ENHANCING AIS to IMPROVE WHALE-SHIP COLLISION AVOIDANCE and MARITIME SECURITY

Philip A. McGillivary, US Coast Guard PACAREA,
Kurt D. Schwehr, University of New Hampshire Center for Coastal Ocean Mapping
Kevin Fall, Woods Hole Oceanographic Institution and Intel Research Berkeley

Whale-ship strikes are of growing worldwide concern due to the steady growth of commercial shipping. Improving the current situation involves the creation of a communication capability allowing whale position information to be estimated and exchanged among vessels and other observation assets. An early example of such a system has been implemented for the shipping lane approaches to the harbor of Boston, Massachusetts where ship traffic transits areas of the Stellwagen Bank National Marine Sanctuary frequently used by whales. It uses the Automated Identification Systems (AIS), currently required for larger vessels but becoming more common in all classes of vessels. However, we believe the default mode of AIS operation will be inadequate to meet the long-term needs of whale-ship collision avoidance, and will likewise fall short of meeting other current and future marine safety and security communication needs. This paper explores the emerging safety and security needs for vessel communications, and considers the consequences of a communication framework supporting asynchronous messaging that can be used to enhance the basic AIS capability. The options we analyze can be pursued within the AIS standardization process, or independently developed with attention to compatibility with existing AIS systems.

There are ongoing discussions of increasing AIS bandwidth to allow additional information to be exchanged in routine Advanced Notice of Arrival (ANOA) messages. Such messages can be used to carry a wide range of information such as whale position estimates, but also for other security-related purposes (e.g. cargo and passenger manifests). While increasing bandwidth may improve the current situation modestly, bandwidth limitations are not the only capabilities missing from the AIS framework. Additional capabilities, such as security (e.g., authentication of messages and privacy of ship position reports), and tolerance to disruption of service, are also required to permit the proposed communications method to comprise a trusted element in support of overall maritime domain awareness (MDA). Furthermore, the ability to extend the capabilities of the existing AIS system to be compatible with bandwidth supplied by other systems (e.g., commercial WiFi or WiMax) is highly desirable. One communications technology option, called Delay or Disruption Tolerant Networking (DTN), being developed with support from the US Defense Advanced Research Projects Agency, includes a set of protocols providing many of these features. DTN can be used to carry authenticated, secure asynchronous messages across a wide variety of underlying communication technologies, including the Internet (where ANOA messages may be submitted today). The range of existing VHF radio or AIS messaging, now limited by centralized “one-hop” protocols, can also be extended using the DTN ability to use of multi-hop communication nodes. DTN uses temporary message storage within communication nodes such that messages delivered using multiple hops are not lost during network outages or times of high network congestion. The multi-hop capability of DTN also

allows messages to be physically transmitted from vessels beyond the range of current communication methods.

The adoption of a new message-based network architecture such as DTN, in concert with lower-layer improvements in AIS and ensuring compatibility with other commercial technologies, is a useful approach to meeting future maritime communication needs through use of appropriate new technologies. This approach to improving communications can help minimize whale-ship strikes in the future by making data such as whale position information more widely available at lower cost, while also providing improved communication capabilities for other applications relevant to maritime security. The ramifications of improved communications capabilities could be significant, as improved data sharing can not only provide additional bandwidth for additional ANOA data, but also improve message security (e.g. via authentication), reduce loss of life, reduce costs of maritime rescue and investigation efforts, avoid expensive ship repairs and schedule delays, and minimize costly closures of commercial fisheries for protection of endangered whale species. In addition to these cost savings for general maritime operations, the methods proposed could provide improved protection specifically for whales, including several critically endangered species. Examples are discussed for minimizing ship interactions with Humpback Whales and endangered North Atlantic Right Whales on the east coast, and North Pacific Right Whales, Humpback Whales, Blue Whales and Beluga Whales in west coast and Hawaiian waters.

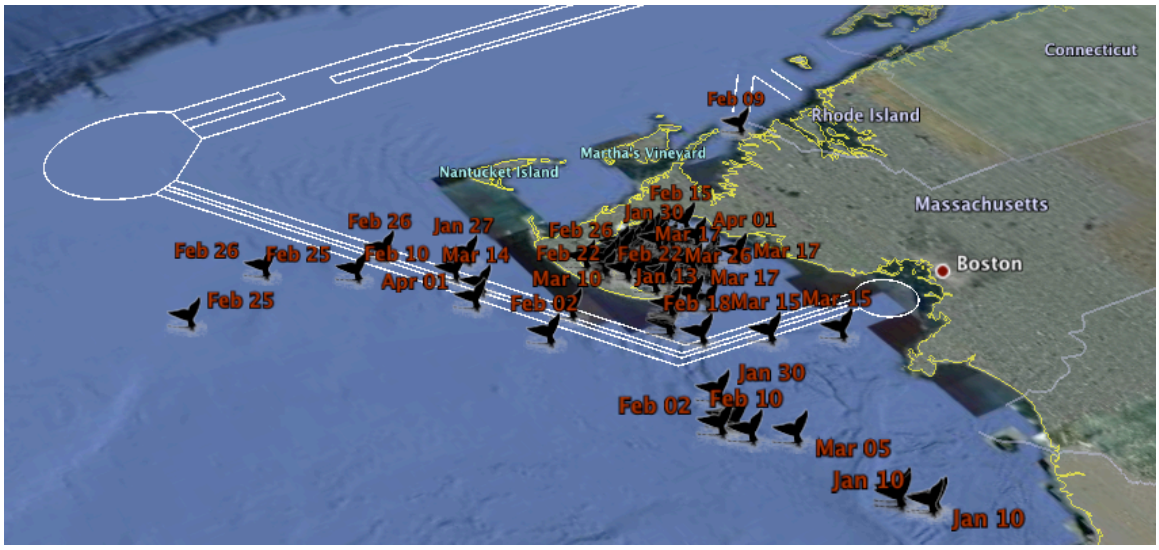

Figure: North Atlantic Right Whale sightings for January-March, 2009 recorded by the NOAA observing program viewed in Google Earth.