Towards a flyway conservation strategy for waders

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Waterfowl migratory flyways are one of the world's biological wonders. Their maintenance and enhancement should be a global conservation priority. There have been, and are, a great variety of local, national and international conservation initiatives and actions that contribute towards conserving migratory waterfowl. Many vital places on wader flyways continue, however, to be degraded and destroyed directly or indirectly by human activities. To put in place a unifying flyway conservation programme a number of key preliminary steps are needed These include identifying and filling gaps in knowledge of how waders use the flyways; identifying when and where human activities have an adverse impact; quantifying such impacts and filling gaps in knowledge; and identifying the current level and efficacy of conservation action along flyways. Based on existing information, the paper describes examples of flyway research and conservation and identifies known gaps in knowledge. Examples are drawn largely from the East Atlantic flyway but most are just as relevant to wader flyways worldwide. Suggestions for taking forwards a co-ordinated programme for wader flyway conservation are made.

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INTRODUCTION

There is considerable worldwide interest in the field of waterfowl biology. Our knowledge of such aspects of a bird's life cycle as reproductive biology, moulting and migratory strategies increases with each year. In our pursuit of scientific ideal we should not, however, lose sight of the fact that bird migratory flyways are one of the biological wonders of the world. They are a living reminder that we all inhabit one planet and that what may seem to be local actions can have consequences for the environments of other biotopes and in other hemispheres.

Migrant waders make some of the most spectacular of these migrations, often travelling non-stop in flights of several thousand kilometres. Our interest in the detail of their annual cycles in relation to migrations is thus both justified and, in world conservation terms, one of our highest priorities.

Whilst taking great satisfaction from our common and necessary interest in the detail of what makes up the flyway there is a grave danger that we lose sight of the whole picture. In the UK and mainland western Europe much work has been done to promote the conservation of estuaries and coastal wetlands, the wintering grounds of so many of the same East Atlantic flyway bird populations as breed in eastern Europe and northern Asia. Indeed these migratory bird populations and their use of international networks of sites have often been a major element in the development of conservation measures for wetland ecosystems and their wildlife.

These coastal wetlands in western Europe of course form just one part of the links in the chain that makes up the East Atlantic flyway jigsaw. There are similar flyways around and through most other parts of the world (see Davidson & Pienkowski 1987), and similar suites of coastal and inland wetlands, and drier habitats in urgent need of safeguard.

Although much conservation effort is expended at local and national levels, for conservationists to be successful in the objective of maintaining and enhancing the bird populations that use flyways a more holistic vision is required. It is the nature of virtually all major flyways to cross many countries and for birds to utilise different habitats at different times of year. Such habits make standard approaches to research and conservation difficult. Conservation law and its implementation is applied unevenly and levels of research interest patchy. Effective flyway understanding and conservation can be achieved only by an integrated approach along the whole flyway, and perhaps also between flyways. Such an approach requires considerable commitment and co-ordination, but is essential.

It is no longer sufficient to consider the links in the flyway chain in isolation. Research in basic biology, the extent and impact of threats, and the conservation, protection and enhancement of species and habitats are all essential to the maintenance of the flyway.

In this short paper we seek to identify the needs to make whole flyway conservation a reality, and to move towards a structure co-ordinating our activities in the future that will deliver the ultimate aim - the safety, maintenance and

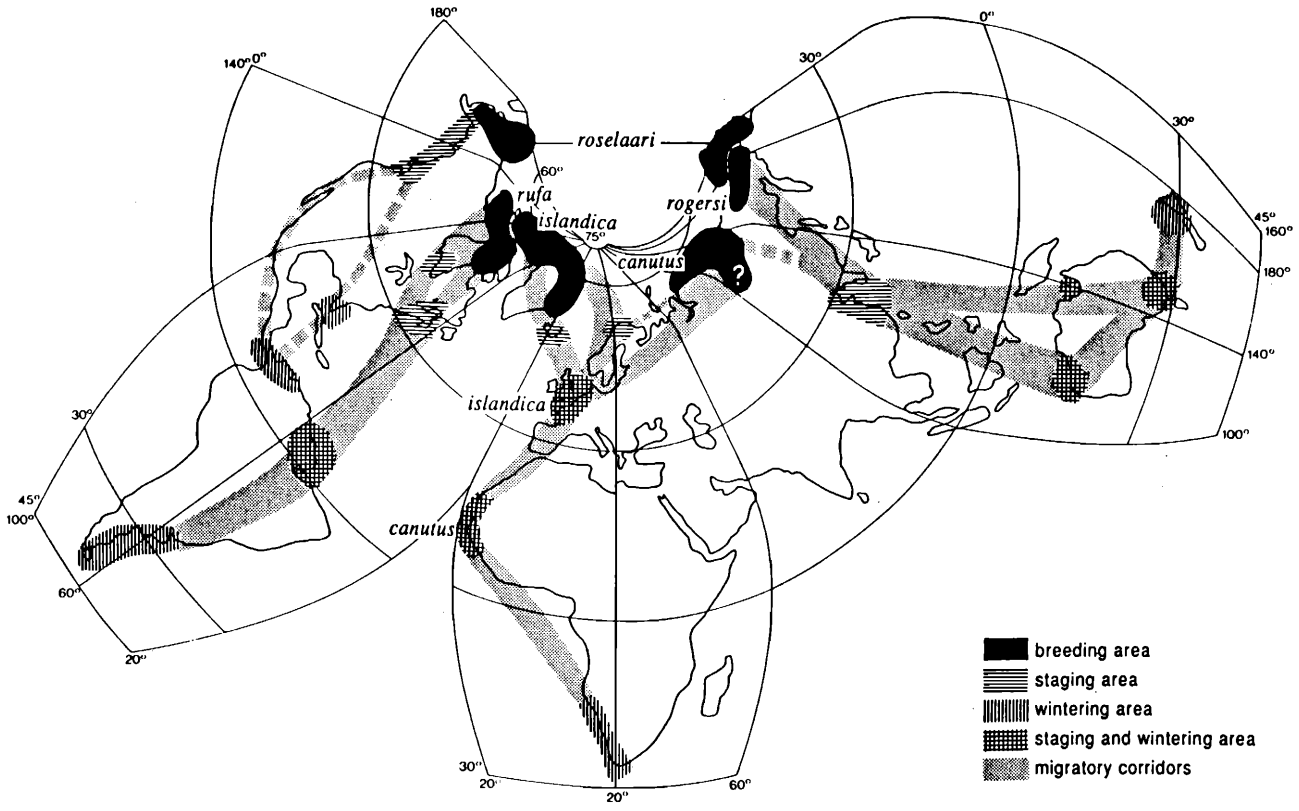


Figure 1. Even for well-researched waders with simple migration systems parts of the worldwide flyway network are poorly established: a recent review of the current knowledge of the migration system of the Knot *Calidris canutus* (Davidson & Piersma 1992) shows that many uncertainties about migration routes remain.

enhancement of migratory bird populations and the habitats upon which they depend throughout the world. Although we will draw examples of the needs and processes of wader flyway conservation largely from the East Atlantic flyway, the approach is largely applicable also to other flyways worldwide.

