Guidance on waterbird monitoring methodology: Field Protocol for waterbird counting

Report prepared by Wetlands International

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Common Standards and field protocol for waterbird counting

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1. What are waterbirds?

Waterbirds have been defined as “species of bird that are ecologically dependent on wetlands”. This is the definition used by the Ramsar Convention on Wetlands. For the purposes of the International Waterbird Census, all species in the following families are considered by Wetlands International to be waterbirds: Gaviidae (Divers/Loons), Podicipedidae (Grebes), Pelecanidae (Pelicans), Phalacrocoracidae (Cormorants), Anhingidae (Darters), Ardeidae (Herons), Scopidae (Hamerkop), Ciconiidae (Storks), Balaenicipitidae (Shoebill), Ciconiidae (Storks), Threskiornithidae (Ibises and Spoonbills), Phoenicopteridae (Flamingos), Anhimidae (Screamers), Anatidae (Ducks, Geese and Swans), Gruidae (Cranes), Aramidae (Limpkin), Rallidae (Rails, Gallinules and Coots), Heliornithidae (Finfoots), Eurypygidae (Sunbittern), Jacanidae (Jacanas), Rostratulidae (Painted Snipes), Dromadidae (Crab Plover), Haematopodidae (Oystercatchers), Ibidorhynchidae (Ibisbill), Recurvirostridae (Stilts and Avocets), Burhinidae (Thick-knees), Glareolidae (Coursers and Pratincoles), Charadriidae (Plovers), Scolopacidae (Sandpipers, Snipes and Phalaropes), Pedionomidae (Plains Wanderer), Thinocoridae (Seedsnipes), Laridae (Gulls), Sternidae (Terns) and Rynchopidae (Skimmers).

Only a few wetland birds are excluded by considering entire families in this way. Conversely, the inclusion of whole families results in the waterbird list containing a few non-wetland species such as some coursers and thick-knees. These rather minor anomalies are thought to be outweighed by the convenience of a whole-family approach to the definition of the term ‘waterbird’ and, in particular, considering the complications that would arise from applying the definition rigidly to every species.

The Ramsar Convention on Wetlands has widened its approach to include more families traditionally regarded as seabirds, as well as certain raptors and passerines. In 2008, the African-Eurasian Migratory Waterbird Agreement has also included some migratory seabirds. Hence, it is possible that a small number of additions will be made in the coming years to the families and species included in waterbird counting programmes.

2. Why count waterbirds?

Long-term monitoring of waterbirds by continental-scale censuses provide crucial information which underpins the conservation of waterbirds and their wetland habitats.

The rationale behind waterbird monitoring was summarised eloquently by Matthews (1967) at the time when international coordination of waterbird counting was beginning: “...while man is recklessly unleashing new insults on his environment, background monitoring of populations is essential to detect the threats as they develop and before they become catastrophes apparent to all”.

Waterbirds are well-known indicators of the quality of certain types of wetlands. A powerful tool which makes use of this characteristic is the so-called 1% criterion, whereby any site which regularly holds 1% or more of a waterbird population qualifies as a wetland of international importance under the Ramsar Convention on Wetlands. The 1% criterion has been adopted by the European Union to identify Special Protection Areas (SPAs) under the Birds Directive. It is also used by BirdLife International in the identification of Important Bird Areas (IBAs) in wetlands throughout the world.

Standardised monitoring of Arctic breeding species, and species dependent on inter-tidal habitats is even more important in the light of human induced climate change (Houghton et al. 2001). Global warming is expected to have especially pronounced effects on tundra and other Arctic environments, and, through sea level rise, on intertidal habitats (Boyd & Madsen 1997). Waterbird monitoring will play a significant future role in monitoring the effects of these changes on the millions of waterbirds which depend upon these habitats.

3. What is the International Waterbird Census?

The International Waterbird Census (IWC) is a site-based counting scheme for monitoring waterbird numbers, organised since 1967 by Wetlands International, formerly the International Waterfowl and Wetlands Research Bureau (IWRB). The Census operates at a global level, and the former division into four separate continental-scale surveys was superseded in 2003 by a new strategy for global coordination. Coordination at continental level takes place as follows:

- Global coordination, and the counts in the Western Palearctic and southwest Asia are organised from Wetlands International headquarters in Wageningen, The Netherlands
- The African Waterbird Census is coordinated from an office in Nairobi, Kenya
  The Asian Waterbird Census, which includes Oceania, is coordinated from an office in Delhi, India
- In the Americas, the Neotropical Waterbird Census is coordinated from the Americas office of Wetlands International in Buenos Aires, Argentina

The aims of the census are as follows:

- To monitor the numerical size of waterbird populations;
- To describe changes in numbers and distribution of these populations;
- To identify wetlands of international importance for waterbirds at all seasons;
- To provide information to assist protection and management of waterbird populations through international conventions, national legislation and other means.

