Understanding the potential impacts of disturbance on harbor seals

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- Overview of NRC report findings
- Insights into research and management from other regions
- Areas for future research

http://www.abdn.ac.uk/lighthouse

NRC Committee Terms of Reference

1. What is the Body of Scientific Studies on the Impact of the Oyster Farm on Drakes Estero?

2. What Effects Can Be Directly Demonstrated by Research Conducted in Drakes Estero Itself?

3. What Effects Can Reasonably Be Inferred from Research Conducted in Similar Ecosystems?

1. **What is the Body of Scientific Studies on the Impact of the Oyster Farm on Drakes Estero?**

- Strengths
  - Well structured long-term, volunteer-based, monitoring programme
- Weaknesses
  - High observer variability
  - Disturbance data not representative

NRC view on disturbance data

"Although the NPS seal monitoring program at Point Reyes provides robust data on seal abundance trends, the disturbance data serve mainly as an indicator of a new sources of disturbance or a large change in known source of disturbance. "

NRC Report p44

Cannot use the disturbance data to

- compare the relative importance of different sources of disturbance
- provide insights into spatial and temporal variation in disturbance

NRC view on Becker et al. ms

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Modeling the effects of El Niño, density-dependence, and disturbance on harbor seal (*Phoca vitulina*) counts in Drakes Estero, California: 1997–2007

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ABSTRACT

Harbor seal (*Phoca vitulina*) haul-out site use may be affected by natural or anthropogenic factors. Here, we use an 11-yr (1997–2007) study of a seal colony located near a mariculture operation in Drakes Estero, California, to test for natural (El Niño-Southern Oscillation (ENSO)), density-dependence, long-term trends) and anthropogenic (disturbance or displacement related to oyster production activities) factors that may influence the use of haul-out subsites. Annual mariculture related seal disturbance rates increased significantly with increases in oyster harvest (r_s = 0.55). Using generalized linear models (GLMs) ranked by best fit and Akaike's Information Criteria, ENSO and oyster production (as a proxy for disturbance/displacement) best explained the patterns of seal use at all three subsites near the mariculture operations, with effects being stronger at the two subsites closest to operations. Conversely, density-dependence and linear trend effects poorly explained the counts at these subsites. We conclude that a combination of ENSO and mariculture activities best explain the patterns of seal haul-out use during the breeding/pupping season at the seal haul-out sites closest to oyster activities.

Key words: information-theoretic, AIC, *Phoca vitulina*, harbor seal, disturbance, Point Reyes, Drakes Estero, El Niño, density-dependence, mariculture.

"Harbor seal surveys conducted with NPS supervision were not designed to test the influence of shellfish mariculture on the seal population, but statistical analyses of monitoring data indicate a correlation between counts at sites when seals haul out to rest on sand bars within the upper estero and the combined signals from the 1998 El Niño and oyster production. Although this cannot be used to infer cause and effect, it highlights the need for a more detailed assessment of the extent to which different disturbance sources may impact harbor seals both on land and in the water."

NRC Report p5

2. What Effects Can Be Directly Demonstrated by Research Conducted in Drakes Estero Itself?

None of the scientific research projects within Drakes Estero was designed specifically to assess whether the oyster farm operations were impacting the local harbor seal population, and this constrains attempts to draw definitive conclusions about potential impacts. Analyses of monitoring data found a correlation between seal counts and years since the last ENSO event and oyster harvest levels at two haul-out sites within the upper estero (Becker et al., 2009), but this cannot be used to infer cause and effect. Consequently, research that has been conducted within Drakes Estero cannot be used either to directly demonstrate any effects of the oyster farm on harbor seals ***or to demonstrate the absence of potential effects.***

NRC Report p5

3. What Effects Can Reasonably Be Inferred from Research Conducted in Similar Ecosystems?

Tabulated Summary of Reported Values of Harbor Seal Flushing Distances

NRC Report

Appendix D

Disturbance Source	Mean (m)	SD	Range (m)	Habitat Type	Reference
Powerboat	No Data	No Data	<100–300	Small Estuary	Allen et al., 1984
Powerboat	144	No Data	28-260	Island Archipelago	Suryan and Harvey, 1999
Powerboat	80	No Data	No Data	Glacial Fjord	Mathews, 1996
Powerboat	105	105	No Data	Glacial Fjord	Lewis and Mathews, 2000
Stationary Powerboat	191	125	27–371	Island Archipelago	Johnson and Acevedo-Gutierez, 2007
Motor yacht	533	No Data	100–1150	Large Estuary	Brasseur and Reijnders, 1994[a]
Rubber Dinghy	350	No Data	70–650	Large Estuary	Brasseur and Reijnders, 1994[a]
Cruise Ship	200	No Data	<100–850	Glacial Fjord	Nansen et al., 2006[a]
Cruise Ship	123	No Data	No Data	Glacial Fjord	Mathews, 1996
People	No Data	No Data	<100–200	Small Estuary	Allen et al 1984
People	200	No Data	10–400	Large Estuary	Brasseur and Reijnders, 1994[a]
People	142	135	No Data	Glacial Fjord	Lewis and Mathews, 2000