INFORMATION NEEDS

To put in place effective flyway conservation action, we need several types of information about the flyways and the way in which wader species and assemblages use them. To provide this information we need the answers to several questions that can be grouped into three broad categories, summarised as:

Basic biology

a. Where are the sites used?

b. What is the ecology and population dynamics of the wader species?

c. What role does each site play in the annual cycles of each species?

d. How is each site related to the usage of other sites in the flyway?

e. What features of each site determine how it is used?

Threats and opportunities

a. What pressures threaten continued usage of each site?

b. What are current constraints on site use by waders?

c. How can be, and are, sites modified, and what are the consequences of these modifications?

d. How can this knowledge be best used to develop and implement flyway conservation programmes?

Conservation actions

a. What level of conservation law provision exists in different countries along a flyway?

b. How can this conservation law be used to deliver national actions and international co-operation?

c. How does site-based conservation fit into the broader needs of dispersed species?

d. How can the flyway conservation needs of waders be linked with the sustainable use and development of their habitats?

e. How can conservation provision for wader flyways be enhanced, especially where weak?

Although some of these questions are deceptively simple, as we describe below they can be very complex to answer. Nevertheless to provide clear and strong arguments for conservation action to safeguard waders' needs, increasingly detailed understanding of how and why nationally and internationally important populations

of waders use their flyways, and what pressures and impacts affect this usage.

Much action is directed towards individual sites on a flyway - it is often information on the links between sites (and flyways) that is most difficult to gather and so least known. Furthermore it is important also to consider individual sites of identified high importance for migratory wader populations within the wider matrix of the relevant ecosystems, since some wader populations are widespread around the resource (see *e.g.* Davidson *et al.* 1991; Davidson & Stroud 1995).

Conservation programmes, at both national and international levels, are generally directed towards the safeguarding of individual sites, sometimes within a broader framework of sympathetic land-use action. Conservation of flyway populations of waders can be, and often is, approached through the general safeguard of sites used by the flyway wader assemblage. However, since each wader species has a different set of requirements, and uses a different suite of sites, it is also essential to understand flyway usage by individual species and populations. This poses challenges for assessing how and whether sustainable development of wetland habitats can be consistent with flyway wader conservation.

THE BASIC BIOLOGY

To achieve a successful programme of conservation and management of any biological system, species or habitat, a depth of knowledge of the mechanics of the system is a prerequisite. In 1987 the Wader Study Group reviewed the current state of our broad knowledge of wader flyways (Davidson & Pienkowski 1987). This revealed that although much has been discovered in recent years about the distribution and patterns of usage of wader flyways there remained substantial gaps in knowledge for all flyways. This is particularly so when considering the detail of migration routes, the interdependence of wintering sites, and the breeding biology and distribution of many species. Further reviews of flyways and reserve networks for various groups of waterbirds appear in Boyd & Pirot (1989) and Salathé (1991a).

There has perhaps been more extensive and detailed investigation of the East Atlantic flyway than for any other wader flyway, and there have been further discoveries and review of wader usage of this flyway (*e.g.* Smit & Piersma 1989) since the reviews in Davidson & Pienkowski (1987), but startlingly large gaps remain even here.

International assessments have been generally restricted to single flyways and broad patterns of usage by individual species or populations within a flyway. Yet to set conservation priorities in context and to stimulate conservation action more comprehensively we need also to understand worldwide flyway occurrence and use by the relevant species. Few such assessments have been made in detail (but see Hunter *et al.* 1991; Lane & Parish 1991; Gill *et al.* 1994).

As a follow-up to the broad assessment of flyway conservation for waders (Davidson & Pienkowski 1987), the Wader Study Group has more recently published a worldwide review of the migration systems of one wader species, the Knot *Calidris canutus* (Piersma & Davidson 1992), a species chosen because it is generally considered to have a simple migration system (Figure 1) and to be amongst the best known migrant waders. Certainly the Knot has been the target of a great deal of interest and research over the last 20 years. This review has permitted a comparative assessment of key characteristics in each subspecies and also allows an appraisal of the extent to which our current knowledge can contribute to the development of flyway conservation action (Table 1).

Table 1. Is knowledge of the key features of flyway use by Knots *Calidris canutus* sufficient for developing conservation action?

	subspecies				
Topic	*canutus*	*islandica*	*rufa*	*rogersi*	*roselaari*
Population size & trend	☺☺	☺☺☺	😐	😐	😐
Breeding location	☺☺	☺☺	☺☺	😐	😐
Non-breeding location	☺☺	☺☺☺	☺☺	☺☺	😐
Site roles & links	☺☺☺	☺☺	😐	😐	☹
Key features of sites	☺☺☺	☺☺☺	☺☺	😐	☹
Pressures on sites	☺☺☺	☺☺☺	😐	😐	☹
Constraints on site use	☺☺	☺☺	😐	😐	☹

Level of knowledge: ☺☺☺ good, ☺☺ fair, 😐poor, ☹ none.

