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Mitigating a social conflict between conservation and fisheries in the Baltic Sea

Mitigating a social conflict between seal, conservation and fisheries in the Baltic Sea:

multilevel and synergistic approaches

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Contents

Foreword	4
Summary	5
1. Introduction	7
2. Methodology	9
3. Analysis of existing conflict mitigation measures	10
3.1 Technical solutions for reducing seal-induced catch and gear damage	10
3.2 Management strategies that affect the behaviour and abundance of seals	19
3.3 Economic measures to support coping capabilities	25
3.4 The role of governance and institutions	31
4. Interdisciplinary synthesis of conflict mitigation strategies	40
4.1 A complex multilayered scenario	40
4.2 Four types of mitigation measures	42
4.3 Roadmap for further scientific research	44
5. Conclusion	47
References	49
Appendix 1. Five seal management case studies	54
1. Seals as part of the hunter's economy in the Åland Islands	54
2. Seal hunter Anna-Carin Westling in the Swedish Bothnian Bay coast - utilization of the whole seal	55
3. Feasibility and effectiveness of seal deterrents in coastal trap net fishing – development of a novel mobile deterrent in Finland	56
4. Estonian experiences with acoustic harassment devices	58
5. The case of Denmark: derogation shootings around Bornholm Island	59
References appendix 1	62
About this publication	63

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Foreword

The concept of '*seal-fishery conflict*' is used in this report when referring to the complex contradictions stemming from seals' impacts on fishing livelihoods that have become a pertinent social struggle between stakeholder groups of the Baltic Sea. Tensions are most remarkable between coastal fisheries and seal conservationists. As existing knowledge has been scattered and the conflict has become increasingly problematic, the ***Regional solutions for mitigating seal-fishery conflict in the Baltic Sea - Interdisciplinary synthesis*** (RESOCO) project's aim was to compile Nordic knowledge and best practices and build an up-to-date interdisciplinary synthesis to set the stage for alternative solutions on how to effectively reconcile the seal-fishery conflict in the Baltic Sea. This type of comprehensive synthesis has not been performed before. The report takes a pragmatic stand by turning the attention to approaches and instruments that have been suggested to be helpful or that have the potential to help mitigate the conflict. The report synthesizes this knowledge into an actionable roadmap yet also presents existing gaps and needs of further research.

The RESOCO project was funded by the Fisheries Co-operation program of the Nordic Council of Ministers (2020–2022). The project group consisted of academic institutions from Finland (*Natural Resources Institute Finland, Luke*: Kristina Svells (project leader), Petri Suuronen, Pekka Salmi and Esa Lehtonen), Sweden (*Swedish University of Agricultural Sciences*: Sara Königson and Sven-Gunnar Lunneryd; *Lund University*: Åsa Waldo and Maria Johansson), Denmark (*Aalborg University*: Nelson F. Coelho and Naja Dyrendom Graugaard), Estonia (*the University of Tartu and the Estonian Marine Institute*: Markus Vetemaa) and an NGO from the Åland Islands (*Archipelago Pares*: Viktor Eriksson).

The outcome of the project was discussed and refined based on the RESOCO final seminar held in Helsinki on 23–24.8.2022. The seminar revolved around three panels¹.

The RESOCO team acknowledges the direct and indirect contribution of stakeholders involved in the Baltic Sea seal conservation and fisheries sectors. We also acknowledge coastal communities and authorities for sharing publicly their knowledge and expertise. We wish to express our appreciation for the Fisheries Co-operation program of the Nordic Council of Ministers (2020–2022) for supporting financially the project. Finally, the team thanks the support from all project partners' institutions that made managing this international research project consortium possible.

1. Material from the final seminar is available at <https://www.luke.fi/fi/projektit/resoco>.

Summary

The conflict between seal conservation and fisheries in the Baltic Sea has become remarkably serious and threatens the existence of coastal fishing activities in the Baltic Sea. Seals cause significant catch losses, gear damage and various types of hidden damages and losses. In particular, reports of damage caused by the grey seal, the largest and most common seal species in the Baltic Sea, have increased drastically with the growth of the seal population. Even though a wide range of technical mitigation measures have been developed, the seal-fishery conflict has not been adequately resolved. Technical means alone do not provide an adequate solution for the growing grey seal population and involve considerable costs and additional work to fishers. Successful management of the conflict requires a wide range of locally tailored management tools and the political will to implement them.

In the ***Regional solutions for mitigating seal-fishery conflict in the Baltic Sea - Interdisciplinary synthesis*** (RESOCO) project, funded by the Fisheries Co-operation of the Nordic Council of Ministers, the usefulness of existing and emerging seal conflict mitigation and management tools was compiled. Tools were classified into four groups: technological solutions, population management, economic measures, and institutional instruments. The outcome of the synthesis "Mitigating a social conflict between seal, conservation and fisheries in the Baltic Sea: multilevel and synergistic approaches" is based on a wide range of material, including reports from various projects, scientific publications, and interviews with key stakeholders. The synthesis also includes examples of real-life cases in the mitigation of seal-fishery conflict from Finland, Åland Islands, Sweden, Denmark, and Estonia.

The key message is that mitigation of seal-fishery conflict requires not only a broad knowledge base but also better understanding between key stakeholders, particularly between the coastal fisheries sector and conservation organizations. Furthermore, reconciliation between conflicting parties requires a wide range of governance actions and the political will to implement them. At the heart of this reconciliation is the acceptability and legitimacy of different means and solutions for conflict mitigation.

The synthesis assesses the interconnections of tools and means and identifies possible combinations of these tools to effectively move forward. To support the necessary decisions, not only insight into the scale and significance of the problems but also information on alternative governance arrangements and their applicability in different situations is needed.

International agreements play an important role in the management of and affect national room for manoeuvring in the mitigation of the conflict. At the national level, coordination between the use of fishing grounds and the protection of seals requires cross-sectoral agreement on objectives, means and implementation. When both resource and environmental sectors have a clear understanding and guidelines, it is easier to agree on the use of appropriate combinations of measures and responsibilities. National seal management plans can support both national and regional planning and participatory decision-making on the application of different

management measures in practice. However, progress requires solutions and measures in the wider Baltic Sea setting. International coordination, co-operation, and the exchange of best practices between the Baltic Sea countries are prerequisites to success in mitigating the conflict.

Keywords: coastal fishing, grey seal, conflict, governance instruments, management plan, Baltic Sea

1. Introduction

The grey seal (*Halichoerus grypus*) population in the Baltic Sea has been growing rapidly in the last 35 years. Since the late 1990s, the annual growth of the grey seal population has been 5–6% (Harding and Härkönen, 1999; Harding et al., 2007; Hansson et al., 2018; Swedish Agency for Marine and Water Management, 2019). Recently, the population has also been expanding in the southern Baltic Sea. From a conservation perspective, this is an example of successful management. However, in concert with the growing grey seal population, seal-induced catch losses and gear damage have dramatically increased among coastal fisheries (Kauppinen et al., 2005; Fjälling, 2005; Königson et al., 2007; Königson et al., 2015; Svendsen et al., 2019; Vetemaa et al., 2021). The impact of seals on coastal fisheries and aquaculture has been devastating. In many Baltic Sea regions, seals are considered by fishers to be the greatest threat to the viability and continuation of their livelihoods (Svendsen et al., 2019; Vetemaa et al., 2021). The total societal costs of grey seals to Baltic Sea fisheries have been extensive and much larger than the direct observed costs (Svendsen et al., 2019; Waldo, S. et al., 2020; Waldo Å. et al., 2020; Blomquist and Waldo, 2021; Johansson and Waldo, 2020). These issues are related to the reduced adaptability of small-scale coastal fisheries, and there is an urgent need to find effective long-term solutions.

All seal species in the Baltic Sea are strictly protected (HELCOM 2006), and there is strong public empathy associated with these species (e.g., Johansson and Waldo 2020). At the same time, fishing and aquaculture in the Baltic Sea region are recognized as important livelihoods that support the well-being and employment of people in coastal areas and provide healthy and highly appreciated locally produced food. These livelihoods are now at risk because of seal impacts. The management approach adopted has mandated the protection of seals but has failed to adequately consider the socioeconomic impacts of such a policy. This contradictory situation has resulted in deep frustrations among fishery professionals and is contesting the legitimacy of administration and research. Despite various technological solutions and support mechanisms developed and applied, the conflicts remain increasingly more serious. Without technological mitigation solutions and compensation payments executed thus far, the situation will become much worse for coastal fisheries.

The conflict between Baltic Sea coastal fisheries and the conservation of grey seals has been severe since the mid-1990s (Bruckmeier and Høj Larsen, 2008; Varjopuro, 2011; Bruckmeier et al., 2013). During the first decade of the 21st century, the main instruments for conflict mitigation in Sweden and Finland included fishing technology development, financial support for seal-safe gear investments, compensation payments for seal-induced damage, protective hunting, and seal management plans. Before the launch of the EU ban on the trade of seal products (EC, 2009), hunted seals could be used holistically as a resource. The trade ban has hindered opportunities to move forward in conflict mitigation, and it will be presented in several sections of this report (see the main discussion in [3.4.1](#) and [Chapter 5](#)).

The ***Regional solutions for mitigating seal-fishery conflict in the Baltic Sea - Interdisciplinary synthesis*** (RESOCO) project report aims to move towards a more balanced state of the conflict by providing tools for mitigating it especially as a social conflict. The approach is therefore largely societal; nonetheless, technical, economic and biological aspects are also important. The key outcome is a synthesis of state-of-the-art knowledge and proposals of alternative solutions on how to effectively reconcile the conflict, including various measures and approaches that have been applied—or are available—in mitigating the seal-fishery conflict. To prepare a pragmatic, regionally applicable and acceptable package of measures, a range of local, regional and national information and best practices used in mitigating seal-fishery conflicts have been stimulating yet challenging. Furthermore, the RESOCO project presents five case studies as examples of difficulties and successes experienced in the local real-life context (see [Appendix 1](#)).

2. Methodology

The present review largely builds on international and national research, development projects and activities conducted in the Baltic Sea region over the last 30 years, including the *"Nordic Seal"* and *"Integrerad förvaltning av fisk och säl i en blå bioekonomi"* [Integrated governance of fish and seals in a Blue Economy] projects, several Fisheries Local Action Group (EU) funded projects such as the *Baltic Sea Seal and Cormorant Transnational Cooperation Project* (Svels et al., 2019), and other national and international projects addressing seal-fishery issues of the Baltic Sea (e.g., ECOSEAL, 2013). Most of the material originates from natural and social science (quantitative and/or qualitative) studies conducted by the project partners, some of whom have career-long experience with academic research on seal-fishery issues in the Baltic Sea. Additionally, some new data were collected from a literature review and interviews and stakeholder engagements.

