Quest for the mating ground of the North Atlantic right whale in the Outer Fall/Jordan Basin region of the central Gulf of Maine

The NEAq research team studies right whales on Jordan Basin, November 2010.
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Final Report on Research Activities: 2010 and 2011

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Summary: In November and December 2010 and December 2011, a joint international research effort was initiated in the central Gulf of Maine. Funds received by the New England Aquarium (NEAq, Boston, MA) from the U.S. Marine Mammal Commission (Washington DC) and the State of Maine Department of Marine Resources were combined with a grant received by the Canadian Whale Institute (CWI, New Brunswick Canada) from the Canadian Wildlife Federation (Kanata, Ontario)/TD Financial Group . These funds were used to initiate a new vessel survey program for right whales (*Eubalaena glacialis*) in November and December in the Outer Fall/Jordan Basin region in the central Gulf of Maine. The goal of the research program was to survey the area to locate and obtain photographs of right whales for individual identification, skin biopsy samples and faecal samples for genetic and hormone studies respectively, and to use these data to test the hypothesis that this area is the mating ground for the critically endangered North Atlantic right whale. For an area to be considered a potential mating ground, there must be the co-occurrence of adult males, females that give birth twelve to thirteen months later, and the sightings must be in November, December, or January to coincide with the estimated gestation time and peak in calving.

Vessel surveys were conducted on three days in 2010 (November 16, 30 and December 18) and on one day in 2011 (December 13); right whales were located in the Outer Fall/Jordan Basin region on each survey day. Even with just a few surveys, the two years appear to be quite different. In 2010, there were a total of 32 right whales photographed of which 30 have been matched (to date) to 20 known individuals in the right whale catalogue. There were 11 males (9 adult, 2 juvenile), five females (1 adult, 4 juveniles), and four whale of unknown sex (all adult and believed to be male). The one adult female seen was a known reproductive female that was available to become pregnant at the time of the sighting (i.e. based on a three year calving interval and an estimated gestation time of 12 months, her next calf was due in winter 2012). However, this unexpected demographic composition in 2011 coincidently was followed in the winter of 2012 with the lowest number of right whale births (n=6) since 2000. During the December 2011 survey, there were a total of 20 right whales photographed on the single survey day of which 15 have been matched (to date) to 13 known individuals in the right whale catalogue. There were six males (all adults and five known fathers) and seven females. There were no juveniles and no unknown sex whales. All seven females had calved previously and all were available to become pregnant at the time of the sighting (i.e. they are due to calve in winter 2013 season).

The research team documented the presence and location of vessel traffic and fixed fishing gear in the Outer Fall/Jordan Basin region. Right whale sightings were transmitted after each survey to the National Marine Fisheries Service Sighting Advisory System and helped provide the justification for the implementation of voluntary dynamic management areas to reduce the threat of vessel/whale strikes in the Jordan Basin area in November and December 2010 and 2011. Additional protective measures to reduce the threat of vessel strikes are needed as the voluntary measures in place are reliant on regular surveys for implementation. In recognition of the importance of the Outer Fall/Jordan Basin region to right whales, the results of these shipboard surveys were combined with the results of other surveys of this region to formally request, through the National Marine Fisheries Service Atlantic Large Whale Take Reduction Team, the closure of the region to commercial pot fisheries from November through January.

With this study we were able to demonstrate that it is possible to conduct vessel surveys for right whales in this offshore area, at a time of the year with limited day light and few good weather days. We were able to collect data on right whales that are useful for describing the seasonality, distribution and habitat use patterns of right whales. The data from this survey effort, when combined with the results from aerial surveys, have provided a growing body of evidence to support the hypothesis that the Outer Fall/Jordan Basin region is a mating ground for the North Atlantic right whale. The right whales seen in the Outer Fall/Jordan Basin region coincide with the estimated time of conception for this species and the demographics coincide with the portion of the population expected on a mating ground. In addition, our effort to include volunteers on the research trips resulted in several Maine and New Brunswick fishermen,

Maine politicians and journalists joining our team and gaining a greater understanding of the international efforts to recover the right whale population in American and Canadian waters.

Introduction

Two essentials for the recovery and long-term persistence of an endangered species are successful mating and rearing of offspring. After more than thirty years of intensive study of the endangered western North Atlantic right whale (*Eubalaena glacialis*), much is known about the approximately 450 - 500 individually identified animals: five seasonal critical habitats have been identified and the general migration route is recognized. Calving and feeding areas between the east coast of Florida and the Bay of Fundy in Atlantic Canada are known. Scientists and managers have identified and begun to mitigate the two human activities, vessel strikes and fishing gear entanglement that present the greatest known threats to the whale's recovery throughout their range. However, one of the critical remaining mysteries is the location of a right whale mating ground. Two-thirds of the cataloged North Atlantic right whale population is not seen in late fall/early winter months – the presumed period of conception - despite comprehensive monitoring for these whales in Cape Cod Bay in the northeast U.S. and on the calving grounds off the southeast U.S. The location of the right whales' mating ground and identification and protection of this area from adverse human activities may well be critical for species survival and recovery.

The gestation time for right whales is estimated to be about twelve to thirteen months (Best 1994), and in the North Atlantic most calves are born on the only known calving ground in the southeast U.S. in December, January and February (Kraus and Rolland 2007). Courtship groups (Surface Active Groups or SAGs) are seen in several critical habitat areas and include a focal female and many males (Kraus and Hatch 2001). Although these SAGs have many of the characteristics of mating groups, they occur at the wrong time of the year for conception to occur and there is no evidence of delayed implantation in large whales; thus, the function of SAGs on feeding and calving grounds remains unknown (Parks et al 2007, Frasier et al 2007). For an area to be considered a potential mating ground, there must be the co-occurrence of adult males, females that give birth twelve to thirteen months later, and the sightings must be in November, December, or January to coincide with the estimated gestation time and peak in calving.

