 2012. Unpubl. table of preliminary updated estimates of population size of selected shorebird species in the East Asian-Australasian Flyway based on trends in *The Action Plan for Australian Birds 2010* (Garnett *et al.* 2011).

108. Moores, N., D. Rogers, R.-H. Kim, C. Hassell, K. Gosbell, S.-A. Kim & M.-N. Park. 2008. The 2006-2008 Saemangeum Shorebird Monitoring Program Report. Birds Korea, Busan.

109. Kazansky, F. 2014. Personal communication (questionnaire response).

110. Dann, P. 2013. Personal communication (questionnaire response).

111. Gill, R. E., Canevari, P. & Iversen, E. H. 1998. Eskimo Curlew (*Numenius borealis*). In: Poole, A.; Gill, F. (ed.), The birds of North America, No. 347, pp. 1-28. The Academy of Natural Sciences and The American Ornithologists' Union, Philadelphia and Washington DC.

112. Gratto-Trevor, C and Rausch, J. 2014. Personal communication.

113. Delany, S., Scott, D., Dodman, T. & Stroud, D. (2009). An Atlas of Wader Populations in Africa and Western Eurasia. Wetlands International, Wageningen.

114. Cao, L., Zhang, J., Barter, M. and Lei, G. 2009. Anatidae in eastern China during the non-breeding season: geographical distributions and protection status. *Biol. Conserv. 143: 650-659.*

115. Kentie, R., Both, C., Hooijeijer, C.E.W & Piersma, T. 2014. Age-dependant dispersal and habitat choice in black-tailed godwits *Limosa limosa limosa* across a mosaic of traditional and modern grassland habitats. Journal of Avian Biology *45(4): 396-405.*

116. Thorup, O. (comp) 2006. Breeding Waders in Europe 2000. International Wader Studies 14. International Wader Study Group, UK.

117. Grant, M.C. 1997. Breeding curlew in the UK: RSPB research and implications for conservation. *RSPB Conservation Review 11: 67-73.*

118. Grant, M., Orsman, C., Easton, J., Lodge, C., Smith, M., Thompson, G., Rodwell, S. & Moore, N. 1999. Breeding success and causes of breeding failure of curlew *Numenius arquata* in Northern Ireland. *Journal of Applied Ecology 36: 59-74.*

119. Valkama, J. & Currie, D. 1999. Low productivity of Curlews *Numenius arquata* on farmland in southern Finland: Causes and consequences. *Ornis Fennica 76: 65-70.*

120. Berg, Ǻ. 1992. Factors affecting nest-site choice and reproductive success of Curlews *Numenius arquata* on farmland. *Ibis 134: 44-51.*

121. Taylor, R.C. & Dodd, S.G. 2013. Negative impacts of hunting and suction-dredging on otherwise high and stable survival rates in Curlew *Numenius arquata. Bird Study, 60:2, 221-228.*

122. Douglas, D.J.T., Bellamy, P.E., Stephen, L.S., Pearce-Higgins, J.W., Wilson, J.D., and Grant, M.C. 2014. Upland land use predicts population decline in a globally near-threatened wader. *J. Appl. Ecol. 51(1):194-203.*

123. Brown, D and Dereliev, S. AEWA international single species action plan for the conservation of the Eurasian Curlew *Numenius arquata. In prep.*

124. Jensen, F.P. & Lutz, M. 2006. Management Plan for Curlew (*Numenius arquata*) 2007-2009, Natura 2000 Technical Report-003-2007 under the Directive 79/409/EEC on the conservation of wild birds. Office for the Official Publications of the European Communities, Luxembourg.

125. Marks, J. S. & Redmond, R. L. 1994. Migration of Bristle-thighed Curlews on Laysan Island: timing, behaviour and estimated flight range. *Condor 96: 316-330.*

126. Gill, R. 1998. Trouble in paradise: the Bristle-thighed Curlew. *WWF Arctic Bulletin: 12-13.*

127. Collar, N. J., Gonzaga, L. P., Krabbe, N., Madroño Nieto, A., Naranjo, L. G., Parker, T. A. & Wege, D. C. 1992. Threatened birds of the Americas: the ICBP/IUCN Red Data Book. International Council for Bird Preservation, Cambridge, U.K.