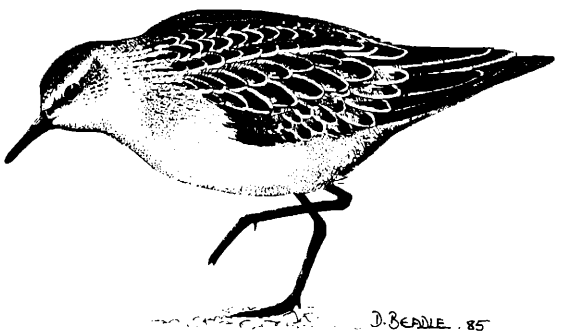
The results are alarming: the only subspecies for which levels of knowledge appear broadly adequate for developing conservation action are the two (*canutus* and *islandica*) using the East Atlantic flyway, and even for these there remain uncertainties about some of the most basic information including population sizes and trends,

and the location of breeding grounds. For other subspecies knowledge is even poorer and for one (*roselaari* - probably the scarcest subspecies) almost nothing is known. If gaps of this magnitude exist for a well-researched wader species then it follows that similar or greater gaps exist in the knowledge of how other individual species and populations use flyways.

This paper seeks not to identify all such gaps but merely to identify the need to address this issue in a co-ordinated fashion. There is a clear need for further review of the current state of our knowledge of wader flyways and their species. In addition such a review should set out to identify those gaps in our knowledge of these flyways and species. In particular such a review should set out to identify those gaps in our knowledge that hold back the process of flyway conservation. Only following this last step can we then start to set priorities for filling gaps either through guidance to rather *ad hoc* continued efforts or through a co-ordinated and funded programme of research, whichever is appropriate to the urgency of need and availability of resources.

For waders, the Wader Study Group can play an invaluable role (especially through its rôle as the IWRB Wader Research Group) in providing a forum for bringing together information from wader-workers worldwide and making it available to an international audience through publication of its *Bulletin*, *Bulletin Supplements*, and new publication series *International Wader Studies (IWS).* Special volumes such as those providing first estimates of the size of breeding wader populations in Europe (Piersma 1986), summarising international flyway conservation (Davidson & Pienkowski 1987), reviewing the status of waders breeding on European wet grasslands (Hötker 1991), and the migration of Knots (Piersma & Davidson 1992) provide focused information to answer the basic questions underlying conservation strategy development.

Likewise there is a very important source of this key basic information about the location of sites and wader populations in the international wader and waterfowl count programmes and databases co-ordinated by the International Waterfowl and Wetlands Research Bureau (IWRB), the most recently established being the Neotropical Wetlands Census (NWC). In addition the various national and supranational count and population indexing programmes such as the JNCC/RSPB/BTO Birds of Estuaries Enquiry in the UK (*e.g.* Prater 1981; Kirby *et al.* 1992) and (Meltofte *et al.* 1994) for the international Wadden Sea provide the essential basis for developing conservation programmes.



Red-necked Stint

THREATS TO THE SYSTEM - AND OPPORTUNITIES

Knowledge of the basic biology of the flyway, their species and habitats is also essential to this second element of our suggested approach. To reach our ultimate goal of flyway conservation, maintenance and enhancement, we have to acknowledge and understand the pressures that are being placed on the system both naturally and through the activities and impact of people. Recent analyses of patterns of human activity on the estuarine wintering grounds of waders and wildfowl in Britain indicate alarming extents of habitat loss and the frequency of occurrence of a wide variety of potentially damaging human activities (Davidson *et al.* 1991). Not only has, for example, at least 25% of Britain's estuarine habitat been destroyed during the last 2,000 years but such piecemeal land-claim for a wide variety of human uses is continuing (despite the many conservation designations applied to estuaries) at an apparently little diminished rate. This affects many of the estuaries of great importance for migrant and wintering waders.

The results of such survey work gives considerable concern when examining a flyway as a whole and assessing its future. It is the nature of bird migration to be so dependent on chains of suitable sites that pressure points or bottle-necks will occur naturally. The safeguarding of these places is vital to the maintenance of the whole system (Lane & Parish 1991).

As the area of suitable habitat for waders becomes progressively reduced the many continuing human activities are compressed into smaller and smaller areas. Furthermore many of these activities are themselves apparently increasing in scale. This leads to increasing potential pressure from 'traditional' uses such as shell-fisheries and bait-digging as well as the wide variety of recreational activities. Rather little is known in detail about the effects and impacts such as disturbance to waders but a *Wader Study Group Bulletin Supplement* (Davidson & Rothwell 1993) provides a summary of the current limited knowledge of recreational disturbance to waders in north-west Europe.

Such comprehensive survey assessments as Davidson *et al.* (1991) have been made elsewhere, especially in the USA (*e.g.* Tiner 1984), but are not yet consistently available for other major parts of flyways. It is clear, however, that similarly great impacts of human-generated habitat loss and degradation is widespread throughout many parts of the world (see *e.g.* Lane 1987; Smith *et al.* 1987; Bildstein *et al.* 1991; Biber & Salathé 1991; Finlayson & Moser 1991; Hunter *et al.* 1991; Lane & Parish 1991).

We require a comprehensive examination of the activities that could potentially have an adverse impact on migratory bird populations on the flyway. It is essential that we can assess the likely impact of humans, both through their existing activities and via the effects of changes in our use of habitats. Such a programme of investigation could involve also all-encompassing problems such as global warming. How will this affect bird distribution? Will areas

