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Manual on field survey methods

Methods and procedures to be used for aerial bird surveys in GORWIND Project

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Principles of sampling

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Field transects for the GORWIND project were chosen so that they would systematically cover the whole of Riga Gulf. To provide the most precise data for further bird distribution modelling, transects were placed every 3 km, except the deep areas where they were placed every 6 km. Total length of transects are 2000 km in the Latvian part of the Riga Gulf (Figure 1) and 2200 km in the Estonian part of the Riga Gulf (Figure 2). Transects are placed in North – South direction thus most of them are placed against the depth gradient. If they are flown in the middle of the day (which is the most suitable timing for flights from various aspects) the sun is either in front or back of the aircraft and thus do not obscure the visibility on the sides of plane.

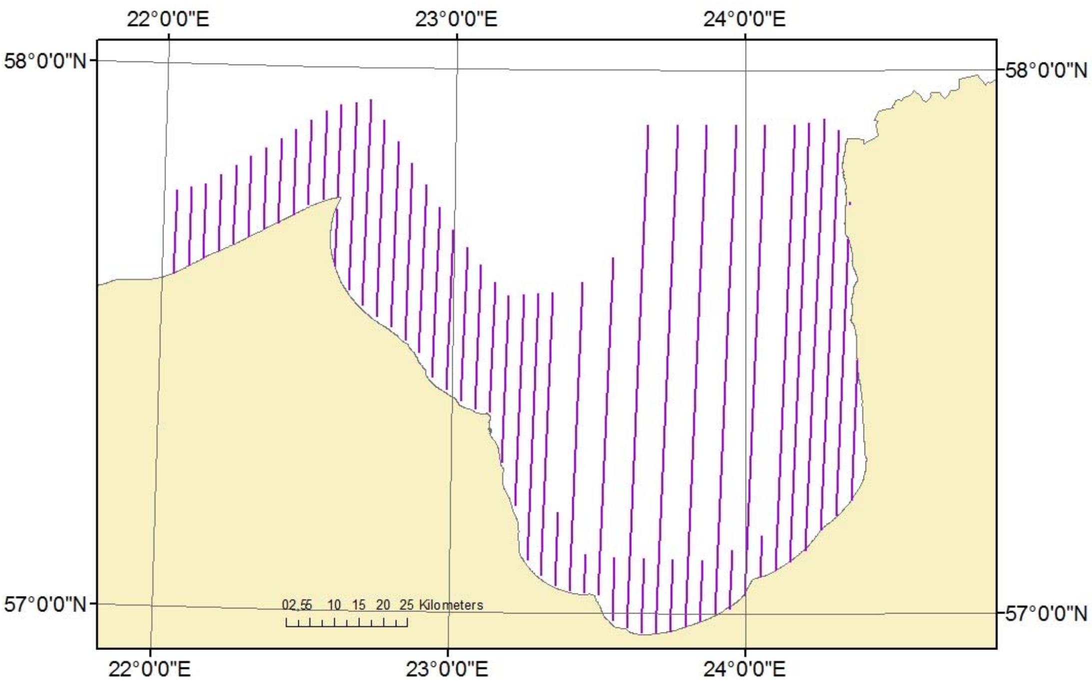


Figure 1. Bird count transects in the Latvian part of the Riga Gulf.