The census takes place every year in over 100 countries with the involvement of around 15,000 counters, most of whom are volunteers. More than half the effort is concentrated in Europe, but involvement in other parts of the world has increased markedly since 1990. Between 30 million and 40 million waterbirds are counted each year around the world, and details of the counts and the sites where they take place are held on the newly upgraded, state-of-the-art IWC database. The IWC is thus by far the most globally extensive and one of the longest running biodiversity monitoring programme in the world.

4. Where to count waterbirds?

Site delimitation
Many of the sites where waterbird counts take place are self-contained and their physical boundaries are clear and obvious. Lakes, estuaries and certain coastal bays are typical examples of such sites. The physical delimitation of many sites, especially large and complex ones, may not, however, be so straightforward. Examples include stretches of river and open coast (how long is a site?), and groups of small lakes (how many make up a site?). Areas adjacent to counting sites but comprising different habitats may be included within the site boundaries or considered as separate sites. At such sites, decisions need to be made about where to draw the boundaries of “wetland sites” for the purposes of waterbird monitoring. Each case is usually best decided according to its geography and local knowledge of its use by birds. Once the boundaries have been decided, they should not normally be changed. Wetlands International accepts the judgement of national waterbird count coordinators about what constitutes a “wetland site”. National count coordinators in turn usually accept the judgement of local observers, whose counting site is often their “local patch”. Countries with national waterbird monitoring schemes usually have a well-established network of sites with “traditional” boundaries that are recognised and used by counters. It is important that these sites and their boundaries are changed as little as possible, so that consistency of coverage from year-to-year is maintained. Recording site boundaries and other information on maps is the best way of maintaining this consistency. See “Maps and GPS recorders” on **page 8.**

Even at very large sites, it is important to record and store waterbird counts at the level of individual “count units”, where a count unit is a geographical area covered by one or two counters on a single visit. Many sites are made up of numerous such count units, and at local

and national level, this allows practitioners to see which parts of a site are the most important. Also, in the event of threats to a site, it is important to have detailed information about patterns of waterbird usage at the site. Finally, if a change in boundaries of adjacent sites is considered necessary, it is a relatively simple matter to re-allocate certain count units to a neighbouring site. Data stored at the level of entire sites are not so flexible. Data stored at a relatively fine level can always be merged, but it is impossible to separate data after they have been combined.

Counting complex sites
Most large or complex sites are divided into sub-sites for the purposes of counting. Each sub-site is a separate count unit. It is best if counting of sub-sites is closely coordinated and simultaneous, with one or two counters per site unit, especially at tidal sites where birds move around in response to the tidal cycle. Each sub-site of a complex site should be counted in the way described under the heading "Ground Count" **on page 9**. At previously uncounted sites, identifying the best route to walk and the best vantage points to use can take a number of visits to the site in different conditions. The proportion of birds using a site that are registered by counts can be considerably improved by local knowledge of:

- tidal conditions;
- best light conditions at different vantage points;
- periods of maximum disturbance;
- other local variables which affect counting efficiency.

Priority sites
No country is able to monitor all the wetland sites in its territory, and it is necessary for national waterbird count coordinators to prioritise site coverage. Decisions about which sites to count should be based on their relative importance. Any sites desisgnated as Ramsar sites, identified as IBAs or having other international or national designations because of their importance for waterbirds should have the highest priority for counting. The availablity of volunteers also influences which sites can be counted on a regular basis, and sites in remote regions may be under-represented in a national counting scheme. It is useful if such sites can be counted using an expedition approach (**see page 10**).

If volunteer capacity allows, however, it is also important to complement priority sites with counts from other, non-protected sites. This approach would allow earlier detection of population changes that would be otherwise masked by the so called buffer effect and it would allow the assessment of the effectiveness of conservation measures.

The importance of regular, standardised counting
One of the fundamental aims of IWC is to monitor changes in waterbird numbers. Counts rarely cover every individual in a population, rather, they quantify a sample of the population. If counting methods are standardised, the proportion of the population of each species represented by the counted sample varies little from year to year. Thus, although waterbird counting cannot usually be used to determine absolute population sizes, it is possible to work out how numbers of each species are changing by calculating population trends. The basic assumptions that are made when doing trend calculations are firstly that the proportion of a species that is counted in a given year is representative of the total number in the population, and secondly that the same sites have been counted in the same way every year. The computer program that calculates the trends is able to compensate for years when a site was not counted, but it cannot make allowance for different levels of coverage at a site in different years, and sites with this type of coverage are excluded from trend analyses. Counting the same sites in the same way every year should therefore be one of the principal aims of all waterbird monitoring schemes.

5. How to count waterbirds?

Anybody who can reliably identify birds can contribute to waterbird monitoring activities. Counting a realtively small site holding up to two or three thousand birds of 10 or 20 species is within the capabilities of any experienced birdwatcher, but counting large sites holding many thousands of birds of many species usually needs more practice, experience and organisation.