Recently a vital clue was found in the form of a seasonal concentration of right whales seen along the southwestern margin of Jordan Basin (referred to hereafter as the Outer Fall/Jordan Basin region) in the central Gulf of Maine in November, December and January. The first right whale was seen in this area on January 14, 2002 by a biologist on a U.S. Navy vessel (T. Fetherstone, personal communication). A larger area of right whale concentration around this initial sighting was identified during broad scale aerial surveys of the Gulf of Maine by researchers at the Northeast Fisheries Science Center in Woods Hole, Massachusetts (Cole *et al.* 2009). Preliminary identification of the right whales photographed there has shown that approximately half of the known population made use of the central Gulf of Maine between November and January from 2004-2007. Calving by five females one year after being sighted in this area during the presumed conception time, and the large proportion of fathers seen in this area relative to other habitat areas, strongly suggest that this region is a mating ground for the North Atlantic right whale (Cole et al 2009). In addition, many of the right whales identified in Jordan Basin area are ones that are rarely seen during surveys of the other known critical habitat areas, including a number of males that have not yet been genetically sampled.

The purpose of this study was to undertake a vessel survey of Outer Fall/Jordan Basin region in the late autumn and early winter (November and December). Although researchers surveying in airplanes can photograph right whales for individual identification, it is thought that aerial observers usually only see about half of the whales in a survey area due to the speed of the aircraft and the diving behaviour of the whales. In addition, photographic documentation of scarring on right whales is better determined from vessel based photographs. To assess if Outer Fall/Jordan Basin region is a mating ground, and to

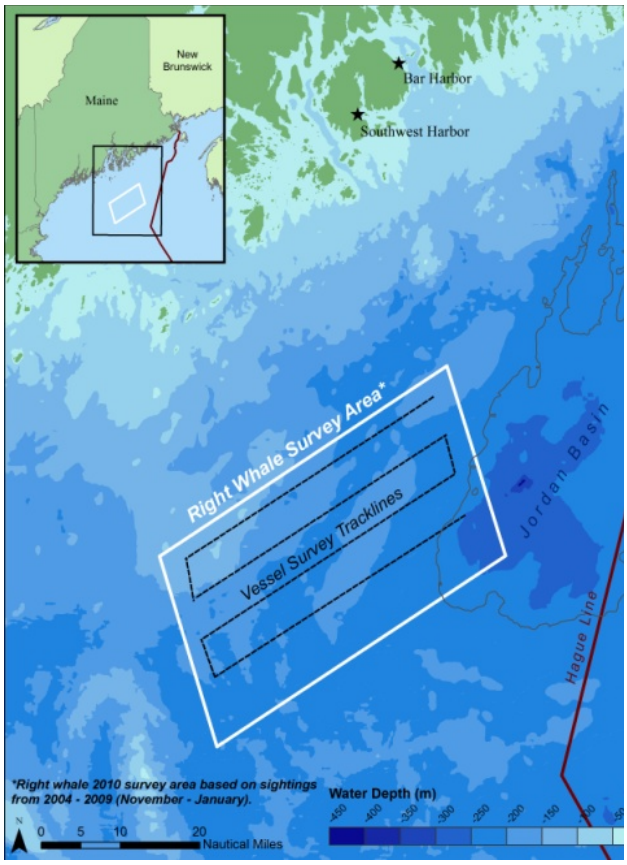
maximize the data collected to integrate into ongoing studies on individual identification, life history, genetics, scarring, health assessment, and hormone assays, vessel-based surveys were conducted to:

- Collect photographs for individual identification, life history information, and detailed examination of scars, and body and skin condition for visual assessment of health, and of fishing gear entanglements;
- Collect biopsy samples of whales not previously sampled to contribute new data for the genetics research and establish the relationship of the whales sampled and parentage of past and future calves;
- Collect fecal samples for hormone assays;
- Collect data on vessel traffic observed in the area and on the location and type of fixed fishing gear to provide data that will be used to reduce the risk of human activities on right whales in this habitat area. The vessel data will be provided to the National Marine Fisheries Service Sighting Advisory System and fishing vessel data will be shared with the Atlantic Large Whale Take Reduction Team.

Methodology

Vessel Surveys, Data Collection, and Data Management

The NEAq/CWI right whale research team traveled from Boston MA and Campobello Island NB respectively to Bar Harbor Maine to conduct vessel surveys in an area southwest of Jordan Basin. Vessel surveys were conducted from the charter vessel *Friendship* V, a 112-foot diesel powered, jet-drive catamaran. Vessel surveys were weather dependent and required that visibility be greater than two nautical miles and a sea state of four or less (Beaufort scale). The vessel departed from either Bar Harbor or Southwest Harbor at 4am in order to be at the first waypoint at the northeast corner of the survey area before sunrise.



During the surveys, the vessel was steered along track lines a speed of 12-14 knots, with two observers/photographers and a recorder on watch from the upper deck and two people resting; the watch was rotated each 45 minutes to one hour to reduce observer fatigue and exposure to cold (Brown *et al.* 2007). The time and position data were logged every minute on a computer linked to a GPS. The recorder logged sightings of all marine mammals and human activities (vessels and fishing gear).

When right whales were observed, the vessel left the track line to obtain photographs of each right whale for individual identification. Photographs of right whale callosity patterns were used as a basis for identification and cataloging of individuals, following methods developed by Payne *et al.* (1983) and Kraus *et al.* (1986). The cataloging of individually identified animals is based on the use of high quality photographs of distinctive callosity patterns (raised patches of roughened skin on the top and sides of the head), ventral pigmentation, lip ridges, and scars (Kraus *et al. 1*986, Hamilton *et al*. 2007). An attempt was made to identify each right whale in the field to determine if a biopsy sample had already been collected. Techniques for the collection of skin and blubber biopsy samples from individually identified right whales follow those described by Brown *et al.* (1991). Sampling was to be conducted only if the animal had not been previously sampled or could not be identified in the field. Following collection of high quality photographs for individual identification and other associated data, the vessel returned to the track line to resume the survey. Vessels surveys were carried out until sunset (there were approximately nine hours of daylight available).

Sighting Data Reports to Mitigate Vessel Strikes of Right Whales

At the completion of each survey, the date, time and location of the right whale sighting were transmitted to the National Marine Fisheries Service (NMFS) Sighting Advisory System (SAS) once our research vessel reached cell phone range. NMFS/SAS uses the data to alert the shipping industry to the presence of right whales through Notices to Mariners, and if the right whale aggregation is greater than three animals, results in the implementation of a voluntary dynamic management area.

Entanglement Response

The M*/V Friendship V* was equipped with a first responder disentanglement kit, and all of the research staff has previously been trained in disentanglement techniques by the whale rescue team at the Provincetown Center for Coastal Studies (PCCS). First responder kits consist of long aluminum or carbon fiber poles that can be outfitted with specialized attachment and cutting gear and a telemetry buoy equipped with satellite- and VHF radio-monitored tags for tracking.

