Age Ratios and Abdominal profiles

Sample size and biases
We aim to get an optimum number of individuals sampled, bearing in mind:

1. the trade-off that more individuals gives a more precise estimate, but is more time-consuming (and costly) to obtain
2. Non-independence among samples. Samples taken from the same flock are non-independent, samples taken from the same site on successive days are non-independent (the degree of non-independence is difficult to judge, although can be statistically estimated). Samples from different parts of the area may be variably non-independent.
3. Biases relating to flock size: flocks of different sizes might tend to have differing average age ratios or API’s.
4. Biases relating to position in flock. As a result of dominance/fitness patterns, age ratios and API’s might differ between periphery and core and between leading and trailing edge of flocks. Some parts of flocks (esp core) might be harder to observe than others.

We would like the 95% confidence limits for the age ratio to be ±2.5%. Using a bootstrap trial for age ratios, if 1000 independent birds are sampled at a juv ratio of 0.25, then the 95% confidence limits on the estimate would be 23-27%, which is acceptable. Note that these confidence limits could be substantially wider with non-independent sampling.

Sampling bias can be minimised by (1) attempting to sample a range of places, flock sizes, positions in flock; (2) sampling a large number of flocks and dates; (3) Using a linear modelling approach to account for the influence of variables such as flock size, date, position in flock.

Timing
1. White-fronted geese become difficult to age later in the winter, whereas for RBG it is relatively straightforward to age throughout the winter.
2. Early arriving geese might have different age ratios to later arriving geese.
3. There is considerable mobility among geese on this flyway, but within-season movements are poorly understood. Therefore it is not clear whether age-ratio sampling at different times of the season results in sampling different components of the population.
4. Because the key variable to be estimated is the (rate of) change in API over time, API sampling needs to be done throughout the winter.

Sampling area
The LIFE+ study area, broadly extending from Kaliakra to the Romania border and ~15km inland is considered to be the sampling area.

Study species
Priority is RBG. I am not sure whether we should do White-fronted Geese also. They are numerous and are important for the SPA, and may well respond similarly to RBG to changes in habitat. However, they are hard to age past mid-winter. My suggestion is that in 2012-13 we try to sample both species for API, but probably do not attempt to age EWFG.

Data
API’s for RBG are assessed against the template used for Barnacle Geese (8 point scale). API’s for EWFG are assessed against the template used for White-fronted Geese.
There must be regular checks of quality and consistency among fieldworkers for both variables. Although ageing RBG is straightforward, do not assume that all fieldworkers are actually using the same criteria.

**2012/13 Pilot work**

**Deliberate sampling**

Sample throughout Jan and Feb (and early Mar if possible), to get an initial feel for any seasonal variation (although seasonal effects could vary dramatically between years, given the variable phenology of the whole system).

When there is an opportunity to gather some data the following day:

1. Obtain a list/map of current/recent known goose feeding locations for the entire study area. This does not have to be precise, or strictly quantitative. A short list of areas where there is a good chance of a good number of geese should be produced – sites for which the available data indicate brief/intermittent use, and/or low numbers can be discarded. Areas which are difficult to access can be discarded. The aim is simply to allow selection of the range of sites that could be visited to search for flocks, so that we can avoid biases caused by searching in one particular area only.
2. Pick an initial area at random from the shortlist. DO NOT pick the best area or the nearest area preferentially. Make the shortlist only include viable places, and then pick at random.
3. Drive to the selected area. When a viewable flock of RBG is first encountered, it should be sampled. Do not keep moving around until a bigger (or otherwise preferred) flock is found – sample the first one you find. This reduces flock selection biases.
4. Once a flock is selected for sampling, record the basic details about that flock:
   - Date/time
   - Position of observers (GPS)
   - Location of flock (compartment code)
   - Flock size (number of birds of each goose species in field; size bins are OK to use)
   - Give the flock a unique id number for that date
5. Select a sector of the flock to sample. First, evaluate the shape and movement of the flock, and identify the approximate locations of the leading edge, the trailing edge, the core and the sides. It will often be rather messy (e.g. more than one leading edge) – don’t worry too much, it’s not critical, just make a judgement call. If one or more of these sectors is not visible due to topography, bird density, distance, then ignore it. Pick one of the sectors at random, and sample a block of 50 birds (see below).
6. When a block of 50 birds has been sampled, move to the next sector in the sequence and sample another block of 50. Rotate through all the visible sectors in sequence.
7. If the flock is smaller than ~300 birds, it is best to sample the whole flock.
8. For each block that is sampled, record the following:
   - Species being sampled, sector (leading, trailing, side, core)
9. For each bird that is sampled, record the following:
   - Age, API.
10. When sampling a block of birds, scan systematically across the block, sampling every bird that you can see as you come to it. If a bird is obscured from view (e.g. by other birds) ignore it (you can wait for a few seconds for it to emerge if this seems likely). If sampling a leading edge block, start with the foremost bird and work back in. Same for sides or trailing edge.
11. When one 50-bird block from each of the visible sectors of the flock has been sampled, the fieldworker(s) need to decide whether to count more blocks (of different birds) in the same flock, move to a different flock in the same area, or move to a different area. This decision will depend on the number of geese in the flock and in the study area overall, how many areas they are known to be
occupying, how easy they are to find etc. Ideally, we sample only one round of blocks per flock, and keep moving on to different flocks/areas, to increase independence of sampling. However, where it is clear that a large amount of time would be spent finding another flock to work with, it may be worth continuing to sample the same flock and/or different flocks in the same area.

12. In all flocks, different species need to be block-sampled separately. Where it is a mixed flock, both species can be sampled in sequence (or by different observers).

**Data gathering during catching attempts**

When there are teams waiting for birds to walk in front of cannon nets, it is possible that further useful data can be gathered. It might be possible to continue gathering data in this way in future years, if capturing birds for x-ray, lead levels (etc) becomes an ongoing activity, in which case it is useful to test out any difficulties.

The same method as above should be used to record data. It is important to note that the data were gathered during catch attempts, rather than systematic age/API sampling.

**Fieldwork equipment**

- Good quality scope, tripod and window mount
- Map of the field compartments with their codes on
- GPS
- Digital voice recorder may be best means of recording data for a 1-person team. If using a DVR, a crib sheet of instructions and required data is needed. Otherwise, use data recording sheets.
- Crib sheet of API scores for both species

**Data structure**

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Variables</th>
<th>Level 2</th>
<th>Variables</th>
<th>Level 3</th>
<th>Variables</th>
<th>Level 4</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fieldwork day</td>
<td>Date</td>
<td>Flock</td>
<td>Unique identifier</td>
<td>Block</td>
<td>Species</td>
<td>Bird</td>
<td>Age</td>
</tr>
<tr>
<td>Observers</td>
<td>Start time</td>
<td>Compartement</td>
<td>Observer location</td>
<td>Flock size by species</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At the point of data entry, the block and bird data can be concatenated. E.g. for each block there needs to be only a single row of data for the age ratio:

<table>
<thead>
<tr>
<th>Block id</th>
<th>Num birds sampled</th>
<th>Num juvs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Links to the info about species, sector, flock id</td>
<td>Usually 50 buy may not be in all cases</td>
<td>0-50</td>
</tr>
</tbody>
</table>

And for API it can be:

<table>
<thead>
<tr>
<th>Block id</th>
<th>Num juv birds with API</th>
<th>Num ad birds with API</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

If this is quicker than a row for each bird.
Abdominal profile indexes for Barnacle Goose applied for Red-breasted Goose due to physical similarities

Options proposed for API profiles scores for Red-breasted Goose