

GOOSE PRE-HATCH REPRODUCTIVE SUCCESS

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PURPOSE

Annual reproductive success sets the stage for an individual's contribution to the gene pool and is one of the determinants of population growth (or decline). It is governed by a depreciative process that starts with an initial investment of eggs and ends (from a northern perspective) with the fledging of young and their movement south during migration. The depreciation involves a cascade of interactions with the habitat (e.g. quantity and quality of forage), competitors, predators and parasites. In many areas, predation is the leading cause of nesting failure in birds, and thus nesting success is a major component of predator-prey interactions. As geese are precocial (i.e. their young leave the nest immediately after hatch), the measurement of pre-hatch and post-hatch components of reproductive success requires different methods. Measures of reproductive success described here extends until young depart from the nest (those extending from departure of the nest until fledging are described in another protocol). The components of reproductive success that are of interest here are:

Laying date: date that the first egg is laid in a nest

Hatching date: date at which the majority of eggs hatched in a nest

Clutch size: total number of eggs laid in a nest

Nesting success: proportion of initiated nests where at least one egg hatch

Hatching success: proportion of eggs still present in the nest at hatch that produce goslings

TIME PERIOD

On Bylot Island, the monitoring period for goose nests usually extends from 10 June to 18 July. Dates may need to be adjusted slightly at other sites depending on the latitude.

PROCEDURE

Reproductive success is usually determined on all (or a sample of) nests found during measures of abundance (see protocols for snow geese and dispersed goose nesting species). Ideally, nests should be found as early as possible during the laying period. However, nests found at any stages can be useful for some components of reproductive success. In programs where geese are marked (e.g. with neck-collars), nests of all marked females that are found opportunistically in the colony are also included in the sample of nests to monitor reproductive success.

Each time a nest is found, we proceed in the following manner:

- 1) If the female is near the nest, look for a neck collar (or a leg band) and, if possible, write down the number. This is especially important at hatching because we can usually approach females at a much shorter distance.
- 2) Put a pre-numbered wooden stake 10 to 15 feet north of the nest. Put the wooden stake on an elevated place, with its larger side towards the direction you would normally come from. This will

facilitate finding the stake from a certain distance. The nest will be identified by the wooden stake number (**write it down**).

- 3) Record the nest position in a GPS, using the number on the pre-numbered stake. To assign numbers, use guidelines provided in the abundance protocols (i.e. alphacode of the species followed by a number, especially for dispersed nesting geese; see protocol on goose abundance).
- 4) Note the habitat type (patch) in which the nest is found, either wet or mesic.
- 5) With a permanent marker, write a different number (1, 2, 3, ...) on both tips of each egg. Number the eggs from the dirtiest one (no 1) to the cleanest one, if possible. If the nest already contains marked eggs, **continue the sequence of numbers**. If several nests are close to each other, mark the nest number on the large tip of each egg as well to minimize confusion during next visits.
- 6) In the field book, write down the following information:
 - Number of eggs
 - The stage of the nest AND of each egg in the nest (see tables in appendix for nest and egg stage codes)
 - Signs of predation (see table in appendix for codes)
 - The numbers on the eggs already present (if the nest was found before your visit), the number given to the new eggs (circle these numbers) and the number on the broken eggs (put an X on these numbers).

It is important to note this information during each visit.
 - Note the **color rank** of each egg, from the dirtiest to the cleanest (note: two eggs may be of equal color: e.g., if there are two eggs equally dirty and a white one, the color rank will be 1, 1 and 3).
 - All other appropriate information, like the presence of a white egg (no dirt at all), the female on the nest (or nearby) should also be noted.
- 7) If the incubation period has started (warm eggs) at the first visit, measure the length and width of the eggs and weigh them. This will be used to determine the incubation stage. For the weight, be aware of reading errors while using the spring scale. Note all these results on your field book.
- 8) Before departure, cover the eggs with down and other material found around the nest.

During laying, you should take note of nests where it is obvious that all eggs have been taken or destroyed by predators before the nest is found. Give them a number (first letter of your name + number) and write down the information but do not mark these nests with a wooden stake as they do not need to be revisited. During nest visits, avoid excessive disturbance of the nests because it could result in nest destruction by predators. For example, avoid visiting the same sector in consecutive days (space the visits in one sector by 2 to 3 days). It is preferable to work in groups instead of being spread out over a large portion of the colony. By focusing our activities in one sector, we minimize disturbances.

Ideally, nest should be visited a minimum of 3 times (laying period, beginning of incubation, hatching period). Thus, all nests found during laying should be revisited during incubation (usually during the first quarter or third of incubation) to determine total clutch size. Whenever you pass by a surveyed nest, you can verify its content but generally not more than 5 or 6 times because visiting nests too frequently increases disturbance.

Every time a nest is revisited, **repeat steps # 1, 5, 6 and 8 mentioned above. Do not forget to write down the number on the eggs (REALLY important)**. For nests totally destroyed by predators, take out the wooden stake because those do not need to be revisited. However, be careful to distinguish a

predated nest from one that hatched successfully and where goslings have left. When marked nests are found empty during a revisit, always note the number of hatched eggs (based on the **number of shell membranes**) or of predated eggs remaining. The presence of soft shell membranes in the nest is a reliable indicator that the nest has hatched with success. However, large pieces of hard shell with simply a hole in them are indicative of predation because those are not found in nests where goslings hatched successfully (goslings trample the eggshells into fine pieces).

All nests that are still active during hatching (with marked young or not; see below) need to be revisited in order to determine their final outcome. When it is confirmed that goslings have left the nest or that the nest has been totally destroyed by predation, the wooden stake can be taken out and no additional visits are required.

