Research on

Sea Ducks in the Baltic Sea

Gotland University
Passion & Science

This brochure gives an introduction to sea duck ecology and summarizes recent research results and ideas discussed at a workshop in Visby, Sweden, June 2011. The workshop focused on the interactions between sea ducks and their food in the Baltic Sea and was attended by 26 sea duck researchers and marine biologists from eight countries around the Baltic Sea and USA. The workshop was arranged by Gotland University and financially supported by Nord Stream. Since 2008, Nord Stream is sponsoring a research project at Gotland University on the interactions between sea ducks and bottom fauna in a changing Baltic environment (www.hgo.se/seaducks).

The map shows important wintering and spring staging areas for sea ducks in the Baltic Sea. These important sea duck areas differ with respect to physical conditions such as bottom substrate, water depth, and salinity, as well as benthic communities. Data from Skov et al. 2000.[1]

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Photo: Kjell Larsson
Front cover: Long-tailed Ducks
Layout: Helena Duveborg

The Baltic Sea is one of the largest brackish water bodies in the world, a unique ecosystem, very different from other marine environments. It supports nearly three million sea ducks during the non-breeding season, but here, as throughout the northern hemisphere, most sea duck populations are declining. The Baltic Sea has experienced many substantial changes in the last 50 years mainly due to eutrophication, chemical pollution, overfishing and other human activities, and it will continue to change due to global climate change.

What are sea ducks?

Sea ducks are those duck species which spend the non-breeding season in marine environments where they mainly dive for bivalves, their most important food source. Five common sea duck species are found in the Baltic Sea: the Common and Steller's Eiders, the Long-tailed Duck, and the Common and Velvet Scoters. Despite using different habitats and breeding areas, they share a preference for offshore waters and a dependence on benthic invertebrates in winter. Sea ducks are probably the least studied group of waterfowl in the northern hemisphere.

Sea ducks

– wintering in the Baltic Sea

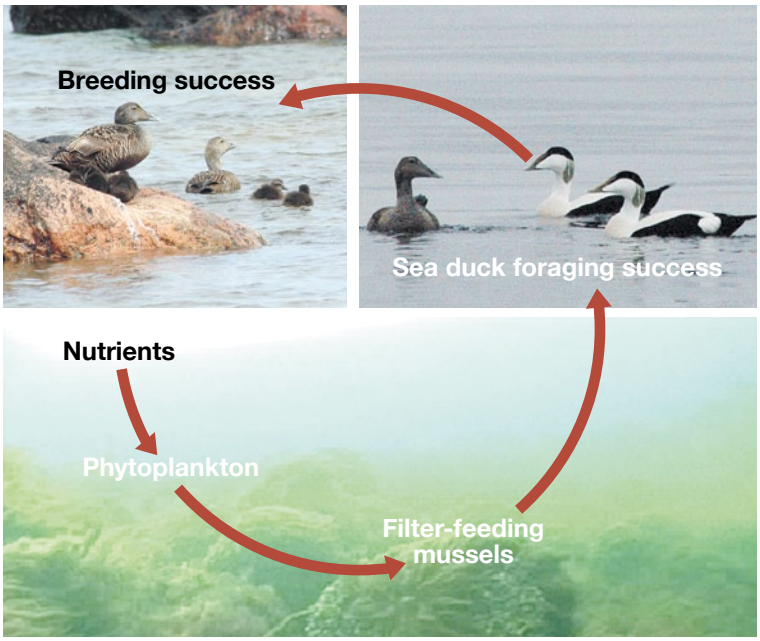
The Baltic Sea is among the world's most important sites for wintering sea ducks and many other migratory waterbirds, most of which nest in the Arctic tundra or boreal forest. The most important areas for wintering waterbirds in the Baltic have been identified mostly in shallow coastal waters or over offshore banks, where diving birds concentrate because they can easily dive to reach their food on the sea floor. In winter, more than 90 % of the birds can be found within areas covering less than 5 % of the Baltic Sea.