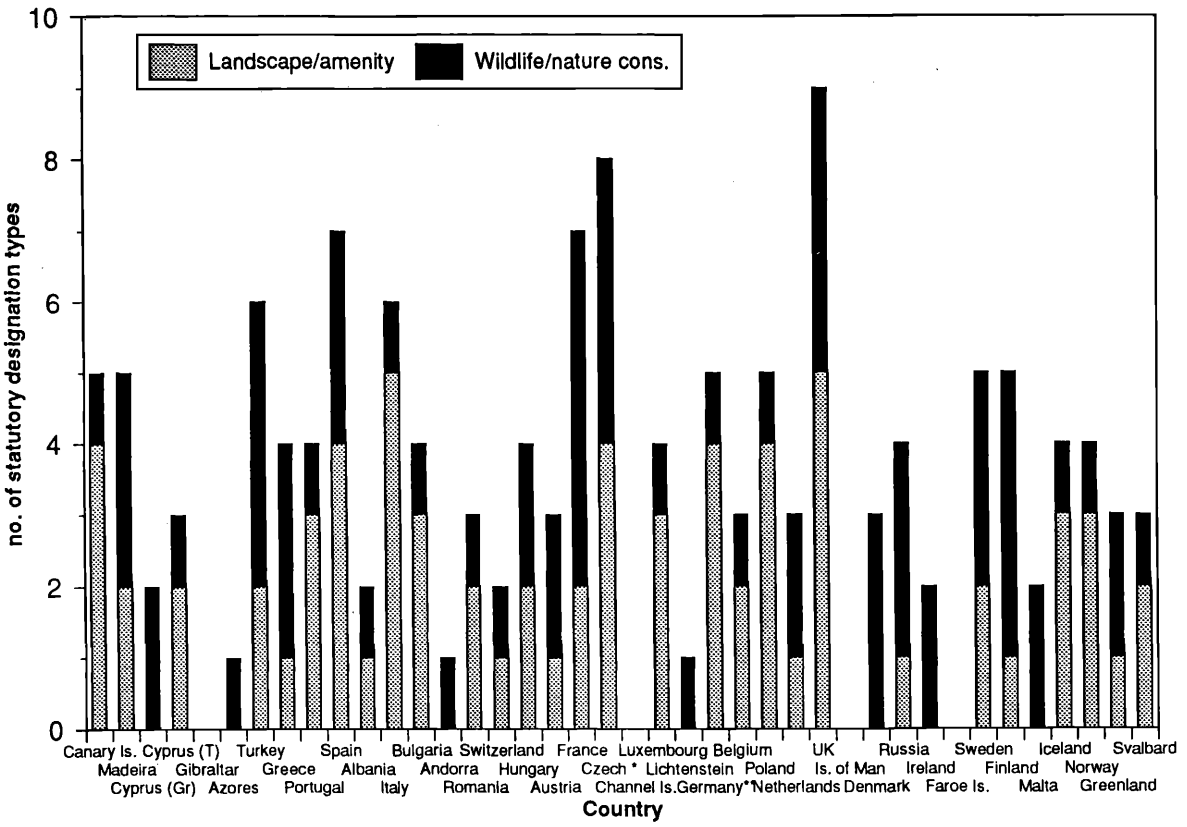


Figure 2. The number of different types of domestic statutory wildlife and landscape conservation site designations in each European country (derived from information in Grimmett & Jones 1989).

and locations of breeding and wintering habitats change, through for example inundation of tidal flats by rising sea-levels and constriction of Arctic tundra breeding areas consequent on possibly altering Arctic climate? Over long time-periods major natural population declines in arctic-breeding species have been linked to the periods of Pleistocene glaciation, when the area of suitable breeding habitat would have been severely restricted (Baker *et al.* 1994), but will additional human pressure artificially depress the size of populations so making them less able to survive periods of natural stress?

On a smaller scale we should be quite clear as to the impact of exploitative activities like shellfish harvesting (an activity that has recently caused substantial impact on waders and wildfowl in the hugely important international Wadden Sea - C. Smit, pers. comm.), tidal power, 'amenity' and storm surge barrages, waste disposal and pollutant discharge, dock and harbour construction, marina and recreational developments, channel dredging, and drainage of inland wetlands.

For an activity such as shellfish farming and harvesting we need to know how damaging this is to wintering bird populations. The Ramsar Convention requires 'wise use' of our wetlands, so we need to know to what extent such activities are 'wise' in the sense of ensuring sustainable use of the ecosystem. Is there a sustainable level of harvesting that provides for birds as well as for people? Are some harvesting methods more damaging than others? Is there a consistency of effect and impact of the activity on waders in different parts of their flyway perhaps dependent on densities of birds, or is such impact entirely site-specific?

Finally, on a very small scale, how does piecemeal small land-claim or recreation or shooting impact on birds? Answering such a question can require detailed research in each location, but at least in the UK there have as yet been few impact studies for which there is adequate 'before and after' data with which to make an assessment For some countries collecting such site-specific information may not be practicable so we need detailed studies undertaken in such a way as to provide general principles applicable elsewhere.

It is essential that we are able to answer questions such as these if we are to understand human impact on the flyway, and use this understanding to direct effort towards reducing any impacts found to be adverse. As with the basic biology there will be clear steps in the process. There is a need to identify what is known and what is required to be investigated. There is also a need to set out to fill the gaps in our knowledge in a co-ordinated and planned fashion to provide maximum benefit to achieving conservation and management goals. International co-operation means that not everyone has to 'invent the same wheel': general studies made in one country can be applicable also to others. This results in the cost-effective use of the limited resources available for conservation science.

In addition it is vital to consider the patterns of impact of human activities on migratory birds such as waders in the broader context of the impact on the habitats on which such birds depend, and to understand the human impacts on the many other wildlife features of these places. Developing an effective conservation programme for these habitats is the mechanism through which international measures such as the 'Ramsar' Convention

and the EEC Directive on the Conservation of Wild Birds are effected. In Europe these measures provide safeguard for much larger areas of some habitat types than will sites selected for their intrinsic habitat importance under the EC Directive on the Conservation of Natural Habitats and Wild Flora and Fauna (Davidson & Stroud 1995).

Understanding impacts on habitats and developing conservation safeguards for these places thus underpins the safeguard of migratory waders. Waders and other migratory waterfowl are very valuable linking international networks of these sites, and the continued presence of all of these network sites are essential for safeguarding the populations.

CONSERVING FLYWAY POPULATIONS OF WADERS

Many countries have developed considerable programmes of conservation effort that include safeguarding migratory waders and their habitats. Some of the site-based designations and broader-based land use and management are operated through domestic legislation. Others are implemented through the application of non-statutory safeguard such as nature reserves managed by voluntary conservation bodies such as, in the UK, the Royal Society for the Protection of Birds (RSPB).

Many countries on wader flyways also apply domestic conservation measures in response to international conventions such as Ramsar, Berne and Bonn, or international law such as the European Communities' Directive on the Conservation of Wild Birds, and the more recent Directive on the Conservation of Habitats and Species. Other international measures derive from bilateral agreements between countries sharing migratory bird populations (see Biber-Klemm 1991).

One international wader conservation mechanism, the Western Hemisphere Shorebird Reserve Network (WHSRN) has become a highly successful international non-statutory mechanism for raising support and awareness of the importance of key wetland sites on the flyways of American waders since its inception in 1985 (WHSRN 1990; Hunter *et al.* 1991). WHSRN now has four categories of reserves: *hemispheric, international, regional,* and *endangered species.* By 1991 there were 12 hemispheric, four international and one regional WHSRN reserves covering about 1.5 million ha and supporting 30 million shorebirds. Reserve membership is entirely voluntary. Central to the network is the understanding that the conservation and management of shorebird habitat remains the responsibility of the inhabitants of the region in which the reserve is located. Within this structure there are three levels of site participation - *certified sites, dedicated sites,* and *secured sites* - affording increasing levels of voluntary and sometimes statutory safeguard.

