The Effects of Sea Ice Loss On Harp Seals

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Abstract

This paper explores how the declining rate of sea ice affects the harp seal. Prior to researching, harp seal population was anticipated to diminish due to habitat loss from warming ocean temperatures. It will start by discussing the sea ice projections for the next 50 years and how much it is predicted to decrease. As of now, it is anticipated that there will be little to no ice in the summer 30 to 50 years from now. All decadal ice will most likely be gone and the only ice remaining will be very young. The harp seal range is throughout the northern Atlantic from eastern Canada to northern Russia. They can grow up to 400 pounds and be 6 ½ feet long. Harp seals rely on this sea ice for protection, mating, and most importantly as a platform for their babies while they cannot swim. Additionally, these seals are a main food staple for polar bears and killer whales within their range, and they are vital in the culture and economy of Inupiat and Canadian communities. After examining the importance of harp seals to their environment, the paper discusses the effects of less sea ice on their own populations. Having less sea ice could detrimentally reduce the number of pups able to survive due to the inadequate amount of ice. Potential methods to reverse this trend include the proposed implementation of artificial platforms to increase harp seal habitat, in order to make up for the declining sea ice.
To provide a firm understanding of the reliability of Arctic sea ice estimates, scientists have reviewed 300 summer Arctic sea ice forecasts from 2008-2013. These scientists were from the University College London (2014), National Snow and Ice Data Center (NSIDC), University of New Hampshire, and University of Washington. They were able to find the following data:

From 1979-2013, in the month of September, the depth of Arctic sea ice decreases approximately 13.7% every decade. Sea ice was recorded at its lowest depth in 2012; it was 16% lower than the average from 1981-2010. “…Sea ice is well below normal and continues an overall pattern of decreasing sea ice during summer in the Arctic,” said Walt Meier, scientist at NASA (2014).

The rapid decrease of Arctic sea ice can be predicted through Global Climate Models (GCMs). Through analyzing past data and developing GCMs, it is estimated that the Arctic will be ice-free in the next 30-50 years. (Holland, Bitz, & Tremblay, 2006).

The Community Climate System Model was used to make seven different models projecting possible sea ice decline based on previous data and trends. Of all the times sea ice was predicted using this model, 50% of the predictions...
included a tipping point. Figure I shows the seven predictions for September sea ice coverage in the Arctic. The gray bar highlights where the tipping point is located. (Holland, Bitz, & Tremblay, 2006).

The Canadian Cryospheric Information Network (CCIN) estimates, based on current trends, the Arctic will very likely be ice-free by 2100 and is even likely to happen before 2050. This downward trend can be seen in Figure II. Emission scenarios are shown in this graph (RCPs) (Pauly, 2014).

There are many factors going into making accurate predictions in Arctic sea ice extent fifty years from now. It is now widely accepted that the rapid decline in Arctic sea ice is directly affected by anthropogenically driven climate change. Gathered data from both University College London (2014), NASA/Goddard Space Flight Center (2014), Holland, Bitz, & Trumblay (2006), and Pauly (2014) provides us with evidence proving that there is currently a downward trend of sea ice coverage in the Arctic. When there is less ice covering the Arctic Ocean, there is a low albedo effect. This results in accelerated basal melting of the remaining ice.

Based on the most educated assumptions, it is predicted that 50 years from now there will be little to no ice during the summer months in the Arctic. The remaining ice will be very young ice and there will most likely be little to no decadal ice left. Decadal ice is vital in animal habitats due to its thickness and strength. An animal that could be potentially affected by sea ice loss is the harp seal.
The harp seal (*Pagophilus groenlandicus*) is a semi aquatic marine mammal that lives throughout the northern Atlantic and Arctic Oceans. They can grow up to 400 pounds and reach 5 to 6 ½ feet in length. Harp seals are carnivores, eating mostly crustaceans and fish, and spend little time on land (National Geographic, n.d.). There are three main population stocks: one is off the east coast of Canada, another is on the eastern side of Greenland, and the last is off of eastern Russian in the White Sea (Zeal for the Seal, n.d.). The estimated population sizes are 4 to 6.4 million in the Western North Atlantic stock, 300,000 off eastern Greenland, and 1.2 million in the White Sea (Seal Conservation Society, n.d.). They can dive to depths of 1,200 feet for up to 16 minutes long (NOAA, n.d.). Harp seals can live to be 30 years old in the wild and tend to group up in large colonies when on the ice. They have eight pairs of teeth in the upper and lower jaw. Both their front and back flippers have claws (Zeal for the Seal, n.d.). Their main predators are killer whales, polar bears, sharks, and humans. Other deaths result from boat strikes, fishing gear, and oil spills. However, one of the most important threats to harp seals is the loss of their sea ice habitat (NOAA, n.d.).