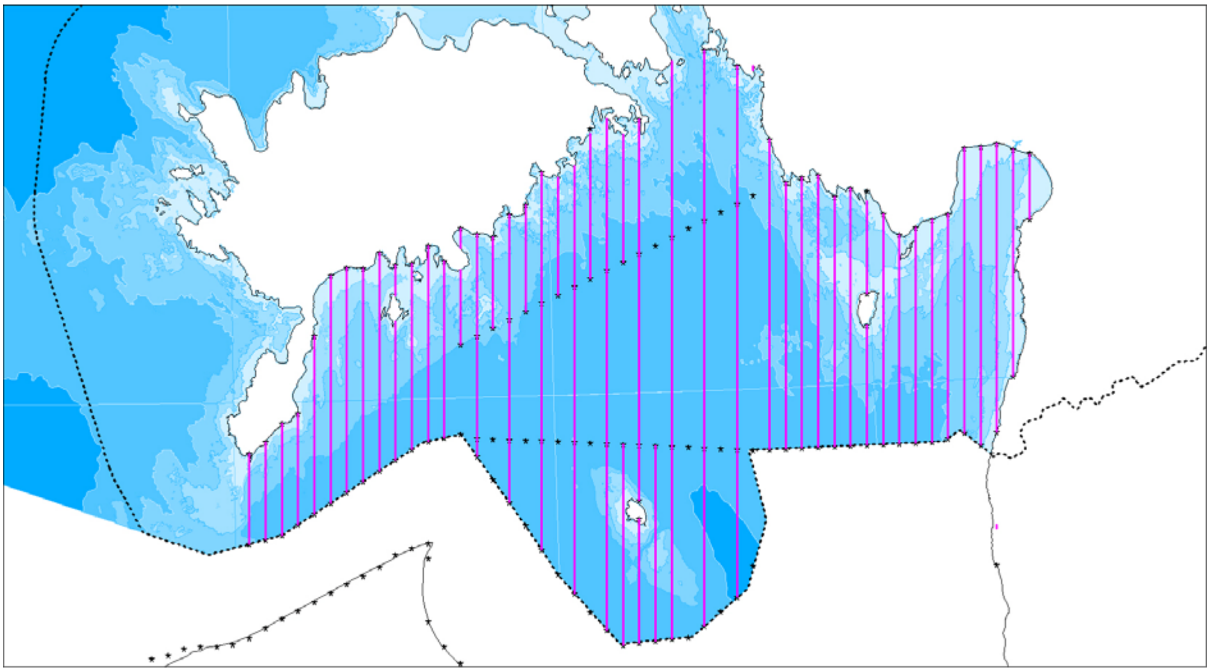


Figure 2. Bird count transects in the Estonian part of the Riga Gulf.

The chosen sampling design will ensure even geographical coverage of the project territory with most survey effort put on the depth zones where highest variations' in bird densities are expected. Data collected using this sampling design will be well suited for the spatial modelling.

Each transect has to be flown 5 times during the project according in different seasons as described below in the subchapter "Timing of surveys".

Distance sampling

Distance sampling data collection method (Buckland et al. 2001) was chosen for fieldworks in GORWIND project. Distance sampling allows using all observations collected during the counts and is not restricting them to one particular counting belt. The method takes into account the well-known fact that detectability of objects decreases with increased distance from observer.

Density estimations using distance sampling in line transects are based on the same principles as the classical strip surveys in line transects (Figure 3), which is not a distance sampling method. To estimate object density in strip surveys a formula

$$D = n / 2 \omega L , \qquad (1.1)$$

where D is density, n – objects recorded, ω – strip width on one side from thansect and L – lenth of transect, is used. The detectability of objects within the strip should be 100%. The objects that fall outside this zone are not recorded thus often a lot of data is left unused.

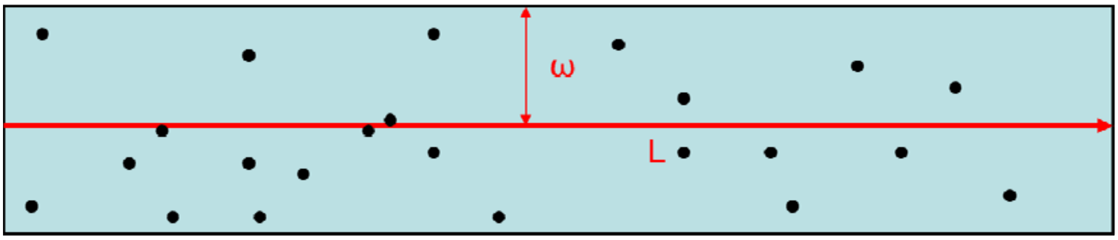


Figure 3. Population density in classical strip transects are estimated using formula D = n / 2 ω L. Using strip transects the objects of interest outside the strip are not counted. Width of the strip should not be larger than area where detectability of the objects is 100%.

Usually observers observe objects outside the “classical” strip, however, the further from the strip they are, the more often they are unnoticed. So usually objects near to the transect are all or almost all noticed while those far from the strip are not (Figure 4). A theoretical line exists where number of detected objects beyond the line is equal to number of undetected objects on observer’s side of line. Thus this “theoretical line” makes a “strip” and the same formula as used for the strip transects can be used to estimate the density. The problem, however, is that we do not know the distance to this “theoretical line”. Thus we need an empirical data to establish a relationship between the detectability of objects and their distance from the transect.