128. Tibbits, L & Sowl, K. 2013. Personal communication (questionnaire response).

129. Vilina, Y. A., Larrea, A. & Gibbons, J. E. 1992. First record of Bristle-thighed Curlew *Numenius tahitiensis* in Easter Island, Chile. *Wader Study Group Bulletin 66: 43-44.*

130. Brooke, M. De L. 1995. The modern avifauna of the Pitcairn Islands. *Biological Journal of the Linnean Society 56: 199-212.*

131. Sandercock, B. 2013. Personal communication (questionnaire response).

132. Lesterhuis, A. 2013. Personal communication (questionnaire response).

133. Senner, N. 2012. The Effects Of Global Climate Change On Long-Distance Migratory Birds. PhD thesis. Cornell University.

134. Gallo-Orsi, U. & Boere, G. C. 2001. The Slender-billed Curlew *Numenius tenuirostris*: threats and conservation. *Acta Ornithologica 36: 73-77.*

135. Nagy, S. & Crockford, N. 2004. *Implementation in the European Union of species action plans for 23 of Europe's most threatened birds.* BirdLife International, Wageningen, The Netherlands.

136. BirdLife International. 2008. Slender-billed curlew quest. Available at http://www.birdlife.org/news/news/2008/12/sbc_launch.html

137. RSPB. 2010. Slender-billed Curlew Project Page. Available at: http://www.rspb.org.uk/ourwork/projects/details.asp?id=198450

138. S Marks, J.S., Redmond, R.L., Hendricks, P., Clapp, R.B. and Gill, R.E. 1990. Notes on longevity and flightlessness in Bristle-thighed Curlews. *Auk 107:779-791.*

139. Crockford, N. 2009. Can you help find the Slender-billed Curlew? *Wader Study Group Bulletin 116(1): 62-64.*

140. Buchanan, G. & Crockford, N. 2012. *in litt.*

141. Gretton, A. 1991. The ecology and conservation of the Slender-billed Curlew (*Numenius tenuirostris*). Cambridge, U.K.: International Council for Bird Preservation (Monogr. 6).

142. Graves, G. R. 2010. Late 19th Century abundance trends of the Eskimo Curlew on Nantucket Island, Massachusetts. *Waterbirds 33(2): 236-241.*

143. Roberts, D. L.; Elphick, C. S.; Reed, J. M. 2010. Identifying anomalous reports of putatively extinct species and why it matters. *Conservation Biology 24(1): 189-196.*

144. Schekkerman, H., Teunissen, W. & Oosterveld, E. 2005. Breeding productivity of Black-tailed Godwits under 'mosaic management' a new agri-environment scheme. Alterra-report 1291, Alterra, Wageningen (in Dutch with English summary).

145. Both, C., Schroeder, J., Hooijmeijer, J., Groen, N. & Piersma, T. 2006. The balance between reproduction and death of Black-tailed Godwits. *De Levende Natuur 107: 126–129.*

146. Roodbergen, M., Klok, C. & Schekkerman, H. (submitted). Adult survival of Black-tailed Godwits (*Limosal l. limosa*) in the Netherlands 2002–2005 does not explain the ongoing decline of the breeding population. *Ardea.*

147. Alves, J. 2013. Personal communication (questionnaire response).

148. Zwarts, L., Bijlsma, R.G., van der Kamp, J. & Wymenga, E. 2009. *Living on the edge: wetlands and birds in a changing Sahel.* KNNV Publishing, Zeist, the Netherlands.

149. Round, P. 2014. Personal communication.

150. Robin, F. 2013. Personal communication (questionnaire response).

151. Klein, D. 2013. Personal communication (questionnaire response).

152. Kleijn, D., van der Kamp, J., Monteiro, H., Ndiaye, I., Wymenga, E. & Zwarts, L. 2010. Black-tailed godwits in West African winter staging areas: Habitat use and hunting-related mortality. Alterra-report 2058, Alterra, Wageningen, The Netherlands.

153. Melville, D. 2013. Personal communication (questionnaire response).

154. Fellows, S. D. & Jones, S. L.. 2009. Status assessment and conservation action plan for the Long-billed Curlew (*Numenius americanus*). U.S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication, FWS/BTP-R6012-2009, Washington, D.C. http://www.fws.gov/mountain-prairie/species/birds/longbilled_curlew/, assessed 1 June 2014.