The empirical material was compiled by holding interdisciplinary meetings between the project partners. Broad contextual experience and academic expertise in the social and natural sciences was available from the project group. The Natural Resources Institute Finland (Luke) contributed expertise in conflict mitigation, technical solutions, societal research, governance systems, and the co-production of fisheries knowledge. From Sweden, Lund University contributed knowledge of the environmental psychological aspects of human–wildlife interaction, including people's appraisal of the fishery-seal situation and attitudes towards and motivation to accept or oppose different management measures. The Swedish University of Agricultural Sciences (SLU) contributed expertise in quantifying damages for fisheries, conflict mitigation and technical solutions along with strong knowledge of bycatch mitigation processes connected to the seal-fishery conflict. From Denmark, Aalborg University contributed expertise in research on conflicting perspectives on seals between different actors and stakeholders, the co-production of hunters' knowledge, and social science methods of 'tracing' seal narratives in a local context. From Estonia, the University of Tartu and Estonian Marine Institute contributed expertise on fisheries, seal-fishery interactions, and conflict mitigation measures. The NGO Archipelago Pares from the Åland Islands contributed local expertise and a practical understanding of the seal and fisheries situation. The NGO has several active seal hunters and fishers as members and provides a valuable perspective from a grassroots level.

At an initial online meeting between the project partners held in September 2020, the objectives for the synthesis were developed and followed by two whole-day workshops where the material was collected and discussed. Between meetings, there was assigned preparation and homework for all partners to fill in tables of themes (see [Chapter 3](#)) and gather relevant material such as literature, academic articles, other research results and experiences.

3. Analysis of existing conflict mitigation measures

The study of conflict mitigation measures is divided into four thematic sections: 1. **technical solutions** for reducing seal-induced catch and gear damage, 2. **population management** and experiences of hunting and other human activities that affect the behaviour and abundance of seals, 3. existing knowledge and experiences of **economic measures** used to support fishers' and fish farmers' capacities to cope with seal-induced challenges, and 4. experiences of the role of **institutional instruments** in mitigating seal-fishery conflicts. Each theme is divided into several subsections, where challenges, benefits and future opportunities related to these specific conflict management measures are described.



Figure 1 A trapped grey seal in a fisher's net creates challenges for small-scale fisheries in the Baltic Sea. Photo: E. Lehtonen

3.1 Technical solutions for reducing seal-induced catch and gear damage

This section assesses technical solutions for reducing seal-induced catch and gear damage. These measures include the use of: Seal-proof fishing gear designs and materials; Alternative (active) capture methods; Seal deterrent used in the vicinity of fishing gear or aquaculture cages; Autonomously moving seal deterrent (watchdog); and Seal-safe fishing areas created with the help of seal deterrents or seal fences.

3.1.1 Seal-proof fishing gear designs and materials

Trap net fisheries (Pontoon trap)

There have been substantive research activities on gear modifications intended to mitigate seal-induced damage in Baltic coastal fisheries (e.g., Lunneryd et al., 2003; Lehtonen and Suuronen, 2004; Suuronen et al., 2006; Lehtonen and Suuronen, 2010; Königson et al., 2015). The most successful example of gear modification intended to mitigate seal-induced damage is the pontoon trap (Hemmingson et al., 2008), which is now the most common trap net design utilized in coastal fisheries in the northern Baltic Sea. The trap has a seal-proof fish chamber made of a double wall of firmly stretched netting of extra strong polyethylene (Dyneema) material. The trap includes a wire grid in a funnel to physically prevent seals from entering the chamber through the funnel. The grid allows fish to enter.

It is notable that while the fish chamber of a pontoon trap is seal proof, seals are still able to catch fish and disturb the capture process in other parts of the trap net and in the vicinity of the gear (Lunneryd et al., 2003; Fjälling et al., 2006). Seal may remain in the wings and funnels of the trap net and catch fish that enter it. However, large mesh trap nets, with wings and leader nets made of netting with large meshes, may be helpful in reducing seal presence when targeting salmon (Lunneryd et al., 2003). Technological solutions such as seal deterrents are needed to keep seals away from the vicinity of the gear (see [3.1.3](#) and [3.1.4](#)), while seal-proof gear is certainly an important component of the solution.



Figure 2 Emptying of a pontoon trap. Photo: SG Lunneryd

The pontoon trap was developed for catching migrating fish such as salmon, trout and whitefish. However, in some cases, the trap can also be used to catch other species, such as cod, perch, herring, European whitefish and flatfish, replacing gill net fisheries, which are highly vulnerable to seal-induced damage. Ongoing trials are

being carried out to implement pontoon traps in the cod fishery of the southern Baltic (Ljungberg et al., 2022), showing that pontoon traps also have the potential to catch cod when placed at water depths of approximately 25 metres.

In recent years, there have also been developments of a new trap net design to be used in deep waters and exposed areas for multiple species, the so-called rocket trap. This trap includes pontoons that lift the fish-holding chamber above the surface. It is important that a trap net fishery is ergonomically acceptable to fishers and easy to clean, as algae and other debris may quickly fill the gear such that it is no longer efficient. This challenge must be addressed to be able to carry out viable and seal-safe trap net fishing activities in the future.



Figure 3 A fish chamber covered with debris and algae. Photo: SG Lunneryd

Various new netting materials, such as Dyneema, PET-plastic netting and Combi-steel materials, offer additional possibilities to improve gear seal resistance and increase the lifespan of netting relative to regular nets. One of the major challenges linked to seal-proof gears and materials is their high price compared to ordinary materials. Furthermore, fishers often have no knowledge of these new materials. Closer co-operation with manufacturers of new-generation seal-proof fishing gear and netting materials is needed.

Pot fisheries

In Sweden and Denmark, coastal cod gill net and long-line fisheries in the south and central Baltic Sea have suffered dramatic increases in seal-induced catch losses and damage to fishing gear. To mitigate this situation, cod pots have been tested as an alternative to traditional gill nets and longlines (Königson et al., 2015; Kindt Larsen, et al., in press). Study results show that pots can be a useful alternative form of gear

for use in the Baltic cod fishery, at least part of the year. Pots can protect from seal-induced damage, unlike a gill net that acts as a dinner table for seals. Pot fishing is advantageous in that consumers have the common perception that fish caught by pots are of high quality and that pot fishing is sustainable with low or zero bycatch of marine mammals and birds (e.g., Suuronen et al., 2012). Pot fishing could be a potential alternative, for instance, for the Baltic cod gill net fishery in case the cod stock recovers.

Pot fishing in general suffers from poor efficiency when target fish stock is weak, resulting in low fish density. Nonetheless, there are strong indications that pot fisheries can be further developed to target multiple species (Köningson et al., in press). Future development should focus on pot designs with adequate capture efficiency and that are practical and that work in various conditions.

3.1.2 Alternative (active) capture methods

A potential means to avoid seal damage is to use active fishing gear such as seine nets or trawls instead of passive gear such as gill nets or trap nets. Active (towed) gear seldom suffers from serious seal damage, although seals may also disturb the active fishing process, especially during gear hauling. One of the challenges with active fishing gear is the difficulty of obtaining permission to conduct fishing in coastal waters. Towed gear such as trawls and seines is banned in many coastal areas. Furthermore, heavy investment costs and a lack of experience in the use of active gear can be a significant barrier, but the availability of government support may become important in shifting fishers' strategies towards active methods. Fishers would benefit from long-term training in new capture methods.

Especially in Sweden, seining may show more potential than trawling in shallow and protected coastal waters because it is generally more accepted than trawling due to its lower towing speeds, lesser bottom contact, lower engine sound, and lesser perceived ecosystem damages (Suuronen et al., 2012). Fishers around the Baltic Sea are generally interested in and optimistic about testing seine fishing as an alternative approach, but thus far, small-scale seining that could be used by traditional gill netters has rarely been tested, and therefore, there is very little experience with this method. Nonetheless, seining is considered a potential option for several fish species, such as herring, vendace, perch, and flatfish. Clearly, more development actions of active fishing gear are needed in coastal regions around the Baltic Sea, and small-scale seining should not be categorized as trawling. Studies are needed to find suitable bottom surfaces, estimate impacts on bottom surfaces and assess the need to increase the selectivity of gear.



Figure 5 Bottom seining for herring with a small gill netter. Photo: SG Lunneryd

In Finland, some Fisheries Local Action Groups (FLAGs) have funded local small-scale projects to find alternative (active) fishing tools, such as seine nets, that would not be as problematic due to seal problems. These new methods are rarely traditional in the area but may be traditional elsewhere. Consequently, in some cases, there may be problems of obtaining fishing permits from local water owners for the use of new methods. Moreover, Finnish fisheries legislation restricts the use of seine nets near river mouths. Despite their potential, FLAG projects' results have been meagre. Fishers have not been able to take the time and risks to appropriately test gear in their busy fishing seasons. Thus, to be effective, future projects should also budget funding to compensate fishers for the work they perform in testing new fishing gear.



Figure 6 Reparation of a small-scale bottom seine for flounder. Photo: SG Lunneryd

3.1.3 Seal deterrent used in the vicinity of fishing gear or aquaculture cages

Promising results in reducing damage caused by grey seals in the Baltic Sea have been obtained by using acoustic deterrent devices (ADDs) (Fjälling et al., 2006; Vetemaa et al., 2021; Lehtonen et al., 2022; see also cases 3 and 4 in [Appendix 1](#)). ADDs produce sounds of high enough intensity to cause discomfort in seals that enter the vicinity of the gear where an ADDs are mounted; hence, ADDs offer a potential way to discourage seals from entering the gear. Despite their promising results, ADDs have not been widely adopted by fishers in the Baltic Sea, although in Finland, many trap net fishers use ADDs, and every year, the number of such fishers increases. ADDs are widely used by the aquaculture sector in the northern Baltic Sea to protect fish cages from grey seal attacks; up to 50% of fish farmers in Finland use ADDs. In fact, in general, fish farmers were the ones who started to use ADDs in the northern Atlantic region (e.g., Götz and Janik, 2013), including the Baltic Sea.