– in the food web

Sea ducks make use of a very abundant food source by diving to forage on underwater bivalves in the Baltic, and even the smallest species, the Long-tailed Duck and Steller's Eider, regularly dive up to 20 meters to reach their food. The Blue Mussel is the most abundant bivalve on hard bottoms in the Baltic Sea and the most important food item, especially for Common Eiders and Long-tailed Ducks in the central Baltic Sea. Besides blue mussels sea ducks take a variety of other bivalve species as well as other invertebrates and even herring eggs in spring.

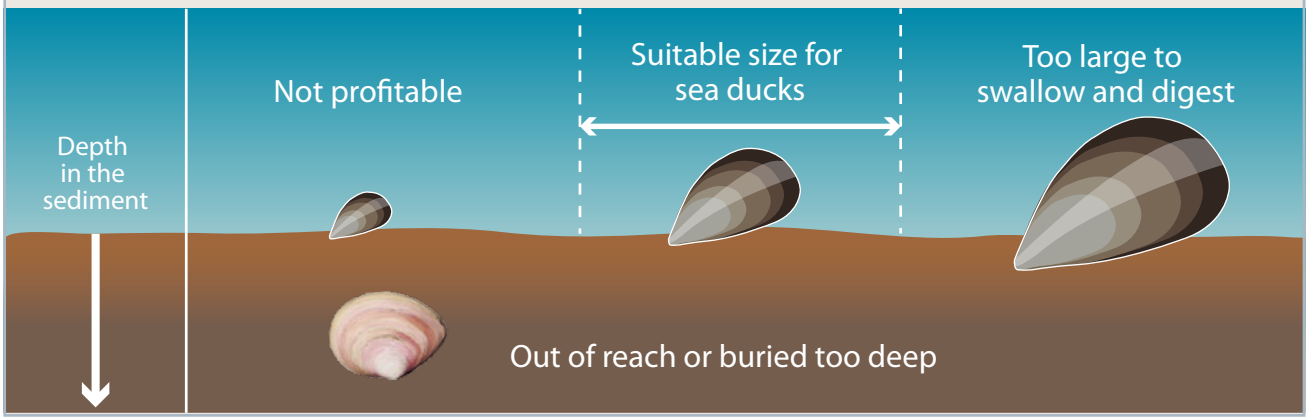
Common Eiders and Common Scoters

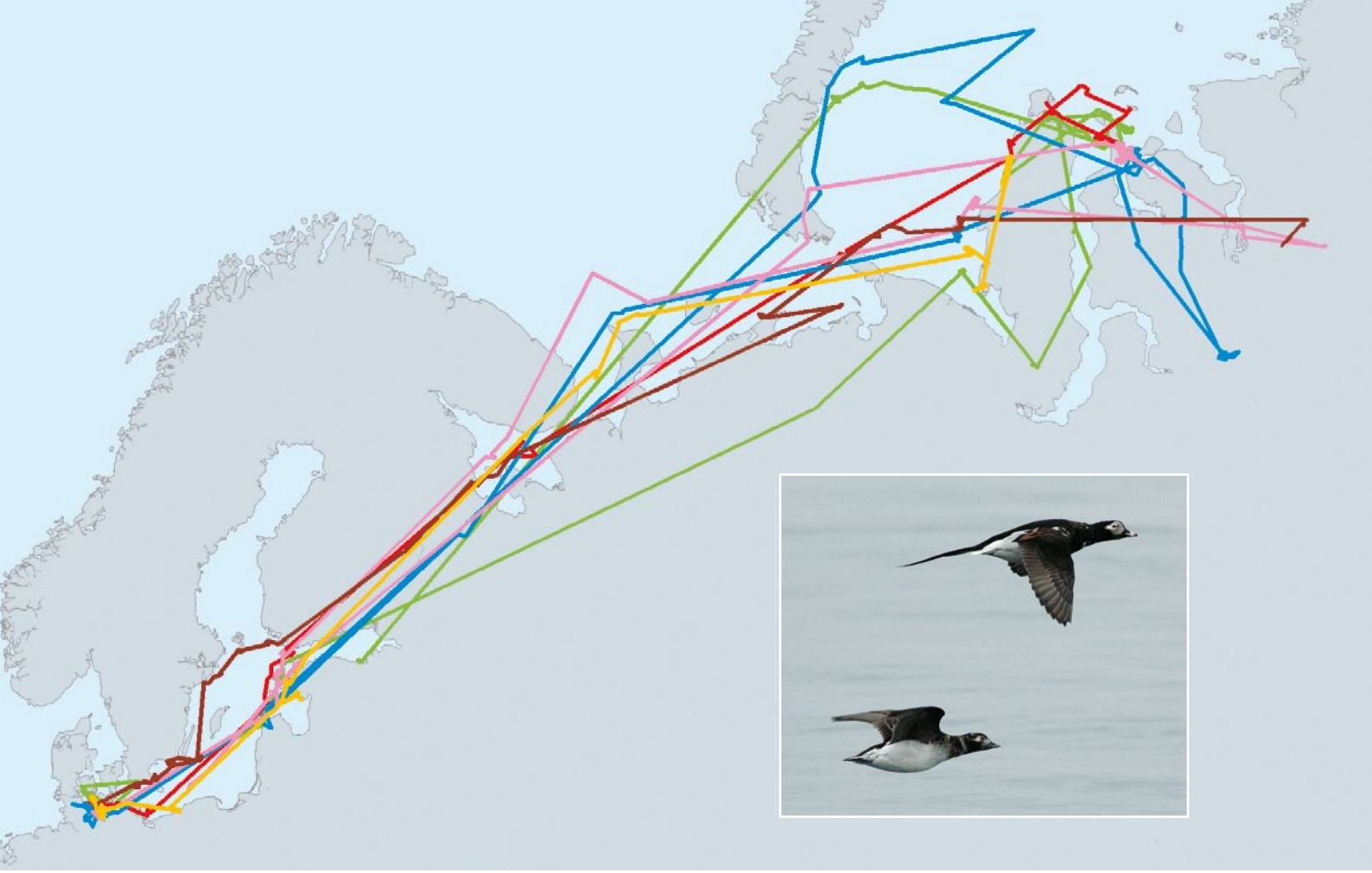
Most bivalves feed by filtering plankton from the seawater. Because different phytoplankton groups have different energetic and nutritious qualities, the species composition of phytoplankton in seawater affects the growth and condition of mussels and thus their quality as a food for sea ducks. Changes in plankton composition, for example due to changing nutrient input to the Baltic Sea, can directly affect mussel quality, and thus the food intake, condition and breeding success of benthic feeding birds such as sea ducks.



Sea ducks swallow mussels whole, but since it is only the flesh that is of nutritional value they must consume large quantities of mussels each day to maintain their energy balance.

Not every mussel attached to, or buried in, the sea floor is actually good food for a sea duck. The birds have to balance the energy gained from the soft body parts of the mussels with the energy spent for diving and digesting, including crushing the shells. Mussels should therefore not be buried too deep to be reached and should be of the right size. This means that they should be large enough to contain enough flesh to be a profitable prey, but at the same time not too large to be swallowed and crushed in the gizzard. Shell thickness and flesh content of mussels differ between species and regions. Sea ducks also differ considerably in size with the largest species, the Common Eider, being able to swallow much larger prey than the much smaller Long-tailed Duck. Thus, the optimal prey size depends on prey type and bird species. Finally, bivalve numbers should be high enough to enable sea ducks to find enough suitable prey during relatively short dives. By using this knowledge we can estimate the amount of harvestable food from bottom fauna samples.





Migration movements of Long-tailed Ducks marked with satellite transmitters. The birds leave the Baltic Sea in mid May. Many birds use the White Sea as a stopover site before they begin their final migration to the nesting areas in the Russian Arctic. The birds were marked in winter in the southwestern Baltic Sea. Data from Ramunas Žydelis.