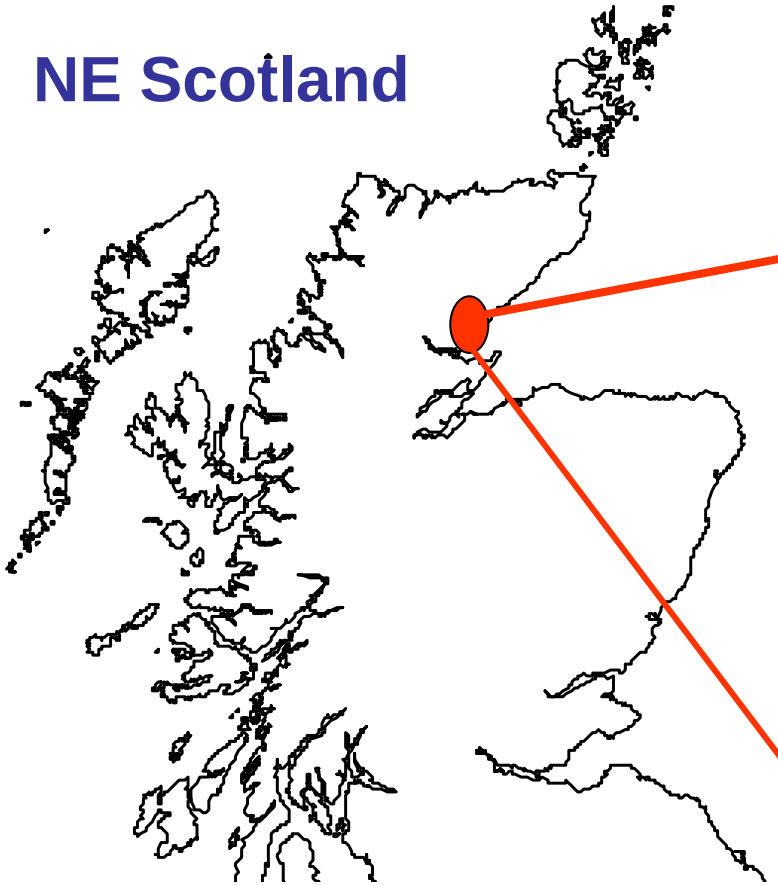
Mean flushing distance in eight studies = 80-500m

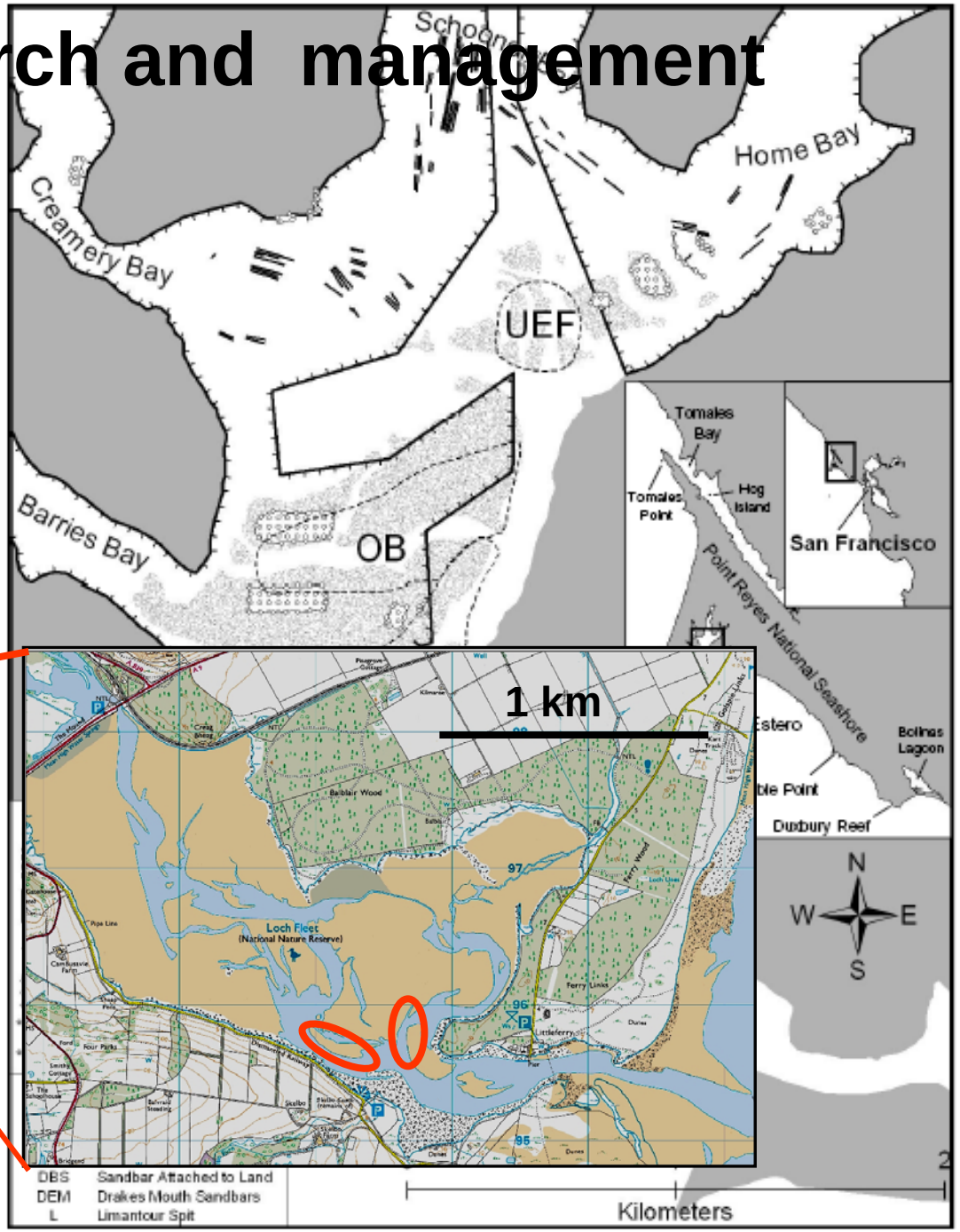
Insights into research and management from other regions

