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The effect of variable detectability on density assessments of bowhead whales during seismic surveys

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PROBLEM

Whales exposed to seismic operations vary their dive-cycle behaviour making them less available to be seen.

Figure 1. Bowhead whales vary their dive-cycle behaviours to spend less time at the surface in areas ensonified by seismic operations.

CONCLUSION

Accounting for variable behaviour will improve abundance estimates in the Beaufort Sea during seismic operations.

Question 1

What was the distribution and density of bowhead whales in an area ensonified with seismic sounds?
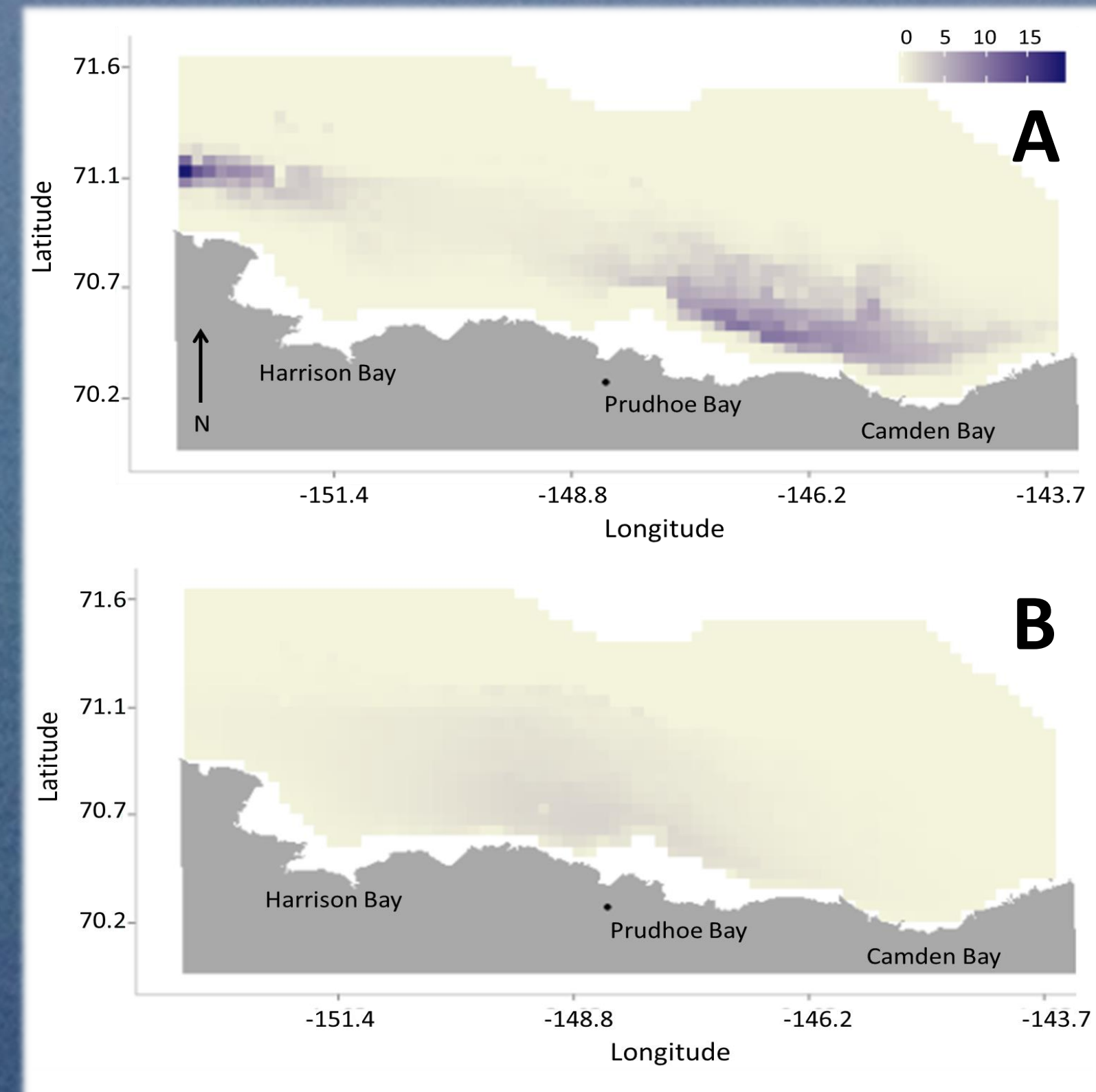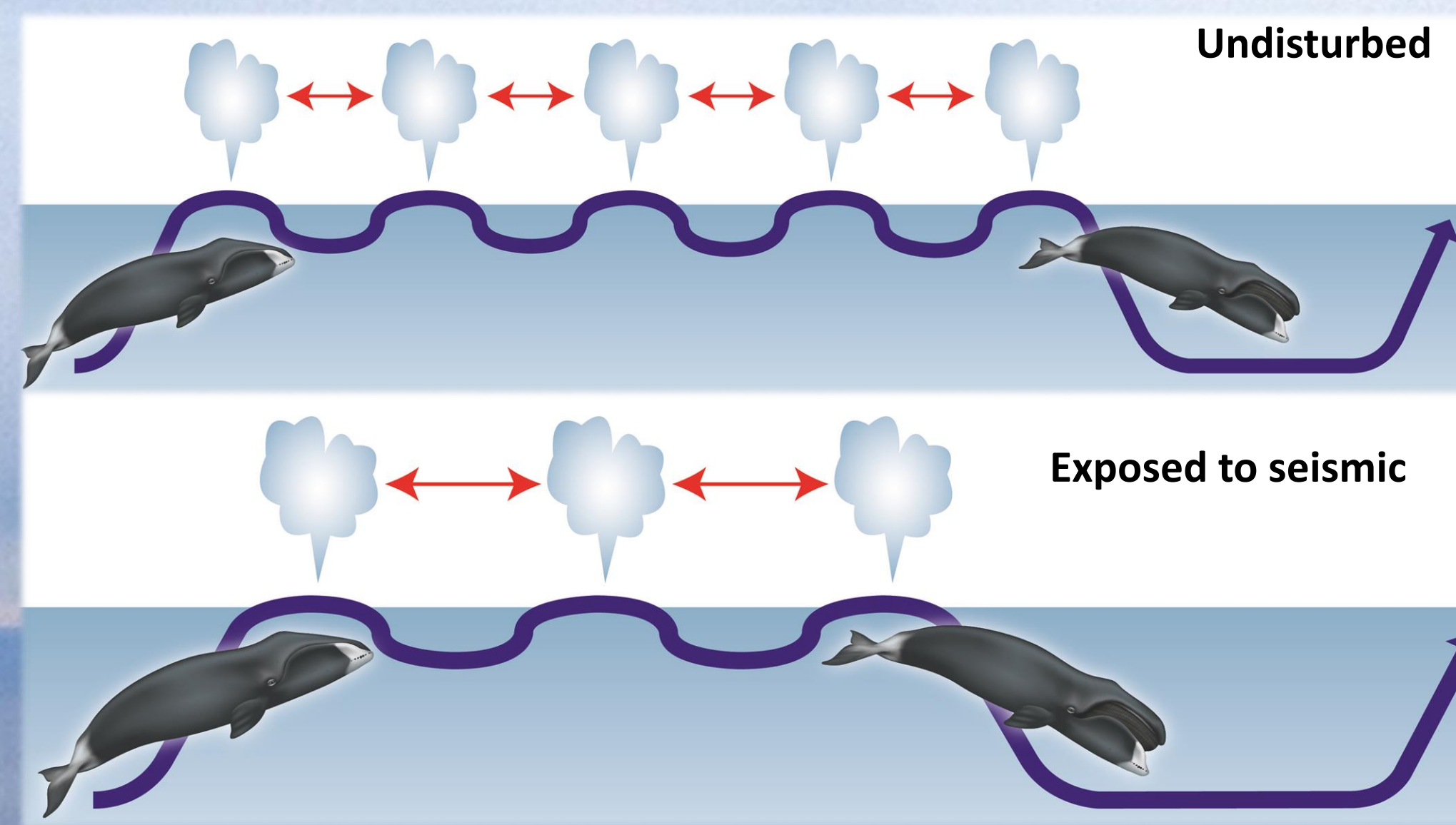