Equipment

The equipment needed for counting waterbirds is simple, comprising optical aids to enable correct identification and accurate counting, and a means of recording observations, principally, the numbers of birds of different species counted. It is assumed that observers will know how to feed and clothe themselves appropriately for the conditions which prevail at the site to be counted, and that they will be able to find their way around the site without difficulty. The potential dangers at remote sites, where it may be possible to get lost or stranded, and which can experience extremely cold or hot temperatures should not be under-estimated. These considerations will affect how the counter equips him or herself.

Binoculars
Binoculars are essential. 8x30, 8x40, 10x40 and 10x50 are the most widely used by birdwatchers. The first number specifies the magnification of the binocular (8x or 10x), the second number is the diameter in millimetres of the objective lens, and is a measure of the light-gathering power (and also the size) of the binocular. Magnification above 10x is rarely optimal because it is difficult to hold more powerful binoculars steady. An objective lens below 30mm in diameter performs less well in poor light conditions, and one above 50mm is too bulky for most observers. The additional robustness and optical superiority of high quality binoculars makes them well worth the additional expense if money is available.

Telescope
Identifying and counting birds is usually more accurate if a tripod-mounted telescope is used. It is possible to manage at many sites without one, but large sites where the birds are frequently more than 500m distant are best covered using both binoculars and a telescope. It is useful when counting to have a wide angle of view, and a telescope with 20x or 30x magnification is preferable for this reason. Zoom lenses are rarely of comparable optical quality to a lens of fixed magnification, and invariably have a narrower field of view, but they are flexible, and the high end of the zoom (often up to 60x) is useful for reading ring numbers (bands) of marked birds or for clinching identification of distant and difficult species. It is necessary to combine the telescope with a stable tripod, and with a good quality panhead connecting the telescope to the tripod. It is important to be able to pan and tilt the telescope smoothly when working through flocks to identify and count the birds, and only a good quality panhead allows this. As with binoculars, it is well worth spending extra money, if available, to buy a high-quality instrument, and it is a waste of money to mount a high-quality telescope on a poor quality tripod or panhead.

Identification Guide
Most observers spend a lot of time familiarising themselves with the field characteristics of all the species they may encounter, especially in the first months and years after taking up birdwatching. A good way to do this is by absorbing the information provided in identification guides. Nowadays, good identification guides are available for most parts of the world and a field guide is an important part of the bird counter's equipment. It is often considered best practice to take detailed notes and sketches of any unfamiliar species encountered, and to use an identification guide to identify the species when observations are complete. Careful note-taking for identification purposes is time-consuming and may cause unacceptable delay to progress with a count, and it is wise to always keep a field guide handy for occasions when an unfamiliar species is seen. Always having a field guide available is a good way to minimise identification errors when counting. Most waterbirds are quite conspicuous and, with notable exceptions, straightforward to identify in good conditions if care is taken. The most frequently encountered problem is identifying birds at long range in the extensive and flat terrain preferred by most congregatory waterbirds. This is when the additional power of a telescope

is needed, but at some sites, a certain proportion of the birds will often remain unidentified because they are too distant to see properly.

Notebook and pencil
Bird counts and other information collected during birdwatching and counting visits to sites are best recorded in a field notebook using a pencil (always carry at least one spare). Pens rarely work if it rains, and can dry up at any time. The type of notebook used is a matter of personal preference, but most people prefer a small one with a hard cover that fits into the pocket of a jacket or coat. Rigorous and methodical recording are essential, and the count of each species should be carefully recorded. Records should also be kept of the dates of all observations, the weather, and at coastal locations, the state of the tide, and any factors of relevance to the observations being made. Field sketches and descriptions of unidentified birds can be made, and notes kept of a host of interesting things such as any disturbance or threats to the site, ring (band) numbers read, the number of active fishermen, numbers of other animals or plants of interest, and contact details of other birdwatchers. Suggested methods for recording counts are detailed under the heading “counting techniques” on **pages 8-10.**

Electronic recording devices
A number of battery-powered gadgets are available which can be very useful for recording bird counts. *Pocket dictaphones* can be used to record information, but the inability to get an overview of observations made can be a real disadvantage. Various types of *compact computer* are also increasingly used, and developments in *cellphone* technology and software provide increasing opportunities for recording ornithological data. The advantage of these is that they make data management and submission less time consuming than with traditional note taking. Cellphones with in-built GPS also allow a more accurate recording of the location of the observations. A disadvantage of these methods is the danger of battery exhaustion, technical malfunction or breakdown. This can be partly overcome by taking spare batteries and/or solar chargers to the field. Most observers still find that the simplicity and reliability of a notebook and pencil make them the best way to record their data, but this is likely to change in the years to come.