Loch Fleet

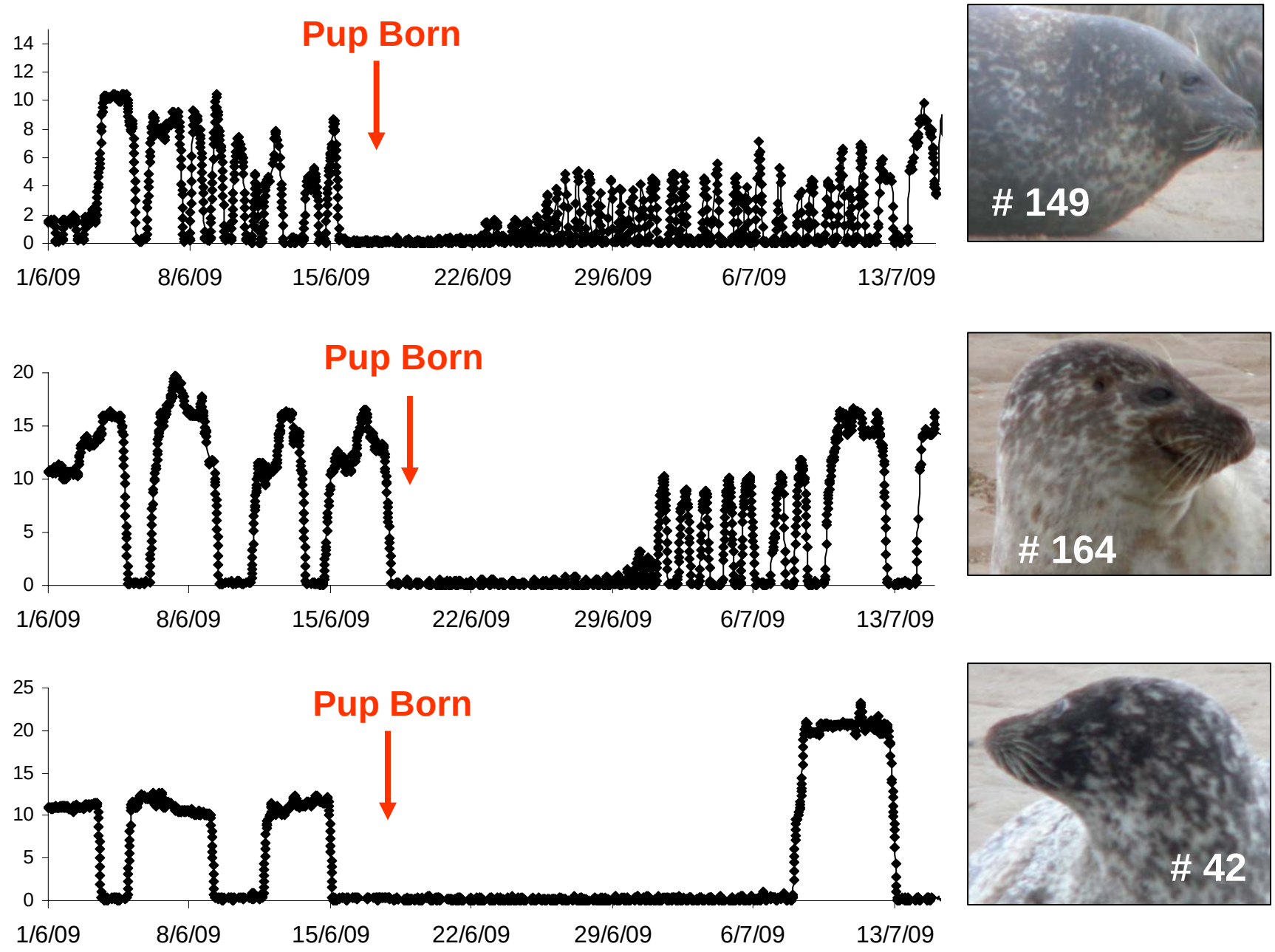
National Nature Reserve

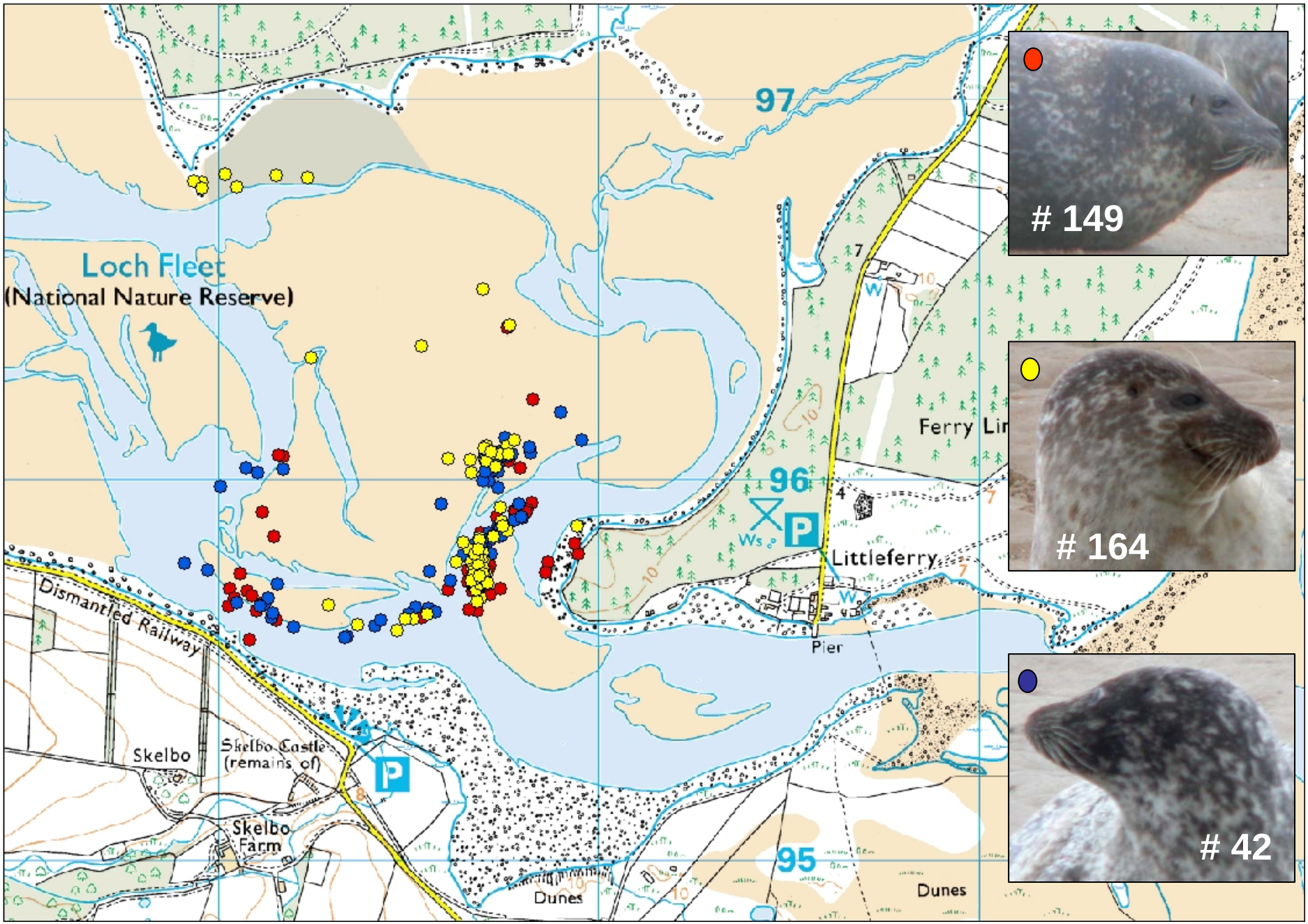