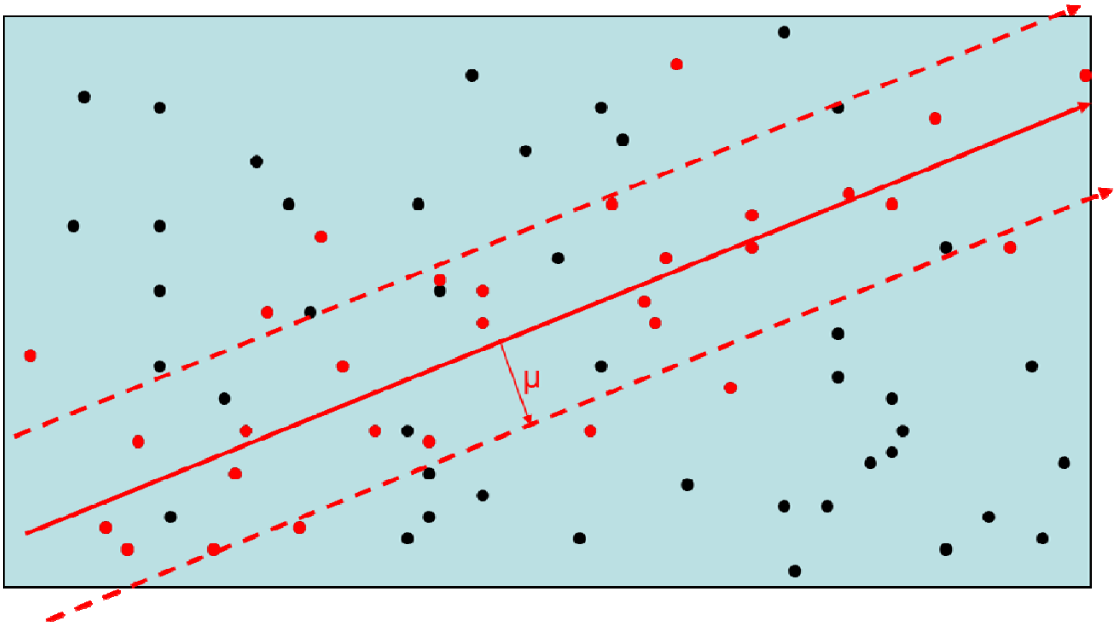


Figure 4. Theoretical distance (μ) exists where number of detected objects (red) beyond the line is equal to number of undetected (black) objects on observer’s side of line. In this case similar formula as that used for strip transects (D = n / 2μL) can be used to calculate the density.

Collecting data using the distance sampling methods requires that not only number of objects along transects are counted but also distance to every object is recorded (Figure 5). The distance is recorded as perpendicular distance to the transect line. Alternative method that records distance from observer and angle from transect in field also exists. Then the perpendicular distance is calculated from these 2 variables later.

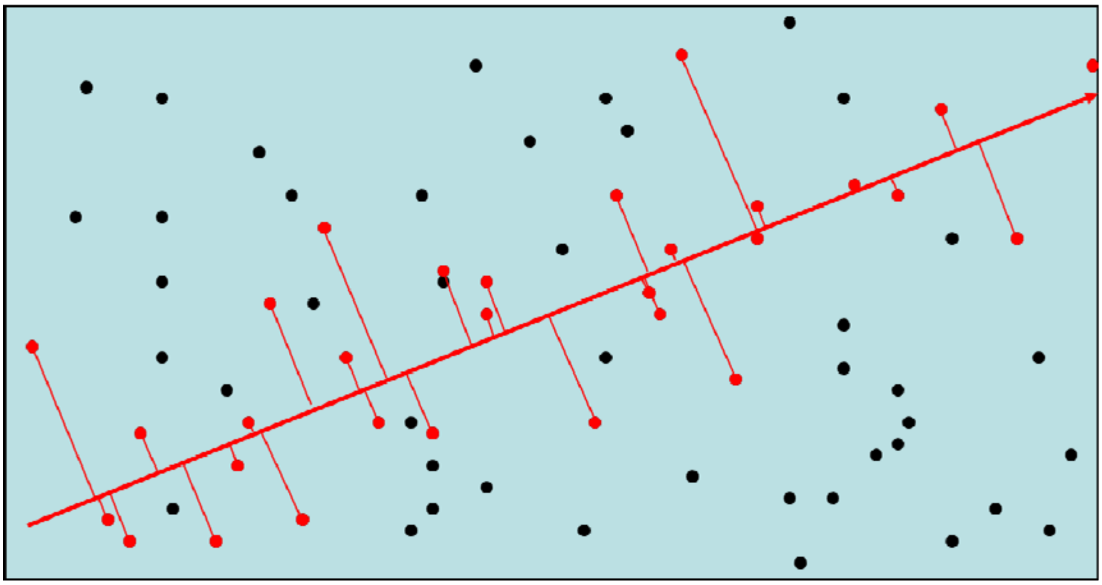


Figure 5. Using the distance sampling approach, distance to every observation perpendicular to the transect is recorded.

