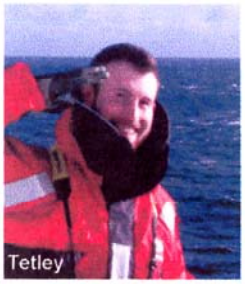

Implementation of a Multi-discipline Approach in Understanding Minke Whale (*Balaenoptera acutorostrata*) Interactions with Environmental Variables, in the Moray Firth, North East Scotland.

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1. Introduction

The minke whale (*Balaenoptera acutorostrata*) is the smallest and most abundant of the baleen whales occurring in Scotland's coastal waters (Robinson *et al.*, 2005). Sightings of *B.acutorostrata* have been recorded in the Moray Firth, the largest embayment of its kind in the north east of Scotland. No focused research has been conducted regarding the reasons why this area is frequented by this cetacean species. Therefore, the aim of the following study was to investigate *B.acutorostrata* distributions in association with underlying environmental variables.

2. Methods

Dedicated research surveys were carried out by the CRRU in the southern outer part of the Moray Firth (see Figure 1) between 2000 - 2004. Surveys followed three line–transect routes across the study area, using ridged inflatable boats to collect GPS positions of *B.acutorostrata* encounters. Positions were then compared to data of underlying environmental variables using geographical information systems (GIS) & remote sensing methods, including Advanced Very High Resolution Radiometer (AVHRR) and Sea-Viewing Wide Field-of-View (SeaWiFS) satellite imagery.

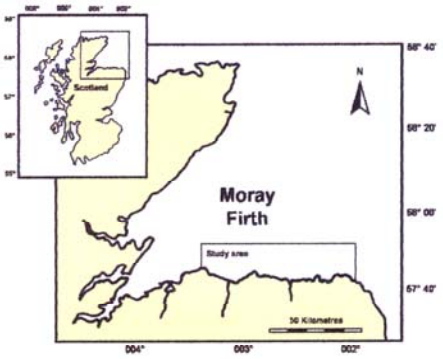

Figure 1. Map of the layout and location of the Moray Firth, NE Scotland. The extent of the study area in the southern outer section is shown.

3. Results

During this study 121 *B.acutorostrata* encounters were recorded between the months May - October. Areas of highest encounter frequency had shallow depths (10-14 metres), steep slopes (70-74 degrees) and sandy gravel sediment types (see Figure 2). Two oceanographic features were observed in the embayment (see Figure 3). These were identified as (1) the Dooley Current, and (2) runoff water being transported out from the inner Firth. Chlorophyll-a concentrations appear to be higher within the study area when sea surface temperatures were warmer. *B.acutorostrata* encounters were significantly higher during periods when the warm plume was in dominance (see Figure 4).

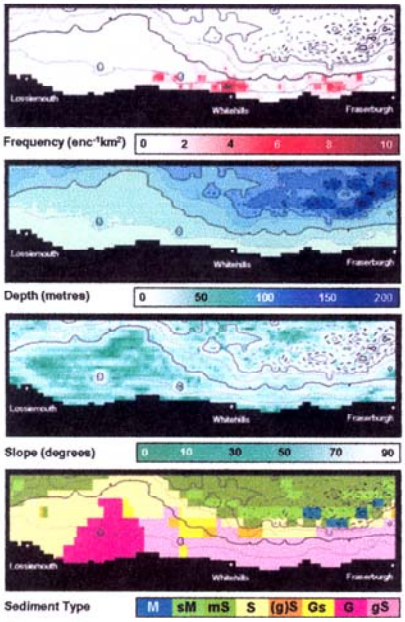

Figure 2. GIS layouts of *B.acutorostrata* encounter frequency, depth, slope & sediment type (**M** = mud, **sM** = muddy sand, **mS** = sandy mud, **S** = sand, **(g)S** = slightly sandy gravel, **Gs** = gravely sand, **G** = gravel & **gS** = sandy gravel). Contours corresponding to depth are shown on each layout.

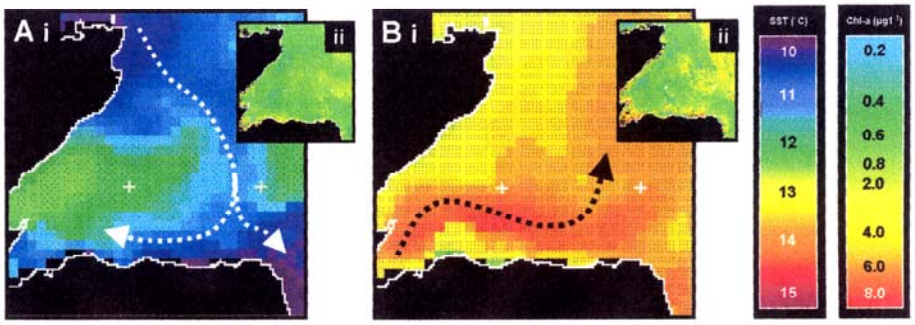

Figure 3. Selected images best showing the presence and interactions of two oceanographic features identified in the Moray Firth. **A i** AVHRR composite image of sea surface temperature (SST) in June 2001(**cold water current**, moving into and across the mouth of the embayment, labelled with white arrow) **ii** SeaWiFS composite image, chlorophyll-a (Chl-a) concentration, June 2001. **B i** AVHRR composite image of SST in September 2001(**warm water plume**, extending from the Inner Firth, labelled with black arrow) **ii** SeaWiFS composite image, Chl-a concentration, September 2001.

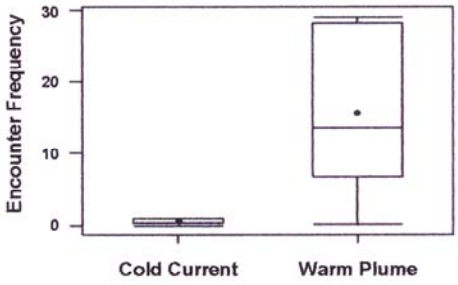

Figure 4. Box plot showing differences in *B.acutorostrata* encounter frequency between months when either the cold water current or warm water plume feature was in dominance. A Mann-Whitney U test showed there was a significant difference in encounter frequency between these two periods (**W = 24.5 p = 0.0167**). The mean (●), interquartile range (▭) and range (⊥) are shown.

4. Discussion

From *B.acutorostrata* stranding records, the sandeel *Ammodytes spp* forms the largest part of the stomach contents (Pierce *et al.*, 2004). It is hypothesised that these environmental factors stimulated higher *B.acutorostrata* encounters by forming optimal habitat to forage for *Ammodytes*, which require certain sediments in which to bury themselves (Macleod *et al.*, 2004), and phytoplankton prey to draw them out of the sediment to forage (FRS, 2004). Therefore, these two factors could indicate where & when *Ammodytes* are most often available to foraging *B.acutorostrata*.

5. Acknowledgments

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