155. Jones, S. L., Nations, C. S., Fellows, S. D. & McDonald, L. J. 2008. Breeding abundance and distribution of Long-billed Curlew (*Numenius americanus*) in North America. *Waterbirds 31: 1-14, 2008.*

156. Dugger, B. D. and Dugger, K. M. 2002. Long-billed Curlew (*Numenius americanus*). In The Birds of North America, no. 628 (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, Pennsylvania and American Ornithologists' Union, Washington, D.C.

157. Saafeld, S. T, Conway, W. C., Haukos, D. A., Rice, M., Jones, S. L. & Fellows, S. D. 2010. Multiscale habitat selection by Long-billed Curlews (*Numenius americanus*) breeding in the United States. *Waterbirds 33: 148-161.*

158. Page, G.W., Warnock, N., Tibbitts, T. L., Jorgensen, D., Hartman, C. A. & Stenzel, L. E. 2014. Annual migratory patterns of Long-billed Curlews in the American West. *Condor 116: 50-61.*

159. Sauer, J.R., Link, W.A., Fallon, J.E., Pardieck, K.L., Ziolkowski, D.J.Jr. 2013. The North American Breeding Bird Survey 1966-2011: Summary Analysis and Species Accounts. *North American Fauna 79: 1–32.*

160. Butcher, G. S. and Niven, D. K. (2007) Combining data from the Christmas bird count and the breeding bird survey to determine the continental status and trends of North American birds. National Audubon Society.

161. Jones, S., Carlisle, J. & Howe, B. 2013. Personal communication (questionnaire response).

162. Warnock, N. 2013. Personal communication (questionnaire response).

163. Long-billed Curlew Conservation Action Plan. Available at: https://www.fws.gov/mountain-prairie/species/birds/longbilled_curlew/Table_2-1_AC-CP.pdf

164. Urban, E. K., Fry, C. H. & Keith, S. 1986. *The birds of Africa Vol. II.* Academic Press, London.

165. Morozov, V. 2000. Current status of the southern subspecies of the Whimbrel *Numenius phaeopus alboaxillaris* (Lowe 1921) in Russia and Kazakhstan. *Wader Study Group Bulletin, 92: 30-37.*

166. Snow, D. W. & Perrins, C. M. 1998. *The Birds of the Western Palearctic vol. 1: Non-Passerines.* Oxford University Press, Oxford.

167. Grant, M.C. 1991. Nesting densities, productivity and survival of breeding Whimbrel *Numenius phaeopus* in Shetland. *Bird Study 38: 160–169.*

168. Grant, M.C. 1992. The effects of re-seeding heathland on breeding whimbrel *Numenius phaeopus* in Shetland. I. Nest distributions. *Journal of Applied Ecology 29: 501–508.*

169. Grant, M.C., Chambers, R.E. & Evans, P.R. 1992. The effects of re-seeding heathland on breeding whimbrel *Numenius phaeopus* in Shetland. II. Habitat use by adults during the pre-laying period. *Journal of Applied Ecology 29: 509–515.*

170. Grant, M.C., Chambers, R.E. & Evans, P.R. 1992. The effects of re-seeding heathland on breeding whimbrel *Numenius phaeopus* in Shetland. III. Habitat use by broods. *Journal of Applied Ecology 29: 516–523.*

171. Wilke, A.L. & R. Johnston-González . 2010. Conservation Plan for the Whimbrel (*Numenius phaeopus*). Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts.

172. Boertmann, D. 2004. unpublished data.

173. Delaney, S. & D. Scott. 2002. Waterbird population estimates - Third Edition. Wetlands International Global Series No. 12, Wageningen.

174. Gunnarsson, T.G. & Katríndóttir, B. 2013. Personal communication (questionnaire response).

175. Perkins, A. 2013. Personal communication (questionnaire response).

176. Johnson, J.2013. Personal communication (questionnaire response).

177. van Roomen, M. 2013. Personal communication (questionnaire response).