In a recent study, ADDs were deployed over two fishing seasons in Baltic salmon (*Salmo salar* L.) trap net fisheries along the Finnish coast in collaboration with commercial fishers (Lehtonen et al., 2022). Deterrents were anchored beside the fish chambers of traps near trap net funnels. The results indicate that a fisher with a pontoon trap equipped with an ADD can expect to catch on average 3.4 salmon per day, whereas using a pontoon trap without an ADD, a fisher can expect on average 2.1 salmon per day. The deployment of ADDs produced an average 64% increase in salmon catches. The study suggests that in salmon trap net fisheries, an ADD is a useful and economically viable (given that the investment is subsidized) mitigation tool for reducing seal-induced catch losses. Moreover, fishers' views of the effects of ADDs were found to be largely positive.

There are several challenges associated with using ADDs. They require an electricity source (solar and wind energy, a fuel cell generator, or hybrid units), which may be

complicated to arrange at sea. It is also noteworthy that the sound of ADDs on the market only keeps seals away at a distance of approximately 40–50 metres. In addition, there are gaps in the knowledge of how ADDs may affect other marine life. There is a need to study the potential long-term effects of ADDs. The so-called "dinner bell effect", whereby ADDs would attract seals to fishing gear (e.g., Königson 2011), may be reduced by using new-generation seal scaring devices that send a "pulse wall" of several different frequencies transmitted in randomized cycles. It is believed that such a sound pattern could reduce the habituation of seals to the sound. However, to be implemented, ADDs must also be accepted by fishers, who often express fear of the dinner bell effect (Waldo Å. et al., 2020).

A major inconvenience of ADD systems is their relatively high price, although in Finland and Estonia, public support is available for fishermen to purchase deterrents. Furthermore, potential sound interference with other marine activities, such as sailing, kayaking, recreational fishing, diving and swimming, as well as potential negative interactions with marine life (e.g., diving seabirds) may be a cause of concern. Hence, there is an urgent need to demonstrate that ADDs are not harmful to seal welfare. The potential impact on porpoises and dolphins is a special concern that must always be taken into account when underwater sound is utilized. Underwater surveillance systems operated by navies also need to be accounted for and may restrict the use of deterrents in certain areas. It is noteworthy that more effective and environmentally friendly seal deterrents are frequently being introduced to the market.



Figure 7 Anchored seal ADD. Photo: E. Lehtonen

3.1.4 Autonomously moving seal deterrent (watchdog)

An autonomously moving seal deterrent system is under development in Finland. It is planned to be able to move autonomously around aquaculture sea cages or stationary fishing gear. Because it is in motion, it is supposed to reduce seal-induced gear and catch damage in a much wider area than a single stationary ADD. Autonomous systems will of course be relatively expensive, but they can replace several stationary ADDs. Hence, the overall cost may not be that much higher. Sensitivity to rough seas, various technical issues, and potential equipment losses require further consideration. A long operating time and stability are key design features of the development process. Potential negative interactions with marine life (e.g., diving seabirds) require further study. Permissions to use autonomous vehicles at sea are still somewhat open; there will be some limitations. A prototype (Proto-I) is available so far, but a new design (Proto-II) is under development. The system shows potential and may offer new solutions for many types of purposes, especially in aquaculture but likely also for capture fisheries. A functional prototype will be presented in 2023–2024.

3.1.5 Seal-safe fishing areas created with the help of seal deterrents or seal fences

Straits to inshore bay areas and river mouths can be "closed" by seal deterrents (seal deterrent fences) and thereby create seal-free fishing areas. Preliminary tests conducted in Finland using a seal deterrent to prevent seals from entering fishing areas indicate reduced net and catch damages and better catches compared to previous years when the system was not in place (see the Naantali case in Lehtonen et al., 2022).



Figure 8 Area marked for research on seal deterrents. Photo: E. Lehtonen

The effects have been promising, but tests have not yet offered complete protection. In general, each strait and river mouth may require several deterrents, and installation and maintenance can be labour intensive. Summer residents and recreational fishers, when near an ADD, may find deterrents harmful and find the emitted sound uncomfortable. This approach is applicable only in coastal areas where there are bays and semiclosed areas, such as in the Archipelago Sea in Finland and Stockholm Archipelago in Sweden. Estonia has an open coast, and there are practically no potential areas available. However, river mouths in Finland and Sweden show great potential. Only very early experience is currently available on various applications and setups, and it is not yet clear how wide straits can be effectively closed. Intensive research is underway in Finland, where there are approximately 30 potential coastal semiclosed areas that in principle could be closed with ADDs. In Sweden, there is less suitable space, and in other Baltic countries, there are only a few potential areas. The methods are not appropriate for populated sites and areas with heavy boat/vessel traffic.

Seal-Box 1. Technical solutions for reducing seal-induced catch and gear damage

Adaptations and modifications of fishing and fish farming practices play an important role in mitigating seal induced damage. Moreover, appropriate gear modifications particularly for trap net fisheries and the use of strong materials show potential to reduce seal-induced damage and losses. However, certain fishing practices (such as gill net and long-line fishing in open waters) cannot be modified to protect them from seals. Fishers have in some areas reduced the damage by shortening the amount of time the gear is left in the water (soaking time), resulting in reduced catch and thereby causing additional costs. Pot fishing may serve as an alternative for some forms of gill net fishing, but low commercial acceptance may be an issue. Mobile gear such as seine nets may show potential in some cases but would likely require further development to become feasible for small-scale fisheries.

It is important to assess the functionality of alternative practices in collaboration with fishers, gear manufacturers and researchers to implement seal safe fishing gear. The fact that seals may linger around modified gear and take fish before they have a chance to enter the seal-proofed part has stimulated research on how to keep seals away from fishing gear. Acoustic seal deterrents (ADDs) have shown potential in reducing seal damage and are likely becoming a common solution at least in trap net fisheries and aquaculture in the northern Baltic Sea. Several new approaches, e.g., seal-safe fishing areas furthered by seal deterrents and various ADDs, are under development.

Measures included in Technical solutions for reducing seal-induced catch and gear damage are [3.1.1 Seal-proof fishing gear designs and materials](#), [3.1.2 Alternative \(active\) capture methods](#), [3.1.3 Seal deterrents used in the vicinity of fishing gear of aquaculture cages](#), [3.1.4 Autonomously moving seal deterrent \(watchdog\)](#), and [3.1.5 Seal-safe fishing areas created with the help of seal deterrents or seal fences](#).

3.2 Management strategies that affect the behaviour and abundance of seals

This section assesses management strategies affecting the behaviour and abundance of seals. These measures include: Population management and hunting regulations; Protective seal hunting in the vicinity of fishing gear and fish cages; Live capture and removal of problem (nuisance) seals from fishing gear; and Multiple uses for seals as a resource.

3.2.1 Population management and hunting regulations

Seal hunting is a controversial mitigation measure, especially when the aim is to manage the overall seal population (ref. Suuronen et al., sub.). Coastal fishers in the Baltic Sea countries studied by Svendsen et al. (2019) found measures affecting overall numbers of seals, such as hunting, to be the most important means to mitigate the problems of seal impact. Citizens in many Baltic Sea regions are perceived to resist seal hunting, and NGOs have used the historical cull of marine mammals in the 1900s (HELCOM, 2019a, p. 2) as an important case in their campaigns against the use of products processed from mammals. This has affected seal hunting policies in many countries. However, it is difficult to find concrete reasons why sustainable, ethical and fully controlled seal hunting could not be an acceptable method to control the growth of animal populations, similar to the hunting of land-based mammals such as moose, wild boar and deer. The management of seals, classified as predators, also manages ecosystems.



Figure 9 Seal hunting in the winter. Photo: SG Lunneryd

Seal hunting requires time and resources and is perceived to be difficult and expensive by many hunters and fishers. In general, only 20–50% of the hunting quota is utilized yearly in various countries (Finland, Åland Islands, Sweden, Estonia). It is noteworthy that seal hunting is restricted in many ways. There are large, protected areas and defined seasons for hunting, and hunting in general is not allowed in areas where there are humans nearby. Often, there are difficulties in knowing who has ownership and hunting rights on small islands and skerries far from the coast, which are sometimes not even charted on maps.

In the Baltic Sea region, hunting has lately had a minor impact on overall population sizes. The Baltic grey seal population is growing at a minimum of 3,000 individuals per year, and hunting takes approximately 1,500 individuals yearly in the sea basin (Suuronen et al., sub.). In Bothnian Bay, hunting activities are increasingly directed to ringed seals because they are easier to hunt than grey seals.

Due to the EU directive (read more in [3.4.1](#)), seals' value as a hunting resource is minimized, which in turn prevents the use of hunting as a management mitigation measure. This has in practice blocked the utilization of seals as a natural resource and decreased the motivation for hunting. To increase the motivation for seal hunting, hunting rules need to be changed in areas where hunting on ice is occurring, such as in Finland. In some areas, an earlier start of the hunting season could be considered. This is needed because milder winters are foreseen due to climate change, providing only minimal or no ice cover and making grey seal hunting even more difficult than it is today.

In order for hunting to be efficient and become more helpful considering the huge challenge with numbers of seals and low motivational incentives for hunters, a revision of seal sanctuaries and Natura 2000 areas is needed, especially in Sweden, Finland, Åland Islands and Estonia, where hunting is severely restricted due to conservation areas (see HELCOM target recommendations in [3.4.1](#)).

3.2.2 Protective seal hunting in the vicinity of fishing gear and fish cages

In protective hunting, the goal is to affect the number and behaviour of gear visiting seals and thus decrease losses to fishing livelihoods. Removing the most problematic seals that regularly visit fishing gear or aquaculture plants lessens the immediate losses that seals cause.

Public acceptability of protective hunting seems to be higher than hunting to control the overall seal population. On the one hand, this measure is often viewed by fishers as too time consuming and complicated. On the other hand, fishers often claim that restoring seals' timid behaviour, caused by hunting, would keep seals away near human activities and reduce seal damage to fisheries and aquaculture.



Figure 10 Protection hunt to help a herring gill netter. Photo: SG Lunneryd

More knowledge is needed about the effects of protective hunting. For example, there have been very few studies of the almost twenty years of protection hunting in Sweden. It is obvious that protection hunting cannot be the only form of hunting that decreases damage. One study in which several seals were shot in the vicinity of salmon trap nets did not show a decrease in reported seal damage. Nonetheless, fishers were convinced that the measure helped, and indeed, seal damage in a similar area without similar hunting showed much higher levels of damage (Lunneryd et al., 2022).

Successful protective hunting requires intensive communication and collaboration between fishers and hunters so that mainly hunters take responsibility. Another supportive strategy is to build small huts on land in the vicinity of fishing gear (trap nets, for example) to shelter hunters while they wait for seals to emerge. Overall, the same problems with hunting motivation mentioned in the previous section are at play.