NE Scotland



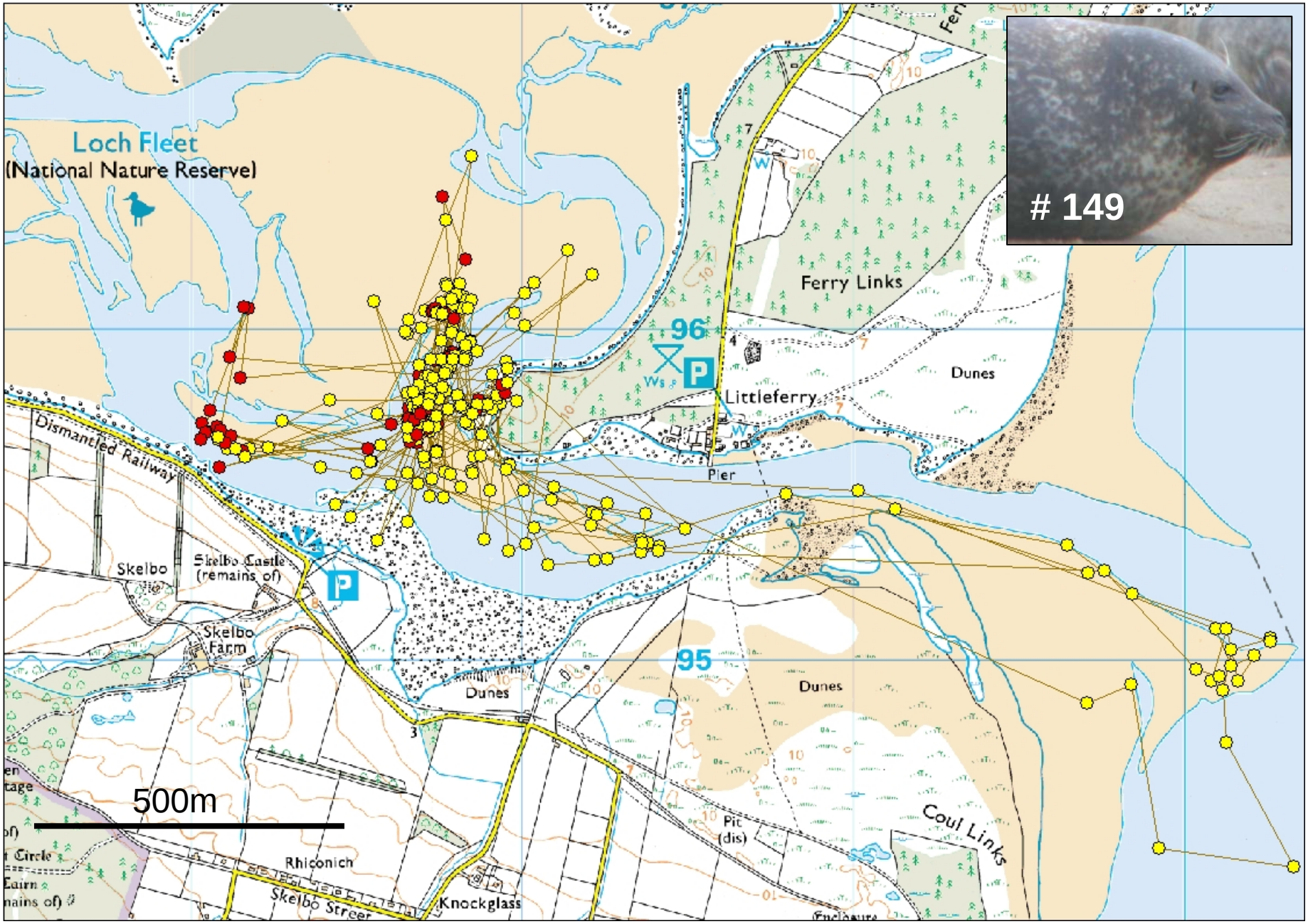


Distance from Haul-out site (km)

