

Preliminary report:

The diet of house mouse on Nólsoy – insights from stable isotope analysis

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Project funded by
Tórshavn Kommuna
Umhvørvisstúðul - 2016



Aim:

To trap house mice (*Mus musculus domesticus*) (Jones et al. 2011) on two sites on Nólsoy in order to compare diet and other biological features of the mice living in Urðin with the mice in the Northern part of the island. The Ramsar designation of Nólsoy is based primarily on it hosting a large population of European Storm petrel (*Hydrobates pelagicus*) colony on Nólsoy. So this project falls under a priority to explore potential impacts from Invasive Alien Species (IAS) on the native nature on Nólsoy. If IAS such as the house mouse are found to consume storm petrel chicks or eggs, this can have conservation implications for the storm petrel on Nólsoy.

Conclusion:

This project provided valuable information and insight into how future data collection should be planned and executed. However, the study did not provide a clear answer to whether mice in the colony consume storm petrels or not. The analysis does give some indication that some, if not all,

captured mice consume storm petrels. It is not possible at this stage to elaborate if this consumption is due to predation or scavenging. To address this, further study is required. This study also found that cats do prey upon storm petrels in Nólsoy at night.

Introduction

Invasive Alien Species (IAS) are a persistent threat to biodiversity globally, and on Nólsoy there has primarily been concern over possible rat invasions. There have been five independent sightings of brown rat (*Rattus norvegicus*) on Nólsoy over the past 100 years (Hammer 2011). However none seem to have resulted in a persistent population of rats. On Nólsoy there are also cats and mice (*Mus musculus faeroensis*), which can also pose a potential threat to the birdlife on Nólsoy. Due to the potential threat to birdlife, cat ownership on Nólsoy is regulated to some extent. As an IAS, mice have received less attention and study, compared to the more destructive rats and cats. However, there now exists evidence that mice can also have a significant detrimental effect on seabirds which nest in burrows by preying upon eggs and/or chicks (Dilley et al. 2015).



Figure 1. Nearly fledged European storm petrel chick from Nólsoy (photo:JKJ).

The European storm petrel (*Hydrobates pelagicus*) colony "Urðin" on Nólsoy, is among the worlds' largest colonies, with an estimated 50.000 breeding pairs. In 2012 Nólsoy was designated a Ramsar area, mainly due to this large storm petrel colony. Due to the colony's size, it has so far never been accurately assessed, however there are indications that the colony has decreased in numbers. The distribution of storm petrels around Nólsoy has declined, and number of individuals caught systematically in the colony has declined over the past 30 years (Jensen, J-K. Pers. comm.).



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Figure 2. Urðin in Nólsoy – An estimated 50.000 pairs breed in this part of Nólsoy – making it one of the largest single colonies in the world.

There are several potential drivers of population change such as climate change, food availability and such, but considering that there exist anecdotal accounts of mice in Urðin, a study to gain insight into the diet of mice in the colony is long overdue. One much used method to develop a general impression of diet, is the use of stable isotope analysis. The ratio of carbon (C) and nitrogen (N) isotopes will reflect a marine/terrestrial gradient and trophic level respectively.

Methodology

a. Trapping

Previous studies have shown a low trapping rate using mesh box traps (Gylfe 2001). Our study therefore used a different approach. In order to maximise our chances of trapping mice, traps were placed in pairs (1 snap trap and 1 mesh trap) in wooden tunnels (fig.5). The 26 tunnels were placed in a transect through the colony in Urðin. 10 sets of traps were likewise placed in pairs at the control site at 4 different locations, north of the village (fig 3). The traps were placed 7. August 2016, and were checked at least every 3rd day. After mice were caught, they were placed in separate plastic bags, labeled and frozen until dissection. The trapping was stopped 31. October 2016.