Table 2. International conservation measures and agreements relevant to waders and their habitats.

A. Worldwide
- Ramsar Convention (1971)
- World Heritage Convention (1972)
- CITES (1973)
- Bonn Convention (1979)

B. Europe/Africa/West Asia
- Berne Convention (1979)
- EEC Wild Birds Directive (1979)
- African Convention (1968)
- EEC Habitats and Species Directive (1992)
- African/Eurasian Waterbird Agreement (Bonn Convention) (1995)

C. East Asia/Australasia
- Bilateral agreements:
- USA, Japan, China, Australia, India, ex-USSR
- *e.g.* JAMBA (Japan-Australia Migratory Birds Agreement)

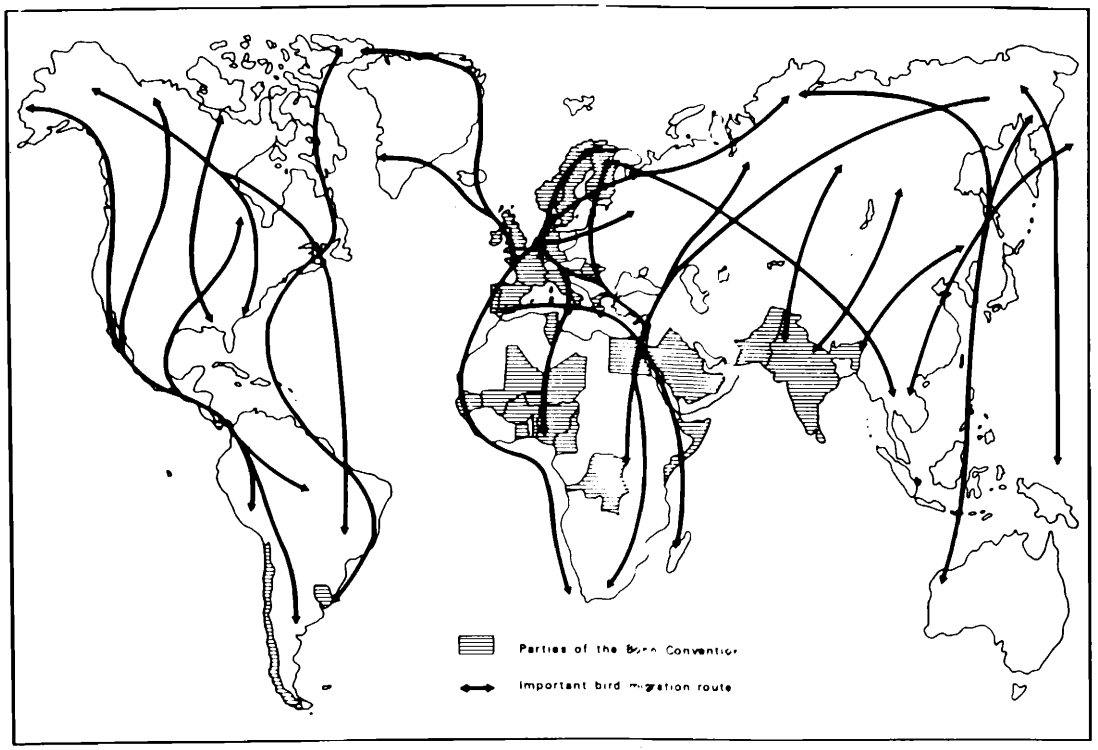
D. Americas
- Protection of Migratory Birds Convention (1916)
- Protection of Migratory Birds & Game Mammals Convention (1936)
- Western Hemisphere Convention (1940)
- US-Japan Migratory Birds Convention (1976)
- US-USSR Migratory Birds Convention (1976)
- Western Hemisphere Shorebird Reserve Network (WHSRN) (1985)
- North American Waterfowl Management Plan (NAWMP) (1986)

There are thus rather numerous international commitments relevant to waders made by countries throughout the world. These main international designations are listed in Table 2. Most measures lead to the identification and/or formal designation of sites important to waders during their annual cycle, and some require that these sites are the subject of special safeguards within a broader matrix of measures to safeguard birds throughout their range and commitments to the sustainable use of wetlands and their birds.

In a single country there can also be a multiplicity of domestic site safeguard measures. These include:

- statutory wildlife designations which in part are designed to implement the international commitments listed above;
- non-statutory wildlife designations, some of which are sites owned or managed by voluntary conservation bodies; and
- a variety of statutory and non-statutory landscape designations, which provide for management safeguards in places of importance to migratory waders.

There are, for example, at least 18 different wildlife and landscape conservation measures (some statutory, some voluntary) relevant to the conservation of migratory wader sites in Britain (Davidson *et al.* 1991). Many of these have a complex relationship of overlapping boundaries and are selected, designated and managed by many



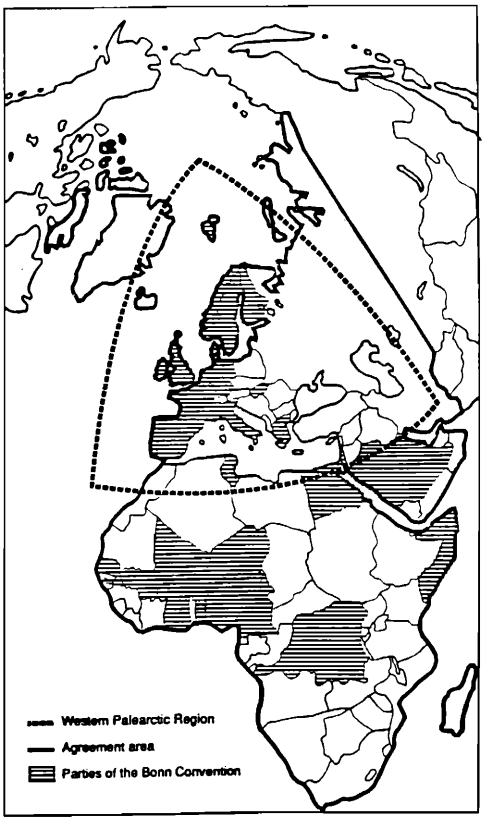


Figure 3. a). Parties to the Bonn Convention and the most important migration routes (from Boere 1991); and b). the agreement area for the proposed Western Palearctic Waterfowl Agreement (WPWA), from the Netherlands Ministry of Agriculture, Nature Management and Fisheries (1991) between range states of the Bonn Convention.

different organisations. Most countries in Europe have several categories of statutory wildlife and landscape conservation measures, although the diversity and type of designation varies considerably (Figure 2).