Harp seals spend most of their time in the water throughout the North Atlantic and Arctic Oceans, between Newfoundland and northern Russia. They are able to stay in the water and swim for long periods of time, rarely going onto land or ice. These seals have also been known to sleep while swimming, reducing the need to get out of the water (Seal Conservation Society, n.d.). The seals mainly use the ice to mate and give birth upon. They prefer ice that is rougher and at least 0.25 meters thick, which is solid and can hold their weight. It is crucial for their survival that the newborn pups have enough firm ice to stay afloat on to remain dry. When they are first born they do not have much blubber and cannot swim, making it imperative that they stay out of the freezing water.
Harp seals use delayed implantation; after weaning their baby, females mate and the spherical embryo does not implant in the uterus wall for about three months. This delay in implantation helps better time the birth so there will be sufficient pack ice for them to give birth upon. The mothers give birth in the southern boundaries of their range in late February and only have one pup at a time. When they are born, they weigh less than 25 pounds and are 3 feet long, with white wooly fur known as lanugo. They are nursed for 12 days and are then weaned. The mother’s milk is 48% fat, allowing the baby to gain five pounds per day while the mother loses around seven pounds per day. After they are weaned the pups do not eat for six weeks and lose half of their body weight before being able to swim and find food on their own (NOAA). Due to many reasons, including these harsh birthing and rearing conditions, 30% of the babies die within the first year (NOAA).

Harp seals serve as an important part of the arctic ecosystem, as both predators and prey. As prey, stated previously in the paper, they serve as a primary food source for two major predators: polar bears and killer whales. Polar bears are particularly dependent on seals as a food source (Blackburn, 2010). With the loss of ice platforms near areas abundant in fish, which are the seals’ main food source, we see a loss of nutrition and lower reproductive rates. With these drops in population and lack of health in the harp seals that survive, polar bears are left without food for longer periods of time necessary for proper growth and nutrition (Global Warming and Polar Bears, n.d.). This can result in cannibalistic behavior. While polar bears have been known to kill each other for social dominance, this is the first time biologists are observing polar bears killing each other as a food source. Polar bear populations are not only dropping from this cannibalistic behavior, but also from starvation itself. Of the polar bears that are left, biologists are observing more underweight or starving bears, thus resulting in smaller bears, fewer cubs,
and lower survival rates (Polar Bears: Longevity & Causes of Death. n.d.). A decreased seal population could result in increased cannibalistic behavior and starvation among the polar bears.

Killer whales in general have an extremely diverse population, and have been observed worldwide preying on more than 140 different species. Therefore, the decline in the population of harp seals most likely would not drastically affect killer whales as a whole. However, specific regional groups of killer whales are known to have more narrow diets, favoring only a certain species in some cases. Knowing this, it is possible that if there was a pod of killer whales in the north Atlantic that specifically preyed on harp seals, they may be affected by a decline in harp seal populations (Killer Whales: Diet & Eating Habits. n.d.).

As a predator, a decline in harp seal populations would not have as drastic affect on any one species, as they would in their function as prey as discussed above. Harp seals feed on a wide variety of fish, thus it is unlikely the population of any one of these food groups would see a drastic rise in populations in the seals’ absence within the ecosystem. Although harp seals were previously thought to be the major cause for declines in North Atlantic cod populations, cod only makes up a small fraction of a harp seal’s diet (Mackenzie, 1996). Harp seals also prey on species that prey on cod, therefore the decline in harp seal populations would not drastically change cod populations.