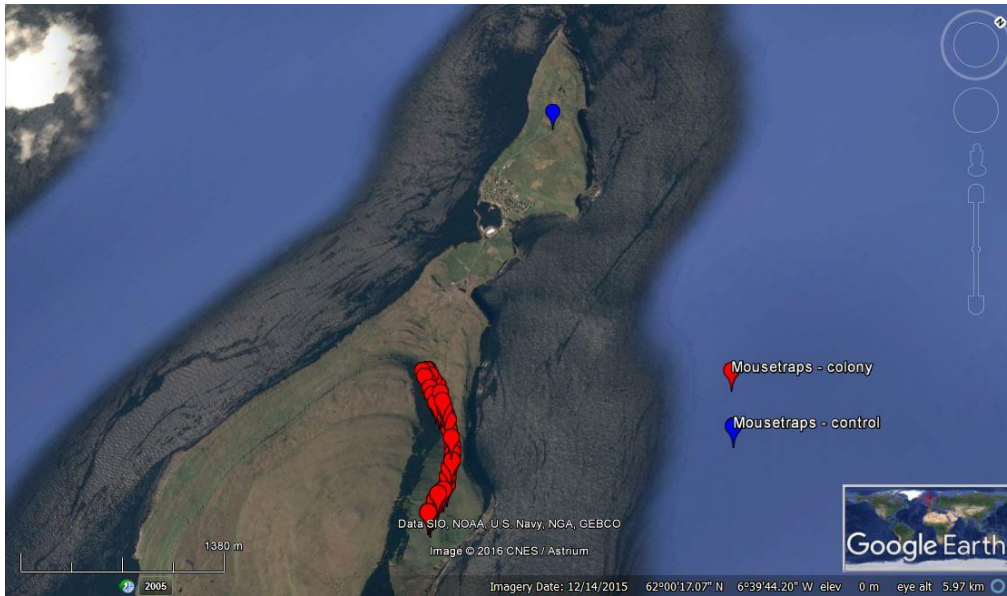


Figure 3. Map showing traps set in the Urðin colony and at control site

Arthropods were caught at the colony and control site using fall traps with water in them, and seeds of two grass species were collected for dietary reference material. Wings of preyed upon storm petrels (likely due to cat predation) were found mainly at the tip of the Urðin colony and were used for dietary references (fig.4).



Figure 4. Two types of grass seeds, storm petrel carcasses and two types of arthropods (not shown) were used as dietary reference material.



Figure 5. Each wooden tunnel contained a set of one mesh box and one snap trap

b. Dissection and sampling

After trapping and freezing 10 mice in the control area, and 20 in the colony, they were defrosted, measured and weighed. The sex and maturity was determined via dissection and the stomach and intestines were stored. Muscle tissue from the left hind limb was sampled and stored separately in tin foil, to prevent contamination. After removing all interior soft tissue and carcass, the skin was sewn back together, dried and preserved for long-term museum storage (fig. 6)



Figure 6. Mouse skins were preserved taxidermically for potential future study.

All the caught arthropods were separated into subsamples of harvest men and beetles. Muscle tissue was extracted from storm petrel wings as reference material.

c. Sample preparation and stable isotope analysis

Since lipid content can influence the N isotope composition, a subsample of mouse tissue and arthropods was taken for lipid extraction. Lipid-extraction was undertaken with a Soxhlet apparatus using a 2 chloroform : 1 methanol solution. Following two cycles of lipid extraction, all the samples were oven dried at 40°C for 48 hours. The samples were then ground to a powder (fig 7).



Figure 7. Beetles dried, and ground up

The stable isotope analysis was done with continuous flow isotope ratio mass spectrometry (CF-IRMS) on an average of 0.8 ± 0.1 mg of sub-sampled material loaded into tin cups and combusted in a Costech ECS 4010 elemental analyser coupled to a Thermo Finnigan Delta Plus XP mass spectrometer.

d. Statistical analysis

The statistical analysis was undertaken on R using core package (R Core Team 2016) and R package “siar”.

Results

In the control area, 8 snap traps and mesh box sets were used. In August 10 mice were caught in the control area. In the colony, 58 tunnels were used. In August 0 mice were caught, in September 2 mice were caught, and in October 20 mice were caught. None were caught in the mesh traps. A total of 22 mice were caught in the colony, and 10 mice at the control area.

