Assessing distribution and trends in population sizes and productivity in arctic breeding shorebirds: some suggestions

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This discussion paper was originally prepared at the suggestion of Hugh Boyd and Guy Morrison (Canadian Wildlife Service) as background to round-table discussions at the 1994 International Ornithological Congress and to Canadian Wildlife Service deliberations on the feasibility of developing an monitoring programme for breeding ground density and productivity of shorebirds in the Canadian arctic. Although focused on opportunities in the Canadian arctic many points are common also to current wider discussions on developing global monitoring networks for arctic shorebirds. Whilst a comprehensive annual arctic monitoring programme may be a logistically and financially unattainable ideal, there is much to be gained from a better co-ordination and collaboration of existing work at different levels of effort and detail. A number of approaches are suggested that would each yield consistent information at varying levels of detail. Each would enhance our knowledge and understanding of arctic-breeding shorebirds. Implementing even some of these approaches will aid development of international conservation initiatives for arctic-breeding migratory shorebirds. The approaches proposed are in line with the 1992 Odessa Protocol objectives, now being taken forward by the Wader Study Group, of improving international collaboration on data collection and developing international standard field methodologies.

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INTRODUCTION

This note provides some thoughts and suggestions (none of them, however, particularly novel) about how better to collaborate in combining and comparing consistent information on breeding waders from different parts of the arctic. It stems from discussions with Guy Morrison and Hugh Boyd about the potential for establishing monitoring programmes for arctic-breeding shorebirds in Canada, but has also wider applicability to other discussions about circumpolar monitoring of shorebird breeding densities and performance.

At this stage in their development the ideas are largely based on a personal viewpoint, in turn partly derived from experience gained from six summers of research in an extreme part of the Canadian arctic. They are prepared in my rôle as WSG/IWRB Liaison Officer, a rôle which includes promoting the better international collaboration of shorebird researchers world-wide. I believe that there is considerable potential from capitalising on current interest and enthusiasm for international flyway shorebird research and the recent increased accessibility of the Russian arctic for the development of wider collaboration in compiling and comparing breeding arctic shorebird information.

There are, however, considerable difficulties involved in devising useful collaborations in such an inaccessible area. Hence the risks of trying to develop too ambitious a programme in the light of the considerable resource and logistical difficulties, and the consequences of the failure of an overambitious programme should be borne in mind. But these difficulties should not be used as a convenient excuse for inaction - much can be achieved by promoting well-structured projects designed to meet realistic (and clearly defined) objectives.

This note starts by setting the context of the current issue for those unfamiliar with the history of assessing shorebird populations by briefly outlining the rationale of current practice. I then stress the value of attempting to gather better information on arctic shorebird breeding populations, and conclude by suggesting a structured sequence of projects that might contribute to a better understanding of the distribution and population performance of arctic shorebirds.

HOW IS SHOREBIRD POPULATION MONITORING CURRENTLY ACHIEVED?

Long-term monitoring programmes for assessing waterfowl populations (*e.g.* the Wetland Bird Survey - WeBS (formerly the Birds of Estuaries Enquiry and National Wildfowl Counts) in the U.K.; the Maritime Shorebird Survey and International Shorebird Survey in North America; the co-ordinated Wadden Sea counts; and IWRB's International Waterfowl Census) have proved of great value in both providing a baseline that adds to and aids our better understanding of waterfowl population dynamics. This in turn contributes to the development of more effective conservation action.

These surveys usually count all relevant species in the selected sites. The behaviour of some species means that they are poorly covered by such general surveys (*e.g.*

the high tide estuary counts so useful for shorebirds are of little value for geese which at that time are feeding dispersed inland on farmland). In such circumstances additional special surveys of a species or group of species are undertaken.

Long-term programmes are needed for shorebirds, particularly those breeding in the arctic, to fully assess population trends since major year-on-year fluctuations are known to occur in these populations. Results of one-year studies conducted in isolation have, therefore, a high risk of misinterpretation. Coping with this problem is a major challenge for assessing (and/or monitoring) arctic populations.