Tally counter

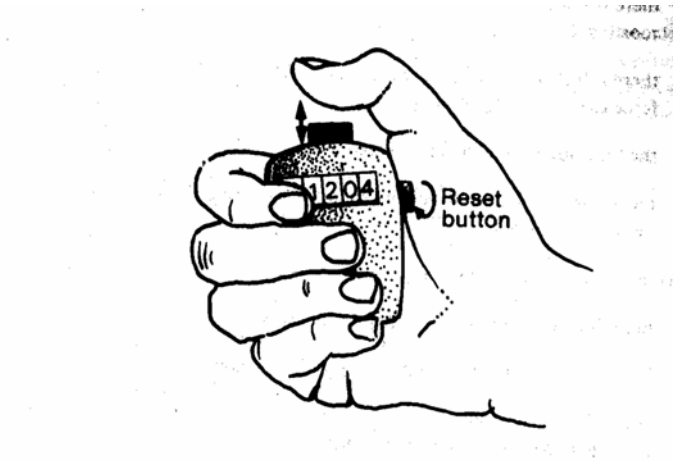


Figure 3 : Tally counter used for accurately counting waterbird flocks.

These devices can be extremely useful, especially at sites with large numbers of birds. Each click of the button advances the count on the display by one unit. Experienced observers may use one, two or more tally counters to enhance the speed and accuracy of their counts (See “How to count in “blocks”” on **page 10** below for details.)

Maps and GPS recorders
Monitoring is by its nature a frequently repeated activity, and observers become very familiar with the sites they count. Use of a map for every count is therefore rarely necessary, but on early visits to a site, a detailed map (paper or electronic, at a scale of around 1:50,000 or less) is an essential prerequisite to getting to know the site and how it is used by the birds. At large and remote sites, a Global Positioning System (GPS) recorder can be invaluable for establishing the spatial basis of counts, and for ensuring that counts of identical geographical areas are conducted on each visit.

Once a counting routine is established, the boundary of the area counted, the route walked by the counter and the vantage points used for counts should be recorded on a copy of the map. These should not normally change between years. The main reason for this is to ensure consistency of coverage from year to year. When counters retire and new ones begin counting a site, it is crucial that coverage continues as it did before. Copies of all site maps should be kept by local and national co-ordinators of every national waterbird monitoring scheme. The area counted by each observer is called a count unit, and may comprise a single, self-contained site, or part of a larger, complex site. The map should be checked before (and, if necessary, during) every count, and at complex sites counted by a team, the site co-ordinator should ensure that everybody knows precisely the boundary of the count unit for which they are responsible. At sites designated as Ramsar Sites or having other international or national status (e.g. nature reserves), the boundaries should coincide with the boundary of the designated area wherever possible. If a larger area is counted than that designated, the designated area should if possible be counted as a sub-site of the whole so that species totals for the designated area can be readily calculated.

Supplementary information such as locations of breeding colonies, roosts, feeding areas, threats to the site, habitat changes and any changes in the boundaries of the area counted can all be usefully recorded on copies of the map. The increasing use of GIS methods through the availability of free Google software now makes the use, recording and storage of mapped information straightforward for anybody with access to a broadband internet connection.

Identification
Correctly identifying all the waterbird species present at a site is the first necessity of waterbird counting. Bird identification is a skill which takes time to master and beginners make more mistakes and miss more scarce species than experienced observers. Correct identification includes a process of elimination, and knowing which species are most likely to occur at a site in a particular season reduces the number of species that need to be eliminated from consideration. The best way to learn is to spend time in the field with an experienced observer who knows which species to expect and who is familiar with the field characteristics of each species. Careful and copious note-taking and field sketching also enhance an observer's powers of observation and reinforce memory of field characteristics. This manual is not an identification guide, and when learning to identify birds, time should be spent consulting identification guides and becoming familiar with the plumage patterns, behaviour and annual cycles of each species. Videos and CD RoMs are also available which provide additional "homework" material for those learning to identify birds, but there is really no substitute for experience in the field, preferably under the guidance of a knowledgeable birdwatcher.

Counting techniques

Any experienced birdwatcher can count waterbirds, and a count on foot of a small to medium sized site is quite a straightforward undertaking. The methods used to count waterbirds in the field depend on many factors, for example:

- the species being monitored;
- the size of the site;
- the accessibility of the shoreline;
- the availability of vantage points from which the site can be scanned;
- the amount of time available to complete the count;
- the number of people involved;

- the available equipment.

The most important element of waterbird monitoring methodology is standardisation. The top priority of counters should be to count the **same site or sites in the same way on every visit**. Each visit should be made at standard dates announced by the national coordinators to allow straightforward and valid comparisons between sites and years .

Sites prone to variable flooding or freezing
Count coverage at ephemeral wetlands in arid areas, and at sites which are prone to freezing cannot be fully standardised in this way. At such sites, it is important to record the extent of flooding or freezing, and whether this has affected the count compared to "normal" years. Ideally, a record should be kept on maps of the extent of flooding or freezing during each year's count. If the site is totally dry or totally frozen and no birds are present, it is very important to submit a nil return, so that missing values are not erroneously added to the data during population trend analyses.