Volunteer observers

Due to the size of the vessel chartered for these surveys, there was room for a team of volunteers to help the researchers search for whales and collect birds counts. The team of volunteers was deployed at five

stations around the vessel, four stations were on the upper deck looking forward, abeam and aft of the vessel, and one or two observers were positions on the bow. The additional four observers on the upper deck reported marine mammal sightings to the researchers and the recorder. The volunteers rotated positions every hour to reduce observer fatigue and exposure to cold. The one or two observers on the bow recorded birds and, when the vessel was off track and the researchers were photographing right whales, helped searched for any evidence of right whale fecal samples floating on the surface of the water.

Results

Vessel Surveys and Right Whale Sightings

We were able to carry out three vessel survey days in 2010 (November 16, 30 and December 18) and one day in 2011 (December 13). The survey days in resulted in a total track line distance of 414 km in 2010 and 177 km in 2011 (Figurea 1a, b, Table 1). Right whales were seen and photographed on all survey days. There were 47 right whales sightings during the four surveys of which 32 were photographed. All of the right whale sightings were within the Outer Fall/Jordan Basin right whale survey area in 2010. In 2011, we continued to see right whales south and west to Cashes Ledge (Figure 1a, b). Not all of the right whales seen were photographed for several reasons: in 2010 on November 16th it was foggy (visibility less than ½ mile) and some whales disappeared into the fog before they could be photographed; on November 30th the right whales were difficult to photograph because of erratic surface and diving patterns; on December 18th, some sightings occurred after sunset and in 2011 on December 13th some right whales were seen at too greater distance to be approached for photographs before they dove. Although we had a pair of night vision goggles on loan from the U.S. Navy, they were not equipped for use with cameras.

In addition to the research efforts on right whales, the research team documented all other cetacean species seen (Figure 2 a,b) and as well as vessel activity and location of fishing gear (Figure 3 a,b). All of the computerized survey data were mapped using Geographic Information System (GIS) software to plot cruise tracks, cetacean and human activity sightings (Figures 1-3). All NEAq sighting and effort data have been submitted to the North Atlantic Right Whale Sighting Database that allows for sighting data to be corrected for survey effort.

During the season of these vessels surveys, the aerial survey team from the Northeast Fisheries Science Center (NEFSC) was conducting aerial surveys of the Gulf of Maine. Because the Outer Fall/Jordan Basin region was too large to be surveyed by vessel in a single day at that time of the year, the right whale sightings from the plane were used to help to focus the vessel survey effort to the area where right whales had been recently seen. There were three aerial surveys in November and December 2010 that covered the Outer Fall/Jordan Basin region, two were the day before a vessel survey, and on one day, November 30, the aerial survey coincided with a vessel survey. In 2011, the trackline for the one survey on December 13th was based on sightings from aerial surveys in November and early December because the aircraft had been out of service.

Photographic Data Collection and Analysis to Date

During our vessel survey effort in 2010, 47 sightings of right whales were recorded of which 32 were photographed (Table 1). Following the field season, photographs from all sightings were compared to the North Atlantic Right Whale Catalog. If a sighting was matched to a cataloged whale, the information automatically becomes available for analyses on distribution, scarring, reproduction and health. Of the 32 photographed sightings, all but two have preliminary identifications to a known right whale in the identification catalogue (Table 2a). The 30 matched sightings were of 20 different whales; none of these whales were seen by us on more than one day. There were 11 males (9 adult, 2 juvenile), five females (1 adult, 4 juveniles), and four whale of unknown sex (all adult and all likely males). The one adult female is

a known reproductive female that was available to get pregnant at the time of sighting (i.e. based on a calving interval of three years and estimated length of gestation, her next calf was due in January 2012).

During our vessel survey effort in 2011, 25 sightings of right whales were recorded of which 20 were photographed – all on a single day (Table 2b). Of the 20 right whales photographed, 15 have been matched (to date) to 13 known individuals in the right whale catalogue (Table 2b). There were six males (all adults) and seven females (all adults). There were no juveniles and no unknown sex whales. All seven females had calved previously and all were available to become pregnant at the time of the sighting (i.e. based on a three year calving interval and an estimated gestation time of 12 months, their next calves are due in January 2013). The photographic data from all vessel effort will be incorporated into ongoing studies on life history, scarring and health assessment.

Comparison of aerial and vessel right whale sightings
Right whale sightings from the aerial survey platform and the vessel platform were compared to assess photographic data. The photographic and sighting data from NEFSC aerial surveys have not been fully submitted to NEAq for matching to the photo-identification catalogue. However, the preliminary matching results carried out by the NEFSC researchers are interesting. Although incomplete, the data suggest that in 2010 the aerial survey team documented only five (25%) of the 20 whales we saw from the vessel (Table 2a). In 2011, they documented only one (5%) of the 20 whales we saw from the vessel and that whale was seen three weeks early (Table 2b). It will take more days at sea with both survey platforms operating in the same area at the same time to assess if more whales are seen from the vessel as suspected. It is clear that the research conducted from the vessel added valuable right whale sighting data that was not obtained during aerial surveys.

Biopsy and Fecal Sampling
The majority of right whales indentified in the photographic catalogue have already been biopsy sampled. Among those seen in the Outer Fall/Jordan Basin region, there were only two right whales that had not been previously biopsy sampled. We were, however, unable to collect a sample from either of these individuals. In both cases, the animal dove and we were not able to relocate the animal; thus no biopsy samples were collected during this survey effort.

Right whales have been observed defecating in this area by observers on survey aircraft. However, much to our disappointment and despite a observer effort directed toward the surface of the water, there were no right whale fecal samples seen during any of the vessel surveys.