If partitioning the transect into 3 sections: the Northernmost part of the colony, no mice were caught, in the middle section “Oksadalsryggur” we caught eight mice, and the southernmost part “Suðuri í Dølum” we caught 15 mice. So a relatively small number of traps (5) in the southernmost part of the colony, caught the majority of the mice.

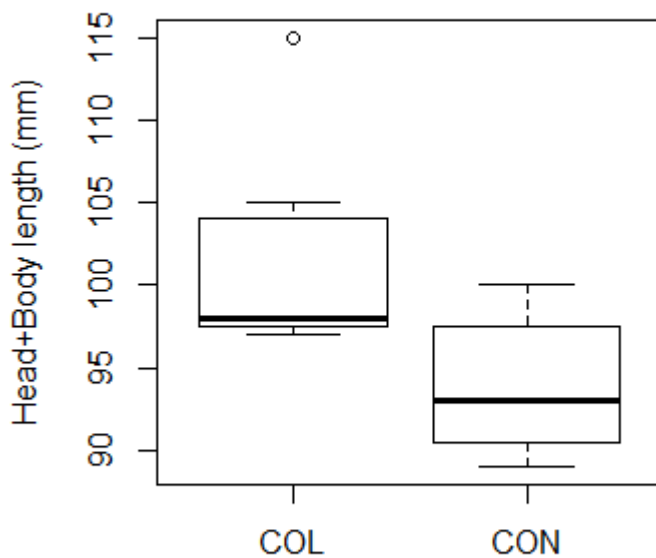


Figure 8. Measurements of adult mice showed the mice in the colony to be significantly larger than the mice caught at the control site, but they did not differ significantly in mass.

When controlling for sex, adult mice from the colony were significantly larger than at control ($t=2.78$, $p=0.016$, $df=14$) (fig 8), but they did not differ significantly in mass ($p=0.953$).

Some studies have shown that vegetation and invertebrates in seabird colonies can become enriched via the seabird guano, which will result in misleading marine and trophically high isotope profiles. To control for this, we collected prey reference material from both the colony and the control site. The $d_{13}C$ and $d_{15}N$ values for vegetation and arthropod samples from the control area and colony, did not differ significantly ($p=0.918250$ and $p=0.186$, $df=3$ respectively), neither did the two types of vegetation or arthropod differ significantly among themselves, so the reference diet data were clustered for further analysis (fig 9).

The dietary reference material was so colinear, that the model was unable to distinguish relative proportions of different food items in the mice's diet (fig.9). However analysing the two groups of mouse stable isotope data (colony/control) in relation to each other, it a significant difference in $d_{15}N$. Mouse tissue from the colony is significantly higher than mouse tissue from the control area ($t=3.19$, $p=0.005$, $df=19$). The $d_{13}C$ levels did not significantly differ between the groups ($t=1.09$, $p=0.29$, $df=19$). This finding suggests that mice in the colony feed trophically higher than mice in the control area. But counter to our expectation if the mice in the colony were consuming storm petrels, there is not detected a "marine" stable isotope signature in the $d_{13}C$. Exploring the individual data points on fig. 9 there is one colony sample that convincingly reflects the expected C/N isotope values for storm petrel consumption. With the limited sample size of this study, type II errors are a potential concern, and future studies should aim to trap more mice, and more importantly sample a greater variety of potential prey types.