Using data collected this way it is possible to establish a detection function empirically (Figure 6). The detectability of objects decreases with increasing distance from the transect.

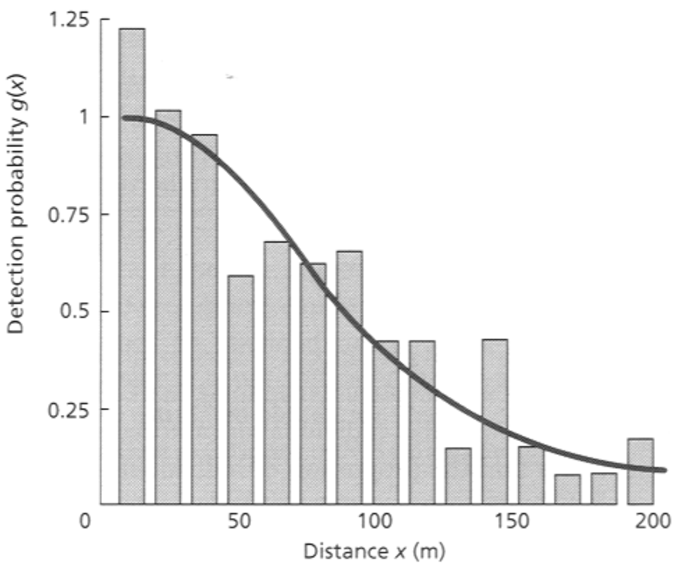


Figure 6. The recorded distances to objects are used to build a detection function. Usually the detectability of objects decreases with the distance from the transect. (figure taken from Buckland et al. 2001).

Detectability of different species is different. Some species are easily recorded at large distances while others are easily missed even at close distances. So the detection functions for them may also be different (Figure 7). Detectability differs also if different counting methods are used. Also different persons counting have different visual and audial abilities and thus there are observer specific detectability curves. Detectability is different also in different weather conditions, sea states or other situations that potentially affect object detectability. Even within the same species individuals with different behaviour (on water, flying, diving, etc.) have different detectability functions.

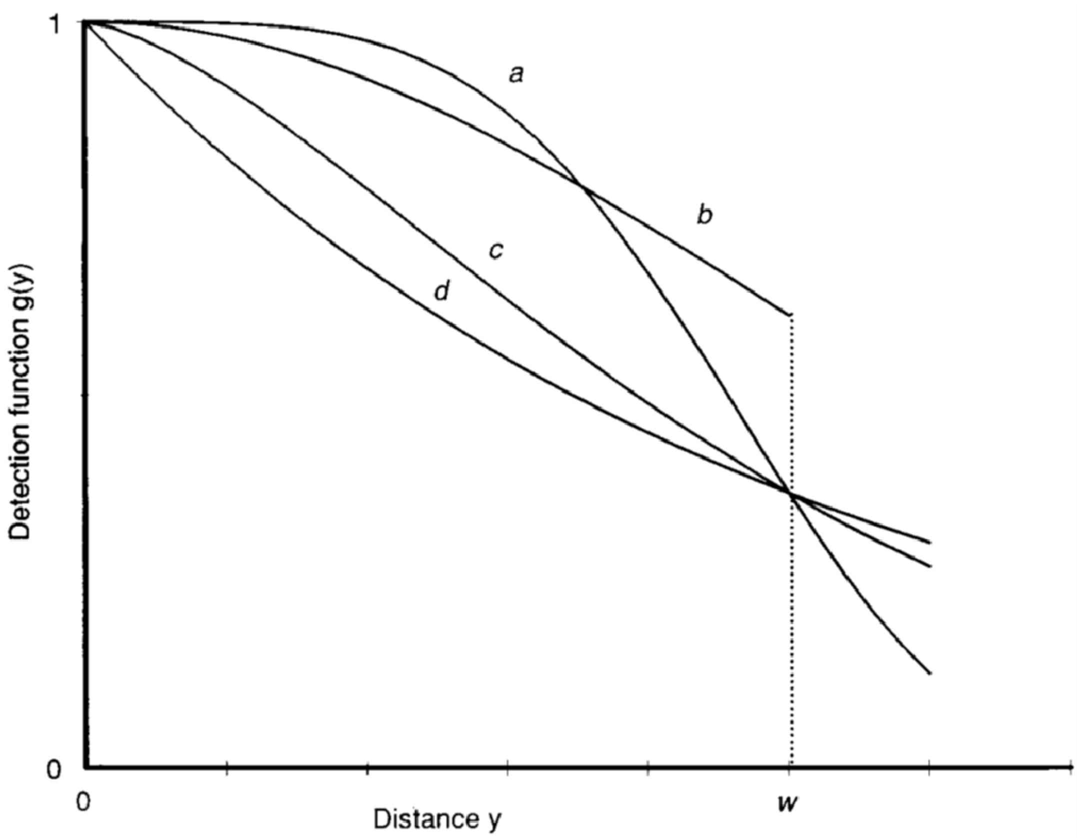


Figure 7. Different objects have different detectability curves. Detectability curves may also be observer specific, method specific, weather specific, behaviour specific, etc. for the same objects. (figure taken from Buckland et al. 2001)