3.2.3 Live capture and removal of problem (nuisance) seals from fishing gear

Grey seals tend to return to the same trap nets to feed (Königson et al., 2013). A modified pontoon trap that catches seals in a specific compartment has been approved for live-trapping seals; however, this approved technique is not widely used by fishers due to technical issues with the modification. Fishers in Finland and Sweden have received compensation payments for the appropriate removal of seals.

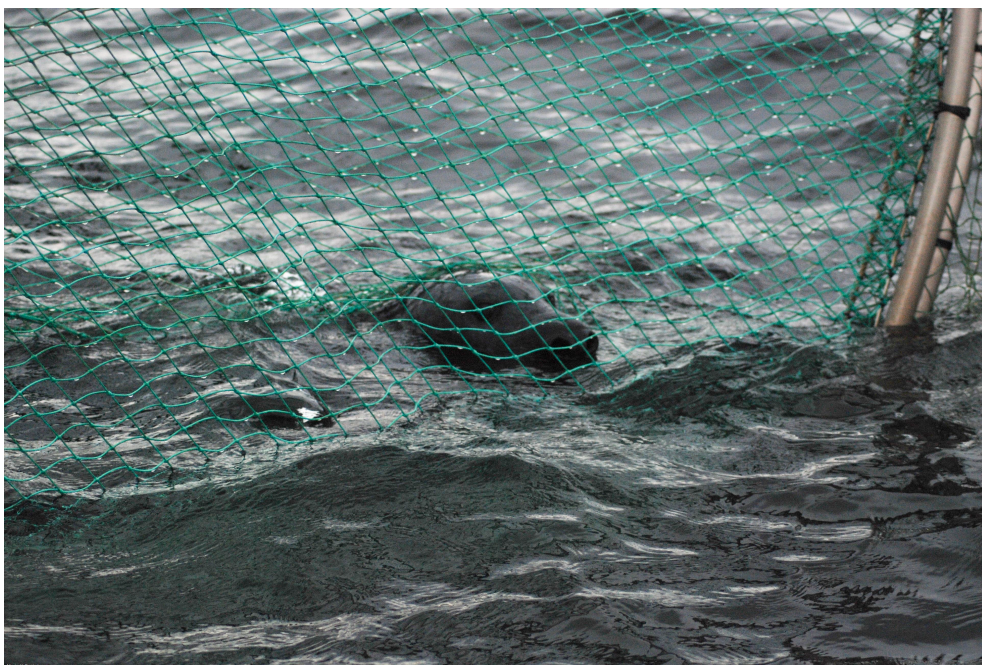


Figure 11 Captured grey seal. Photo: Sara Königson

Removing these 'problem seals' with a device fitted into a trap net may help reduce gear and catch damage, and live-trapping in trap net fisheries could be a cost-efficient solution. Equipment must be very strong and constructed so that it is not an obstacle for fish. In practice, current live-capture technology is challenging and difficult to use, as problem seals, often called 'goalkeeper seals', do not enter deep enough into the trap. Test results from Estonia show that older and more experienced seals do not enter gear, yet they cause the most harm (Vetemaa, 2022). The development of the live-capturing seal-net technique could be an eventual option.

3.2.4 Multiple uses for seals as a resource

Ways to utilize seals could increase the willingness to hunt, fill quotas and create opportunities for hunters and fishers in rural areas to make good use of an available resource (see also cases 1 and 2 in [Appendix 1](#)). For instance, in the Åland Islands, the law regulating hunting states that all edible game must be utilized. The parts of seals that are utilized include blubber for oil, the skin, and the meat for food. Seal meat is a delicacy when handled correctly and can be prepared in many ways.



Figure 12 Seal cutting scheme. Photo: Tiina Tahvanainen/Archipelago Pares

The EU trade ban (see [3.4.1](#)) hinders the utilization of seals as an economic resource and in some cases requires legal work to determine in more detail what is possible and what is not (e.g., exceptions). The Ålandic and Swedish cases ([Appendix 1](#)) demonstrate the hunter's perspective regarding how a hunter uses a seal for oil, skin, and meat and provides seal hunting tourism services. More studies are needed to expand alternative uses of seals.

Seal-Box 2. Experiences of hunting and other human activities that affect the behaviour and abundance of seals

Hunting as a measure for population management is a potentially important element in the package of solutions for fisheries protection, yet it cannot be the only solution. Seal hunting, however, raises questions of social acceptability. It is also fair to ask whether it would be possible in practice to reduce sufficiently seal numbers to make a real difference. There is no consensus about the number of seals that have to be eliminated to balance the seal population and markedly reduce seal-induced damage to coastal fisheries.

Moreover, the EU trade ban challenges both hunters' motivational levels and extracted value from seal products. Furthermore, it challenges fishers and hunters to be creative on how to manage seal carcasses when they cannot be utilized or traded. The use of self-consumption is limited, yet other options include utilizing seal natural resources for energy generation, e.g., biofuel production². Most importantly, seals must always be disposed of.

Measures included in Management strategies that affect the behaviour and abundance of seals are [3.2.1 Population management and hunting regulations](#), [3.2.2 Protective seal hunting in the vicinity of fishing gear and fish cages](#), [3.2.3 Live-capture and removal of problem \(nuisance\) seals from fishing gear](#) by live-capture methods, and [3.2.4 Multiple uses for seals as a resource](#).

2. Delivering seal carcasses to energy production is subsidised in Sweden. The subsidise would cover extra working time, diving services, fuel, transport and the handling of the carcass but not costs for the hunt (weapon, ammunition, boat etc.). It would be a positive way to use the resource and brings in new initiatives, especially with the energy crisis that started in 2022.

3.3 Economic measures to support coping capabilities

This chapter assesses and presents economic measures to support coping capabilities for fishers. These measures include: Economic compensation for calculated seal-induced losses; Payments for coping with seal-induced effects on livelihoods (tolerance payment); Management subsidies for hunting and compensation for the removal of seals; Economic support for investments; and Seal watching and hunting tourism.

3.3.1 Economic compensation for calculated seal-induced losses

Fishers and aquaculture operators face economic losses due to the consequences of seal protection measures and restricted opportunities to manage seal problems at hand. Case-by-case determined economic compensation is in principle acceptable and fair when real losses are known. In this case, such compensation may offer fishers the possibility to cope for a period with seal-induced losses, but it is not a long-term solution, and it is not favoured by fishers, who prefer supplying fish to consumers rather than applying for compensation. Moreover, it needs to be recognized that compensation may not fully replace fishers' personal values and experienced meaning associated with their work (Eklund et al., 2020).



Figure 13 Salmon eaten by seals. Photo: P. Suuronen

The main challenge of this type of compensation is that only a small part of the losses can be detected and economically assessed. It is very difficult to assess how much fish seals have taken from gear or prevented fish from entering due to their presence. The process of calculating and applying for compensation can be cumbersome, and the outcome is haphazard. Nonetheless, this type of economic compensation has been applied in Finland for aquaculture, where the estimation of losses is less complicated than for capture fisheries because the volume of fish

before and after seal visits is better known. In capture fisheries, economic consequences of seal conflict may include, in addition to reduced catches and damaged fish and gear, costs related to changing fishing areas and strategies to manage continuing livelihoods.

3.3.2 Payments for coping with seal-induced effects on livelihoods (tolerance payment)

Because actual fisher-specific losses are difficult to evaluate, fishers in Finland receive so-called tolerance payments for coping with the seal problem. This helps fishers continue their livelihood. The process of applying the payment is simple. Tolerance payments are not based on actual damage. The sum of tolerance payments in Finland, including the Åland Islands, is based on the value of the catch that each fisher has registered. It is applied in Åland only for commercial fishers with more than 30% of their total income generated from fishing and in Finland for those whose fishing turnover is more than € 10,000. In Finland, fishers were paid 15% of their catch value but no more than € 7,000 in 2020. In Åland, 21 fishers applied and received a total of € 85,240 (on average € 4,059 per fisher) in 2019. Some fishers have considered this system problematic or unfair because catches decrease along with seal problems; those incurring seal induced damage and therefore with less or no fish to sell might not even be allowed to apply for the compensation. However, the simplicity of the Finnish/Åland tolerance payment system is a significant advantage, and it also encourages increasing fish supplies and investing in the protection of fishing activities from seal impacts. Tolerance payments could also be defined as equal sums for all or regionally defined sums.



Figure 14 Seal-damaged cod from a gill net at 220 m depth in the Åland Sea. Photo: SG Lunneryd

Figure 15 Grey seals are large animals. Photo: SG Lunneryd.

In Sweden, one-third of seal-induced losses for coastal fishers are compensated, summing annually up to € 5,000–10,000 per fisher, with the total compensation being € 1,5 million. The funding is based on the number of fishing trips with seal damage reported in fisher logbooks and the catch value of those trips (Waldo S. et al., 2020). Estonia adopts a system of smaller compensations and fishers do not usually ask for such compensation, as they find the bureaucracy difficult and, as observed elsewhere across the Baltic Sea, they would rather fish. Moreover, as total support from EMFAF and other funds in Estonia is higher than the first sells value of catch, it is difficult to propose a solution that increases the need for financial help even more.

3.3.3 Management subsidies for hunting and compensation for the removal of seals

Coastal fishers in the Baltic Sea often prefer population management via hunting as the core method for mitigating the conflicts they experience with seals (Svels et al., 2019; Waldo S. et al., 2022). As suggested in cases 1 and 2 ([Appendix 1](#)), it is costly and time consuming to hunt seals in an ethical way that is acceptable by most stakeholders of society. One way to find common ground for Baltic Sea countries to relieve seal pressure on local fishers and fish stocks could involve seal hunters receiving compensation to monitor the health of seal populations by collecting certain data. All hunting activities are already closely monitored with quotas and can be stopped in a matter of days if seals show signs of rapid decline or health issues. On the one hand, Baltic Sea nations interpret European Maritime and Fisheries Fund (EMFF, from year 2021 European Maritime, Fisheries and Aquaculture Fund EMFAF) regulations differently. In Finland, the authorities are not allowed to allocate EU funds to increase interest in seal hunting by paying subsidies to hunters.

A compensation system for the appropriate removal of seals has been applied in Finland since 2020. The aim is to compensate for costs of the proper handling of male seals removed from trap nets, gill nets or fish farming facilities. This payment can be used only to support the appropriate handling and transportation of removed seals (€ 300 per seal + transportation costs). The ultimate aim is to decrease seal visits in the long run and support fishers' opportunities to remove the most problematic seals.

This compensation is useful as one of many conflict mitigation measures, although Finnish fishers have considered the sum too small to be functional. However, the compensation sum could increase in Finland to better motivate fishers to apply the system. With a capture device, this could be feasible, yet very few fishers have utilized this option thus far. A similar system was tested in Sweden in autumn 2021 with a fee to transport seal carcasses to destruction sites. No one applied for this compensation, as the sum was too low to even compensate for the direct costs of destruction.