Mitigation of Vessels Strikes and Fishing Gear Entanglement of Right Whales
Vessel strike mitigation:
The right whale sighting information (date, time, position and number of animals) was reported at the completion of each survey to the NMFS Sighting Advisory System for marine advisories sent to vessel traffic in U.S. waters via email, Notices to Mariners and posting on the web. The right whale sightings from these vessel surveys contributed to the designation of a voluntary dynamic management area(s) (DMAs) whereby mariners are requested to avoid or transit at 10 knots or less inside the areas where persistent aggregations of right whales have been sighted. Implementation of this measure in the Jordan Basin area is reliant on the sighting of right whales during visual surveys (http://www.nefsc.noaa.gov/psb/surveys/SAS.html) and right whales must be seen every two weeks in order to continue the implementation of the DMA. Additional protective measures to reduce the threat of vessel strikes are needed in the Outer Fall/Jordan Basin region as the voluntary measures in place (DMAs) are solely reliant on regular surveys for implementation.
Fishing gear mitigation:
The Outer Fall/Jordan Basin region is now recognized as an important area for right whales based on the seasonal consistency of sightings, and the demographic composition of the portion of the population seen

in the area since 2004. During vessel surveys, the location of fixed fishing gear was recorded and the results shared with the Maine DMR and Maine Lobstermen'a Foundation. In January 2012, the results of the fixed fishing gear seen during these shipboard surveys were combined with the results of the aerial surveys of this region to formally request, through the National Marine Fisheries Service (NMFS) Atlantic Large Whale Take Reduction Team, the closure of the region to commercial pot fisheries from November through January (Kraus *et al*. 2012). The proposal is currently under review by the NMFS

Response to Entangled Right Whales
During the surveys of the Jordan Basin area in November and December 2010 and December 2011, there were no sightings of entangled right whales.

Serious Injury Documentation
Full body photographic sequences were obtained for each right whale photographed to the extent possible (portion of body above water or visible through the water) to be used in studies to monitor scarring and changes in scarring for each whale over the years. All right whales sighted were visually examined in the field and later from photographs in the laboratory for any signs of serious injury. None of the right whales seen in the Jordan Basin showed any injuries that were deemed serious (i.e. deep cuts or wounds). Photographs of right whales with new scars will be incorporated into ongoing biennial scar analyses (e.g. Knowlton *et al*. 2011).

Public Education
Conservation efforts to promote the recovery of endangered species are dependent, in part, on public awareness of a species' plight and recovery progress. Right whales are no exception and in 2010 and 2011 several members of the right whale research team engaged public interest through traditional media outlets (print/online and radio) and postings on the NEAq website. The bog entries for 2010 begin with http://rightwhales.neaq.org/2010/11/1-quest-for-right-whale-mating-ground.html and for 2011 with http://rightwhales.neaq.org/search?updated-min=2011-01-01T00:00:00-05:00&updated-max=2012-01-01T00:00:00-05:00&max-results=31.

There has been a great deal of media interest in these surveys. The principal investigator, Moira Brown, and head naturalist on the chartered vessel, Zack Klyver, have provided ten interviews for articles published in the print media in Maine and in Canada, and two live radio interviews for stations in Maine and Canada for a total of 12 media events on the Jordan Basin project. The media events were published or aired as follows:

- November 15, 2010 Mount Desert Islander (Bar Harbor Maine) *Team Seeks Winter Mating Ground*
- December 8, 2010 Mount Desert Islander *Right Whale Research Trip Originates on MDI*
- December 20, 2010 Canada Newswire, Press Release from Canadian Wildlife Federation *Team of international researchers 'making waves' in their efforts to protect endangered whale species*
- December 29, 2010 Bangor Daily News (Bangor Maine) *Winter mating of right whales focus of research off Maine coast*
- January 5, 2011 CBC (Canadian Broadcasting Corporation) Radio International
- January 7, 2011 WERU, Blue Hill, Maine. Live interview on talk show *Boat talk*
- January 13, 2011 Postmedia News Canada (parent for several major Canadian newspapers) *Scientists hunt for right whales.*
- February 7, 2011, Boston Globe, Front Page of the Metro Section *Some rare right whales prefer Maine in winter*
- February 14, 2011 Boston Globe Editorial *Right whales: Maine is for lovers*

- March 18, 2011 Canadian Wildlife Federation/Biosphere Magazine (March/April 2011) *Making Waves to Protect the Right Whale.*
- March 30, 2011 Working Waterfront *Right whale spending the winter in the Gulf of Maine.*
- December 19, 2011 Bangor Daily News *Maine Lobstermen Join Gulf of Maine Right Whale Expedition*

Value added to the Outer Fall/Jordan Basin survey program through volunteers

The Outer Fall/Jordan Basin region surveys were staged out of Mt. Desert Island, Maine. The vessel chartered for these surveys was the *Friendship V*, a 112 foot long catamaran used for whale watching during the tourist season. The operators of the charter vessel obtained a Coast Guard endorsement for these research surveys to permit a research crew of twenty persons for each excursion. Thus, in addition to the six member research team from the NEAq/CWI, each survey was augmented by 12- 14 volunteers to help the researchers search for whales. The volunteers were recruited for each survey from the local whale research community in the Bar Harbor Maine area, the Maine Department of Marine Resources, commercial fishermen from Maine and New Brunswick, and other interested parties (please see acknowledgements for a list of the participants). These volunteers supplied valuable assistance to the research team by providing additional observers to search for whales. The volunteer program also presented an opportunity to include fishermen as part of the observer effort so they could learn about how right whale researchers survey and collect data on right whales to monitor individuals, life history and scarring. One or two of the volunteers on each survey effort were professional ornithologists from Maine who collected data on the species and number of all birds observed. An opportunity for at sea bird counts in the central Gulf of Maine in the late fall and early winter are rare and our platform was able to provide an opportunity for Maine birders to augment their offshore data in November and December. The results of the bird counts collected during the four surveys are presented in Table 3.

Discussion

The joint international Outer Fall/Jordan Basin region vessel survey effort in November and December 2010 and December 2011 was the first of its kind for right whales in this area of the central Gulf of Maine. The surveys were conducted to help address a critical gap in right whale biology: the location and seasonality of the right whale mating ground. For this region to be considered as a potential mating ground, we expected the co-occurrence of adult males older than 15 years (Frasier *et al.* 2007), adult females that give birth twelve to thirteen months later usually on the calving ground in the southeast, and the sightings must be in November, December, or January to coincide with the estimated gestation time (12-13 months) and peak in calving (December through February) for this species (Kraus and Rolland 2007). Even with just a few surveys, the results for 2010 appear quite different to those obtained in 2011 and in the years previous to 2010.