The importance of harp seals is not strictly limited to their ecological role. The harp seal plays a key part in lives of many people, both economically and culturally. Economically, the Canadian government estimates that 5,000 to 6,000 Canadians get their income from the Canadian commercial seal hunt, the largest mass slaughter of marine mammals in the world. If harp seal populations were to decline, the Canadian Department of Fisheries and Oceans may have to lower the quota for the number of harp seals to be hunted, thus resulting in a loss of
profit for the seal hunters (Seal Hunt Facts, 2012). Furthermore, among native Canadian groups, the seal hunt has been a significant cultural event. Since 2000 B.C.E., the seal hunt has held symbolic significance for native boys since their first kill represents their transition from childhood to adulthood (Seal Hunts, 2000). Declines in the harp seal population may make this hunt more difficult, thus possibly creating loss of tradition and cultural strain.

Canada’s harp seal hunting season is from November 15th to May 15th, when the ice is thick enough to travel on or thinning to drive through on a boat. This is when the pups are just being born and are starting to shed their fuzzy white coats. During the year 2006, 325,000 seals were killed throughout the world. Of those killed in the annual hunt, 95% of them were three weeks to three months old. Throughout history the Inuit people have used the meat, fur, and bones for eating, making clothes, and for shelter. However, in recent years most of the commercial hunters leave the carcasses on the ice, just taking the pelts (Harp Seals.org, n.d.).

As important as harp seals are for humans, anthropogenic climate change has had a negative effect on their population, which will only worsen over time. Harp seals’ dependence on Arctic sea ice leaves them extremely vulnerable to climate change. Without sea ice, harp seals will have no place to give birth, and their pups will drown. What little ice that remains is thinner and less fit to support mothers and pups, forcing earlier weaning. This deprives them of nutrients vital to the beginning of their lives. Seal pups that are weaned too early will have less time to adjust between living off their mother’s milk. They have less nutrients and fat to provide nourishment in the period between weaning and fending for themselves. Overall, reduced ice cover has been proven to drastically decrease or possibly eliminate entire years’ worth of pups, and they are losing 6 percent of their population each year (Kovacs, Lydersen, Overland, &
Moore, 2011). They suffer from a lack of space to give birth upon, wean their pups too early, and the surviving pups face increased rates of being crushed by ice and stranding on shore.

The loss of Arctic sea ice also has a relationship with the number of young stranded seal pups. Scientists have noted the stranded pups are as genetically healthy as those who get caught in fishing nets, showing these trends are not a matter of poor genetic variability and thus ill or weak pups (Soulen, Cammen, Schultz, & Johnston, 2013). Instead, increased strandings are a result of decreased sea ice.

The missing ice has an effect on the entire population. Studies have estimated there will be no summer sea ice by 2030, the seals may not be able to adapt to the timeline. Unfortunately few studies have been done on the relation between sea ice and harp seals. One study, conducted with data from volunteers cleaning up seal carcass on beaches and matching the years with ice coverage indicated that there was a positive correlation between ice coverage and strandings (Soulen, Cammen, Schultz, & Johnston, 2013). While this study provides clear relations, more will need to be done to understand harp seals and how they are affected by climate change. In the meantime, other studies about how melting sea ice affects the ecosystem of the Arctic can be extrapolated to the harp seals. These include issues like positive feedback loops and invasive species.

Positive feedback loops occur when sea ice melts, in the context of Arctic biology and ecology and how they are affected by climate change (“Positive Feedback,” n.d.). Sea ice has a higher albedo than water, losing it causes the absorption of more heat. More heat melts more ice, and the cycle continues. As the sea ice melts, female seals will have less space to give birth, and the surviving pups would face an increased risk of being crushed between pieces of sea ice.
In addition, melting sea ice devastates the Arctic food chain. If algae and plankton, which make up 57 percent of the Arctic Ocean’s biological production are affected, it will affect the crustaceans, and fish the harp seals prey on (Voss, 2013). Algae bloom more often in warmer waters, and ocean acidification hampers the ability of shell-forming creatures to protect themselves. Harp seals would have less food to eat due to algal blooms and acidification.