Ground count
Ground counts are the simplest and most common form of census under IWC. The term refers to a count made from the ground (as opposed to an aircraft or boat), usually on foot, although bicycles, cars or other vehicles might be involved. The site is covered systematically, usually by walking the same route on each visit and stopping every few hundred metres to scan with binoculars and/or a telescope to count the birds. When choosing a route (which is best done using a map in the first instance), thought should be given to light conditions (birds are easier to see with the light behind you), and to the risk of disturbing flocks of birds by your presence. At tidal sites, visits should always, if possible, be made at the same stage of the tide. If counts of birds roosting at high tide are to be made (**see page 12**), the site obviously needs to be visited at high tide. At sites with extensive inter-tidal areas, counting at low tide might cause difficulty identifying and counting birds feeding at extreme distance. It is often best to count tidal areas on a rising tide, so that the size of the inter-tidal area is reduced, and birds are within identification and counting range, but before birds have gone to roost. Every site is different, and a number of visits in different conditions are usually necessary, particularly at tidal sites, to establish the optimum time to count in relation to the tidal cycle and other variable factors. Observation during extreme weather conditions should be avoided if possible because such conditions reduce counting efficiency: if there is excessive heat haze, heavy rain or gale force winds, it is preferable if possible to postpone the count until conditions are more favourable.

It is important to use the best vantage points, and to divide the site up into areas that are visible from the chosen vantage points without overlap of areas counted and without missing any part of the site.

Counts are made by scanning flocks of waterbirds (which usually comprise several species) with a telescope or with binoculars as appropriate, and counting each species one-by-one, or in "blocks" of bigger numbers (see "how to count in blocks" on **page 10**). A preliminary scan should be made with binoculars, and the overall number of birds and the proportion of each species should be rapidly assessed, in case disturbance or some other factor causes birds to fly away before you have completed more detailed counts. A preliminary scan with binoculars also gives a good idea of the location of the birds in the area being scanned, and of any landmarks, buoys, boats or other markers that can be used to divide large flocks into smaller units for counting. Close flocks are best counted using binoculars, and more distant ones using a telescope. Flocks should usually be scanned several times, and birds counted one or two species at a time. If time allows, repeated scans can be used to obtain a consistent estimate, i.e. to improve the precision of the count. Scanning repeatedly has the additional advantage of maximising the chances of finding small, inconspicuous or rare species present in small numbers. A tally counter can be used to speed up this process and minimise errors (see **page 7**).

Boat survey
At many sites, especially large, remote ones, boat surveys may be the best way to count the waterbirds. Identifying and counting birds from a boat may, however, be difficult. Boats can cover large distances and give access to areas which would otherwise not be covered. They may also cause less disturbance than would be caused by surveyors on foot, although the opposite can also be true. At extensive and remote sites, for example lakes, rivers or coastal areas fringed with vegetation, or mangrove complexes, there may be no practical alternative to boat survey. Some of the difficulties with boat surveys include the low vantage point offered by small boats, the fact that they are unstable viewing platforms, often preventing the use of a telescope, and the fact that they are slow moving, so that any birds disturbed by the boat may be counted more than once. Boats also cannot be used in adverse weather or tidal conditions. They are, however, widely available for hire in many wetland areas, and much less expensive than aircraft.