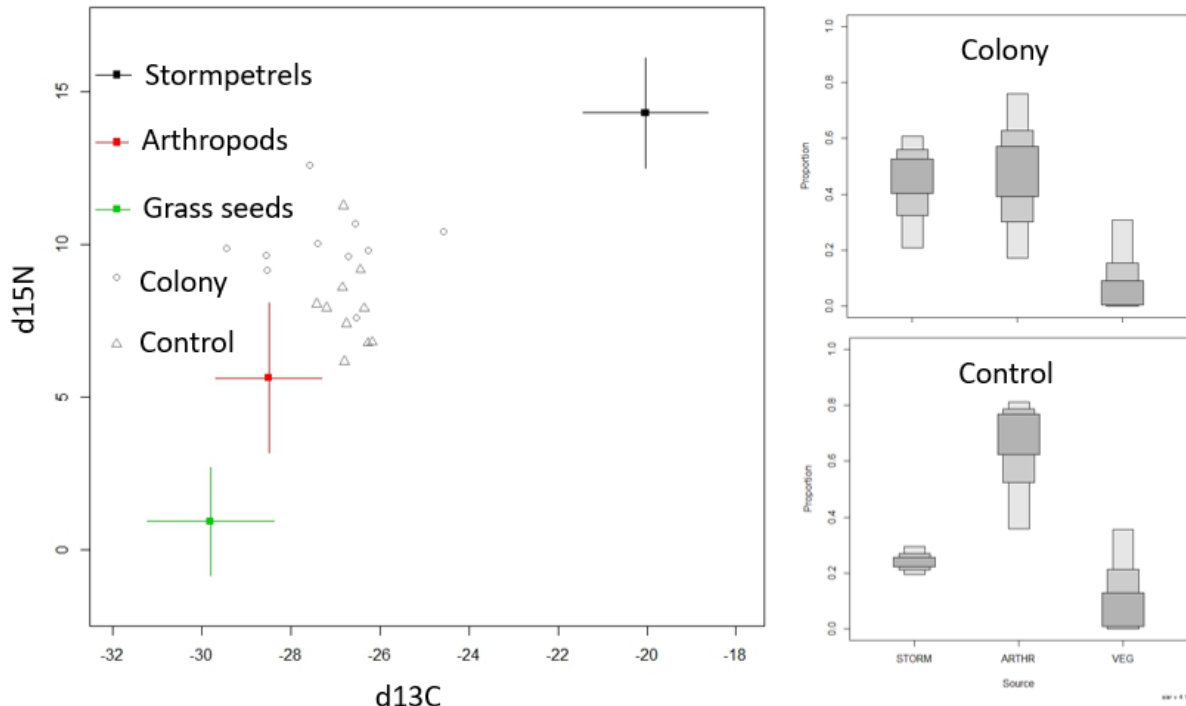


Figure 9. Stable isotope values of muscle tissue of mice in the colony and controls

It is worth noting that most of the storm petrel carcasses (typically wings or wings+tails) were found at the northernmost part of the colony, which is incidentally the closest to the village. Cats are apparently venturing to the colony to predate storm petrels at night.

Conclusions

1. There are clearly mice in the colony, but are not readily caught until September/October.
2. The trapping rate was much highest at the Southern end of the transect.
3. The mice in the colony are on average “larger” than the control mice. But there is not a significant difference between the mass of the mice.
4. The mice in the colony feed at a significantly higher trophic level than the mice in the control area.
5. Dietary sample sizes were too little to get a sufficient resolution to calculate proportional diet.
6. The d13C ratio is not significantly different between colony and control mice, which goes against our prediction of a more “marine” diet of mice in the colony – if they were consuming storm petrel tissue.
7. The SI signature of one sample of colony mice is fairly indicative of storm petrel consumption (higher trophically, and more marine than average).
8. No traps were lost, and no rats were caught, which would suggest that Nólsoy or at least the colony Urðin is still rat-free.
9. Cats are preying upon storm petrels in the northern part of the colony.

Proposed future work:

- Present results at 3rd World Seabird Twitter Conference (#WSTC3) on 12 April 2017, and poster presentation at Island Invasives conference
- Stomach analysis is yet to be done. Although this is unlikely to yield much further insight, this requires special expertise and equipment which I have been unable to get access to yet.
- Deploy camera traps at the colony to investigate potential nest predation at Southern tip of the transect.
- Deploy camera traps at the Northernmost part of the colony, to investigate level of cat predation of adult storm petrels.

References

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