– on migration to the breeding grounds

Most sea ducks winter in ice-free parts of the central and southern Baltic Sea and North Sea coasts. While for example Common Eiders nest frequently in the Swedish and Finnish archipelagos in the Baltic Sea, most sea ducks migrate over long distances. Records from satellite transmitters attached to Long-tailed Ducks in the Fehmarn Belt show how they travel more than 3,500 km twice each year to their breeding sites as far as Yamal Peninsula in the Russian Arctic, where they spend the short Arctic summer, and back.

Sea ducks build up fat and protein stores in their wintering and spring staging areas to fuel migration and partly also for egg formation and incubation, because there is not much food in the Arctic early in the breeding season. Birds leaving the Baltic Sea without sufficient nutrient stores might not breed successfully in that year. Hence, sea ducks represent a natural link between the Baltic and Arctic ecosystems and their breeding success reflects conditions in both environments alike.

– breeding in the Arctic environment

Most Baltic wintering sea ducks breed on the Eurasian tundra from northern Norway to the Taymyr peninsula. One such site is Kolguyev Island in the eastern part of the Barents Sea. Sea ducks there start breeding at the many freshwater lakes as they become ice-free. Later their chicks benefit from the rich invertebrate prey in the fish free lakes. After breeding, sea ducks gather on saltwater to moult, a critical period in the annual cycle because they are flightless for a few weeks whilst they shed and replace their wing feathers.

Breeding habitat of Long-tailed Ducks in the Russian Arctic. The birds nest close to small lakes or ephemeral ponds. Photo: Helmut Kruckenberg.

– breeding in the Baltic

Common Eiders and Velvet Scoters both breed and winter along the Baltic Sea coast. Although they do not travel long distances, they are dependent on resources stored in winter and spring for successful breeding, too.

Above: Incubating Common Eider female.
Below: Common Scoters on spring migration.

Sea duck population declines

Today waterbird numbers are monitored in all countries around the Baltic Sea in many different ways. This was not the case in the past, so our knowledge about the long-term history of sea duck numbers is limited. Generally the populations of most Arctic waterbirds were much larger early in the 20th century. For example, reports from hunters and fishermen indicate that numbers of Long-tailed Ducks were by far larger in the early 1900s than today.

The first major survey of wintering waterbirds in the entire Baltic took place in 1992 and 1993, and this survey was repeated in the same areas with similar methods during 2007–2009[2]. In this period, the winter numbers of the five sea duck species declined altogether by more than 4.2 million birds or by about 60 %.

Results from the most recent surveys of wintering sea ducks in the Baltic Sea are published in a new report[2]

	Estimated total number 1992–1993	Estimated total number 2007–2009	Change in %
Long-tailed duck	4,272,000	1,480,000	-65.4
Common Eider	1,048,000	515,000	-50.9
Velvet Scoter	933,000	415,000	-55.5
Common Scoter	783,000	410,000	-47.6
Steller's Eider	6850	2300	-66.4

The small population of Steller's Eider was regarded as a species of concern already before the year 2000, but among the more abundant species, more recent declines were first noted in Common Eiders. Many of them breed on islands in the Baltic where they can be studied much easier than the birds breeding in the high Arctic. Numbers of breeding Common Eiders increased in Sweden and Finland between 1950 and 1990. Since then, numbers of both nesting females and young produced have declined rapidly[3]. Numbers of arctic breeding sea ducks such as Long-tailed Duck and Steller's Eider have also declined dramatically since the 1990s.

Pressures and threats

Sea ducks in Europe are under heavy pressure. Declines similar to those in the Baltic have also been observed in North American sea duck populations for 20 years or more. Being travellers between two different ecosystems, that is, the Arctic breeding grounds and the temperate marine wintering sites, sea duck populations can serve as indicators of the functioning and services of both ecosystems. Based on research about sea ducks and the communities they live in we can identify various pressures which have possibly caused or at least contributed to the observed declines.

Predation

In the last 20 years the predator communities of both Arctic and Baltic environments have changed. Predation is a natural phenomenon and has shaped life-histories of species as well as the composition of animal communities. Sea ducks are long-lived and their populations can cope with remarkably long series of years of low breeding success, but the long-term average breeding success and survival needs to exceed a certain species specific level in order to keep the population stable.