On aerial flights it is impractical to record individual distance to every observation, so the observations are grouped within distance belts and detection function is calculated using these distance belts.

Method requires also that each individual is recorded separately. This also is impossible in aerial flights. Thus modification of the method is used – unit of observation is a flock of birds and for each flock also the flock size is recorded. Please note that also single birds are recorded, flock size is 1 in this case. If a flock spreads over several distance belts, number of birds is recorded for each belt separately.

Fieldwork procedures

Timing of surveys

There are 5 survey sessions planned in the project: 2 spring counts (April and May), 1 summer count (July), 1 autumn count (October – November) and 1 winter count (January – February).

The light time of day has to be used for counting. The optimal time for counts is from 10:00 till 14:00 when the sun is highest and its reflections on water do not reduce detectability of birds. However, deviations from the optimal time period are allowed, especially in spring and summer counts when the days are long and the sun is high.

Weather conditions

Surveys can be performed only in a weather that is suitable for bird counts. The most important is the sea state – it should not exceed 3 according to Beaufort scale. It is important that there is no fog or any other precipitation during the surveys as they influence detectability of birds negatively. Good light conditions are important, however, it is not mandatory to have a sunny weather. Often slightly overcast weather is even better as there are no sun reflections that reduce detectability of birds.

Flights

Flights have to be performed at altitude of 250 feet (76 m) with a speed that does not exceed 100 knots (185 km/h). Flying higher and faster negatively affects recognising the species. Moreover, the view angles for distance belts that are given below are calculated for the altitude of 250 feet and changes in altitude render the given angles unusable.

Transect belts

Counting has to be performed separating birds into the transect belts. They will allow building detectability functions later at data analysis stage. Special correction factor will be applied for each distance belt. This will allow using all the recorded data, not only data from the main distance belt where detectability is the highest.

Within the aerial transect surveys there is a difference from the classical line transects. The belt that is nearest to the transect line is not used as it falls in the zone below the aircraft that cannot be observed.

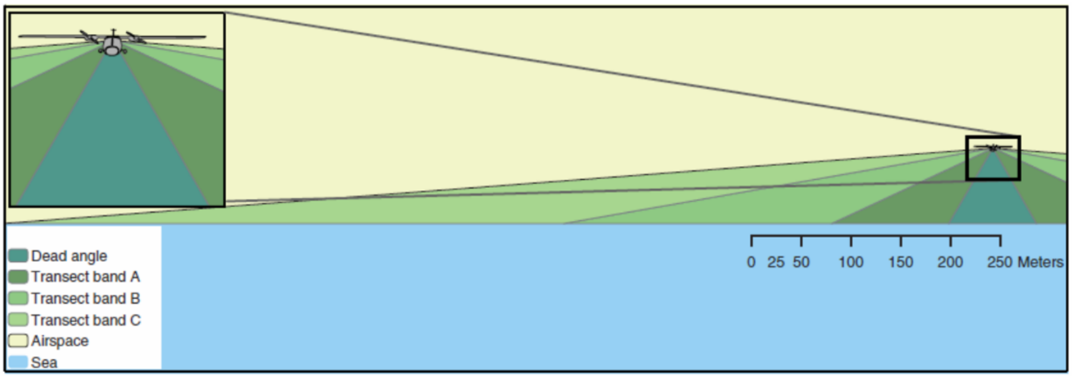


Figure 7. Counting has to be carried out using distance belts. The belt that falls directly below the aircraft is a "dead angle" that cannot be observed.

The boundaries of the distance belts can be estimated using a clinometer – they are located on certain angles from the horizon if the height of flying is known (Table 1). It is important to fly on the suggested altitude as at different altitudes, the angles given below are not applicable.

Table 1. Parameters of distance belts – boundaries or distanced from transect lines and angles from horizon if aircraft flies at altitude of 250 feet.