178. Wymenga, E. 2013. Personal communication (questionnaire response).

179. Tate, D. 2013. Personal communication (questionnaire response).

180. Andres, B.A., Johnson, J.A. & Valenzuela, J. 2007. Whimbrels use novel high tide roosts during the contranuptial season in southern Chile. *Wader Study Group Bulletin 112: 67-68.*

181. Morozov,V. 2013. Personal communication (questionnaire response).

182. Wetlands International. 2014. *Waterbird Population Estimates.* Retrieved from wpe.wetlands.org on 25 Sep 2014.

183. Tomkovich, P. S. 2010. Assessment of the Anadyr Lowland subspecies of Bar-tailed Godwit *Limosa lapponica anadyrensis. Bull. B.O.C. 2010 130(2) pp 88-95.*

184. Marks, J.S. 1992. Molt of Bristle-thighed Curlews in the Northwestern Hawaiian Islands. *Auk 110:573-587.*

185. Brown, K. & Raal, P. 2013. Is eradication of *Spartina* from the South Island feasible? MS. Department of Conservation, New Zealand.

186. Gosbell, K. & Clemens, R. 2006. Population monitoring in Australia: some insights after 25 years and future directions. *Stilt 50: 162-175.*

187. Minton, C., Dann, P., Ewing, A., Taylor, S., Jessop, R., Anton, P. & Clemens, R. 2012. Trends of shorebirds in Corner Inlet, Victoria, 1982-2011. *Stilt 61: 3-18.*

188. Wilson, H., Kendall, B., Fuller, R., Milton, D. & Possingham, H. 2011. Analyzing variability and the rate of decline of migratory shorebirds in Moreton Bay, Australia. *Conservation Biology 25: 758-766.*

189. Köhler, P., Lachmann, L. & Urazaliyev, R. 2012. Numenius species and subspecies in west Kazakhstan. *Wader Study Group Bull. 120(1) 2013:1-10.*

190. Köhler, P. & Köhler, U. 1999. Extension of the known non-breeding range of the Bar-tailed Godwit in southern Africa: A major wintering site in Mozambique. *Vogelwarte 40 (1-2): 142-144.*

191. Watts, B. D. & Truitt, B. R. 2011. Decline of whimbrels within a mid-Atlantic staging area (1994-2009). *Waterbirds 34:347-351.*

192. Smith, F. 2014. Personal communication.

193. Choi, C.Y., Battley, P.F., Potter, M.A., Rogers, K.G., Ma, Z.J. 2014. Bird Cons Intl. *in press.*

194. Peng, H.B., Choi, C.Y., Melville, D.S., Bai, Q.Q., Na, J., Tan, K., He, P., Chen, Y. & Ma, Z.J. 2014. The decrease of food for Great Knots at Yalujiang coastal wetland in the northern Yellow Sea, China. Paper presented at the Australasian Shorebird Conference, 20-21 September 2014, Darwin, Northern Territory.

195. Melville, D.S., Chen, Y., Ma, Z.J., Jin, X. & Potter, M. 2014. DDT and other POPs - a continuing threat to waders in the Yellow Sea? Paper presented at the Australasian Shorebird Conference, Darwin, Northern Territory, Australia, 20-21 September 2014.

196. Zuo, J.C., Yang, Y.Q., Zhang, J.L., Chen, M.X. & Xu, Q. 2013. Prediction of China's submerged coastal areas by sea level rise due to climate change. Journal of Ocean University of China.

197. Gill, R. E., Douglas, D.C., Handel, C.M., Tibbitts, T.L. Hufford, G. & Piersma, T. 2014 Hemispheric-scale wind selection facilitates bar-tailed godwit circum-migration of the Pacific. *Animal Behaviour 90: 117-130.*

198. Philippart, C.J.M., van Aken, H.M., Beukema, J.J., Bos, O.G., Cadee, G.C., Dekker,, R. 2003. Climate-related changes in recruitment of the bivalve Macoma balthica. *Limnology and Oceanography 48: 2171-2185.*

199. Beukema, J.J., Dekker, R. & Jansen, J.M. 2009. Some like it cold: populations of the tellinid bivalve Macoma balthica (L.) suffer in various ways from a warming climate. *Marine Ecology Progress Series 384: 135-145.*

200. Poulin, R. & Mouritsen, K.N. 2006. Climate change, parasitism and the structure of intertidal ecosystems. *J Helminthology 80: 183-191.*

201. Riegen, A.C., Vaughan, G.R. & Rogers, K.C. 2014. Yalu Jiang Estuary Shorebird Survey Report 1999 - 2010. Yalu Jiang Estuary Nature Reserve, China and Miranda Naturalists' trust, New Zealand. 99 pp.