Monitoring programmes are undertaken on non-breeding (mostly wintering) populations. These are particularly effective for coastal and estuarine wintering species since their clumped distribution makes counting the birds relatively straightforward. The programmes rely heavily on volunteer counting networks, without whom such extensive coverage would be prohibitively expensive. Such counts during the non-breeding season have long provided the most reliable global population estimates for many species, sub-species and biogeographic populations of migratory waders.

Note, however, that even with these wide networks complete coverage of all relevant sites is seldom achieved. Population size estimates and population trends therefore have to be derived from indexing analyses that take into account missing counts, an approach that increases in importance in regions where coverage is sparse.

WHY SHOULD BREEDING-GROUND POPULATION ASSESSMENTS BE ATTEMPTED?

There are many species for which such reliable wintering ground estimates are not or cannot be available (see *e.g.* Rose & Scott 1994). These are particularly non-migratory species; migratory species that use inland staging and wintering areas particularly where such species are dispersed widely; and coastal wintering species of rocky shores, and populations in remote geographical areas or areas where regular counting by observer networks is not possible.

Population estimates for these species are now generally attempted on the breeding grounds. In most cases (except for some very rare or localised species) these estimates are, however, based at best on sample surveys and often on more or less informed guesswork (see Rose & Scott 1994). Nevertheless compilations of best available knowledge are of great value in providing a first baseline of known population distribution and sizes as well as identifying gaps in knowledge. Such gaps are many and large.

A good example of the value of even 'best-guess' compilations was the Wader Study Group's *Breeding waders in Europe* exercise (Piersma 1987), which included population estimates from some arctic and subarctic countries and parts of countries notable Iceland, Greenland and Ellesmere Island. *Breeding waders in Europe* (Piersma 1987) has been used widely in underpinning shorebird conservation. Periodic repeats of such exercises can yield coarse-grained intelligence of population trends in different parts of breeding ranges. Such an exercise is now being planned to update and extend coverage for *Breeding waders in Europe* during the next few years.

There is additional value to be gained from assessing breeding populations, notably that identifying changes in breeding populations permit more effective identification of sources of annual population changes and their allocation to different seasons. There has, for example, been a major decline in the size of breeding wader populations of wet grasslands in many parts of Europe. Assessing trends in breeding populations suggests that this is largely due to habitat loss and changes in land use management on breeding grounds, irrespective of any influence on populations of habitat loss on wintering grounds (Hötker 1991).

WHY WOULD MONITORING POPULATION SIZES AND TRENDS OF ARCTIC-BREEDING WADERS BE USEFUL?

Major influences on the population dynamics of high-arctic breeding waders are known to occur on breeding grounds. Substantial parts of large inter-annual changes in observed population sizes on wintering grounds are known to derive from great differences in the numbers of juveniles reaching wintering grounds. This in turn has been shown in some cases to be caused by periodic breeding failures or extremely low breeding success over large parts of the range of some species. Such failures seem to derive from a complex interplay between weather conditions on breeding grounds and the level of depredation of eggs and chicks by foxes and jaegers (skuas), which in turn is related to cycles of lemming abundance. In extreme cases substantial adult mortality as well as minimal breeding success can be involved in a major population change (*e.g.* Boyd 1992).

Much of the understanding of these major influences on the population dynamics of arctic shorebirds has come so far from individual studies in small areas of the arctic, or from *post hoc* interpretation of broad patterns of weather conditions and evidence from banding recoveries and winter population counts. Setting these individual studies in a broader context would contribute much to their use in understanding broader geographical patterns in shorebird populations.

Developing a mechanism for the delivery of annual assessment of breeding densities and breeding productivity throughout breeding ranges, in relation to climatic, depredatory and other relevant factors, would be of great value in aiding fundamental understanding of the contribution of this part of the annual cycle to the population dynamics of arctic-breeding shorebirds. This

in turn would be of substantial benefit in providing improved baseline information invaluable in the development of international conservation efforts for migratory shorebirds.

Such information could, for example, be used to establish the extent of variation in densities and productivity in different parts of breeding ranges and the identification of key zones for conservation attention. Such material could lead also to more informed assessment of the likely effects of global climate change on peripheral and core parts of shorebird breeding ranges.