The research team was able to carry out a total of four survey days, a testament to the challenging weather conditions at that time of the year in the Gulf of Maine. The researchers were successful at locating and obtaining photographs of right whales in the Outer Fall/Jordan Basin region. However, the results from the three surveys in 2010 were surprising. The actual number of right whales seen was lower than expected based on aerial survey research efforts in past years. Between 2004 and 2007, the NEFSC aerial survey team found that approximately half of the catalogued population has used this area in November, December and early January (Cole *et al*. 2009). Our vessel-based research effort in 2010 resulted in the collection of 32 photographed sightings of which 30 have been matched to a minimum of 20 different right including 11 males (9 adult, 1 juvenile), five females (1 adult, 4 juveniles), and four whale of unknown sex (all adult and believed to be male). The one adult female was a known reproductive female that was available to become pregnant at the time of the sighting (i.e. based on a calving interval of three years and estimated gestation, her next calf is due in January 2012), however this female was not seen

with a calf in the winter 2012 calving season. The age composition of the whales documented from the vessel in Outer Fall/Jordan Basin region was quite different to previous years when mostly whales identified were of breeding age (Cole *et al*. 2009). It is worth noting that the distribution of right whales in several habitat areas in 2010 was quite different than expected from decades of previous research (see below and NEAq unpublished data).

Although we had limited data from the one survey day during the 2011 season, the demographics of the right whales seen in the Outer Fall/Jordan Basin region were quite different from the 2010 results, and more closely resembled the results from earlier years. In 2010, we had documented only one reproductive female and quite a number of juveniles (all less than nine years of age, Table 2a), whereas in 2011 we documented no juveniles and seven adult females; all known mothers and all of which were potentially available to get pregnant (Table 2b). Given that more than 30% of the identified individuals in the population are juveniles (Hamilton *et al.* 1998), this skewed age ratio on the Outer Fall/Jordan Basin region in the 2011 data lends further support to the mating ground hypothesis. Furthermore, all of the adult males were a minimum of 24 to 30 years old making all of them potential fathers and five of the six males seen were known fathers as identified through paternity testing (Frasier *et al.* 2007). The different results in the two years make some sense with the privilege of hindsight. The 2012 calving year has been one of the lowest on record since 2000 (only six calves were recorded) suggesting that some factor (perhaps related to prey availability, see below) either caused the whales in December 2010 not to reproduce or resulted in right whales not aggregating in this region.

Analysis of the NEFSC aerial survey data for the Outer Fall/Jordan Basin region has yet to be completed, but preliminary matching suggests that the number of right whales seen during their survey effort was similarly low over the same time period in 2010. They documented only five of the 18 whales we recorded from the vessel (Table 2a). The well below average sightings of right whales typified several survey areas in the summer and fall of 2010. For example, only 62 right whales were seen in the Bay of Fundy and only 30 on Roseway Basin in 2010, areas where usually twice to three times that many animals are seen seasonally with similar effort (NEAq unpublished data). Surprisingly, there weren't any right whale feces seen in the Outer Fall/Jordan Basin region in 2010. There were also no feces seen in the Bay of Fundy or on Roseway Basin in 2010, two well studied feeding grounds where many fecal samples have been collected over the last decade (Rolland *et al*. 2007, Gillett *et al.* 2008, and NEAq unpublished data). It is possible that the low numbers of right whales in three survey areas, as well as the absence of feces, may be indicative of a shift in patterns of concentrations of plankton and of right whales in 2010. We will only learn in the years to come whether the summer, fall and early winter of 2010 will later be recognized as an anomalous year in the distribution of right whales in the Gulf of Maine and Atlantic Canada.

With this study we were able to demonstrate that it is possible to conduct vessel surveys for right whales in this offshore area, at a time of the year with limited day light (about nine hours from sunrise to sunset) and very few good weather days. Regardless of the difficult conditions, we were able to collect data on right whales that are useful for describing the seasonality, distribution and habitat use patterns of right whales. The data from this survey effort, in combination with the results from aerial surveys, are providing a growing body of evidence to support the hypothesis that the Outer Fall/Jordan Basin region is a mating ground for the North Atlantic right whale. The right whales seen in the Outer Fall/Jordan Basin region coincide with the estimated time of conception for this species based on estimated length of gestation (Best 1994) and synchrony of calving (Kraus and Rolland 2007). The demographics of the right whales including the proportion of adults to juveniles seen (this report) lend additional evidence to the mating ground hypothesis and coincide with the portion of the population expected on a purported mating ground.

In the short term, seasonally consistent right whale aggregation areas are recognized as important to the recovery of the species and warrant protection from human activities. For example, right whale sightings from these vessel surveys in November and December 2010 and December 2011 provided the justification for the designation of voluntary dynamic management areas. The Outer Fall/Jordan Basin right whale aggregation area may warrant more aggressive protection measures, that are not reliant on surveys for implementation, including critical habitat designation under the Endangered Species Act and the designation of an Area to be Avoided such as was implemented for the Great South Channel right whale critical habitat to reduce the threat of vessel strikes. It is encouraging that the data from surveys in the region have already resulted in a proposal to implement a seasonal closure of fixed gear fisheries through the Atlantic Large Whale Take Reduction Team (Kraus *et al*. 2012).

In the long term, these data collected during the Outer Fall/Jordan Basin region vessel surveys reported here, the NEFSC aerial surveys (Cole et al 2009) and future survey efforts will provide critical information on the right whales using the area including data for analyses on reproduction, scarring, survivorship, human impacts, and health. Ultimately, if the demographics of the individual right whales seen in this area support the mating ground hypothesis, then a critical gap in right whale biology will be filled. In addition, the ability to include volunteers on the research trips resulted in several Maine and New Brunswick fishermen, and other interested parties gaining a greater breadth of understanding of the research methods used and the international efforts to recover the right whale species in American and Canadian waters. The fishermen have been affected by the U.S. regulations to modify fishing gear to reduce the risk of right whale entanglement in fishing gear, but none of the U.S. commercial fishermen had actually seen a right whale before they participated in one of these vessel surveys. Thus in addition to their research value, this project engaged a few commercial fishermen in the stewardship of the North Atlantic right whale.