202. Ueta, M., Antonov, A., Artukhin, Y. & Parilov, M. 2002. Migration routes of Eastern Curlew tracked from far east Russia. *Emu 102: 345-348.*

203. Hale, R., Calosi, P., McNeill, L., Mieszkowska, N. & Widdicombe, S. 2011. Predicted levels of future ocean acidification and temperature rise could alter community structure and biodiversity in marine benthic communities. *Oikos 120: 661-674.*

204. Kurihara, H. 2008. Effects of CO2-driven ocean acidification on the early developmental stages of invertebrates. *Marine Ecology Progress Series 373: 275-284.*

205. Byrne, M. 2011. Impact of ocean warming and ocean acidification on marine invertebrates life history stages: vulnerabilities and potential for persistence in a changing ocean. *Oceanography and Marine Biology: An Annual Review 49: 1-42.*

206. Widdicombe, S. & Spicer, J.I. 2008. Predicting the impact of ocean acidification on benthic biodiversity: what can animal physiology tell us? *Journal of Experimental Marine Biology and Ecology 366: 187-197.*

207. Gazeau, F., Gattuso, J-P., Dawber, C., Pronker, A.E., Peene, F., Heip, C.H.R. & Middelburg, J.J. 2010. Effect of ocean acidification on the early life stages of the blue mussel *Mytilus edulis. Biogeosciences 7: 2051-2060.*

208. Hofmann, G.E., Barry, J.P., Edmunds, P.J., Gates, R.D., Hutchins, D.A., Klinger, T. & Sewell, M.A. 2010. The effect of ocean acidification on calcifying organisms in marine ecosystems: an organism-to-ecosystem perspective. *Annual review of Ecology, Evolution and Systematics 41: 127-147.*

209. Choi, C.-Y., P .F. Battley, M. A. Potter, K. G. Rogers, & Z. Ma. 2014. The importance of Yalujiang in the northern Yellow Sea to Bar-tailed Godwits *Limosa lapponica* and Great Knots *Calidris tenuirostris* during northward migration. *Bird Conservation International*, published online. doi:10.1017/S0959270914000124.

210. Conklin, J. R. & P. F,. Battley. 2011. Impacts of wind upon repeatable individual migration schedules of New Zealand bar-tailed godwits. *Behavioral Ecology 22: 854–861.*

211. Milton D, Minton C, & Gosbell K. 2005. Are populations of migratory shorebirds in the East Asian Australasian Flyway at risk of decline? Paper presented at the Status and Conservation of Shorebirds in the East Asian-Australasian Flyway; Proceedings of the Australasian Shorebirds Conference, 13-25 December 2003, Canberra, Australia. Wetlands International Global Series 18, International Wader Studies 17. Sydney, Australia.

212. McCafferty, B.J. & Gill, R.E. 1992. Antipredator strategies in breeding Bristle-thighed Curlews. *Amer. Birds 46: 378-383.*

213. Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. 2009. The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology 46: 1323-1331.*

214. Reichenbach M. 2001. Windenergie und Wiesenvögel-wie empfindlich sind die Offenlandbrüter? Windernergie und Vögel-Ausmaß und Bewältigung eines Konflikts. Tagungsband 2. *Fassung: 52-76.*

215. Marks, J.S. & Redmond, R.L. 1994. Conservation problems and research needs for Bristle-thighed Curlews *Numenius tahitiensis* on their wintering grounds. *Bird Conservation International 4: 329-341.*

216. Minton, C., Gosbell, K., Johns, P., Christie, M., Klaassen, M., Hassell, C., Boyle, A., Jessop, R. & Fox, J. 2013. New insights from geolocators deployed on waders in Australia. *Wader Study Group Bull. 120(1): 37–46.*

217. Olson, B.E., Sullivan, K.A. & Adrian H. Farmer, A.H. 2014. Marbled Godwit migration characterized with satellite telemetry. *The Condor 116(2):185-194.*