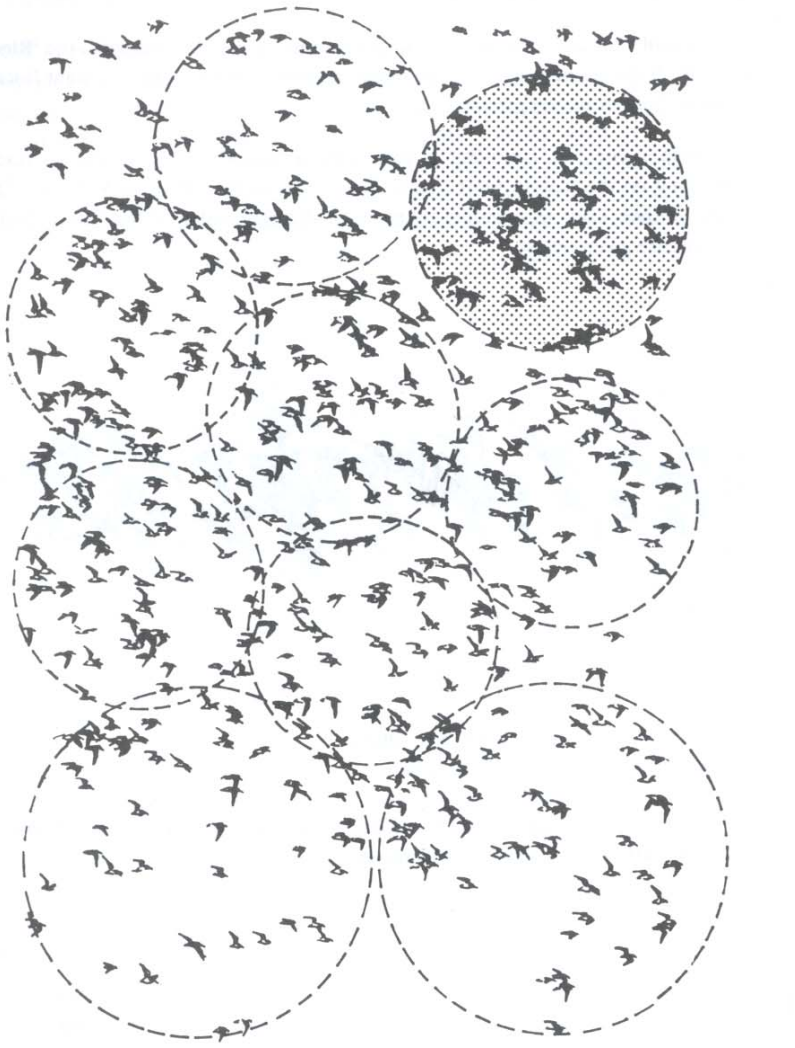
Aerial survey
Aerial survey is often the best method for counting extensive, inaccessible areas, for example offshore waters and big river floodplains. This method is also more suitable for producing consistent counts at ephemeral waters or areas covered (incompletely) by ice. Slow-flying aeroplanes with wings above the cabin, or helicopters, are the most suitable aircraft for aerial survey. Very large areas can be covered in a short space of time (often too short!) and large amounts of information can be gathered. Aerial survey is a good way of identifying areas important for waterbirds at which follow-up ground surveys can be organised. There are two main disadvantages of aerial survey: the high expense (hundreds of dollars or euros per hour) and the often relatively low accuracy of identification and counting which are possible at the necessarily high speeds involved. Aerial surveys are most successful if they are meticulously prepared (logistics can be very complicated), and if recording is carried out fast and efficiently –dictaphopnes, maps, cameras and notebooks all have their place in aerial surveys. Pilots should be prepared to fly low and slowly and surveyors should have strong stomachs. This is a specialised technique, for which a separate instruction manual was produced by IWRB (now Wetlands International, Komdeur et al. 1992).

Expeditions
Waterbird counts in remote regions lacking ornithologists are often first undertaken through expeditions. Once a baseline survey has established where the most important sites are, repeat expeditions are often the only way to ensure that monitoring takes place. Many countries adopt an “annual expedition approach” to IWC, with observers covering numerous sites and hundreds or thousands of kilometres in an intensive effort centred around mid-January each year. This approach can be expensive, and standardised coverage is more difficult to achieve on repeat visits often involving different observers at intervals of a whole year. Maintaining an accurate record of routes travelled, and of counting routes and vantage points used at each site, and ensuring that these maps are used on subsequent expeditions, is a good way to minimise this risk. Involvement and training of local observers at as many sites as possible is highly desirable so that monitoring can be put on a more sustainable basis in the long term.

What to record in your notebook
After recording the site name, date and time of the count, and information relating to weather, habitat and tidal conditions, for example, each species should be given a new line in the notebook, and counts entered as they are made, with each sub-total separated from its predecessor by a comma, a fullstop or a + sign, e.g.: Redshank 104, 11, 29, 6, 1, 5, 36 = 192. The counts are summed at the end of the visit to give an overall total for each species for the day. Many observers save time and space by using two or three letter codes for species, and many take along a friend or relation to do the record keeping.

How to count in “blocks”
Experienced counters can accurately estimate 10, 20, 50, 100 or more birds almost instantaneously, and scan through flocks counting in these “blocks”. It is preferable to estimate in small units (10 is probably the most commonly used block). Tally counters can save time and increase the accuracy of counts (**see page 7**). The tally counter can be used to

count one-by-one, or, each click of the button on the tally counter can be used to represent a “block” of birds.



This flock contains an estimated 450 - 500 birds (i.e., 9 blocks of 50 birds plus several left over). (NB actual flock size is 491 birds).

Blocks of 100 or more are generally only used for birds in flight where time is very limited. The first block may be counted one by one, and the mental image of this first block can then be used to
assess the number of blocks in the flock containing the same number of birds. Some experienced observers use two tally counters to count two species at a time, but this takes practice and can reduce the accuracy of counts.

Birds should be counted one at a time, as at small sites, if there is no shortage of time. It is usually preferable, however, to count faster than this to prevent problems caused by birds moving about in response to the tidal cycle or to disturbance. A tally counter can be useful in these circumstances (see above). It is easiest to count birds in feeding or loafing congregations on the ground or water. If counts of birds in flight are necessary, flocks in flight are often best counted from the back of the flock, scanning in the direction of flight withbinoculars or a telescope. Large flocks introduce an inherent bias; small sites with few birds can be counted with greater accuracy than large sites with many birds.