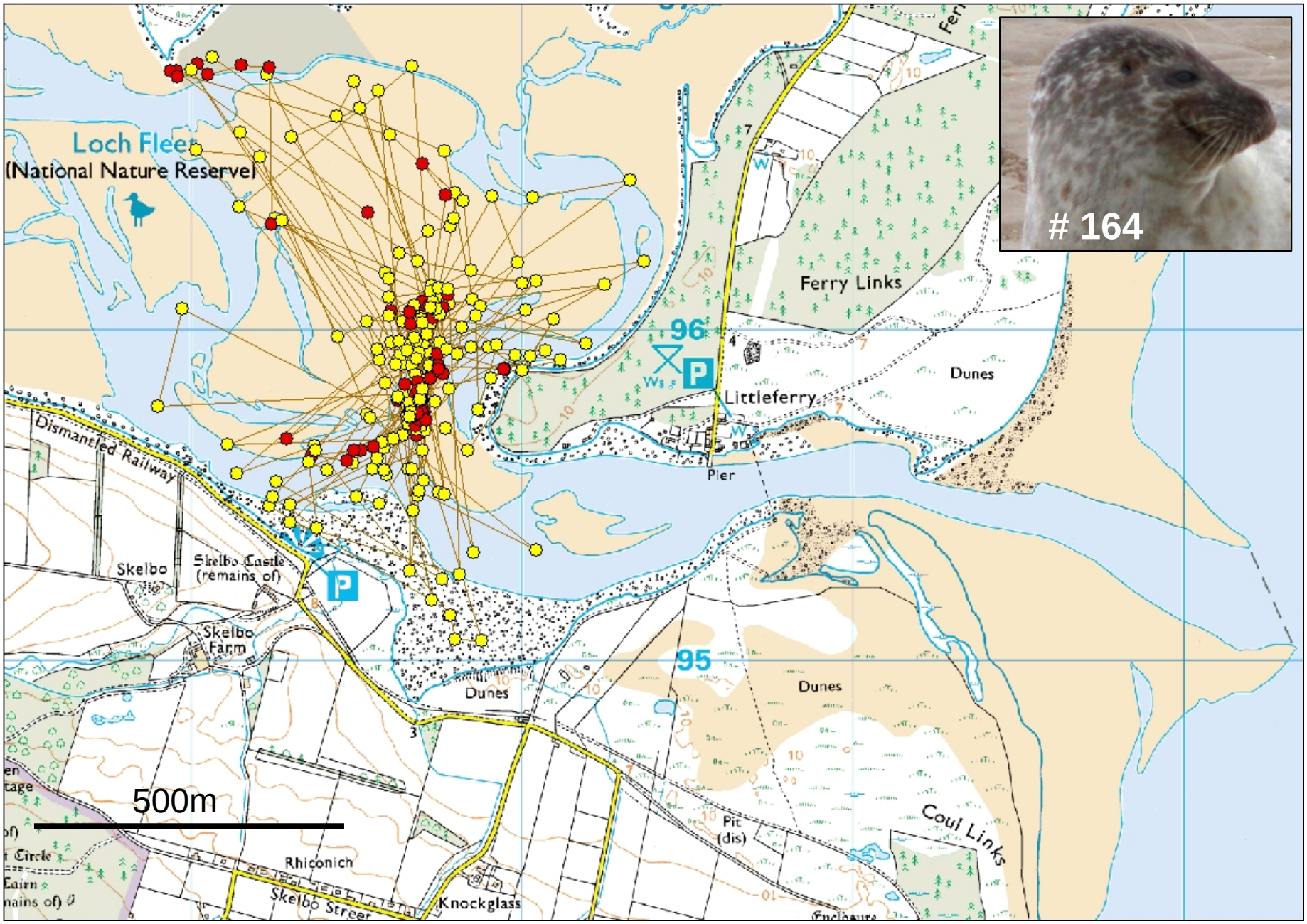




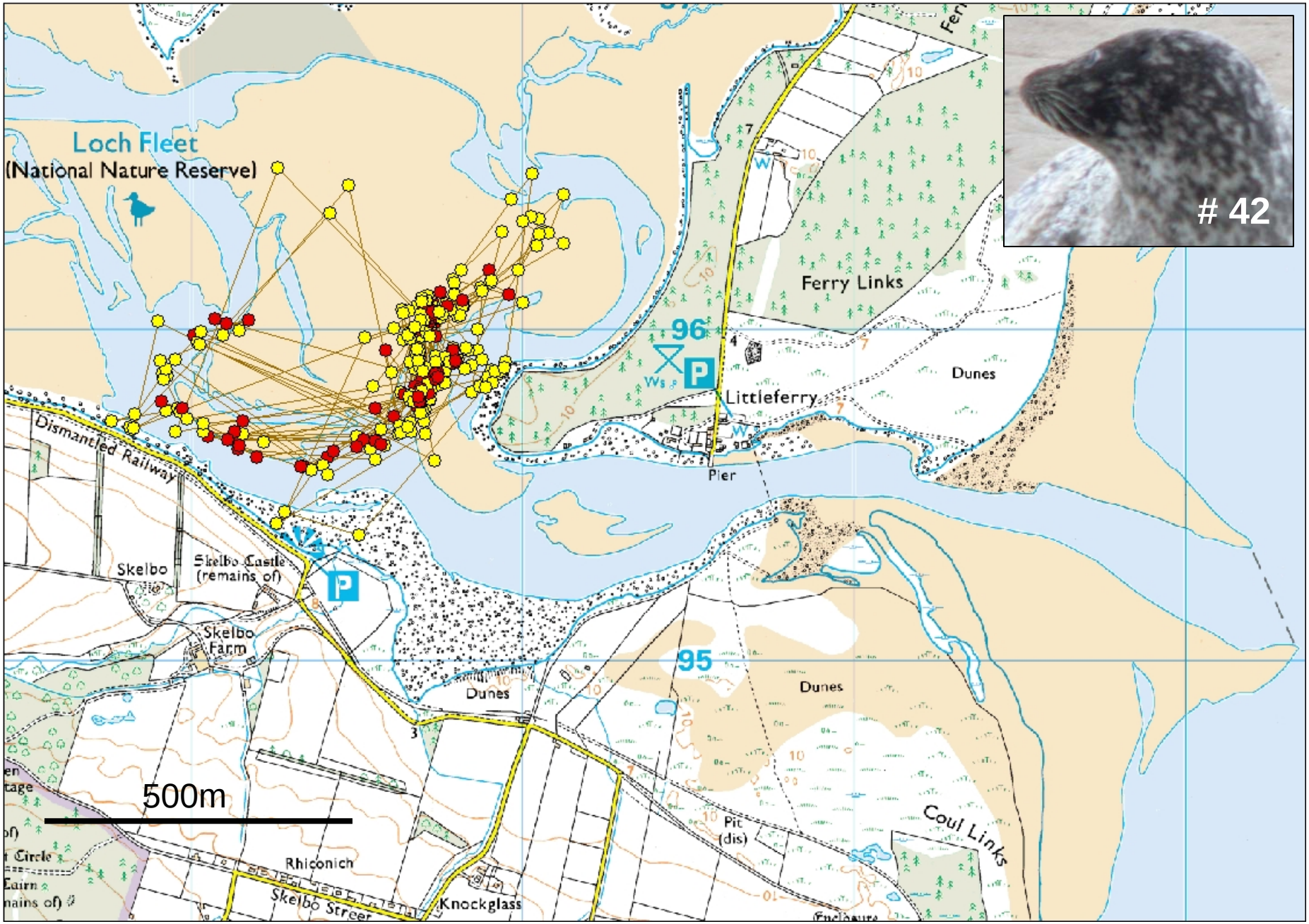
1st week of lactation - haul-out locations