The effect of the compensated removal system is highly dependent on the amount of compensation and ease of the procedure. However, the system seems to be one of the rare direct long-term support measures that have been applied to deal with the problem itself.

It can be difficult to find hunters for such activities. In Estonia, the existing rules for seal hunting make it difficult to hunt seals, which has resulted in only approximately 20 animals being shot annually. In the Finnish archipelago, hunting opportunities are

limited because of the restricted availability of seal hunting licences and difficulties finding appropriate locations for hunting. Hunters' motivation is also hampered by the ban on seal product trading and the seasonality of hunting. In the Åland Islands, seals are hunted primarily in the spring and summer, and during autumn, hunters are busy hunting other game.

3.3.4 Economic support for investments

Economic support helps coastal fishers invest in new technologies that aim to reduce seals' effects on livelihoods. Due to the low profitability and limited funds available for investments, public economic support is a prerequisite for putting the new expensive innovations to use. Without this support, expensive technical tools can rarely be used and invested in by fishers.

Moreover, fishers' self-financing sums may in the long run also become too high in relation to the benefit of the investment. This benefit is assessed against perceptions of the usefulness and costs of alternative gear solutions. Seal deterrent devices have developed quickly and are becoming less expensive. Public economic support for seal deterrents is important, as this can be perceived as an important conflict mitigation measure in the future.



Figure 16 Finnish coastal fisher operating a push-up type salmon trap net. Fishers are subsidized when investing in seal-proof fishing gear. Photo: P. Salmi.

In Finland, EU funds have been channelled towards supporting fishers' investments in seal-proof fishing gear and recently also seal deterrent devices. This compensation covers 50–80% of the total sum and requires co-operation with the Natural Resources Institute Finland (Luke) in monitoring and development. In Estonia, fishers receive 80% reimbursement for investments in seal deterrents. Between 3 and 5 Estonian fishers used this option in 2021.

In Finland, a separate state-subsidized fishery insurance system has been of importance for decades. It compensates for part of the costs of the renewal of gill nets broken by seals.

3.3.5 Seal watching and hunting tourism

Seal watching and hunting tourism may open opportunities for generating local income and form interactions that facilitate conflict mitigation. These activities constitute, however, niche sectors. Hunting tourism would necessitate good knowledge about local waters, land and water ownership and hunting rights, as well as training in security and tourism service delivery. It should be noted that this kind of excursion may require different boats and equipment and that fishers should be prepared to shift from their traditional occupations to a new line of work. This makes it difficult for a fisher to combine seal tourism as an additional income source with the fishing livelihood. Experienced hunters claim that hunting tourism must be directed towards areas where there is a high probability of shooting seals. However, hunting tourism could in special cases be combined with protective hunting near fishing gear, yet this would be a challenging task for both hunters and tourists.



Figure 17 Seal watching on the surface. Photo: SG Lunneryd

Seal watching excursions for tourists are often suggested as an alternative form of business for fishers. A study in Sweden showed that approximately 50 companies had adopted some aspects of seal tourism in 2017, such as seal watching and seal hunting. The revenue linked to seals was estimated to be € 1 M and 48% of the companies claimed that seals were regarded as the most important attraction on tours. The majority also considered seals to be plentiful and predicted a continuation of seal tourism business (Alteg, 2019).



Figure 18 A group of Finnish Fisheries Local Action group managers visiting a seal hunt in the Gulf of Bothnia (2019). Photo: Juha Mäkimartti

Seal-Box 3. Economic measures to support coping capabilities

A tolerance payment system has been applied to enable coastal fishers to continue their livelihood in spite of various seal-induced losses. Economic compensation for calculated seal-induced losses is difficult to implement in capture fisheries because of the hidden damages and heavy additional work involved when each fisher should monitor and estimate the multiple economic losses. Economic compensation should be seen as a temporary solution until efficient instruments that help prevent seal-induced losses become available.

Economic support for gear and device development and investments are crucial for enabling the use of seal-proof fishing gear and seal deterrents. Seal watching and tourism activities may create opportunities for fishers and contribute to a 'pluriactive' livelihood (Salmi, 2005), yet only for a smaller part of the business.

Measures included in Economic measures to support coping capabilities are [3.3.1 Economic compensation for calculated seal-induced losses](#), [3.3.2 Payments for coping with seal-induced effects on livelihoods](#), [3.3.3 Management subsidies for hunting and compensation for the removal of seals](#), [3.3.4 Economic support for investments](#), and [3.3.5 Seal watching and hunting tourism](#).

3.4 The role of governance and institutions

This chapter synthesizes experiences of the role of institutional and governance instruments in mitigating seal-fishery conflicts. These practices include: The EU seal products regime; Management plans for seals; and Potential for partnerships and planning processes.

3.4.1 The EU seal products regime

The European Union (EU) enacted the EU Habitats Directive (HD) in 1992 (EC, 1992) with obligations for EU Member States and with more defined guidelines and criteria than those of HELCOM years later. To understand the impact of international institutions and their mitigation role on the seal and fisheries conflict, we start with an introduction of HELCOM's influence.

HELCOM's recommendations

HELCOM coordinates the management of marine mammals in the Baltic Sea. Under HELCOM (Article 15), contracting parties must *conserve natural habitats and biological diversity and protect ecological processes*. To this end, they will adopt subsequent instruments based on appropriate guidelines and criteria, which may focus on fisheries management and marine mammal conservation.

In Recommendation 27–28/2, adopted in 2006 (HELCOM, 2006), concerning the conservation of seals in the Baltic Sea area, HELCOM sets out general management principles for seal populations and proposes three key management objectives: (i) Population sizes should recover to carrying capacity levels, (ii) populations should expand to suitable breeding distributions in all Baltic regions, and (iii) seals should attain a health status that secures the continued existence of their populations. Based on these recommendations, the Baltic Sea countries have adopted various types of seal management plans with a general objective of achieving favourable conservation status for seal populations. The Specific Reference Levels form an integral part of HELCOM (2006) principles, including levels for population size³.

HELCOM (2006) points out that for all Baltic seal populations below the Precautionary Approach Level (PAL), no allowances for deliberate killing should be issued. For populations between the Limit Reference Level (LRL) and the Precautionary Approach Level (PAL), licences for anthropogenic removal can be issued if a significant positive long-term growth rate can be observed in the population. For populations above the Target Reference Level (TRL), licences for anthropogenic removals can be issued provided that the long-term objectives of the general management principles are not compromised.

The HELCOM Core Indicator Report (HELCOM 2018a) evaluates the status of the marine environment based on the population trends and abundance of the three species of seals that occur in the Baltic Sea. Good status is achieved for each Baltic Sea seal species when (i) the abundance of seals in each management unit has reached a Limit Reference Level (LRL) of at least 10,000 individuals to ensure long-

3. The *Target Reference Level (TRL)* is the level at which the growth rate starts to level off and the population asymptotically approaches the current carrying capacity level (e.g., 0.8 K). Regarding the *Limit Reference Level (LRL)* (the Safe Biological Level), the Minimum Viable Population Size, is to be defined for each management unit, and the *Precautionary Approach Level (PAL)* is the level at which populations are at the maximum productivity level.

term viability and (ii) the species-specific growth rate is achieved, indicating that abundance is not affected by severe anthropogenic pressures. However, in the State of the Baltic Sea report (2018b), HELCOM acknowledges that the Baltic grey seal population is approaching carrying capacity, which has an impact on the extent of population size limitation.

The EU ban on seal products

In 2009, the EU introduced a general ban in the placing of seal products on the EU market in response to public concerns about animal welfare aspects of seal hunting Regulation No 1007/2009 (EC, 2009). The trade ban applies to seal products produced in the EU and to imported seal products. This regulation was intended to support conservation efforts to protect Atlantic seals from the pressures of commercial hunting and stop what were considered cruel hunting methods (see PACE, 2006 Recommendation 1776/2006 Seal hunting). The regulation allowed the trade of seal products derived from indigenous communities as well as seals hunted under marine resource management. The latter exception was withdrawn when the regulation was amended in 2015 (see EU, 2015 Regulation (EU) 2015/1775); this amendment was the result of a ruling by the World Trade Organization, leaving only an exception for indigenous communities. Although the EU trade ban does not aim to manage seal populations *per se*, it can be considered a protective measure, as it impacts the incentive to hunt by making the utilization of catch outside a hunter's own household impossible.

The EU ban on trade in seal products has greatly contributed to and complicated the management of seal populations in the EU region, including the Baltic Sea. The trade ban is a major obstacle to the rational management of the grey seal population. The ban has not only reduced the motivations behind hunting but has also led to the disappearance of the national and international market for seal products. As a result, the potential outcome of the trade ban being lifted is still unexplored. How attractive seal products on the market would be and what the resulting economic value would create is unknown. It might take at least a decade to build a new market. It is also noteworthy that while seals are still legally killed, the trade ban has not only reduced seal hunting motivations but also induced a waste of by-products such as seal skin and carcasses. The trade ban has meant a loss of potential income in many fishing communities along the Baltic coast.

It is generally agreed among coastal communities that to cope with the current system, it should be possible to utilize such a valuable resource as seals by making use of their by-products (skin/pelts/fur, oil, and bones) and meat (see cases 1 and 2 in [Appendix 1](#)). Ziegler et al. (2021) note that few types of food are as stigmatized within environmental circles as marine mammals (including seals) and as ignored as a potential food resource in the general discussion of food security. In many regions, it would be a more sustainable food choice to eat locally hunted seal meat rather than imported meat. A regional derogation of the trade ban would allow seal products to be made available as resources on a small scale, even along the Baltic Sea coast.



Figure 19 Oil production from seals can be used for painting and lamps. Photo: Therese Andersson/Archipelago Pares

When policies such as trade bans are adopted, it is reasonable to assume that they address a certain issue and provide means to mitigate specific problems. Sellheim (2014) notes that the goal formulation of the EU trade ban on seal products is ill-defined and unclear. The ban was established by the European Commission to cover the whole EU area but has granted an exemption for Inuit populations in Greenland. Sellheim (2014) examined the goals of the seal products trade regime and how it is applied in Arctic areas. It became clear that the attainment of goals had consequences that were unprecedented due to conceptual and formulation difficulties. Given indistinct goal formulation during the policy-shaping process and goal formulation in the policy itself, it seemed obvious that the regime does not aim to improve animal welfare standards of commercial seal hunting but rather aims to shut down commercial hunting completely. This, however, affects Inuit and non-Inuit seal hunters equally and is inconsistent with secondary goals formulated in the EU's documents relating to the Arctic (Sellheim 2014). The seal products trade regime has consequences that challenge the EU's overall ambitions. Canada and Norway have jointly appealed the ban to the WTO on the basis of the discriminatory effect that the exemption to Greenland entailed. The trade of seal products based on licenced hunting of overpopulations was not considered to be distinguishable in the ban.