Warming temperatures, besides melting vital ice, also cause organisms from lower latitudes to migrate north to cooler water. This migration could result in more competition for the seals to find food, which as mentioned above is diminishing. New predators may adapt to hunting the remaining seals, in turn decreasing a population already hit by lower birth and recruitment rates.

Global warming can cause metabolic rates to increase, known as $Q_{10}$, which is the increase of metabolic rate for every extra ten degrees Celsius (Eppley, 1972). The remaining harp seals would need more food as a result of increased metabolism and temperature. While there may be fewer other harp seals to compete with in the event of global warming, their prey would be negatively affected by climate change, and they would face new competition and predators.

A potential solution to the prominent issue of global warming leading to the yearly decrease of Arctic sea ice and its consequential effects on the habitat of harp seals is to implement artificial nesting structures so more seals can survive the rapid change of their habitat. Artificial nesting structures have been used for centuries, first appearing in the 19th century in the form of a nest box. Although most commonly used for birds, artificial nesting structures for other mammals have been developed. (May, 2001) The purpose of these structures is to increase wildlife reproduction success in places where natural nests are unsuitable or
unavailable. These structures are most effective when they are placed near original breeding grounds, close to an escape route, and near a sufficient food source. Other important factors that contribute to the structure’s overall success are the materials used to build the structure, how you install it, what predator guards you have, how you monitor it, and how you conduct maintenance (May, 2001). Considering these factors and the evolution of artificial nesting structure technology, it could serve as a viable option for harp seal populations.

The IUCN (International Union for Conservation of Nature) has created a similar project called the Saimaa Ringed Seal LIFE Project. In this project, volunteers produced and placed man made snow drifts around two lakes in the Saimaa area in order to boost Saimaa seal reproductive success in temperate winters (IUCN, 2014). Because the project has been successful thus far, the Saimaa Ringed Seal LIFE Project plans on extending the placement of the artificial drifts to include the entire Lake Saimaa water system.

By placing artificial platforms into the Arctic for harp seals, we could create habitat for the seals, potentially increasing the overall survival rate. Because pups do not have a sufficient amount of blubber to keep them warm in the water and because pups cannot swim for the first six weeks of their life, it is crucial for harp seals to have thick, solid ice to nurse and wean on (Sargent, 1991). As the seals grow older, sea ice serves as a place to escape predators, rest, sleep, and give birth upon. Artificial nesting platforms shaped like icebergs, will help to conserve and maintain the harbor seal population by increasing their rearing habitat.

After completing our research, we have concluded the best course of action would be to propose that the United States Fish and Wildlife Service, partnered with other organizations like the EPA (Environmental Protection Agency) and WHMI (Wildlife Habitat Management
Institute), come together to start a program that will construct and implement artificial nesting structures in the Arctic for harp seals in order to increase the animals’ rearing habitat.

Conclusion

Since the Arctic sea ice is decreasing so drastically within the next 50 years, and is predicted to be ice-free by 2050, the harp seal population will be greatly affected. Research showed that sea ice is important to harp seal babies who are born and live on the ice for the first six weeks of their life, because they are not able to swim and hunt on their own. Due to this decline of ice the seals will have less area and weaker ice to give birth upon, nurse, and for the babies to grow. With more reduced ice it is likely that more and more pups will die due to the diminishing amount of stable ice. As a result, both polar bears and killer whales will have less harp seals to prey on, leading their population to possibly decline and forcing them to find a new food source. This decrease could also cause the Canadian Department of Fish and Ocean to lower the quota allotted to commercial seal hunters, decreasing their income. To help offset the absence of sea ice, it is proposed that a program be developed with the purpose of creating artificial nesting platforms to expand the seals’ nesting habitat, which in turn would increase the pups’ overall success rate.
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