218. Kelly, P. R. & Cogswell, H. L. 1979. Movements and habitat use by wintering populations of Willets and Marbled Godwits. *Studies in Avian Biology, 2, 69-82.*

219. Gombobaatar, S. 2014. Personal communication.

220. Gombobaatar, S. & Monks, E.M. (compilers), Seidler, R., Sumiya, D., Tseveenmyadag, N., Bayarkhuu, S., Baillie, J. E. M., Boldbaatar, Sh. & Uuganbayar, Ch. (editors) (2011). Regional Red List Series Vol.7. Mongolian Red List of Birds. Zoological Society of London, National University of Mongolia and Mongolian Ornithological Society. 1036 pp.

221. Senner, R. 2012. One Species but Two Patterns: Populations of the Hudsonian Godwit (*Limosa haemastica*) Differ in Spring Migration Timing. *The Auk, 129(4):670-682.*

222. Senner, N, Hochachka, W.M., Fox, J.W. & Afanasyev, V. 2014. An Exception to the Rule: Carry-Over Effects Do Not Accumulate in a Long-Distance Migratory Bird. *PLoS ONE 9(2): e86588. doi:10.1371/journal.pone.0086588*

223. Walker, B.M., Senner, N.R., Elphick, C.S., Klima, J. 2011. Hudsonian Godwit (*Limosa haemastica*). In Poole A, editor. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Available online at http://bna.birds.cornell.edu/bna/species/629. Accessed 8 September 2013.

224. Aleskey Antonov, A. 2014. Personal communication.

225. Trolliet, B. Enigmas about Whimbrel Numenius phaeopus in the East Atlantic Flyway. Waterbirds around the world: A global overview of the conservation, management and research of the world's waterbird flyways. p 363. The Stationery Office, Edinburgh, UK.

226. Jóhannesdóttir, L., Arnalds, O., Brink, S. & Gunnarsson, T.G. 2014. Identifying important bird habitats in a sub-arctic area undergoing rapid land-use change. *Bird Study*, DOI: 10.1080/00063657.2014.962481.

227. Danny Rodgers, D. 2014. Personal communication.

228. Reid, T & Park, P 2003, Continuing decline of Eastern Curlew, *Numenius madagascariensis*, in Tasmania. *Emu* 103: 270 – 283.

229. Minton, C., Jessop, R., Collins, P. & Standen, R. 2011. The migration of Eastern Curlew to and from Australia. *Stilt 59: 6-16.*

230. Nebel, S., Rogers, K.G., Minton, C.D.T. & Rodgers, D.I. 2013. Is geographical variation in the size of Australian shorebirds consistent with hypothesis on differential migration? *Emu 113(2): 99-111.*

231. Glover, H.K., Weston, M.A., Maguire, G.S., Miller ,K.H. & Christie, B.A. 2011. Towards ecologically meaningful and socially acceptable buffers: response distances of shorebirds in Victoria, Australia, to human disturbance. *Landscape and Urban Planning 103*: 326-334 doi:10.1016/j.landurbplan.2011.08.006.

232. BirdLife International and NatureServe. 2013. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.

233. Antonov, A.I. 2010. Nesting ecology of the eastern curlew *Numenius madagascariensis* in the south of the species range. *Russian Journal of Ecology 41: 345:356.*

234. Bird records from the Foundation Voorne Bird Observatory website: http://www.radioactiverobins.com/snipes-waders/steppe%20curlews%20num%20arq%20sschkini.htm

235. Bird records from the Oriental Bird Club website: http://orientalbirdimages.org/birdimages.php?action=birdspecies&Bird_ID=1224&Bird_Image_ID=68023&Bird_Family_ID

236. Degtyaryev, V. . 2014. Personal communication.

237. Haig, S.M., Gratto-Trevor, C.L., Mullins, T.D. & Colwell, M.A. 1997. Population identification of western hemisphere shorebirds throughout the annual cycle. *Molecular Ecology 6: 413-427.*

238. Óskarsson, H. 1998. Framræsla votlendis á Vesturlandi. In Ólafsson, J. S. (ed.) Íslensk votlendi – verndun og nýting: 121–129. University of Iceland Press, Reykjavík.

239. Trolliet, B. 2011. Whimbrel (Numenius phaeopus) National Management Plan (2012-2016).