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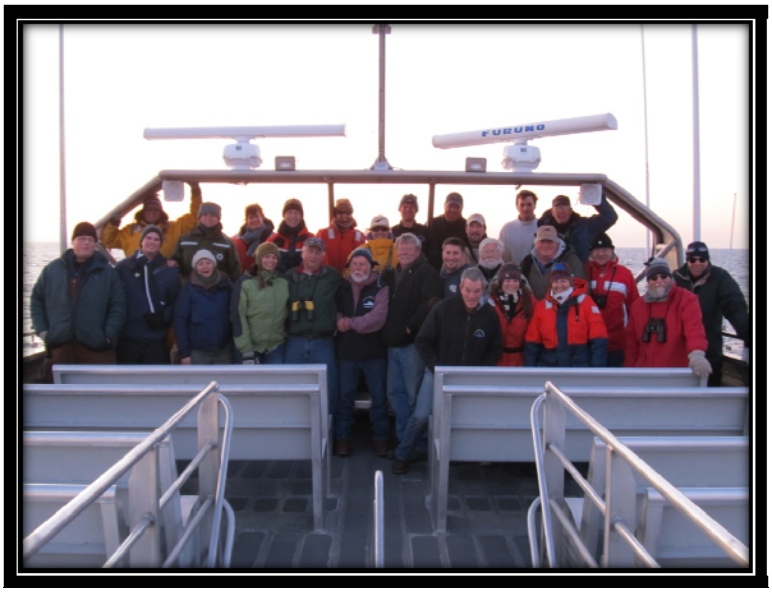

Researchers, volunteers and vessel crew photographed on board the *Friendship V* on 13 December 2011.

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Figure 1a. Right whale sightings and vessel survey track lines from the M/V *Friendship V* in the Jordan Basin area on 16, 30 November and 18 December 2010 (left) and 13 December 2011 (right).

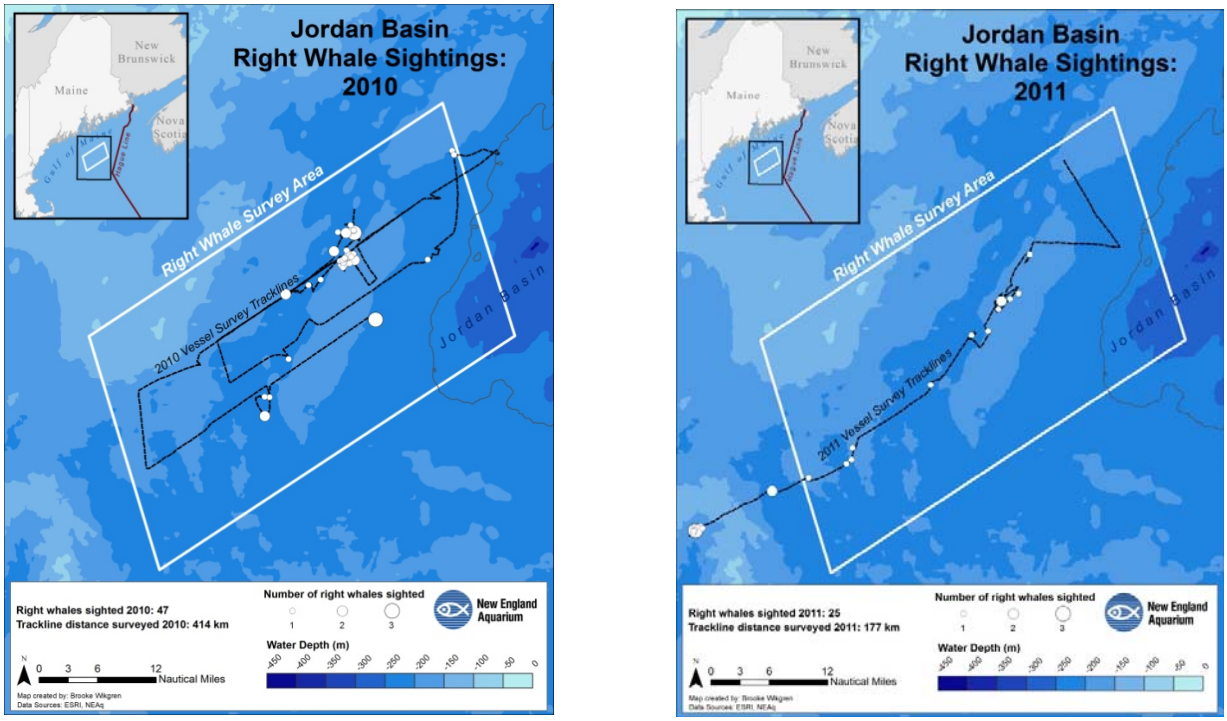

Figure 1b. Right whale sightings and vessel survey track lines from the M/V *Friendship V* in the Jordan Basin area for 2010 and 2011.

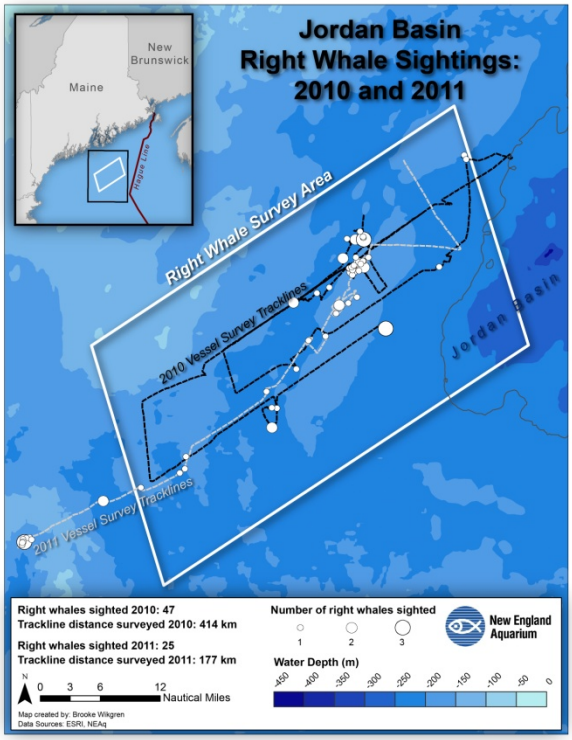

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Figure 2a. Sightings of the other cetaceans observed and vessel survey track lines from the M/V *Friendship V* in the Jordan Basin area in November and December 2010.