The importance of recording zero counts
If a site is visited and no birds are present because of drought, freezing or disturbance, for example, it is important to record a zero count and send it to the national coordinator at the same time as the rest of the year's counts. If the counter is certain the site is dry or frozen, a nil return can be sent to the National Coordinator without visiting it. Failure to submit nil returns will result in incorrect calculation of average counts for the site, and incorrect treatment of the site for population trend analyses (the trend analysis programme will assume that the site has not been counted and will impute missing values for the species usually counted at the site). If a site is destroyed and counts stop for this reason, it is similarly important to inform national coordinators of waterbird monitoring programmes.

Analyses at national or international level assume that all waterbird species present at each site are counted, and when performing calculations for population trend analysis, computer programmes insert a zero for species which are found in the region but which were not recorded during a particular count of a particular site. It is therefore important to make a note of any waterbird species which were present but not counted (as often happens in the UK with gulls, for which counting is optional, for example). It is simplest and best if all waterbird species present at a site can be counted on each and every visit.

Specialised methods

The methods described above will enable counters to successfully undertake counts (sometimes referred to as "core counts") for IWC under most "normal" circumstances. There are a number of additional, more specialised methods which are often used to complement or supplement these standard methods, and three of the most commonly used of these methods are described here. Analyses of data from the International Waterbird Census have shown that standardised counts in January can be used to obtain adequate population estimates and trends for a majority of swans, geese and ducks (Anatidae), Common Coot *Fulica atra*, and many populations of grebes (Podicipedidae), cormorants (Phalacrocoracidae) and waders (Haematopodidae, Recurvirostridae, Charadriidae and Scolopacidae). IWC methods work particularly well for these species because their populations often congregate at a relatively small number of sites during the non-breeding season.

Roost counts
Some species, for example geese (Anser spp. and Branta spp.), waders (e.g. Haematopodidae, Recurvirostridae, Charadriidae and Scolopacidae), herons and egrets (Ardeidae) and gulls and terns (Laridae), form large, concentrated roosts outside the breeding season. Counts of some roosts, for example waders at high tide, may be included in the IWC methodology described above. Other roost counts, for example of geese, should only be undertaken as part of a specially organised monitoring scheme, to ensure that birds at the roosts are not double-counted at their feeding sites.

Counting high tide roosts of waders (shorebirds) can be a very good way to monitor them, but an additional visit to the site when the tide is low or rising may be necessary to effectively monitor other species. Roosts of waders usually congregate close to intertidal areas and are often used faithfully year after year. There are many similarities in approach between doing a ground count (**see page 9**) and counting roosting birds. A preliminary scan with binoculars will locate the main concentrations of birds, and can be used to rapidly estimate the overall number of birds and proportions of different species, in case the birds are disturbed and fly away before detailed counting is finished. Accurate, species-by-species counts can then be made, ideally using a telescope and tally counter. Repeat counts are very useful under these exacting circumstances, and dividing the work between several observers helps prevent overload at big roosts. The sheer density of birds at the roost can cause difficulties, with birds at the back of flocks being particularly difficult to separate and identify. A solution to this problem that is often used is to count the birds as they fly in to roost. Counting birds in flight does present its own difficulties, however. It may be difficult to produce separate species totals for some large flocks of more than one species, and keeping track of rapidly moving flocks can be problematic. Finding a good observation position, using enough observers and getting the timing right are all factors that will improve the completeness and accuracy of high

tide roost counts. It usually takes several visits before the optimum combination of these factors is determined for any particular site.

Counts of colonially nesting species
Some species congregate at colonies during the breeding season, and closely co-ordinated counts at this time may be productive. Many species in the following families can be counted at their colonies: pelicans (Pelecanidae), cormorants (Phalacrocoracidae), herons and egrets (Ardeidae), storks (Ciconiidae), ibises and spoonbills (Threskiornithidae), flamingos (Phoenicopteridae), and gulls and terns (Laridae). Many successful surveys of colonial nesting waterbirds have been carried out at national level, and it may be possible in future to produce international analyses for some species. Colonies in open terrain are relatively easy to count compared to colonies in trees, which are difficult to count accurately. It is extremely important to minimise disturbance of breeding birds, and approaching too close, whether on foot, in a vehicle, an aircraft or boat, should be avoided at all costs. As with all monitoring, using standardised methods and counting the same sites in the same way each season are crucial important considerations.

Separate counts of different age and sex classes
Species with recognisably different adult and immature, male and female plumage classes can be separated according to these classes during counts. This is usually done as a part of detailed demographic studies which are currently beyond the scope of IWC. Sample age counts of many populations of geese and swans in Europe are made each year, and these extensive counts result in much improved understanding of the productivity and population dynamics of these populations. When conducting IWC counts, any dependent young seen during the count are not included in the count totals. It can, however, be very useful at national level to have information about breeding success of different species, and it is useful to record this information in national databases.