The current EU ban on trading sustainably hunted seal products is based on undefined and vague terms and is in many respects unjustified. Other types of exploitation related to seals (such as viewing or hunting tourism) are limited in many Baltic Sea countries and do not offer marked livelihood options. Looking at EU law principles may lead to consideration of the scope and relevance of the directive in certain regions. A different interpretation of the terms of the ban could allow keeping the regime but to expand on practices allowed under it, for example, as part of a wildlife management strategy. There might be enough practice to generate some level of consensus around key concepts. Moreover, there is a need to study

lobbying actors in the EU and their impact on the creation and maintenance of the current regime. This would increase awareness of stakeholders' agendas in Brussels and support discussion on legitimacy that may provide an argument for legal change.

3.4.2 Management plans for seals

National management plans provide a basis for mitigating seal-fishery conflicts by using multiple and context-dependent instruments that help in understanding the positions of interest groups and in finding a common view of the conflict and measures for its management. In some cases, however, the management plan process lacks sufficient involvement of core interest groups. The scope of the management plan may also be narrow (e.g., concentrating on seal conservation and biology), when it rarely helps in conflict mitigation through coverage of the aims and values of main stakeholders and consensus building by using participatory approaches (Peterson et al., 2013).

Seal management plans for the Baltic Sea are found in Finland (Ministry of Agriculture and Forestry, 2007), Åland Islands (Åland Government, 2007), Sweden (Swedish Agency for Marine and Water Management, 2019) and Denmark (Danish Environmental Protection Agency, 2020). Estonia has a management plan (Estonia, 2015) for grey and ring seals but thus far shows limited potential to solve seal-related conflicts according to the fisheries sector. Moreover, several Baltic Sea countries do not have any seal management plans or have such plans under development (Germany, Poland, Russia, Latvia and Lithuania).

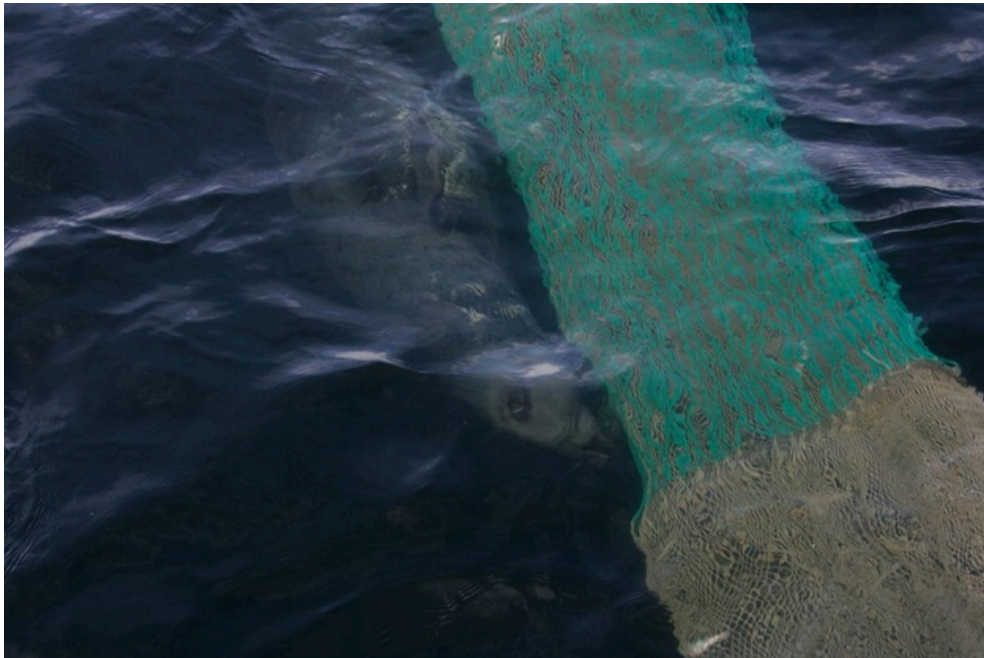


Figure 20 Investigation by seal. Photo: SG Lunneryd.

Management plans can contribute to managing a conservation conflict—such as the seal-fishery conflict—in a better way (Peltola et al., 2022). It is important to pay attention to the bindingness of the agreed measures in the management plan: who is responsible for implementing the stated actions and in what time scale. A crucial element of the management plan is the framework for local and regional involvement in the implementation of the measures. Goal-oriented collaboration, especially at the local and regional levels, may help rebuild trust between local communities (including fishers and hunters) and seal management authorities, together with environmental experts, researchers, and public institutions. In some locations, commercial fishing is accompanied by the tourism industry, which includes hunting tourism and observation of seals as a tourist attraction (see [3.3.5](#)). Due to the complexity of the system, an important aim of a management plan is to have all regulations and policies work together without ignoring the local context. Marked differences exist between management plans in the extent of involving main stakeholders and local communities in planning processes (Peterson et al., 2013). Thus, it is important to focus on the design of the management plan process. It is also central to note that there are guidelines for the implementation of revised management plans for the Baltic Sea (EG MAMA, 2020).

3.4.3 Potential for partnerships and planning processes

Partnerships

The seal-fishery conflict is often hidden, and awareness of seals' effects on coastal fishing is low among the public and even among decision-makers. For instance, in Finland, the wolf issue is well known by the public because it is frequently in the media. The seal conflict is, however, unknown. Thus, balanced research efforts (e.g., social science, biological and economic studies) and the spread of information could benefit the situation. As seal policies are typically determined by knowledge from seal biology, other scientific disciplines, together with local knowledge and values, should be emphasized. One important subject of research is acceptance of various conflict mitigation measures. Better communication of the situation is essential for moving forward in mitigating such conflicts and making decisions based on the best available knowledge. A critical point here is to understand how the public view seals and start dialogue departing from different perspectives. A challenge concerns how to inform the public about the seal-fishery situation or rather how to make the seal issue public.



Figure 21 The grey seal - an unknown animal for most of the public. Photo: SG Lunneryd

Collaboration between hunters and fishers is mostly about hunting of the most problematic seal individuals near fishing gear. Fishers benefit from hunters' removal of seals, as fishers seldom have opportunities to hunt. It is important to target the most problematic seals, which can also be captured and moved to other areas. In general, it is very difficult to retrieve a seal shot near fishing gear without a diver present due to issues of water depth.



Figure 22 Fisher and hunter partnership. Photo: Therese Andersson/Archipelago Pares

Partnerships and collaboration between fishers, researchers and developers produce knowledge about seal-induced effects on livelihoods and create new innovations for mitigating the seal problems of fishers. Co-production of knowledge aims at building trust between parties and helps in mitigating contradictions. Combining multiple types of knowledge (e.g., technological, scientific and context-dependent pragmatic knowledge) strengthens awareness of the current situation.

In Finland, successful co-production projects have already been carried out when developing technological measures such as seal-proof trap nets or seal deterrent devices. Coastal fishers and researchers have not only co-produced useful solutions, but the collaborative process has also strengthened fishers' trust in researchers' roles in supporting fishers' livelihoods.

Planning processes

Spatial planning may steer seal hunting activities and reduce seal-induced losses in coastal fishing by affecting local seal abundance or behaviour. This approach should be included in seal management plans. Spatial planning is needed, especially for steering seal hunting in coastal areas with multiple uses. Many shallow water areas are occupied by recreational fishers, summer cottage dwellers and tourists, which narrows opportunities for hunting, especially during the summer season. Therefore, spatial hunting zones, times and rules should be designed and agreed upon.

Another means of spatial planning involves establishing seal-free areas with the help of seal deterrents (see [3.1.5](#)), which is possible in water areas where seals arrive through narrow routes that can be 'closed' with the help of sound deterrent devices. The benefits of this type of spatial approach are limited from the wider Baltic Sea perspective. However, seal-free areas may become important regional or local sanctuaries, especially for gill net fishing, which is a popular but the most vulnerable fishing method due to the seal impacts. The technological development of seal-proof fishing has involved trap net fisheries. Thus, this management method (closed areas) complements other measures but requires more effort and investment before implementation. The feasibility of this method is uncertain, as building and maintaining an "ADD fence" is extremely expensive and labour intensive and requires considerable technical experience and skills.

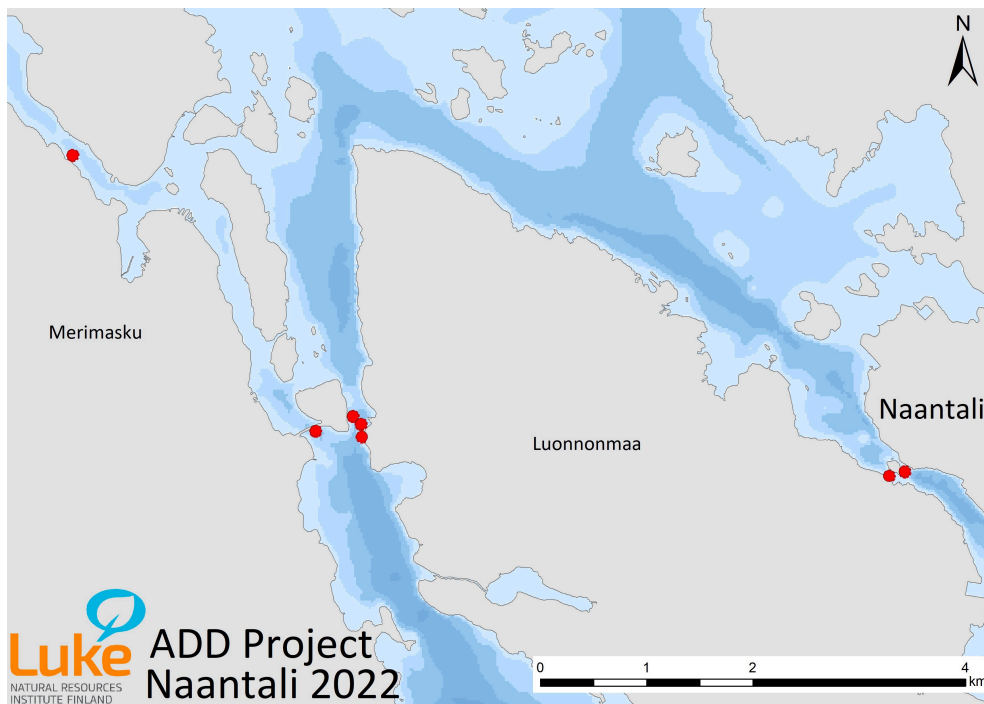


Figure 23 Four ADDs closing two sounds (50-150 m wide) targeting seal-safe water areas in Naantali, Finland.