 # 149: 1st week of lactation - 17th – 23rd June 2009 ● = *Hauled out* ● = *In water*



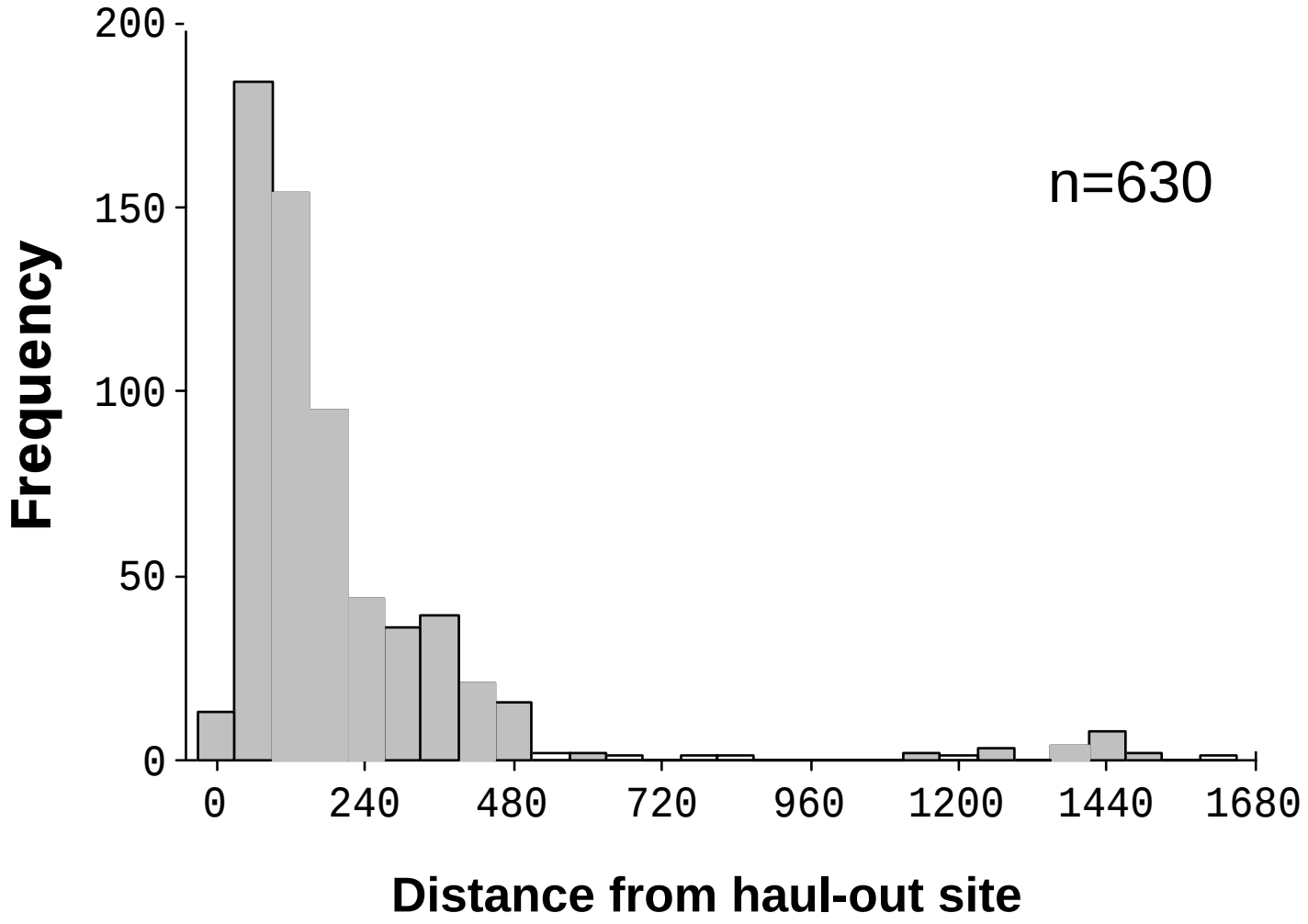
 # 164: 1st week of lactation - 19th – 25th