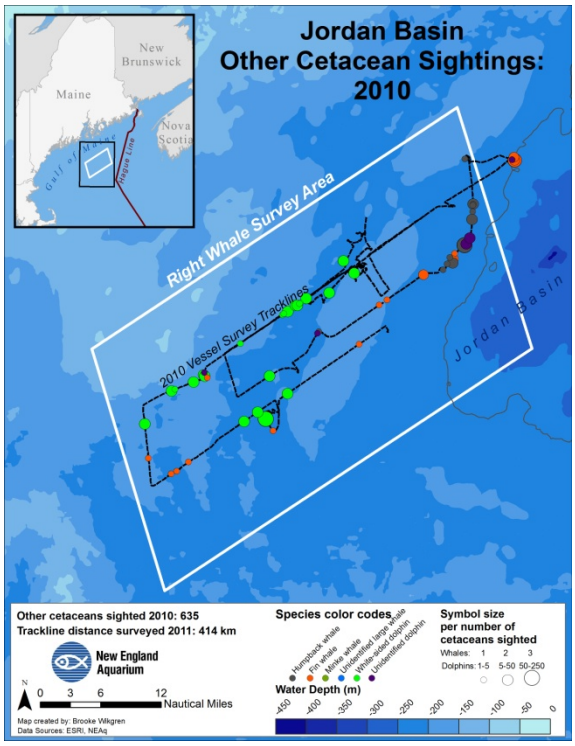

Figure 2b. Sightings of the other cetaceans observed and vessel survey track lines from the M/V *Friendship V* in the Jordan Basin area on 13 December 2011.

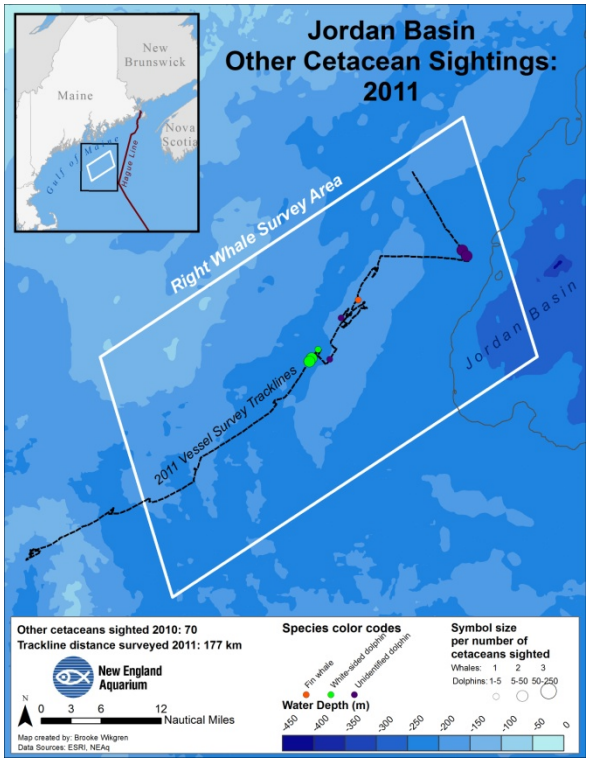

Figure 3a. Sightings of the vessels and fishing gear observed and survey track lines from the M/V *Friendship V* in the Jordan Basin area in November and December 2010.

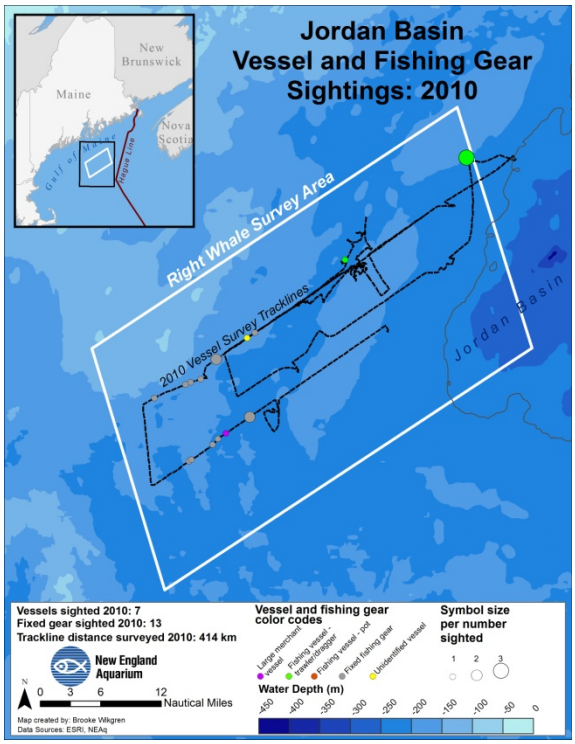

Figure 3a. Sightings of the vessels and fishing gear observed and survey track lines from the M/V *Friendship V* in the Jordan Basin area on 13 December 2011.

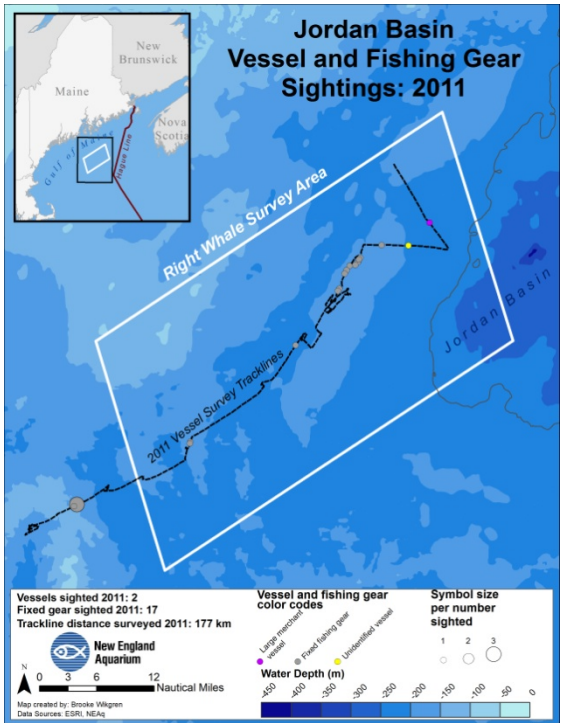

Table 1. Number of marine mammals seen, hours and track line distance (in kilometers) surveyed during three shipboard surveys on R/V *Friendship V* in the Jordan Basin area, November – December 2010 and December 2011. Actual hours at sea were greater than hours on survey because the data logger was activated at sunrise and de-activated at sunset. Transit time to and from the survey area ranged from 2-3½ hours each way per survey.