There are of course many constraints and potential difficulties in attaining this perfect ideal of a global (or even national) network monitoring breeding productivity in arctic conditions. Some are summarised in the next section. There are nevertheless many ways in which:

a. information could be more readily collected at varying levels of sophistication, and

b. could be better co-ordinated and compiled.

Some developments would be linked to existing work and others to new projects.

WHY WOULD INTERNATIONAL STANDARD METHODOLOGIES BE USEFUL?

There is increasing emphasis and effort being given to international flyway conservation. This takes a variety of forms, including the development of reserve networks such as WHSRN, the development of the African-Eurasian and other Waterbird Agreements under the Bonn Convention, and the development of international flyway conservation plans for waterfowl species such as the Greenland White-fronted Goose. The UK Joint Nature Conservation Committee also has a current project intended to promote further development of international flyway plans including for shorebird species. All these initiatives benefit greatly from an understanding of where species' breed and of factors that affect their distribution, breeding density and breeding success.

So as to be able to compare like with like both within and between populations and species, agreed survey techniques with known comparability are essential. Currently, however, survey methodologies are developed generally for each study in isolation from others. So although there are often similarities in types of method employed, results are not always easy to compare. Comparative assessments can often at best derive only semiquantitative values (*e.g.* broad ranges in density).

Discussions at the 1992 Wader Study Group Odessa Conference led to the preparation of the Odessa Protocol (appended). These discussions revealed an urgent need for the better availability of simple (and so widely usable regardless of resource availability) best-practice field research techniques for shorebirds. The WSG is currently in the early stages of developing a programme to provide these, through preparation of a *Field Techniques Manual.*

This manual will need to include guidance on the best ways of assessing distribution, density and productivity of breeding waders in a variety of habitats and climatic zones, including the arctic. The current deliberations about shorebird breeding studies in the Canadian arctic are therefore most timely and could contribute substantially to just such guidance.

WHAT ARE THE LIMITATIONS TO ASSESSING ARCTIC-BREEDING POPULATIONS?

The difficulties of carrying out arctic shorebird surveys at even the simplest level are widely known. It is, therefore, easy to be negative about even attempting to improve collection and co-ordination of such data. But there is considerable potential for success, provided appropriate objectives are carefully devised and set. Nevertheless limitations and difficulties must be borne in mind when planning co-ordinated data collection programmes, since attempting over-ambitious programmes that fail is even worse than inaction.

Such difficulties include:

Logistics and costs

- logistic difficulties of reaching survey sites;
- cost of reaching survey sites;
- difficulty of achieving yearly repeat coverage of even a handful of sites;
- impossibility of achieving more than 'point-samples' from within huge breeding ranges; and
- finding personnel with time and resources to develop and co-ordinate projects.

Survey skills

- how to ensure minimum standards of survey and identification skills for widespread simple surveys;
- difficulty for inexperienced surveyors in recognising breeding clues in inconspicuous species;
- extreme difficulty of finding nests of some species, *e.g.* Knot *Calidris canutus*; and
- need for comparable survey method(s) capable of coping with both high and extremely low breeding densities;

Shorebird biology

Shorebirds have very considerable variation in breeding behaviour, both inter- and intra-specifically. Survey methods have to take into account:

- variations in behaviour and detectability of some species in different places (*e.g.* Turnstone *Arenaria interpres* breeding at high and low densities);
- assessing densities and breeding performance in non-monogamous species and populations;

Table 1. Suggested projects in an arctic breeding shorebird programme.