June 2009 ● = *Hauled out* ● = *In water*



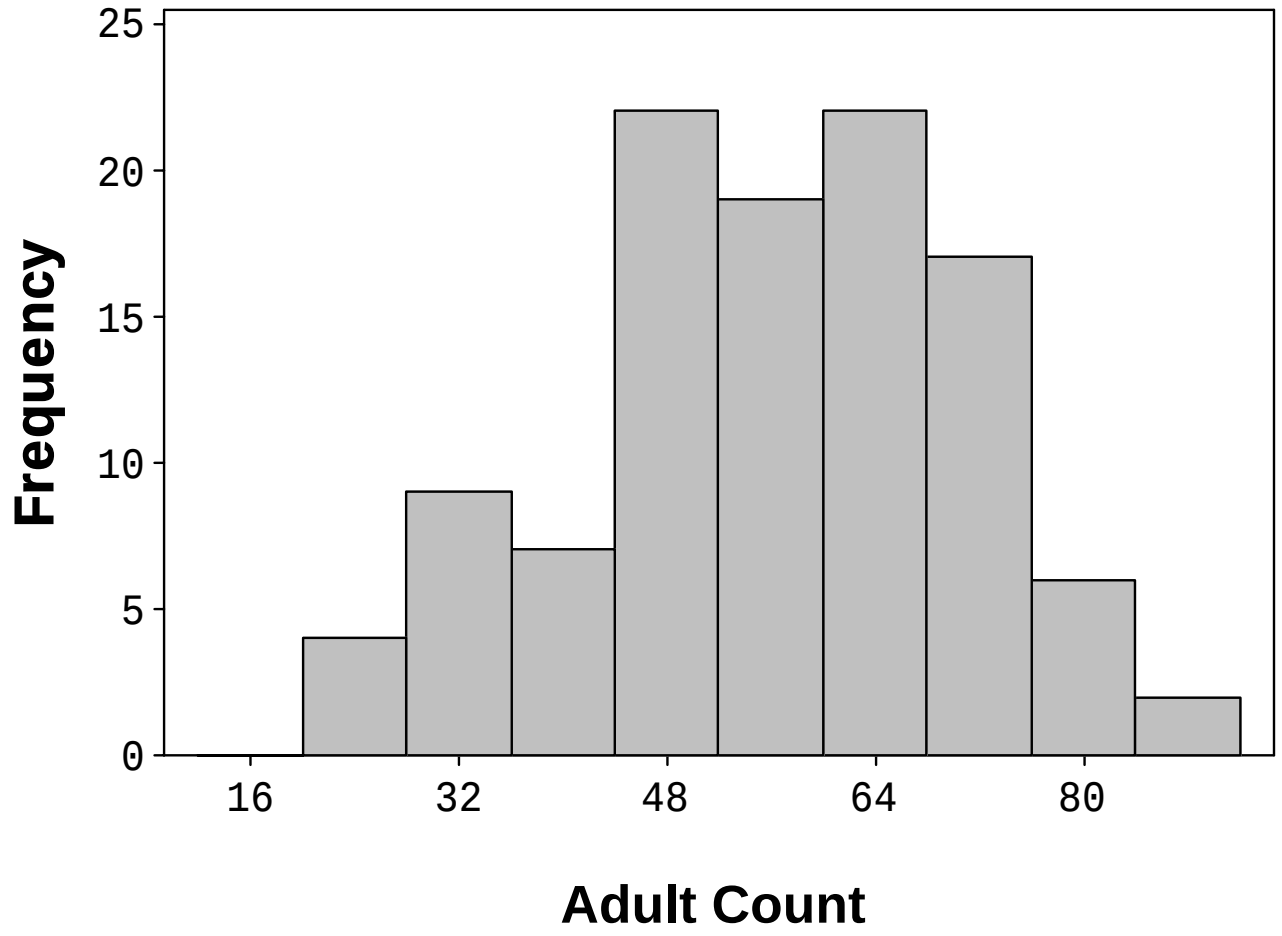
 # 42: 1st week of lactation - 18th – 24th June 2009 **= *Hauled out*** **= *In water***