The development and implementation of both international and domestic conservation programmes for migratory waders is not, however, uniform throughout the flyways of the world. Not all countries have joined even the most worldwide of conventions such as the 'Ramsar' convention or the Bonn Convention (Figure 3), although states can be party to the Bonn Convention without full membership being in place. Legally binding directives such as those from the European Commission apply to only part of the range of most migratory wader populations during their annual cycle - for example only the wintering and/or staging areas of arctic-breeding species. Furthermore the application of common conventions can differ from place to place with differences either in application, or in interpretation, of international law and convention (Biber-Klemm 1991).

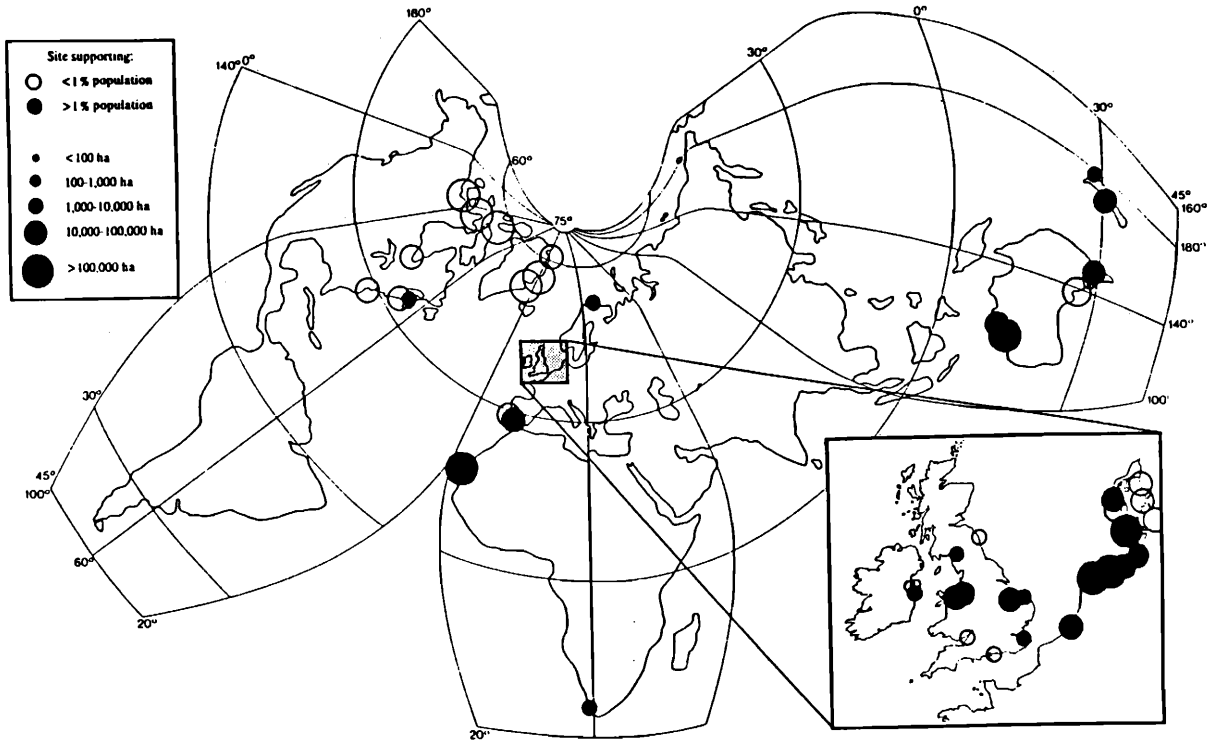


Figure 4. The distribution and size designated Ramsar sites (wetlands of international importance) that regularly support more than 100 Knots. Filled symbols show sites that are internationally important for a Knot population (*i.e.* the site supports >1% of a biogeographical population). Note that some sites support Knots in more than one season, some support populations of both *canutus* and *islandica* Knots, and some provide only partial coverage for the coastal sites used by Knots.

Little assessment has yet been made of the consequences of all this variability on the extent to which wader flyways or individual wader species are afforded safeguard throughout their annual cycle. Stroud *et al.* (1990) have assessed the extent to which bird populations, including many waders, would be included in the proposed Special Protection Area network (EEC Birds Directive) in Great Britain. Davidson & Piersma (1992) have recently made a first assessment of the way in which designations of wetlands of international importance have been applied to each Knot subspecies at different times of year (Figure 4). This shows clearly that there are very great differences in the extent to which Ramsar site designations have been made for different subspecies, for different times of year (breeding grounds are particularly poorly covered) and for different stages of the annual cycle of a single subspecies.

A broader assessment for Knots worldwide of the proportion of each subspecies at each stage in its annual cycle that is afforded some form of conservation safeguard (domestic and/or international) shows a similar pattern of great variability within and between populations (Figure 5). Some subspecies are poorly safeguarded by site designations at most or all times of year; for others the extent of conservation coverage is uncertain because of the uncertainties about the basic site locations for the population.

In parallel to the uncertainty surrounding the extent to which conservation designations apply to flyway populations of waders, there is no clear flyway assessment of the extent to which all these designations are successful in providing safeguards for the populations they are designed to protect. Some information is, however, available for individual countries, and the portents are not good. For Britain, Davidson *et al.* (1991) have described continuing loss and damage to many nationally important estuaries, and at rate twice that of other habitats in Britain. The presence of a designated or proposed internationally important site likewise appears to be little deterrent to further habitat loss since in 1989 over

one-half of Britain's internationally important estuaries faced land-claim proposals that if undertaken would lead to further loss of habitat used by waders (Figure 6). Many other sites on wader flyways worldwide are known to be suffering habitat loss and facing further destruction in the future.