Figure 3. High densities of feeding whales were predicted to occur in the southeast region of the study area towards Camden Bay, where the predicted mean density was 0.84 whales /5km[2] and maximum was 19 whales /5km[2] on 6 September (plot A). In contrast travelling whales were concentrated, but in lower densities, in the central southwest region, where predicted mean densities were 0.42 whales /5km[2] and maximum was 2.51 whales /5km[2] on 29 August (plot B).

Answer 1

* Whale density was best predicted by depth, longitude, and date.
* Analyses revealed temporal and spatial patterns:
   * Whale density decreased through the season.
   * Spatial segregation appeared related to whale activity state (Fig. 3).

Answer 2

* Density predictions WERE influenced by the whales' behavioural reactions to seismic operations (Fig. 4).
* As a consequence, estimates for whales exposed to different levels of seismic sound are underestimated if appropriate correction factors are not used.

Question 2

What was the effect of variable availability on predicted densities of bowhead whales?
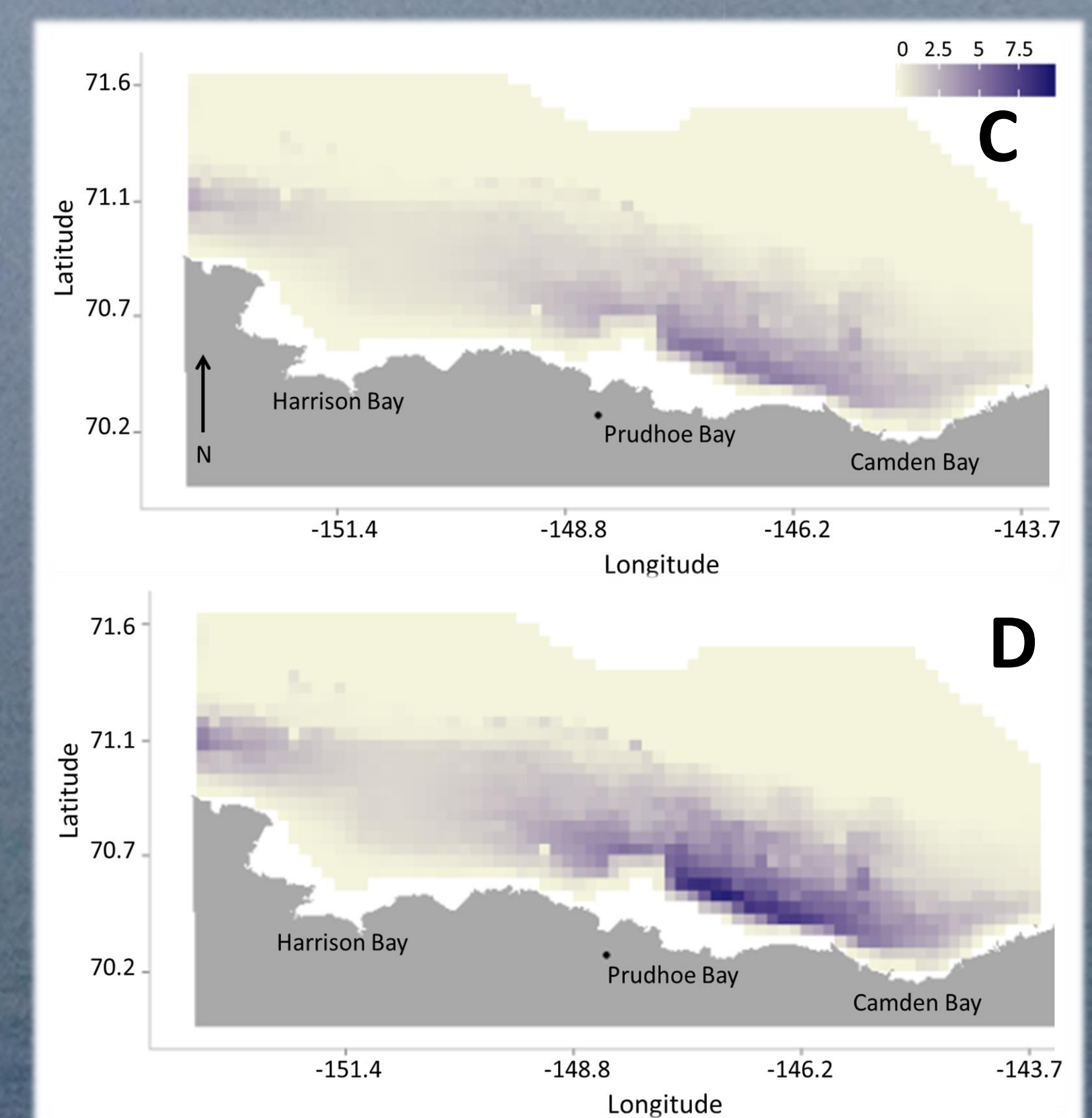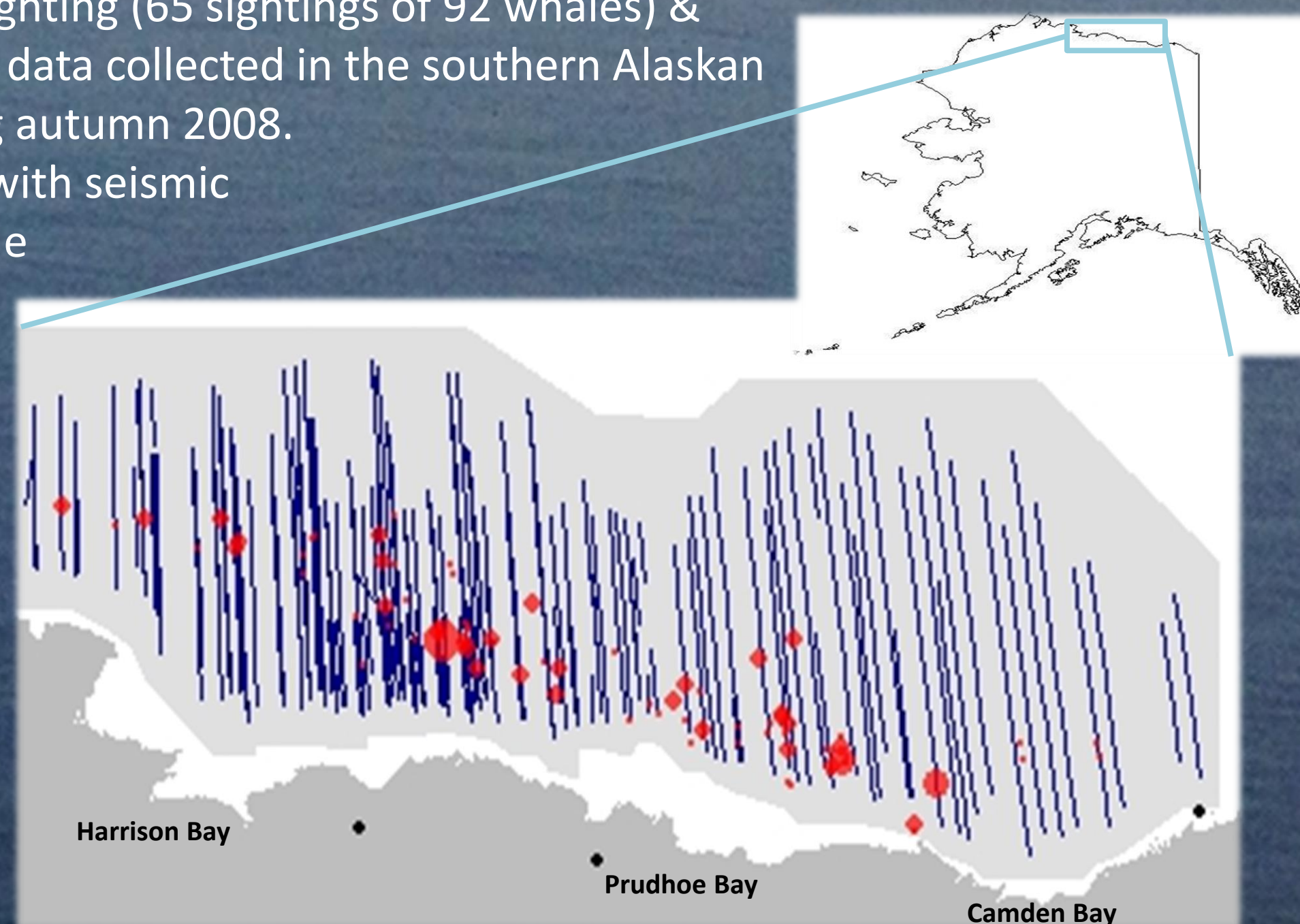

Figure 4. Predicted densities of non-calf bowhead whales exposed to air-gun activity on the 29 August 2008. When behavioural variations related to seismic operations were not accounted for 1028 whales (CV = 0.39) were predicted (plot C). When behavioural changes related to seismic were accounted for 1723 whales (CV = 0.40) were predicted (plot D), 68% more whales than estimated if we only accounted for the availability of undisturbed whales.

Figure 2. Useable sighting (65 sightings of 92 whales) & effort (>10,000 km) data collected in the southern Alaskan Beaufort Sea during autumn 2008. Sounds associated with seismic surveys were audible for all sightings & effort used in our analyses.

Methods

* Sighting data collected in autumn Oct 2008 during industry monitoring surveys of seismic operations (Fig. 2).
* Density surface models were fit to sighting data using distance sampling methods.
* Whale density was predicted over the study season, and for feeding and travelling whales.
* Predicted densities were corrected for variable availability using correction factors specific to season, whale activity, and exposure to seismic sounds.
* Predicted densities of whales exposed to seismic operations using appropriate correction factors were compared to density estimates calculated with correction factors specific only to undisturbed whales.