Band	Band boundaries (perpendicular to transects)	Angle from horizon
A	44 – 163	60 – 25
B	164 – 432	25 – 10
C	433 – 1000	10 – 4
(D)	(> 1000)	(< 4)

Equipment

Plane

The aircraft used for bird transect counts over sea must fulfil certain criteria that are important from safety and data collection point of view. The aircraft must have two engines thus ensuring safety and stability. It has to be high-winged to provide good visibility below the aircraft (Figure 8-9). It is important that nothing obstructs the view. The plane has to provide seats for at least two observes so that they would be able to count birds on both sides of plane.

Figure 8. Two-engine high-winged aircraft (Vulcanair) suitable for aerial bird surveys.

Figure 9. Aerial survey from the board of Cessna 337 in Irbe Strait in 11.05.2011.

The plane has to be equipped with GPS navigation system where the flight transects can be uploaded as well as it has to be able to follow these transects precisely, i.e. flying straight lines. It also has to be able recording tracklog of the flight with high data density (preferably every second if GPS memory allows). It is important that pilot has good experience as such survey flights require higher skill level than usual flights.

Safety suits

Safety on a plane is observer's own responsibility. As flying on very low altitudes will take place the counters have to be dressed in safety suits that, if any accident happens, would allow keep body warm in cold water for a longer period of time (Figure 10).

Small equipment

All bird counters have to be equipped with handheld GPS receivers (Figure 11) that would record tracklog of the flight, provide precise time (including seconds!) as well as allow navigation on routes.

To determine boundaries of the distance belts, clinometers that provide precise viewing angles (to a nearest degree) have to be used (Figure 12). The correct angles for boundaries of distance belts when flying at 250 ft altitude that are used in Gorwind project are given in Table 1.

When making observations from a plane, full attention has to be paid to the sea surface and there is not much time for decision taking. Thus writing observations down on paper is impossible. This is why all observations have to be spoken into handheld dictaphone (Figure 13). It is very important that the Dictaphone is digital, so that data can easily be downloaded to a computer. It is also important to have prominent REC and STOP buttons so that they cannot be confused with other buttons.

Figure 10. Safety suit that has to be used in bird aerial surveys over sea.

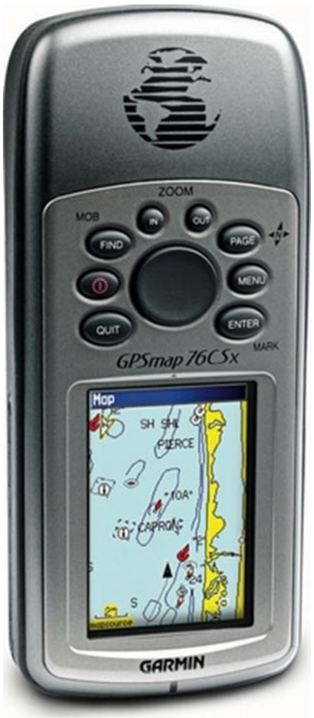


Figure 11. Handheld GPS unit that van be used for aerial bird surveys.

Figure 12. Clinometer that can be used to determine boundaries of the distance belts.

Figure 13. Digital Dictaphone has to be used to record bird observations.

The bird counters have to be equipped with binocular. However it has to be used only for recognising species, especially those in the outer belts. Too frequent or too long use of binocular reduces detectability as other birds in other belts may be missed.

It is recommended also to have field assistance material with sequence of information that has to be spoken into dictaphone when starting a transect and for every observation, so that important information is not missed. An assistance material with correct angles to determine boundaries of distance belts that are adjusted to scales of the clinometers used are recommended.

Field observations

When starting a flight, observer reports into dictaphone his name, date, seat in the plane, identification number of the GPS unit that is used as well as additional information such as weather conditions, etc.

When starting transect, the observer records precise time (including seconds!) that will be used later to synchronise observations (file time) with the real time. It is important not to stop recording after the message. If record is stopped at any time during transect, each new record has to be started with time synchronisation message. The report sequence is as follows:

[start rec] GPS time including seconds, transect No., notes [recording continues…]

The recorder is kept recording while flying the transect. All observations are reported using the following format:

[recording is already started] Species, number, belt, behaviour, sex, age, notes [recording continues…]

Such message is given for every observation. Sex and age can be skipped if it is not possible to identify them in the time which is available. It is important not to stop recording after the message. If record is stopped at any time during transect, each new record has to be started with time synchronisation message. When ending a transect time synchronisation is performed again:

[recording is already started] GPS time including seconds, transect No., notes [stop recording]

All observations in the transect have to be split according to transect belts and behaviour (or sex and age if necessary) so that later in the data entry sheet can be separate record for each data category

Data entry

Data entry into data entry sheets has to be done soon after the flight, preferably at the same day. This way it is possible to restore some information accidentally skipped when reporting observations into dictaphone.