Web-tagging

Web-tagging goslings at hatch can provide considerable information on movements of families post-hatch, growth of known-age individuals, and potentially survival, for goslings recaptured later in the summer (e.g. in banding drives). However, it is labor-intensive and should be conducted only at sites with long-term programs. We describe here this procedure.

During the hatching period, plan nests visits using the estimated hatching dates. When the nesting colony is large, the same sectors need to be revisited every 2 days. We mark goslings in sectors where **nest have been surveyed** since the laying period (nests with wooden stakes) as well as in other sectors of the colony (nest that have not been surveyed, i.e. that we did not find before). Therefore, all nests with goslings are visited, **even new nests**. These visits are spread over the entire hatching period. It is important to mark goslings during the entire hatching period. Two to three teams of 1 to 2 persons will patrol sectors of the colony every day. Avoid unnecessary disturbance of sectors of the colony where nests are being surveyed (i.e. nests with wooden stakes that will be used for estimating the nesting success). Try to mark **the goslings of females with neck-collars in priority**; even if the nest is not surveyed (i.e. does not have a wooden stake).

For each nest where goslings have hatched, you should:

- 1) Note the nest number and date. If the female is marked (collar or leg band) and she is on a new nest (i.e. not surveyed during laying), the nest is positioned with the GPS.
- 2) For **non-surveyed nests** (found for the first time during hatching), give a number to the nest, preceded by the first letter of the last name: e.g. for Reed, R1, R2, ... (avoid giving the same number twice!). For all nests (surveyed or not) note the nest stage, the number of intact and broken eggs, number of living and dead goslings, numbers on the eggs that did not hatch and other appropriate remarks.
- 3) Put a web-tag on the webbing of the right foot of each gosling and put them back into the nest. If goslings are leaving the nest, put them back into the nest. Use web-tags with consecutive number for goslings from the same nest. For each gosling, indicate if it is wet, dry or still into the egg.

If you find nests with young and hatching eggs (i.e. already pierced by the gosling), **young that are still in the egg should also be marked** (see drawing below). If you find a nest where most of the eggs are pierced, young should also be marked in the egg. Do not mark young when many eggs are not pierced yet (i.e. only a small crack can be seen). **Never mark a young if hatching of the egg has not yet started.**

MATERIAL

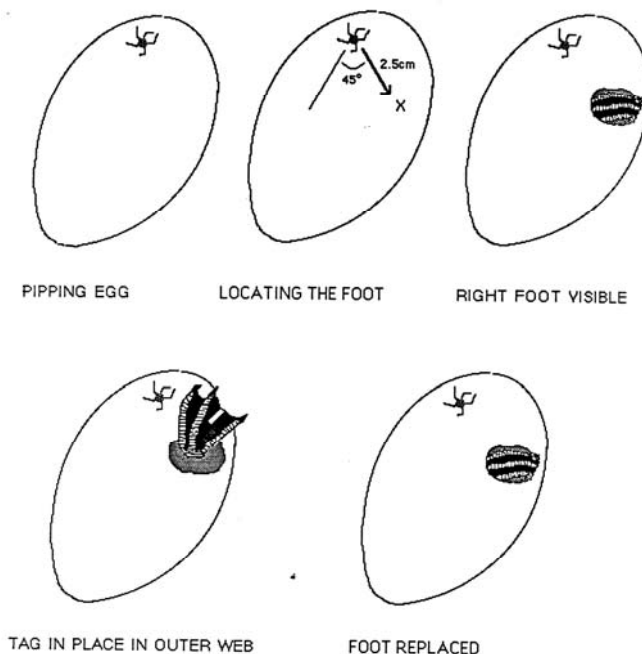
- Painted wooden staked, already numbered
- Small permanent marker
- Binoculars
- 300 g spring scale + plastic bag (DO NOT use other balances)
- Non-electronic caliper
- Field book
- GPS
- Web-tags and pliers (when web-tagging only)

DATA MANAGEMENT

Data should be transcribed to data sheets back at the field camp. Each nest visit is transcribed on a different line. Data from these visits will be used to estimate nest parameters such as the egg laying date and clutch size. Formulas used for these calculations are available with the data sheets.

It is useful to **estimate** the **hatching date** on the data sheets by adding 23 days to the date at which the last egg was laid (we assume that incubation lasts 24 days and starts on the day the last egg is laid). Indicate this date in parenthesis on the data sheet. It will serve as a guide to plan future nest visits during the hatching period. Divide data sheets into groups of nests (e.g. central colony plot, random plot, neck-collared female), when appropriate.

When you enter the information on data sheets, verify if the number of eggs in the nest increased. If it is the case and if the egg laying date and clutch size was already estimated (i.e. we thought that laying was complete when the nest was first found), the egg laying date should be re-calculated, assuming that during the first visit, the nest was still in the laying period. However, do not recalculate if you suspect parasitism during the incubation (ex: clutch > 6 eggs).



NEST STAGE variable

Codes	Definition
0	Female killed or nest destroyed by an observer
1	Cold eggs (may contain one warm egg) but the nest is still active
2	Warm eggs
3	Eggs that just started hatching (strong knocks or small crack)
4	Eggs at the end of hatching (hole-pip)
5	Goslings in the nest (may contain hatching eggs)
6	Empty nest, hatched with success
7	Empty nest, hatched with success but some eggs remaining (indicate how many)
8	Completely predated or abandoned nest (cold eggs found after the beginning of incubation)
9	Unknown

PREDATION variable

Codes	Definition
0	No predation
1	Missing or broken eggs since the last visit
2	Complete predation (ALL eggs broken or missing)

EGG STAGE variable

Codes	Definition
0	Intact, viable, not hatched
X	Broken (not viable)
1	Knocking
2	Pip (small crack)
3	Star-pip, no hole
4	Hole-pip
5	Large hole (gosling is turning inside the egg)
6	Half-shell