In the Baltic, breeding sea ducks always had to cope with various predators like gulls, raptors and Red Fox. The spread of introduced mammalian carnivores like American Mink and Raccoon Dog and the recovery of the previously threatened White-tailed Eagle population have

changed predator-prey relationships. Several studies indicate recent increases in predation rates on Common Eider nests, and on incubating females[4]. Females encountering too many predators may move to poorer breeding sites or avoid breeding altogether. Although predation is not likely to be the only cause of the decline in Common Eider numbers, the changes in predator numbers may contribute to the process.

In the Eurasian tundra, lemming cycles have a strong influence on the annual breeding success of many bird species such as ducks, geese and waders. Every 3–4 years when lemming numbers peak, predators like skuas, Arctic Fox, Snowy Owl and gulls feed on these abundant rodents and birds can raise many young. In other years when lemming numbers are low, predators switch to nesting females, eggs and chicks, and the breeding success of birds will be much lower. For at least the last 15 years these regular lemming cycles have nearly disappeared on the Eurasian tundra and with them the favourable peak years, possibly due to rising global temperatures. At the same time the breeding success of Long-tailed Ducks and Steller's Eiders, which correlated with lemming numbers[5], has seriously declined. Whether a lemming peak observed in 2011 indicates a general return of the lemming cycles is yet unknown. The predator communities in the Arctic will probably continue to change together with global temperatures in future. However, the long-term consequences of such changes are very difficult to predict.

Human impact on marine habitats

To balance their energy demands when diving, sea ducks need rich feeding resources in shallow waters enabling them to reach their prey with minimum energy expenditure. Today, many important sea duck wintering sites have been affected or destroyed by sand and gravel extraction or by dredging of shipping channels and coastal development. Overexploitation by commercial mussel fisheries has caused food shortages for Common Eiders and other bivalve feeders in the Wadden Sea. Lack of food impairs the condition of breeding females and can cause mass starvation under unfavourable weather conditions. Ship traffic and offshore wind farms may permanently displace sea ducks from favoured feeding grounds. Shipping is predicted to increase and plans for offshore wind farm construction exist in all Baltic countries.

Oil pollution

Oil illegally discharged from ships or spilled during accidents still kills huge numbers of waterbirds each year around the world. Enforcement of international regulations has successfully reduced the volume of oil released in European waters, but the incidence of small discharges from ships remains intolerably high. Several tens of thousands of Long-tailed Ducks die each year in the Baltic Sea because of the many small oil spills along the major shipping routes. Some of the major shipping routes in the Baltic Sea still cross or pass very close to the most important wintering sites of Long-tailed Ducks[6].

Long-tailed Ducks.

Bycatch

Gillnets are the main type of fishing gear in which birds can become entangled while diving, and then drown. Gillnets are commonly used in shallow waters, including offshore banks, which are important for wintering sea ducks. Past generations of fishermen used the nets to catch sea ducks for food. Today gillnets are only used to catch fish but they are still frequently set in sea duck habitats, and unintentionally caught sea ducks form the majority of the more than 70,000 birds annually bycaught in the Baltic Sea[7].

Hunting

Sea ducks have been hunted by man for centuries. Hunting bags have decreased recently with sea duck declines in the Baltic, but still c. 65,000 Common Eiders and c. 10,000 Long-tailed Ducks are shot each year around the Baltic Sea. Besides direct mortality the traditional lead shot used to hunt waterfowl are frequently ingested by ducks in search of grit to aid digestion. Ingestion of poisonous lead shot is another cause of mortality, for instance amongst breeding Common Eider females in the Gulf of Finland.

Hazardous chemicals

Anthropogenic and naturally produced hazardous chemicals are known to affect Baltic wildlife and may be ingested by sea ducks when consuming bivalves which filter large volumes of sea water. Possible effects of hazardous chemicals on sea duck populations in the Baltic Sea are yet unknown.