50% of “at-sea” locations within **100m** of haul-out location

95% of “at-sea” locations within **500m** of haul-out location

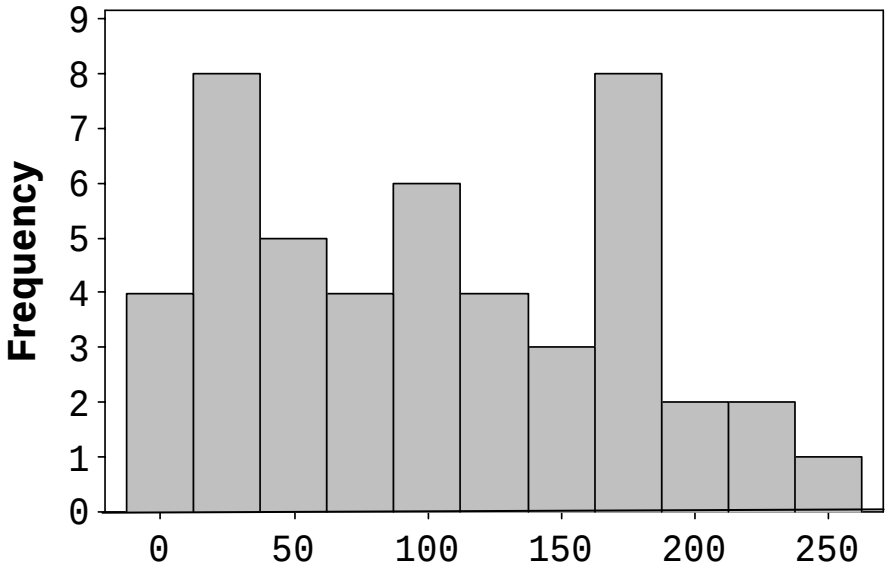


Distribution of daily counts in Loch Fleet 2008 & 2009 Pupping Seasons

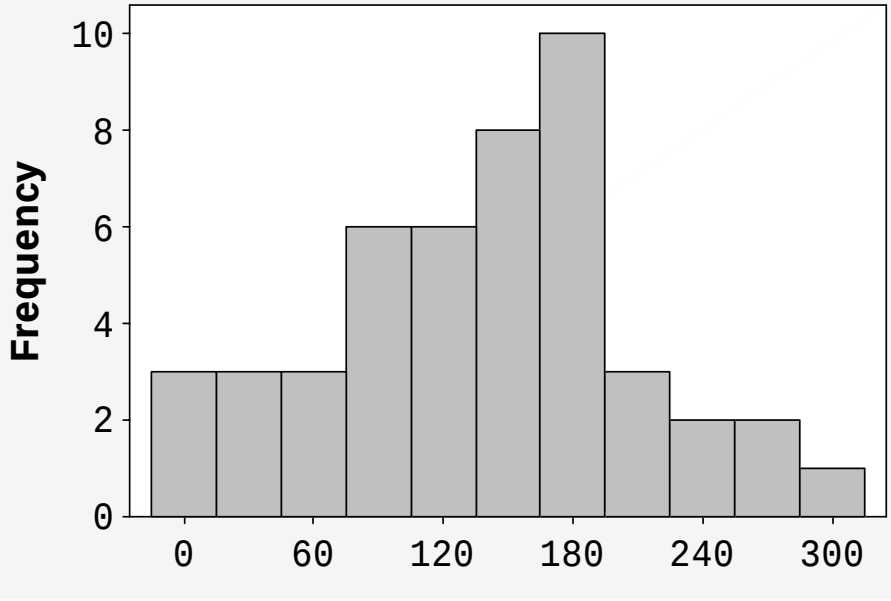


Do over-dispersed count distributions result from undetected disturbance events?

High Harvest years



Low Harvest years



15 April – 15 May Counts; 1997-2008 (excluding 1999)

Lessons learned

- Harbor seals are closely associated with haul-out sites during early lactation.
- Disturbance both on land and in water may influence haul-out site use.
- Disturbance may occur at relatively long range - both in air or water.
- Many disturbance events may therefore go undetected.

Areas for further research

- Need to better characterise the activities of mariculturists – boats & people
- Ideally, also study fine-scale movements of harbor seals in response to these activities
- Explore alternative predictive modelling frameworks that do not rely on any of the disputed datasets