Seal conservation areas (seal sanctuaries) can be regarded as a result of spatial planning for seal protection purposes. In Finland, there are eight seal conservation areas, established from the beginning of 1998 when seal populations were still relatively small (Ministry of Agriculture and Forestry, 2007). Now the situation is different, and it may be time to reassess the feasibility and number of these areas. The existence of these protected areas narrows opportunities for managing the seal population because hunting is not allowed there. Studies are, however, needed to assess the effect of protected areas on controlling the seal population. Some of the protected areas are also important for the tourism sector, and in some cases, tourists may not visit them. In the Åland Islands, fishers are reluctant to create hunting activities within the protected areas. As part of coastal planning, it should be considered that some seal sanctuaries should be changed or discontinued.

Along the Swedish coast, a majority of the most important haul-out or resting islands for seals are protected areas, especially in the south Baltic. The hunting situation will become more challenging in the future, as there is an ambition to increase Natura 2000 areas for grey seals where hunting will be restricted. In Estonia, there are much less suitable haul-out sites for seals than in Finland and northern Sweden. Therefore, all more important haul-out sites are under protection. Since seals cannot be hunted in these areas, where most of them are located, hunting is very time-consuming, and there is a danger of hunted/wounded animals disappearing in deeper waters.

Seal-Box 4. Experiences of the role of institutional instruments in mitigating the seal-fishery conflict

The EU directive banning the commercial use of seal products is a highly controversial and political issue that limits opportunities to mitigate the seal-fishery conflict, although seals are still being utilized locally as a resource in some Baltic Sea regions. While there is little hope of exemptions to the EU ban, there is a strong will to reach agreements for regional exceptions. Critical societal conditions, and especially management plans, are assessed for reconciling these conflicts. Planning processes should focus on approaches that facilitate local and regional solutions and a set of instruments that catalyse a shift towards an improved balance between the fisheries sector and environmental protection interests.

Baltic Sea-wide collaboration could facilitate knowledge transfer about the seal situation and best practices developed and implemented for conflict mitigation and an international seal management plan covering the Baltic Sea and policy agreement would support the coordination of national and local activities in conflict mitigation.

Coastal fishers generally lack trust in research, fisheries and seal research alike. Therefore, the co-production of knowledge is essential to moving forward in mitigating the seal-fishery conflict. Information, knowledge and a civil understanding of the seal situation needs to reach the public.

Measures included in The role of governance and institutions are [3.4.1 The EU seal products regime](#), [3.4.2 Management plans for seals](#), and [3.4.3 Potential for partnerships in planning processes](#)

4. Interdisciplinary synthesis of conflict mitigation strategies

This section synthesizes possible strategies to mitigate the social conflict that has emerged between conservation and fisheries or to eventually address it in some parts of the Baltic Sea. The first section describes the complexity of the situation from a governance perspective and the needed balance of interests. The second section provides a summary of mitigation measures. The third section discusses conflict resolution strategies.

4.1 A complex multilayered scenario

As all of the Baltic Sea coastal states, except the Russian Federation, are members of the EU, the EU's legal regime is binding on them. Three legislative acts of the EU are relevant for seal population management: the EU Habitats Directive (HD), the EU Marine Strategy Framework Directive, and the Regulation on trade in seal products.

In EU law, the HD (EC, 1992), has set objectives of promoting the maintenance of natural habitats and biodiversity while also considering economic, social, cultural and regional factors. The HD (EC, 1992) forms the foundation of EU strategies on the management of seals. Annex II of the Directive requires EU Member States to maintain all marine mammals that occur in European waters, including grey seals, at a Favourable Conservation Status (FCS). Conservation status is taken as 'favourable' when three basic criteria are satisfied.

Criteria for favourable conservation status under EU Habitats Directive

- Criterion 1: Population dynamics of the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- Criterion 2: The natural range of the species is neither reduced nor likely to be reduced for the foreseeable future.
- Criterion 3: There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The task of identifying conservation status is passed to individual countries. In the evaluation of status, the Favourable Reference Value (FRV) is central. The FRV consist of the Favourable Reference Population (FRP), the Favourable Reference Range (FRR) and Favourable Reference Areas (FRA). The FRP is defined as the "population in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the species". What it means for a species to be a 'viable component' of its natural habitat has been a controversial issue (e.g., Epstein, 2016). The best expert judgement may be used to define it in the absence of other data. FRV must reflect at least the size of the population when the directive came into force (1994); information on historic distribution and population may be useful when defining the favourable reference population.

The conservation status of the Baltic grey seal population today is *good*, according to the standards set by EU environmental law, namely, in the HD (Annex II, V), and deemed of *Least Concern* under HELCOM and IUCN standards (HELCOM, 2019b). Hence, the management of the seal-fishery conflict, at least at a regional level, is possible without compromising the conservation status of seals. This situation makes it possible to reconcile the protection of the species with the conditions necessary for operations of the fishing sector along the Baltic Sea coast.

The aim of the proposed strategy is to set the stage for improved and alternative approaches on how to effectively secure the sustainability of Baltic Sea costal fisheries together with the conservation needs of seals. Striking such a balance is a complex task that requires interdisciplinary knowledge, broad stakeholder involvement and local expertise. Several types of governance instruments are needed simultaneously, and their successful application calls for technical solutions, population control, policy changes and institutional arrangements, such as management plans and co-management, economic measures in combination with local knowledge and involvement, to mention a few examples (Figure 24).

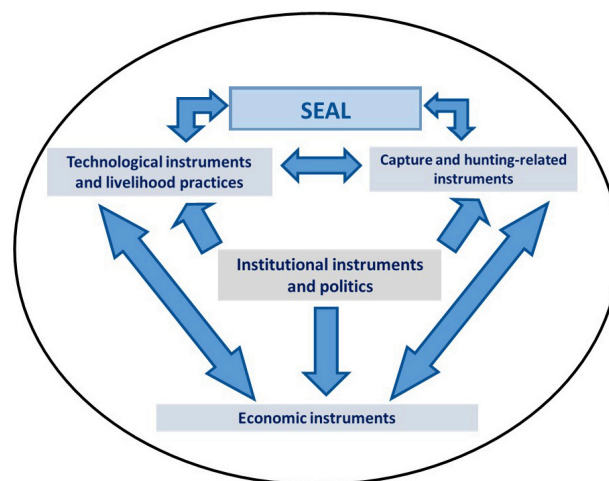


Figure 24 Types of conflict management measures (Salmi et al., 2022)

The **key message** is that the effective mitigation and reconciliation of the seal-fishery conflict in the Baltic requires not only a broad knowledge base but also the inclusion of local needs and a better understanding of the roles of interactions and forum for dialogue between key stakeholders, particularly between the fishery sector, nature conservation organizations, and public authorities (see, for comparison the moose governance study by Johansson et al., 2022). An essential finding of this project is that the tools and means available for the mitigation of the conflict are interconnected (as shown by the arrows in Figure 24). Thus, a holistic understanding and wide range of locally tailored management tools, in combination with a political will to implement them, are needed (see Dressel et al., 2018).

4.2 Four types of mitigation measures

The challenge of implementing practical solutions

New technologies, such as **seal-proof gear** (see e.g., [3.1.1](#)), aim to protect fisheries and prevent seals from accessing catch or damaging gear. Various other practical solutions have been developed to reduce the damage caused by seals (see e.g., [3.1.2](#)). In many other types of fishing, such as gill net and long-line fishing, the use of technical solutions is more limited but necessary to develop.

The active participation of fishers in deploying these new techniques is essential. This participation helps ensure the utilization of existing infrastructure and sharing of practical knowledge as new gear is developed. Operating these techniques economically and ergonomically also requires active economic support. As fishers often lack the economic conditions to perform such tasks, investment subsidies are essential.

Acoustic seal deterrents (see e.g., [3.1.3](#)) offer an opportunity to reduce seal-induced losses not only for many types of fishing gear but also by allowing the establishment of seal-free fishing grounds in specific coastal fishing areas and fish farming. However, this approach still requires more research and development.

Broad local support will remain central to the establishment of **seal-free areas** (see e.g., [3.1.5](#)). A major advantage of using deterrents is their widespread acceptance compared to hunting, for example.

The effective **removal of "problem seals"** (see e.g., [3.2.3](#)) reduces the number of seals in the vicinity of gear and thereby may allow a period of reduced damage. The removal of problem seals easily meets divided opinions between conservation authorities and the fishing sector, although the actual numbers of hunted seals are relatively small, and efficient local hunting of individuals is achievable without compromising conservation development.



Figure 25 Herring left over after the seals' dinner. Photo: SG Lunneryd

Avenues for economic instruments and governance rearrangements

As demonstrated in 3.3.2, **compensations and tolerance payments** work as instruments for helping fishers continue their livelihood, although fishers would prefer a solution that does not compromise their ability to deliver fish to consumers. Compensations and payments are seen as complementary to other conflict mitigation instruments, not a permanent and singular solution (see e.g., [3.3](#)).

Although there are many ways to alleviate the practical problems of the seal conflict, the conflict persists and is worsening. National seal **management plans** (see e.g., [3.4.2](#)) can support both national and regional planning and participatory decision-making on the application of different management measures in practice. Due to the polarization of the conflict, a challenge concerns how to reach agreement between stakeholders about measures, schedules and frameworks for local participation and action.

Reducing controversy on potential management measures requires that both decision-makers and citizens be aware of the impact of seals on the fishing sector and of the potential ways in which these problems can be alleviated. The knowledge base, measures and those who are responsible for actions should be clearly set out in national seal management plans drawn up jointly by the various key stakeholders. A well-prepared management plan can support international, national and regional planning and decision-making to reduce conflict. This report describes a wide range of tools for this purpose.

The management plan and other institutional means promote a common understanding and action. There is a need for **interactive planning and consensual decisions** (see e.g., [3.4.3](#)) on which targets will be set for the seal population and the continuity of the fishing sector. Plans and decisions should be made not only more generally nationwide, such as in connection with a management plan, but also in more detail and more flexibly regionally, such as in seal advisory boards.