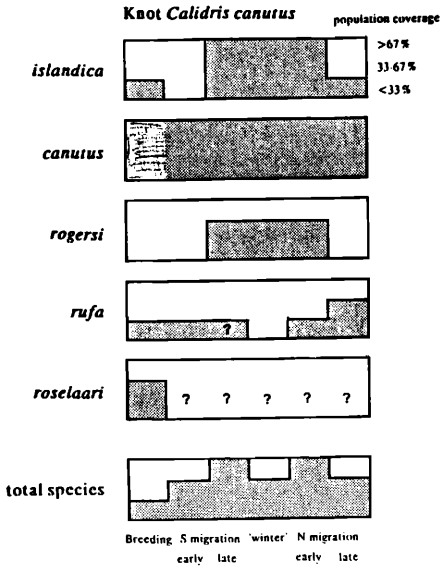


Figure 5. Estimated proportions of Knot populations occurring within designated conservation sites during different stages of their annual cycle. Conservation designations include both domestic and international designations. The light shading for breeding *canutus* refers to the recently designated Great Taymyr Reserve which covers a substantial part of their known Siberian breeding range (P. Prokosch, *pers. comm.*).

Perhaps partly in response to these perceptions of the current failure of the many conservation designations to safeguard migrant waders, there are several new conservation initiatives under development. Several of these relate to the development of a co-ordinating role through international management plans. The IUCN, for example, established in 1985 its global wetlands programme, and at about the same time ICBP developed its Migratory Birds Conservation Programme (Salathé 1991b, c).

More recent, and of particular significance to the flyway conservation of waders, is the African-Eurasian Waterbird Agreement (AEWA) currently nearing completion under the terms of the Bonn Convention. This exciting new prospective agreement provides a mechanism for co-ordinating and linking conservation action on the two major wader flyways in the western Palearctic (Figure 2), and provides a framework for developing consistent site safeguards and co-ordinated species/population conservation strategies. International management plans are also in preparation for some other individual waterbird species, notably on the White Stork *Ciconia ciconia* (Goriup & Schultz 1991), and the Greenland White-fronted Goose *Anser albifrons flavirostris* (Stroud 1992). These provide useful models for potentially wider use.

Other recent international developments (see also Salathé 1991a) include the establishment of an International Wadden Sea Secretariat, proposals for an Action Programme for the conservation of wetlands and waterfowl in South and West Asia (prepared at the IWRB/AWB/Pakistan National Council for the Conservation of Wildlife 1991 Karachi Conference); an East Asia Flyway Network co-ordinated by the Asian Wetland Bureau (AWB); and the IWRB/WHSRN/Ducks Unlimited Neotropical Wetlands Programme. Alongside these are numerous national initiatives such as in the UK the RSPB's Estuaries Campaign and Species Action Plan programme, the JNCC Coastal Review (including the NCC/JNCC Estuaries Review), and English Nature's Estuaries Initiative.

To summarise, ensuring the long-term survival of any migratory flyway needs compatible standards to be applied throughout its range, taking account of local situations. To determine this, as with the first two elements of our strategy, requires a review of conservation effectiveness along the flyway. Again this requires co-ordination and an aim of identifying the weak links in the chain, both in terms of sites and of key features of wader ecology and flyway usage. Having undertaken this review, a programme of action to correct such deficiencies could be implemented.

Some first steps in identifying flyway features for priority action can already be attempted. We have, for example, highlighted the parts of the annual cycle for one arctic-breeding migrant wader for which there is little site safeguard (*e.g.* during the breeding season) - but note that measures other than site safeguard are often more appropriate for conserving such widely dispersed populations. The priority lists of species provided by the draft Western Palearctic Waterfowl Agreement Management Plan (Netherlands Ministry of Agriculture, Nature Management and Fisheries 1991) permit a broader assessment of the characteristics of the most threatened and vulnerable wader populations on the East Atlantic and Mediterranean/West Asian flyways. Of the 50 wader species and populations in the Western Palearctic 31 (68%) are listed as threatened, rare, decreasing or vulnerable, making waders amongst the higher risk groups of waterbirds (Table 3). Western Palearctic waders are thus in general in need of priority conservation action.

Different 'high risk' wader species and populations occur in all breeding zones from arctic to temperate, depend on all main types of wintering and staging area habitat and use East Atlantic and Mediterranean-West Asian Flyways. it is interesting to note, however, also that widespread species - those with major parts of their population using in more than one breeding zone, non-breeding habitat or flyway are markedly less vulnerable than those of more restricted distribution. This emphasises the importance of range conservation for migratory waders.

Table 3. The percentage of various groups of waterfowl populations and species in the Western Palearctic that believed to be in an unfavourable state. Species and populations are included as in an unfavourable state if they are listed as threatened, rare, decreasing or vulnerable in the Western Palearctic Waterfowl Agreement Draft Management Plan (Netherlands Ministry of Agriculture, Nature Management and Fisheries 1991).

	% of spp./population in unfavourable state
waders	**68**
divers & grebes	73
cormorants, herons, egrets, storks etc.	70
swans & geese	84
ducks	58
rails	57
gulls & terns	65

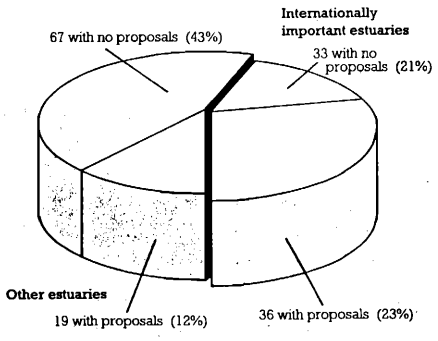


Figure 6. Proportions of internationally important, and other, British estuaries affected by land-claim proposals in 1989, from Davidson *et al.* (1991).