	Project	*Objective*	*Suggested methods*	*Who could collaborate*	*Suggested output(s)*
Desk studies & reviews					
1.	Rationale, objectives and implementation plan for a co-ordinated programme	Clear and agreed objectives set within a logical framework, with identification of how co-ordination will be achieved, who will do it, and what resources will be needed.	Working Group: discussions based on options paper	?In Canada, CWS Shorebird Committee, consulting with other technical experts/ arctic researchers	Programme proposal; programme plan after adoption
2.	Assessment of best-practice methods for density and performance assessment	To identify and recommend compatible survey methods for different programme elements.	Working Group (possibly under framework of WSG Field Techniques Manual project)	?In Canada, CWS Shorebird Committee, consulting with other technical experts/ arctic researchers; WSG network	Manual of recommended standard arctic wader field research techniques
3.	Compilation of known information on population distributions and densities	Synthesis of currently available information for each arctic shorebird species available widely as current baseline for any future programme.	Analysis of distribution of presence/absence and breeding records from museums and literature. Estimation of densities in different parts of range; population estimates based on distribution and densities. Extends Meltofte's (1985) approach.	?Individual species experts encouraged to take on exercise to standard specification and/or in Canada CWS shorebird researchers do work for all species? (Nb Dr P Whitfield has recently drafted an analysis for *islandica* Knots.)	Report for all species and/or series of journal papers for each species or group of species.
Qualitative annual summaries					
4.	Summary of breeding ground conditions for shorebirds in each year	Summary of conditions from as many arctic locations as possible, as background to interpreting population trends and more detailed surveys.	Annual questionnaire survey to as many teams as possible visiting arctic during May-August. Questionnaire could include: general weather summary per month, snow-melt timing & snow cover, lemming abundance, were jaegers (skuas) breeding etc.	Any visitor to an arctic location who has a basic understanding of weather and wildlife. Does not require detailed shorebird knowledge to contribute. In Canada might be possible to co-ordinate through Polar Continental Shelf Project field network.	Annual published summary of conditions in each location. This is already done for Russian arctic by Russian Wader Studies Group (and reprinted in *WSG Bulletin, e.g.* Tomkovitch 1994).
5.	General recording of shorebird species composition and evidence of breeding	Improving information base of breeding distributions to build on project 3. above.	Annual questionnaire to as many teams as possible visiting arctic during May-August. Questionnaire would include presence or absence of species, qualitative abundance (*e.g.* occasional, scarce, common, abundant), evidence of breeding (territorial display, nest, chicks *etc.*). Could be part of 4. above.	Any visitor to an arctic location who can identify shorebird species. Is not limited to teams undertaking shorebird studies as primary objective. In Canada might be possible to co-ordinate through Polar Continental Shelf Project field network.	Annual summary report as feedback and encouragement to contributors. Periodic (*e.g.* five-yearly) report updating distributions *etc.* from project 3.

Table 1. (continued)

	Project	*Objective*	*Suggested methods*	*Who could collaborate*	*Suggested output(s)*
Simple density estimations					
6.	Opportunistic population density estimates	Improving coverage of known density estimates undertaken to standard comparable methodology	Co-ordination. Capitalise on existing projects by encouraging teams already undertaking arctic (shorebird) research to include a standard density survey (by *e.g.* line transect or constant effort visit). For most areas visits/surveys during early June to early July most useful.	Any visitor or team working in the arctic with a shorebird researcher or enthusiast. Is not limited to teams undertaking shorebird studies as primary objective, but needs competent ornithologist in the party. In Canada might be possible to co-ordinate through Polar Continental Shelf Project field network.	Annual report summarising sites covered and density estimates. Periodic compilation into species density reports/papers.
7.	Programmed population density assessments	Improving coverage of known density estimates undertaken to standard comparable methodology	Structured pattern of survey visits designed to provide a). gap-filling coverage of little-known areas, and b) yearly data from selected sites. Survey methods as 6. above; could be achieved by sequence of brief site visits (*c.f.* Boertmann *et al.* (1991) in Greenland). Funding for fieldwork would be required.	Trained/experienced field survey team to maximise value of data. In Canada ?CWS staff team, through PCSP, and possibly in collaboration with Parks Canada?	Annual report summarising sites covered and density estimates. Periodic compilation into species density reports/papers. Linked to results from 6.
Detailed density & productivity studies					
8.	Detailed breeding density assessment	Precise information on densities, and aid to interpretation of 6. and 7., with opportunity for monitoring variability and change in breeding densities	Simple surveys in 6. and 7. yield estimates subject to potential error from several sources such as differential detectability of species. This project would involve intensive nest and chick surveys of selected sites by experienced surveyors during early June to mid-July period and calibration of simple survey methods. Co-ordination could encourage teams to visit poorly covered regions.	Expert shorebird researchers. Project could a). capitalise on existing research programmes by encouraging collaboration and sharing of results; and b). involve a funded programme of surveys, including yearly at some sites by a core team or teams.	Annual report summarising sites covered and density estimates. Periodic compilation into species density reports/papers. Linked to results from 6. and 7.
9.	Detailed breeding performance assessment	Monitoring of hatching and fledging success at selected sites	Usually combined study of both density (project 8.) and performance. Very difficult to achieve even in single locations: fledging success in waders notoriously intractable question. Requires detailed research studies usually involving suite of methods including capture, marking and radio-tracking. For monitoring a series of years of comparable study from a selected network of sites is needed - but is costly and difficult to establish and run. More likely is ensuring co-ordination and feed of information from individual projects. Funding for fieldwork would be required.	Expert shorebird researchers. Project could a) capitalise on existing research programmes by encouraging collaboration and sharing of results; and b). involve a funded programme of surveys, including yearly at some sites by a core team or teams.	Various, including research papers from individual studies and periodic reports summarising programme.