Date	Hours on Survey	Trackline Distance (km)	Eg Photo'd	Eg Seen	Ba	Bp	Mn	UnLW	La	UnDO	Hg	Pv	Cm
16-Nov-2010	9.4	96.85	22	30	1	0	0	0	68	0	0	0	0
30-Nov-2010	8.65	134.06	9	10	2	9	18	1	64	21	0	1	0
18-Dec-2010	9.0	183.17	2	5	5	15	0	2	422	7	1	0	0
13-Dec-2011	9.0	177.00	20	25	0	1	0	0	40	29	0	0	1
Total	**36.05**	**591.08**	**53**	**70**	**8**	**25**	**18**	**3**	**594**	**57**	**1**	**1**	**1**

Legend: Eg- right whale; Ba- minke whale; Bp- fin whale; Mn- humpback whale; UnLW- unidentified large whale; La- Atlantic white-sided dolphin; UnDo- unidentified dolphin; Hg- gray seal; Pv- harbor seal.

Table 2a. Of the 32 right whales photographed in 2010, 30 have been matched to 20 different individual whales in the Right Whale Catalogue to date. Some whales were photographed more than once, but none were seen on more than one survey day. Five of the 20 whales were seen by the NEFSC aerial survey. If interested in more detail on the lifetime sighting history of these right whales, access www.rwcatalog.neaq.org.

EGNo	Age	Sex	First Year Sighted	Last Year Sighted	Darted	Cow	Last Calving Year	Date of NEAq sighting	Date of NEFSC sighting
1056	A	X	1980	2011	Yes	No		11/30/2010	
1149	A	M	1981	2010	Yes	No		11/16/2010	11/15/2010
1272	A	M	1982	2011	Yes	No		11/30/2010	11/30/2010
1283	A	M	1982	2010	Yes	No		11/30/2010	
1306	A	M	1983	2011	Yes	No		11/16/2010	11/30/2010
1326	A	M	1983	2010	Yes	No		11/30/2010	
1513	A	X	1985	2011	Yes	No		11/16/2010	
1801	22	M	1988	2011	Yes	No		11/30/2010	
2370	A	X	1993	2011	No	No		11/30/2010	
2760	A	M	1997	2011	Yes	No		12/18/2010	
2791	A	F	1997	2010	Yes	Yes	2006	11/16/2010	
2920	A	X	1999	2009	Yes	No		11/16/2010	11/15/2010
2930	A	M	1999	2009	Yes	No		11/30/2010	
3193	A	M	2001	2011	Yes	No		11/16/2010	
3232	8	F	2002	2009	Yes	No		11/16/2010	
3323	7	M	2003	2011	Yes	No		11/16/2010	
3450	U	F	2004	2010	Yes	No		11/16/2010	11/15/2010
3503	5	F	2004	2011	Yes	No		11/16/2010	
3580	5	M	2004	2011	Yes	No		12/18/2010	
3725	3	F	2006	2011	Yes	No		11/16/2010	

Abbreviations: EgNo – right whale catalogue number; A- adult; U- unknown age, sighting history less than 10 year; Unk – unknown gender; M – male; F – female; Cow – known reproductive female.

Table 2b. Of the 20 right whales photographed, 15 have been matched to 13 different individual whales in the Right Whale Catalogue to date. Only one of the 13 whales was seen by the NEFSC aerial survey. If interested in more detail on the lifetime sighting history of these right whales, access www.rwcatalog.neaq.org.

EGNo	Age	Sex	First Year Sighted	Last Year Sighted	Darted	Cow	Last Calving Year	Date of NEAq sighting	Date of NEFSC sighting
1050	A	M	1980	2008	Yes	No		12/13/2011	
1149	A	M	1981	2010	Yes	No		12/13/2011	
1271	A	M	1978	2011	Yes	No		12/13/2011	11/22/2011
1327	A	M	1982	2011	Yes	No		12/13/2011	
1408	27	F	1984	2011	Yes	Yes	2008	12/13/2011	
1716	A	M	1982	2011	Yes	No		12/13/2011	
2123	20	F	1991	2011	Yes	Yes	2009	12/13/2011	
2320	A	F	1993	2010	Yes	Yes	2009	12/13/2011	
2430	A	F	1994	2011	Yes	Yes	2010	12/13/2011	
2645	15	F	1996	2011	Yes	Yes	2010	12/13/2011	
2940	12	M	1999	2009	No	No		12/13/2011	
3260	A	F	2002	2011	Yes	Yes	2010	12/13/2011	
3320	A	F	2003	2011	Yes	Yes	2009	12/13/2011	

Abbreviations: EgNo – right whale catalogue number; A- adult; U- unknown age, sighting history less than 10 year; Unk – unknown gender; M – male; F – female; Cow – known reproductive female.

Table 3. List of bird species (by common name) identified and number counted per survey day for four vessel surveys for right whales in the Jordan Basin area (Figure 1) in November and December 2010 and December 2011. These data were provided for this report by Michael J. Good, MS President Down East Nature Tours, Founder and Director 13th Acadia Birding Festival, Co-founder Penobscot Watershed Eco Center: 150 Knox Road Bar Harbor, Maine 04609.

Common name	11/16/10	11/30/10	12/18/10	12/13/11
Canada Goose			41	
Common Eider (Atlantic)		24		6
Long-tailed duck				1
White-winged scoter			4	
Scoter spp.		6	7	
Red-throated Loon		1		1
Common Loon		4	2	3
Greater Shearwater	57	28		
Northern Fulmar	105	112	37	269
Northern Gannet	15	7	4	39
Double-crested cormorant	3	2		
Herring Gull	43	24	23	3
Laughing Gull	1			
Greater Black-backed Gull	48	140	38	18
Black-legged Kittiwake	38	115	148	97
Phalarope spp.	2			
Red-breasted Merganser	3			
Puffin spp.	2			
Atlantic Puffin	1	11	6	
Razorbill	2	4	3	74
Dovekie	214	176	48	23
Large Alcid species			13	5
Common Murre	6	8	87	
Thick-billed Murre				4
Unidentified Murre			2	
Pomarine Jaeger		4		
Parasitic Jaeger				1
Song Sparrow*		1*		
Dark-eyed Junco*		1*		
Brown-headed Cowbird*		1*		
Pine Siskin*		1*		
American Goldfinch*		1*		

* The five species of land birds seen on November 30 2010 were all seen at a distance of greater than 68 miles from land.