FUTURE DIRECTIONS FOR MIGRANT WADER CONSERVATION

Wader (and other waterfowl) migratory flyways are one of the world's biological wonders. The maintenance and enhancement of these populations through appropriate conservation management of the habitats upon which they depend should be a global conservation priority. Some migratory organisms may be able to survive even after being forced to abandon their migratory habitats through, for example, removal of key sites in a migratory network. Many migratory wader populations would, however, seem unlikely to be able to adopt rapidly a non-migratory lifestyle should key sites in their flyway network be removed. Such removal would prevent the populations from moving between their breeding and wintering grounds: arctic-breeding species could not survive there through the arctic winter, and there would not seem to be suitable large areas of alternative breeding habitats around the coastal and inland wetlands on which so many populations depend for their winter survival. Indeed many of the wader populations that currently use these places throughout Europe are in serious decline largely through habitat destruction (Hötker 1991). Hence destruction of key elements in migratory wader flyways would mean the destruction of the species.

Much is already being done to promote the conservation of migratory waders, but many populations remain vulnerable and face apparently increasing threats to their continued health. To put in place a conservation programme for the future, we need to take a number of key steps. These are:

a. identify what we do not know about the basic biology of the species and fill the gaps, highest priorities first;

b. identify which human impacts are having an adverse impact and quantify such impacts along the flyway. When gaps in our knowledge are identified they need to be filled; and

c. identify the current level of conservation action along the length of the flyway, determine its effectiveness and set about enhancing conservation action where it is seen to be inadequate.

Undertaking these steps, on a worldwide basis or even for a single flyway, will involve considerable work requiring both collation and reappraisal of existing information and collection and collation of further information where gaps are identified.

Such assessments are unlikely to fall easily within the scope of individual organisations, whether national or international. Many of the major advances in our understanding of migratory waders have come from international collaboration by wader-workers and conservationists. It is appropriate to develop such future work vital for the safeguard of migratory waders as international co-operative exercises.

We suggest that to take this international flyway collaboration forward, projects could include the following:

a. Migration and flyway use reviews for individual species and populations, including worldwide appraisals. A model for this could be the *WSG Bulletin Supplement* on Knot migration worldwide.

b. Reviews of individual flyways, drawing in part on individual species reviews and how the patterns of use by many different species combine to give the overall flyway picture. Elements of such reviews appear already in many guises, including the *WSG Bulletin Supplement* on flyway conservation, the various papers in Salathé (1991), IWRB wetland inventories, the WPWA and action plan, the Canadian Wildlife Service's South American shorebird atlas (Morrison & Ross 1990), IWRB flyway population reviews (*e.g.* Smith & Piersma 1989) and reviews such as NCC's Estuaries Review (Davidson *et al.* 1991). An international project compiling flyway characteristics for each different migratory wader species and

population in now being developed through the Wader Study Group.

c. Comparative assessment of human activities, threats and impacts for all parts of a flyway. A model is the basically simple data collection methodology developed for the NCC Estuaries Review (Davidson *et al.* (1991), now being developed by the UK Joint Nature Conservation Committee as a national Coastal Review.

d. Reviews of the flyway-wide patterns of conservation designations for individual species, for wader assemblages and at different parts of the annual cycle.

e. Preparation of species conservation and management strategies, based on the types of information gathered in a. - d. above. Such strategies might be developed under the auspices of the Bonn Convention AEWA. There are a number of models for this approach in waterfowl, including the AEWA White Stork conservation management plan (Goriup & Schultz 1991), and the Greenland White-fronted Goose International Conservation Plan (Stroud 1992). A possible first target for such a strategy for waders could be the Knot, for which much factual preparatory work is available (Piersma & Davidson 1992; Piersma 1994).

f. Preparation of wader conservation strategies for different flyways, *e.g.* for the East Atlantic and/or the Mediterranean/West Asian flyways, and for countries within flyways, *e.g.* the recent national plan for shorebird conservation in Australia (Watkins 1993); and

g. Establishment of a Western Palearctic wader reserve network, perhaps along the lines of the Western Hemisphere Shorebird Reserve Network. An East Asian-Australasian shorebird reserve network is now being developed, as are proposals for developing worldwide networks.

For some of these initiatives it may be most effective to undertake pilot development of the approach using some simpler and/or better known systems (such as developing a flyway conservation for the Knot), as well as targeting those species and issues for which urgent action is believed necessary and for which little is known.

Many organisations and groups could be key participants in co-ordinated development of some or all of these features. For the Western Palearctic these could include WSG, IWRB, Ramsar Bureau, ICBP, IUCN, WWF (*e.g.* WWF-Wattenmeerschelle Schleswig-Holstein), the International Wadden Sea Secretariat, RSPB, JNCC, the European Union for Coastal Conservation (EUCC) and the Russian Wader Studies Group as well as knowledgeable wader-workers throughout the flyways.

WSG has an extremely valuable role to play is all this, since its informal international links with those active in the fields of wader research and conservation in many countries have acted as the catalyst to the collation and publication of much vital background information both as material in its regular *Bulletins* and compiled on special topics in its *Supplement* Series (now published as *International Wader Studies*). There is great scope for this role to continue, for example through the collaborative preparation of further *IWS* volumes. Some are already in preparation, notably on shorebird ecology and conservation in the Western Hemisphere (from the 1991 Quito symposium), American Great Basin shorebirds, and wader research and conservation on European and North Asian flyways (based on the 1992 international WSG conference in Odessa, Ukraine).

For a first phase of future development WSG has identified the following projects, on which collaboration is sought:

1. Collation and analysis of the patterns of human activities and threats to wader habitats in the Western Palearctic.

2. Development of an international flyway conservation plan for wader species and populations, with the preparation of the first such plan for the Knot.

3. Encouragment of individuals and collaborative groups in the preparation of wader species information reviews, as the essential precursor to developing further flyway conservation plans. Two further species reviews, on Dunlins *Calidris alpina* and Kentish Plovers *Charadrius alexandrinus*, are now being prepared for *IWS* publication.

We would welcome comment on these suggestions, and on how such future wader flyway conservation might be best achieved. In particular we would like to hear from anyone wishing to be involved in such projects, and those who may be able to arrange for the provision of resources to undertake such work.

It is perhaps fitting that these ideas for future wader flyway action were first presented at a uniquely international wader conference, held in Odessa, Ukraine, situated in the heart of major wader staging areas on the Mediterranean/West Asian Flyway, and at a time of year (April) when many thousands of waders were passing through *en route* to relatively little-known breeding grounds on a poorly-understood migration route. Many of the approaches proposed in this paper are also incorporated in the *Odessa Protocol on international co-operation on migratory flyway research and conservation* (Wader Study Group 1992), developed at that conference

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