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### Advances in the study of marine mammal predator-prey interactions: a novel real-time visualization of independently collected echosounder data using GeoZui4D

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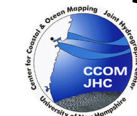
# Advances in the study of marine mammal predator-prey interactions: a novel real-time visualization of independently collected echosounder data using GeoZui4D.

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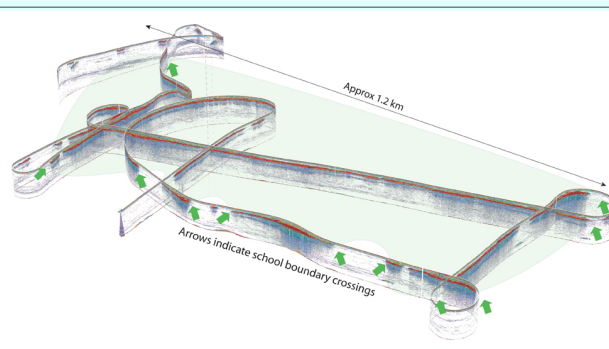
## ABSTRACT

Ecological studies of the relationships between marine mammals and their prey are constrained by sampling strategies that are often pre-designed and static in nature. Recent advances in real-time data visualization can be adapted to acquire and present geo-referenced displays of scientific echosounder data simultaneously from multiple independent platforms in 3-dimensions.

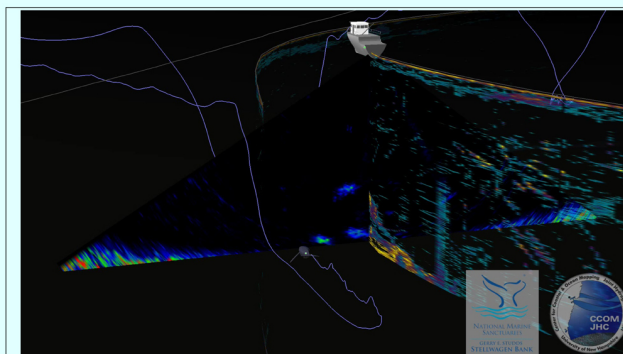
From 2006-2009 we collected concurrent prey data from paired 38 and 120 KHz Simrad EK60 echosounders on two independent sampling platforms in and around humpback whales carrying data-logging digital acoustic tags (DTags) in the Stellwagen Bank National Marine Sanctuary (SBNMS).

Echosounder data were transmitted via ship-to-ship wireless networks and integrated in real time using GeoZui4D. GeoZui4D (**Geographic Zooming User Interface4D**) is a package developed at the university of Hew Hampshire to investigate ways in interactively exploring time-varying geospatial data. The echosounder data is displayed as georeferenced curtains following the active path of multiple data-acquisition vessels. The real-time 3-dimensional display scene can be interactively explored (e.g. rotated, zoomed, panned) to provide increased spatial and temporal awareness of prey distribution and abundance during sampling. The active transmission of prey data allows for real-time visualization and representation of prey fields that can be used to augment adaptive sampling strategies aimed at understanding marine mammal foraging behavior.

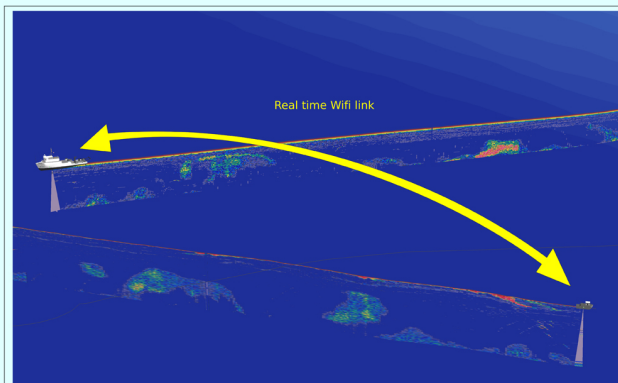
Once sensor data have been extracted from a recovered tag, the addition of this and other concurrently collected information allows for an unprecedented ability to visualize and explore the ecological relationships between marine mammals and their prey. The fusion of additional related environmental data (e.g. CTD, bathymetry, other acoustic data) and analysis is supported by a feature called space-time notes that enables the annotation and coding of events and reconstruction for review or presentation.



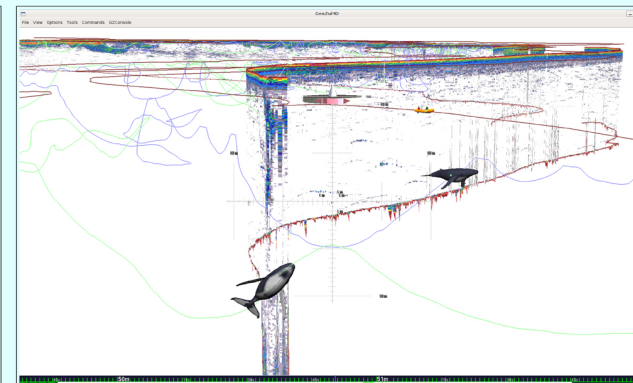
On July 27th, 2009 the boundaries of a school of prey were delineated by steering the RV Auk in and out of the boundary. The Auk is a NOAA research vessel operated by the Stellwagen Bank National Marine Sanctuary. It was equipped with a Simrad EK60 single beam fisheries research sonar with a 38kHz transducer and a 120kHz transducer.



GeoZui4D can be used to reconstruct data from multiple sources. Here are shown EK60, DeltaT and the reconstructed whale track from DTag. The cross section of three whales can clearly be seen in the Imagenex Delta T multibeam data.



Researchers on either ship can see all data in an interactive 3D environment updated in real time. The ships were linked via a wireless network which carried real time sonar data allowing an integrated immediate display of the current situation in GeoZui4D.



GeoZui4D uses 3D widgets to control the view and move through space. Navigation through time is accomplished using the dual timebar located at the bottom.