Species recognition (Table)

SPECIES	IDENTIFICATION *	RECOGNAZIBILITY	DISTURBANCE BEHAVIOUR
DIVERS	Distinction between the two small divers **Red-throated Diver** and **Black-throated Diver** is usually not possible. Large diver - **White-billed Diver** can be identified by the big ivory bill (summer plumage)	Easily recognized with wave scores 0-2, very hard to see with scores 3-4	Usually tend to stay, long running stripes when starting (Pic.1)
SWANS	Adults: very difficult to identify from air. Juveniles: **Mute Swan** young appear greyish-brown and „yellow-billed" species (**Whooper and Bewick's Swan**) are grey	Easy to spot	Usually tend to stay
GEESE	Easily identified species in the coast and coastal waters are **Barnacle Goose** (Pic.2). All other goose species are hard to identify except **Greylag Goose** due to very conspicuous light-grey forewings. **Brent Geese** are very dark and usually fly close to the water surface (Pic. 3)	Easy to recognize when flying or sitting in water	Tend to fly away from approaching aeroplane

SHELDUCK	Easy to identify. White and black, more or less geese size, big bird (Pic. 4)	Easy to recognize	Tend to fly away from approaching aeroplane
DABBLING DUCKS	All this group can be rather hard to identify. When spotting a group of larger dabbling ducks, look for white patches on the front wing (**Wigeons**) or on the back of the wing (**Gadwall**), blue patches on the wing (**Shoveler**) and slender birds with a cinnamon back (**Pintail**) (Pic. 5,6). Small ducks are **Teals** and **Garganeys**. Last one has a blue patch on the wing. Mallard is most easy to identify, with two white stripes on back of the wing	Rather easy to recognize in flight	Tend to fly from approaching aeroplane
AYTHYA SPECIES	Rather easy to identify in a good light. **Pochard** and **Tufted Duck** are more coastal species, **Scaup** tend to be more marine one. Often **Scaups** and **Tufted Ducks** aggregate to mixed flocks. Such situation makes the identifying complicated. **Scaup's** flocks are most often huge and dense (Pic.7). Birds can be identified by a white line on the wings and the light-grey back in males	Easily recognized with wave scores 0-2, hard to see with scores 3-4	Not very „nervous species". Some tend to fly from approaching aeroplane

MERGANSERS GOLDENEYE	Quite easy to identify, but **Goosander** (Pic 8.) and **Goldeneye** (Pic 9.) may look similar in flight. The color of the rump has proven to be the best identification mark from air; it is grey in the **Goosander** and black in the **Goldeneye**	Easy to recognize in flight	Tend to fly away from approaching aeroplane
EIDERS	Easy to identify when **Eiders** (Pic 10.) are in summer plumage, but winter plumage (brownish-black) makes them difficult to distinguish from the **Velvet Scoters**. **Steller's Eider** forms a very dense flocks (rare in Riga Bay)	Easy to spot males in summer plumage, complicated in winter plumage	Usually tend to stay
SCOTERS	Identification of the **Common Scoter** (Pic 11,12.) and the **Velvet Scoter** (Pic 13,14.) may cause problems as they are both black. Identification is easy when birds are flying, difficult if birds are in water. White patches on the wing of the Velvet Scoter are well visible in flight	Easily recognized with wave scores 0-2, very hard to see with scores 3-4 due to black plumage	**Common Scoter** tend to fly a long distance from the approaching aeroplane, while **Velvet Scoter** tend to stay
LONG–TAILED DUCK	**Long-tailed Duck** is black and white, small seabird (Pic 15,16.). Usually rather easy to identify, difficulties to distinguish from the large auks at long distance	Look small in the water. In some light conditions in flight, hard to spot	Often make short, frequent dives in front of the aeroplane