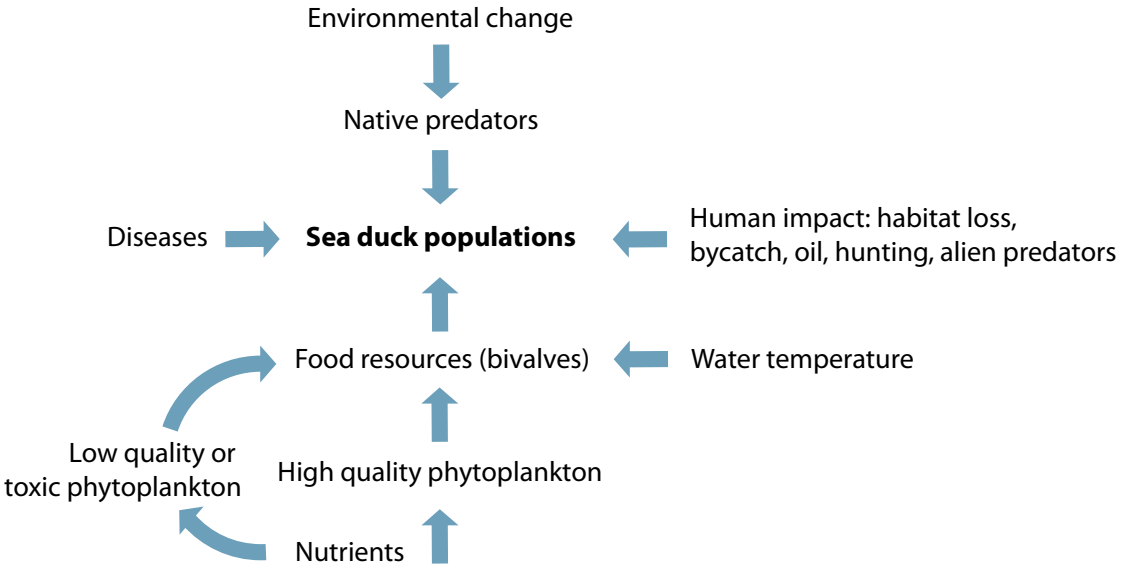
Oiled Long-tailed Duck.

Diseases and nutritional deficiences

Infectious diseases can kill large numbers of waterfowl in a short time. Avian cholera outbreaks have caused mass fatalities in Baltic breeding Common eiders, but it is unlikely that this irregular mortality alone is responsible for the population decline. Lethal paralytic syndrome has been observed in Herring Gulls and other wild birds around the Baltic in recent years, especially in Sweden[8]. Paralytic syndromes may occur in various species and can result from, for example, viral infections, toxins and nutritional deficiencies. Recently a lack of thiamine, also known as vitamin B1, was found to cause paralytic syndrome. This may contribute to adult mortality and breeding failures, and current research tries to identify its causes and consequences in the Common Eider.

Ecosystem changes and global warming

Ecosystem changes affecting food resources during the non-breeding season are potentially the most important reason for the decline of sea duck populations around the Arctic. The ups and downs of sea duck populations in North America have been linked to pollution and ecosystem changes in the North Pacific. The Baltic ecosystem has undergone substantial changes, too. Because of increasing nutrient loads, caused by human activities, bivalve biomass has increased in shallow waters and most likely enabled sea duck populations to grow after 1950. Since the 1990s, in some coastal regions nitrogen and phosphorous levels have dropped again while in other parts of the Baltic Sea nutrient levels remain high. During this period, phytoplankton species



composition has changed in the Baltic Sea as part of a regime shift connected with climate change and overfishing. The proportion of diatoms, which are an important and nutritious food item for filter-feeding bivalves, has decreased while dinoflagellates and cyanobacteria have increased. Many species from these groups are of much lower quality as food for mussels, some cyanobacteria can even be toxic.

Also water temperatures have increased in the Baltic Sea during the recent 25 years. In winter, mussels metabolise their own reserves in warmer water instead of hibernating. These changes may lead to a lower quality of mussels in spring which in turn might affect the sea ducks possibilities to increase their body reserves before migration and breeding. The links between water temperature, nutrient availability, phytoplankton species composition, filtering mussels and sea ducks are complex and we still know very little about how the processes at the lower part of the food chain affect sea ducks.

