

GOOSE POST-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 extend from the departure of young from the nest until fledging (those extending from egg laying until young depart from the nest are described in another protocol).

The component of reproductive success that is of interest here is the *brood size* (number of young accompanying adults) at fledging. In geese, *fledging* is usually defined at the time molting geese are captured, which usually occurs shortly before fledging. In longitudinal studies based solely on marked individuals that can be repeatedly observed, change in brood size of marked adults throughout the summer can provide a reliable index of young survival, and ultimately of *fledging success* (defined as the proportion of hatched young that reach fledging stage) because young remain with their parents well after fledging in geese. However, in most studies brood size is determined mostly on solely on unmarked individuals. Change in brood size can provide an index of young survival but only for families that retain at least one young (because it is unknown if pairs without young had young at hatch or lost their clutch earlier). At sites where geese are banded shortly before fledging using mass banding drives, *total brood loss* (i.e. the proportion of families than lost all their young) can be estimated by combining information on average brood size and the juvenile:adult ratio in banding catches. By then, pair that did not nest or lost their clutch have either left the study site to molt, or have molted earlier and have regained flight ability. Thus, most birds captured at that time can be considered to have hatched goslings. Combining these two sources of information than provide a measure of fledging success.

TIME PERIOD

The monitoring period of brood sizes usually covers the whole brood-rearing period. On Bylot Island, this period typically extends from 10 July to 20 August but dates may need to be adjusted slightly at other sites depending on the latitude. During that time, observations can be done opportunistically but the most important period is toward the end of the rearing period or just before banding occurs. On Bylot Island, we divide the brood-rearing period into 10-day periods:

- 1) 10 to 20 July
- 2) 20 to 30 July
- 3) 30 July to goose banding (~8 August)
- 4) during and after goose banding

PROCEDURE

Brood size

For each period, we are aiming for a sample size of **100 broods** (most importantly during the week preceding goose banding when this number should be a **minimum**). Applying a truly random sampling design to this activity is often difficult because goose families move continuously and observations must often be made on an opportunistic basis (e.g. when geese are at a sufficient distance to be observed with a spotting scope). To obtain a representative sample and minimize the chances of observing the same family twice, observations should be done at several sites within the study area and on several days during each period. Brood size can be determined on either marked or unmarked birds but at study sites where marked birds are present (e.g. Bylot Island and La Pérouse Bay), effort should be put to read neck-collar/leg-bands whenever possible. If you are unable to read the code of a mark bird, you should still record that the bird accompanying young was marked. Note that observations of brood sizes should not be limited to distances at which adult markers can be read (as long as brood sizes can be determined, the observations can be made from great distances).

At study sites where geese are banded at the end of the summer, **observations of brood sizes during that period should be done on groups without newly-marked birds and at different sites from where banding occurs**. If newly neck-collared birds are observed in these groups, these broods should not be taken into account because of the possibility of family ruptures during banding drives.

For each brood observation, the following information should be noted:

- 1) date and time
- 2) name of the site and/or GPS coordinates
- 3) presence or not of a neck-collar/leg-band and the code if possible
- 4) number of young accompanying adults
- 5) approximate age of young (IA, IA, IC, IIA, IIB, IIC or III; refer to the figure below)
- 6) any other useful information (e.g. only one adult present, brood attacked by a predator, etc.)

Total brood loss

At sites where goose banding occurs, keep a detailed record of the **total number of young and adults in each capture**. This total should include any bird that may accidentally die during the process or birds that escaped before entering the net or before being banded (e.g. adults that have regained flight abilities and that fly off the group before entering the net).

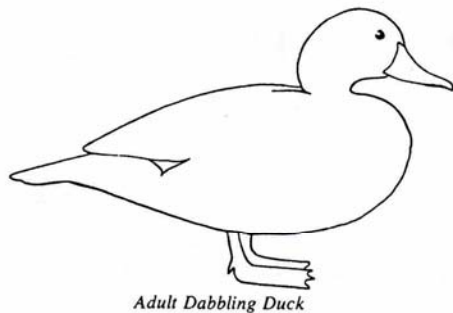
From such data, the proportion of pairs that lost all their young (TBL; *total brood loss*): can be calculated as follows (assuming that all young are accompanied by two parents):

$$TBL = 1 - \left[\frac{N_G : N_A}{BS/2} \right]$$

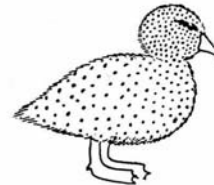
BS = Average brood size (BS) determined just before or at the beginning of goose banding
 $N_G : N_A$ = average gosling : adult ratio over all banding catches

MATERIAL (for brood size determination)

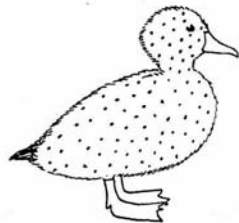
- Tripod and spotting scope
- Binocular
- Field book
- GPS
- Figure of age classification



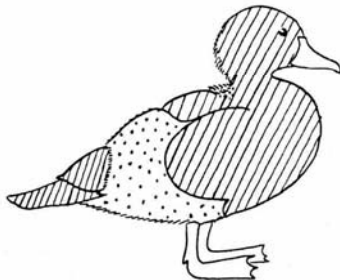
Class I A, young are down-covered; 1-7 days of age



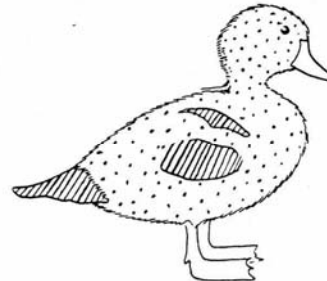
Class I B, young down-covered, but color fading; 8-13 days of age



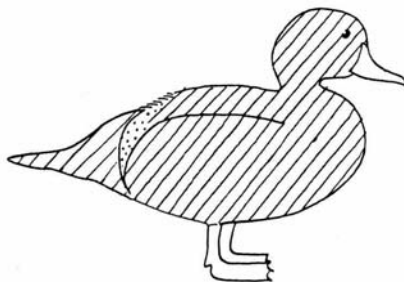
Class I C, young down-covered, but color faded, body elongated; 14-18 days of age



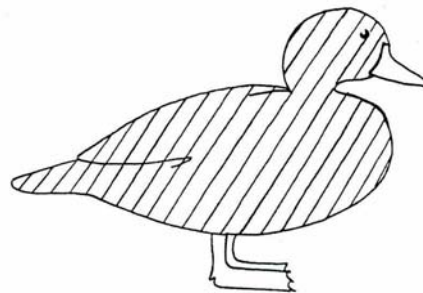
Class II B, over half of body covered with feathers; 28-36 days of age



Class II A, first feathers appear, replacing down on sides and tail; 19-27 days of age



Class II C, small amount of down remains, among feathers of back; 37-42 days of age



Class III, fully feathered but incapable of flight; 43-55 days of age, flying at 56-60 days

Figure 1-5. Plumage development of young waterfowl (after Gollop and Marshall 1954).