- geographical and latitudinal differences in timing of breeding;
- occurrence of relaying after early clutch loss;
- variable occurrence of displaying, but non-nesting, components of populations;
- timing of surveys to cope with reduced breeding density due to early incubation nest losses; and
- surveying species that become invisible during incubation.

Some of these problems are specific to arctic conditions and are likely to set the limits of what can realistically be achieved. Others are, however, common to attempts to make population surveys of shorebirds in many other habitats, and particularly those of temperate and sub-arctic uplands. Best-practice solutions to many of these problems have already been devised for such places and have substantial potential for being applied, with appropriate modifications, to arctic systems.

WHAT MIGHT THEREFORE BE ATTEMPTED?

There are four main types of exercise that might be undertaken, each of which would contribute to a better understanding of the subject. These are:

a. desk studies and reviews to identify what is currently being done, to define objectives and to develop (and if necessary trial) best practice methodology at different levels of detail, and to identify partners and contributors to different projects and objectives;

b. simple, largely qualitative annual compilations of breeding ground conditions and species presence;

c. simple breeding density estimation surveys; and

d. detailed studies assessing breeding density, timing and success. (Note that assessing nest and egg survival is difficult enough to achieve, and assessing fledging success is even harder - methods of assessing fledging success were the subject of a workshop held at the WSG Conference in Büsum, Germany in October 1994.)

It is important to recognised that for c. and d. there may not be one obvious methodology to apply - either several techniques may be equally applicable (in which case assessing their comparability and relative merits will be essential) or different techniques may be needed to cope with different field conditions (*e.g.* high and low breeding densities).

Also needed is a hierarchy of recommended techniques for those with different amounts of resources available to them. Simple techniques (*e.g.* requiring only a map/notebook and pair of binoculars) will be most widely used and should be set out as a recommended baseline. Then identify more 'high-tech' techniques (those that are expensive in terms of people, transport and/or equipment) that can yield more detailed, precise or comprehensive results if the collaborator has access to such resources.

SUGGESTIONS FOR AN ARCTIC BREEDING SHOREBIRD PROGRAMME

Suggestions for elements of a structured programme are listed in Table 1. These focus on opportunities in the Canadian arctic but many have wider applicability. At a global arctic scale there may be opportunities for using the medium of the Wader Study Group and its links with IWRB to aid co-ordination of a programme or some of its elements. Although many results from parts of such a programme are likely to be published separately a major added value of a co-ordinated exercise is the opportunity for drawing together results from each project, year and site in a comprehensive and widely available single source of arctic shorebird breeding information.

REFERENCES

Boertman, D., Meltofte, H., & Forchammer M. 1991. Population densities of birds in Central Northeast Greenland. *Dansk Orn. Foren. Tidsskr.* 85: 151-160.

Hötker, H. 1991. Waders breeding on wet grasslands. *Wader Study Group Bull.* 61, Supplement.

Meltofte, H. 1985. Populations and breeding schedules of waders, Charadrii, in high arctic Greenland. *Meddr. Grønland, Bioscience* 16.

Piersma, T. 1987. Breeding waders in Europe. A review of population size estimates and a bibliography of information sources. *Wader Study Group Bull.* 48, Supplement.

Tomkovitch, P. 1994. Breeding conditions for waders in Russian tundras in 1993. *Wader Study Group Bull.* 75: 27-34.