The current global climate change may affect sea ducks in many different ways and the combined effect is difficult to predict. Although sea ducks might benefit from a reduced ice cover on the breeding grounds helping to extend their breeding season, negative effects are likely to prevail. The heaviest warming is expected in the Arctic where effects on predator-prey relationships e. g. through the disappearance of lemming cycles may be already affecting sea ducks.

Not all effects of the above mentioned pressures on sea ducks can be as easily observed as the hunting mortality or the predation on nests, females and chicks. Indirect effects of food shortage are indeed much more difficult to observe. Birds in poor condition are more susceptible to diseases or parasites, females lay fewer eggs hatching weaker chicks, start egg laying later in the season or skip nesting completely. It is also important to remember that there may be multiple reasons for a population decline, and that perhaps only their cumulative effects finally drive the decline. Also, nature is not at a steady state, and some of the changes that we see may reflect natural variation rather than human activities. It is only from a long term series of high quality data that we can distinguish between natural variation and human impacts. Assessing the relative importance of different pressures at different stages of the annual cycle in birds moving between Arctic and temperate regions is therefore not an easy task.

The future of sea ducks in the Baltic Sea

Sea duck populations are a characteristic and fascinating element of biodiversity in the Baltic Sea, and at the same time they serve as indicators for changing ecosystems. Declining sea duck numbers indicate that our environment is changing in front of our eyes. In the past, the Baltic ecosystem was able to buffer a part of the high organic discharges by fixing them in the food chain for the final benefit of sea ducks. But eutrophication can be detrimental to other parts of the Baltic ecosystem such as the deep water bottom fauna. The nutrient flows in the Baltic ecosystem are complex and subject to change. Under current conditions they may no longer function in the way we know, and reducing nutrient inputs in future might not simply bring the ecosystem back to its previous state. We therefore need to increase our understanding of the links between nutrients, phytoplankton, bottom fauna and sea ducks and how they are affected by a changing global climate.

Although most sea ducks winter in protected areas they have not reached a safe haven, because these areas are also subject to ecosystem changes and various local pressures. Being responsible to protect biodiversity we have to address direct threats to sea duck populations. The direct threats are unlikely to be the ultimate reason for the decline but they put additional stress on populations already suffering from reduced survival, productivity or both. Since management options are limited in the Arctic, management actions at the non-breeding sites are crucial if we want the populations of sea ducks to recover. Targeted management of protected areas including a reduction of bycatch in fishing gear, re-routing of ship traffic, and hunting regulations are examples to help achieving healthy populations of sea ducks.

More to read

1 Skov et al. 2000. Inventory of Coastal and Marine Important Bird Areas in the Baltic Sea. BirdLife International, Cambridge.

2 Skov et al. 2011. Waterbird Populations and Pressures in the Baltic Sea. TemaNord 2011:550. Nordic Council of Ministers, Copenhagen.

3 Ekroos et al. 2012. Declines amongst breeding Eider *Somateria mollissima* numbers in the Baltic/Wadden Sea flyway. Ornis Fennica 89.

4 Lehikoinen et al. 2008. Large-scale changes in the sex ratio of a declining eider population. Wildlife Biology 14: 288–301.

5 Hario et al. 2009. Dynamics of wintering long-tailed ducks in the Baltic Sea – the connection with lemming cycles, oil disasters, and hunting. Suomen Riista 55: 83–96.

6 Larsson & Tydén. 2005. Effects of oil spills on wintering Long-tailed Ducks *Clangula hyemalis* at Hoburgs bank in central Baltic Sea between 1996/97 and 2003/04. Ornis Svecica 15:161–171.

7 Žydelis et al. 2009. Bycatch in gillnet fisheries – an overlooked threat to waterbird populations. Biological Conservation, 142: 1269–1281.

8 Balk et al. 2009. Wild birds of declining European species are dying from a thiamine deficiency syndrome. Proc. Natl. Acad. Sci. 106: 12001–12006.

Steller´s Eider.
Photo: Daniel Pettersson.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