6. When to count waterbirds

The January census
Widely known in the Northern Hemisphere as the “midwinter census” (reflecting its temperate European origin) this was the basis of IWC for the first 40 years of its history, and a count in mid-January remains the most important contribution of national waterbird monitoring schemes to IWC. In Africa, an additional count each year in July has been an important element of the census since it became established in 1990. It was recently decided to broaden the scope of IWC to include counts made during migration periods. In many countries, the IWC count in mid-January is the only count undertaken, but more frequent counting is usually necessary to adequately monitor waterbirds at national level, or to identify and monitor the importance of sites at international level.

The advantages of more frequent census
Many countries in northern and western Europe are able to undertake monthly counts of a large number of sites. These counts form the basis of a good understanding of waterbird usage of wetland sites in all seasons, and this information feeds into policy which protects waterbirds and their wetland habitats. Obtaining one standardised census of a representative sample of wetlands every year is a good basis for national waterbird monitoring schemes. Conducting more frequent counts, especially in the autumn and spring migration seasons, should be considered an important next step.

7. Record keeping

Simple and effective record keeping which allows accurate recording of the information collected is vital to the success of any waterbird monitoring scheme. Many national waterbird monitoring schemes produce standardised recording forms for the use of counters. Such forms are also available from Wetlands International, either in hardcopy or on the website:

Field records
Most counters write their observations in the field, then copy them up onto recording forms when they get home after the count. It is important to do this as soon as possible after the count so that details remain fresh in the memory. See “What to record in your notebook” **on page 10.**

Site forms
Details about waterbird count sites should be recorded on forms, which may be web-based or old-fashioned paper. The most important pieces of information that need to be recorded about sites are the site code, which allows count data to be linked to the correct site in the database, and geographical coordinates, which allow the site to be represented as a point on maps showing count coverage and numerical abundance. The system of geographical coordinates in use by IWC uses decimal degrees, to three or more decimal places. The site code is often added to the form by the national waterbird count coordinator. Another important function of site forms and maps is to show clearly how complex sites comprising a number of sub-sites are divided up for the purposes of counting. A map showing how count units are defined is vital to ensure standardised continuity of counts over the long term. It is useful to include additional information about the site on the site form, including for example its geographical area, altitude, salinity, and the different habitat types it represents.

A large-scale map of the site (including the boundaries used for counting, the route covered during the count and the principal vantage points used for counting) should also be held on file by the counter, and submitted to the national waterbird count coordinator, preferably in electronic format.

Site forms and maps need to be compiled when a site is first counted (or when collection of detailed site information and maps are first introduced to a national waterbird counting scheme). After this, the site forms and maps should be periodically reviewed, and any changes in habitats, boundaries, or other factors should be recorded on new copies of the form and map and copied to the national waterbird count coordinator. Be sure to include the date on every version of the site form and map.

Count forms
A count form (or “visit form”) should be completed every time a site is visited, even if no birds are found. The most important information recorded on these forms is the number of each species counted (including any species which were present but not counted) and the date of the count. Exact totals should be used, and the use of ranges (e.g. 100-200) and other imprecise terms should be avoided. It is also crucial to include an unambiguous site name and site code. In some countries, the national waterbird count coordinator adds the site code upon receipt of the completed count form. Most waterbird monitoring schemes also request information about threats to the site, and about factors which may affect the efficiency of the count such as weather, flooding, freezing, tidal conditions and disturbance. Completed forms should be copied promptly to national waterbird count coordinators to allow rapid compilation of national level databases and timely analysis, interpretation and publication of the information.

8. Linking waterbird monitoring with other conservation and research activities

Waterbird monitoring is a very valuable activity, providing crucial information about waterbird numbers and population trends at the levels of individual sites, countries, and continents. There are many complementary activities to which observers involved in waterbird monitoring can also contribute.

Recording ringed (banded) or marked birds
Many academic and individual researchers trap waterbirds and mark them with rings, neck collars, leg flags, wing tags or colour dyes. Large, brightly coloured markers with conspicuous numbers that can be read using a telescope are increasingly being used. Bird counters are in a strong position to observe such birds and send details to their national ringing office, who will obtain details of the life history of the individual and send them to the observer. An increasing number of colour marking schemes use websites to collect and report mark resighting data, and these should be used as appropriate. If contact details of the ringing office are unknown, they can be forwarded via the national waterbird count coordinator. It is important to note the type, colour and position of the mark, (e.g. left or right leg, above or below “knee”) and numbers or letters inscribed on it. Details of any associated birds (is the marked bird paired? Does it have dependent or independent young?), the size of an associated flock, and habitat being used should also be recorded.

IBA monitoring
Waterbird monitoring coordinated by Wetlands International is closely linked to the Important Bird Areas (IBA) programme of BirdLife International, and waterbird counts are the basis of a high proportion of wetland IBAs. BirdLife International is establishing monitoring at its IBAs, and waterbird counters are in a strong position to contribute to this effort. Details of the BirdLife International partners’ offices in all countries are available on the BirdLife International website, and national coordinators of waterbird monitoring programmes are strongly encouraged to collaborate with the IBA monitoring programme in their country.

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