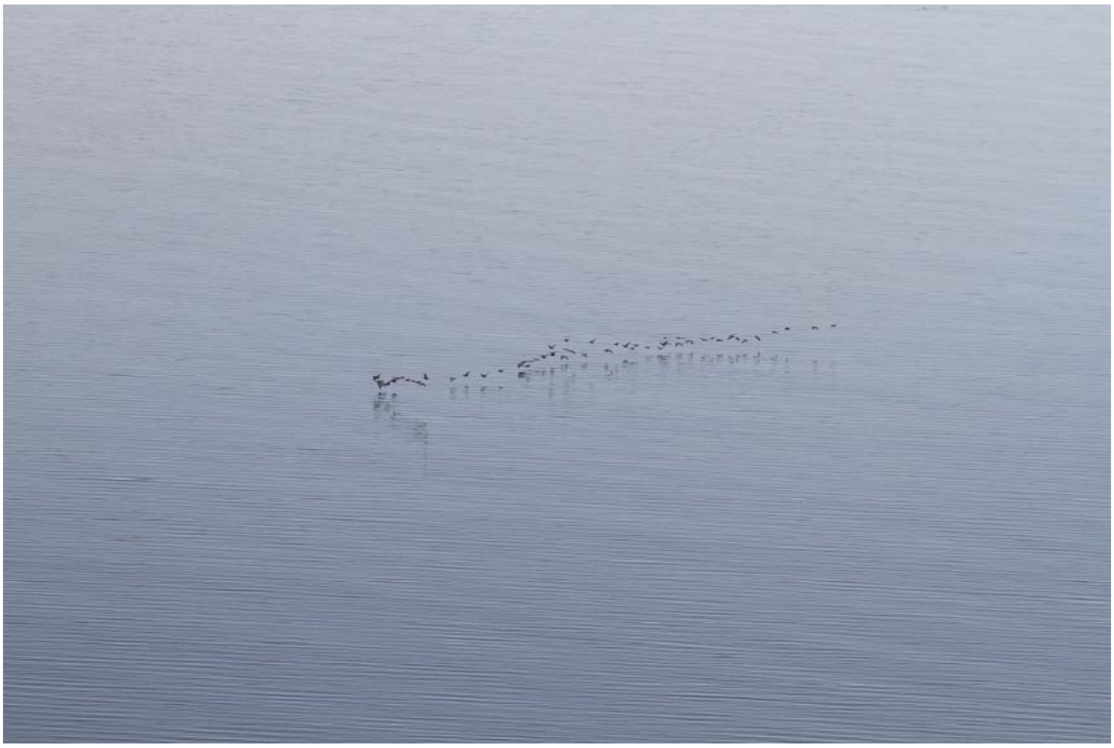
GULLS	Gulls are generally quite easy to identify, in particular the adult birds. Identifying juveniles may cause difficulties. Main identification problems among gulls are in between **Herring Gull - Common Gull** and in between **Great-backed Gull - Lesser-backed Gull**.	Very easy to spot due to white colour.	Usually flying birds are observed from aircraft
AUKS	Due to similar appearance, the Razorbill and Guillemot can not to be identified to the species level	Pretty easy to spot in sunshine, but hard to find in bad light conditions	Tend to stay, some are flying away
CORMORANT	Easy to identify (Pic 17.). Black big slender bird with white patch on the vent	Easy to spot	Tend to take off before approaching aeroplane

* - Komdeur *et al.* 1992, Blomdahl *et al.* 2007

Species recognition (Pictures 1-17)

Picture 1. Long and fairly well visible (even from long distance) “runaway” of the Black-throated Diver. Sea state – 1.

Picture 2. Flying Barnacle Geese with pale upper wings and black neck are well recognizable. Sea state – 1.



Picture 3. Migrating flock of the Brent Goose. Sea state between 0 and 1.

Picture 4. Flying Shelducks are not mistakable.

Picture 5. Mixed flock of the Mallard, Shoveler, Gadwall and Pintail.

Picture 6. Mixed flock of the Mallard and Wigeon.

Picture 7. Dense flock of Scaups in the bad light. Sea state - 2.

Picture 8. Goosanders usually panic when the aeroplane approaches. Sea state - 1.

Picture 9. Typical escaping behavior of the Goldeneye. Sea state –2.

Picture 10. Common Eiders, especially males are very easy to spot. Long-tailed Ducks in background. Sea state – 0.

Picture 11. The flock of the Common Scoter is very dispersed (compared with Velvet Scoter). Sea state – 0.

Picture 12. Common Scoters tend to take to the wings at a long distance from approaching aeroplane. Sea state - 0

Picture 13. Velvet Scoters are usually observed in small and rather dense flocks. Sea state – 1.

Picture 14. Large flock of Velvet Scoters, not very common situation. Sea state between 0 and 1.

Picture 15. Huge and dispersed flock of the Long-tailed Ducks is common feature in Riga Bay. Sea state – 1.

Picture 16. Mixed flock of Long-tailed Ducks, Common Scoters and Velvet Scoters. In such case identification is not easy task.

Picture 17. Cormorant’s colony in Vesitükimaa Island (Sõrve peninsula).

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