To support the necessary decisions, not only insight into the scale and significance of the problems but also **information** on the different types of management and their applicability in different situations is needed. At the heart of the solution is the

perceived **feasibility** and **acceptability** of different means and interactive solutions for conflict mitigation. It is important to consider what would be required by a conflict mitigation measure to be acceptable while at the same time knowing that acceptability changes between groups of people, according to their knowledge and values, in time, etc. Furthermore, **international agreements** and recommendations (see e.g., [3.4.1](#)) play an important role in management and affect national "room" for manoeuvring in the mitigation of the conflict.

At the national level, coordinating the application of management instruments requires a **cross-sectoral agreement** on objectives, means and implementation. **Co-operation between the users** of natural resources and environmental sectors has proven challenging in many respects. However, because coastal fishing is an environmentally friendly form of food production, there is a good starting point for reconciling the targets of seal management (Månsson et al., 2023). When both resource users and the environmental sector have a clear understanding of targets, it is easier to agree on the use of appropriate combinations of measures and responsibilities. **Continuous funding for conflict mitigation**, both between social groups and for reducing impact, must be a common goal for both the resource and environmental sectors in the future.

It is important to realize that the losses caused by seals in the fishing sector are often invisible and little known to the **general public**. Damage and problems caused by land-based animals such as wolves, white-tailed deer, wild boar or geese are better known. It is much more difficult to be aware of the seal problem, which takes place farther out to sea; knowledge about the direct seal induced losses can only be provided by the fishers. Thus, pressure to take action may be weaker and delayed. Seals are considered endangered and highly valuable charismatic animals, and the general public will not easily accept the idea of the reduction of populations.

It is also important to keep in mind that **protection against damage** is also often simpler for terrestrial animals. Damage to production animals by large carnivores and wild boar can be prevented, especially with electrified fences, various repellents and electrified flag lines. The implementation of fisheries protection measures presented in this report is more complex and requires relatively large investments than those for land-based animals. The acceptability of various actions and measures is important.

4.3 Roadmap for further scientific research

The mitigation of the seal-fishery conflict and more harmonious coexistence require a better understanding of the nature of such problems and of ways forward among Baltic Sea coastal countries, decision-makers and citizens. From a long-term perspective, it is important to consider not only ecological sustainability (e.g., the grey seal population and Baltic fish species) but also economic, social and cultural sustainability (e.g., coastal fisheries, fishing villages and cultural heritage). Aggravated by environmental stressors such as pollution and climate change, the maintenance of the status quo in seal management and the inability to mitigate the conflict have the potential to create new risks:

Societal problems underlying the seal-fishery conflict

- A decline in the number of small-scale coastal fishers
- Increasing fishing costs and a consequent decrease in profitability
- The disappearance of a cultural heritage and traditional fishing knowledge
- The loss of fishery as an important local quality in coastal communities
- A decline in the supply of domestic fish
- A decline in jobs near coastal regions
- A deduction of fish stocks at sea and consequent decline in catch
- The deterioration of the health of seals due to a decrease in food availability
- The potential for illegal culling of seals by fishers

Throughout this report, the importance of further mutual understanding and dialogue between the fisheries and conservation sectors is emphasized. This dialogue opens new needs for scientific research. While stakeholders may agree on the risks listed above, they lack the ability to identify key measures to achieve common goals or how to include such measures in their contributions to national management plans. Structuring this dialogue and designing joint management procedures is something that requires further research from the natural and social sciences and humanities focused on implementing the findings of this report. This research would to some extent empower small-scale stakeholders, giving them a position that they thus far are lacking socially and politically.

The results of this line of collaborating research should provide input for decision-makers who seek to implement public policy on conservation and wildlife management and who may lack information on the underlying social impact of the seal-fishery conflict. Research on implementation would, for example, focus on necessary institutional redevelopment around seal management and the multidisciplinary analysis of alternative measures that stakeholders themselves may identify or criticize.

Mitigating the dispute also requires **influencing international agreements**. It is likely not possible to lift the EU-wide trade ban in the short term, but it must be a common goal for the Baltic Sea states in the near future to, at least, have regional exemptions to allow for hunting as a species management tool.

In addition, the realism and impact of the protection criteria of HELCOM recommendations need to be reassessed. This reassessment will require collecting data to consider what constitutes, as of today, a balanced number of seals and the optimal size of stock. This would allow setting a base and ceiling for the size of stock. A redefinition of a balanced seal population should consider wider societal issues, including threats to the production of wild fish and the sustainability of archipelagic and coastal livelihoods and their cultural heritage. To better understand this connection between resource exploitation and human resilience, field research must collect direct accounts of different groups of citizens affected by conflict, not

only through surveys but also through actual interviews that may capture unknown perceptions of the effectiveness of control measures in place for managing the impact of changing seal populations.

Sociotechnical field research is necessary on a wider scale, and not just at the local level. The challenge is regional and thus multilayered. This report shows the results at a comparative level, but there is a need to conduct integrated research to understand the problem. This would require further involvement of existing international institutions that have responsibilities in designing policy that directly or indirectly affects seal management and the conflict with fisheries. Only through multilevel governance analysis may the potential for a joint seal management program be properly assessed.

From a psychological perspective, participation in planning and co-operation between different parties in decision-making processes are beneficial beyond conflict mitigation. Trust, respect, commitment and the building of common targets are also beneficial for preventing future conflicts where the use of and access to marine resources is at stake. Participation also legitimizes output, but it is necessary to ensure whether participation is not merely a formality and that those involved are prepared to handle the social challenges associated with collaboration (Johansson et al., 2020). Assessing this requires independent parties and thus offers a role for academia.

From a governance theory perspective, the human–wildlife conflict is a booming field of research. Rewilding on land has shown that joint management strategies are necessary. The RESOCO project has shown how decision-making power is sometimes contested between stakeholders with respect to marine wildlife. However, there is a need to develop adequate conceptual tools to analyse power disputes associated with drastically changing ecosystem variables such as the growth of seal populations. Ideally, this would compare different regions in which such conflicts exist and show which mitigation and prevention solutions are transferrable and which are context dependent.

Thus, overall, there are three angles for further research: the *first angle* focused on risk assessment and risk perception associated with changing seal populations in the Baltic Sea; the *second angle* focused on gathering up-to-date data on actual changes in the species and how fisheries are affected by this new stressor alongside climate change and pollution; and the *third angle* focused on institutional arrangements and public participation in the implementation of alternative strategies, as they are already contesting existing rules and standards such as the ban on hunting.

5. Conclusion

In order to help mitigating the complex seal-fisheries conflict, this report has compiled current academic research, analysed existing conflict mitigation measures and introduced an interdisciplinary synthesis of conflict resolution strategies.

The management of seal populations is a complicated issue to govern. International agreements and EU directives affect national room for manoeuvring in the seal conflict. The lifting of the EU trade ban as a regional derogation would allow seal products to be made available as a resource on a small scale across the Baltic Sea coastal areas. It would allow the management of seal populations in such a way that they can be used in a versatile and sustainable way as a renewable natural resource. Such an approach would have a highly positive impact on the problem, as the trade ban is a major obstacle to increasing the sustainable exploitation of seal populations.

There are tensions between seals and the fishing sector in many areas outside the Baltic Sea, but the conditions are often somewhat different. For example, several species of seal live on the east coast of Canada, and the number of seals has, as in the Baltic, grown rapidly and created a conflict situation between seal conservation and the fishery sector. However, this conflict differs from that of the Baltic Sea. The conflict in Canada is particularly concerned about the impact of seal predation on fish stocks. For cod, for example, it is feared that seals will prevent the recovery of some depleted and recovering substocks. The direct effects of seals on fisheries, such as damage to gear and catch, are perceived to be less of a problem there. This is partly because fishing on the east coast of Canada is mainly conducted with active fishing gear such as trawls.

Baltic Sea states and regional authorities should promote Baltic-wide dialogue and mutual understanding to find sustainable solutions. Furthermore, this report supports the development of a seal management plan covering the Baltic Sea if one is undertaken in the future. From the fisheries sector's point of view, influencing the size of the seal population is a logical solution, yet future supervision of changes in the seal population is crucial for maintaining a balanced seal population in the Baltic Sea. However, national, regional and international policy plays a key role in controlling hunting and in finding other viable solutions. At the same time, fisheries regulation and quota setting in the Baltic Sea add a layer of complexity and pressure on stakeholders.

This study has created a coherent knowledge base of various measures and practices available in the Baltic Sea and brings together knowledge of possibilities to revise regulations when developing fishing and hunting methods and new gear for coastal fisheries. Although there are challenges, seal deterrents may reduce seal damage in both fishing and fish farming. Fishers represent a guild that flexibly transforms their activity and trade influenced by outer circumstances; therefore, it is important that resilience remains in the lives of fishers and their families.

To reach the outlined goals, special attention must be given to the involvement of local knowledge and active stakeholder participation by fishers, fish farmers, coastal inhabitants, and environmental organizations. Participatory approaches aim to

secure a better knowledge base and the quality and legitimacy of governance instruments aimed at mitigating seal-fishery conflicts. It is obvious that the means used and active in 2022 are not enough. Finding and implementing effective solutions require deeper political will and wider stakeholder collaboration grounded in stable and forward-looking coordination and research-based knowledge about the means adopted.

In conclusion, the RESOCO project's understanding of how to support the above-described seal-fishery challenges in the Baltic Sea involves developing and revising local, regional, national and international management plans and demonstrating the consequences of the EU ban and providing material supporting regional opening for the use of seals as a natural resource.

The results are based on project group expertise and are planned to be carried forward to support a subsequent larger project incorporating the grey seal situation in the Baltic Sea.

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Appendix 1.

Five seal management case studies

1. Seals as part of the hunter's economy in the Åland Islands

As the trade ban on seal products in the European Union (EU) has effectively taken most economic value away from seals, we must therefore make them a valuable part of the hunter's own household to maintain sound ethics in hunting and have catch considered a valued resource. In the autonomous region of Åland, this is mainly being done by NGOs and hunter organizations through inspirational workshops and printed and digital materials for education and lectures. This work is supported by the local government through various funding measures. Interest in seal hunting and the utilization of seals as a resource is growing.

As the number of seals increases, hunting opportunities also increase, and especially among young people, there is growing interest in seal hunting as part of their cultural heritage. The parts of seals that are utilized include blubber for oil, the skin, and the meat for food. Seal meat is a delicacy if handled correctly and can be prepared in many ways. In the law regulating hunting in the Åland Islands, it is also stated that all edible game must be utilized. A local NGO called Archipelago Pares rf made a pamphlet in 2021 with recipes and directions on how to handle seal meat to ensure the highest quality so more people would eat seal following a material made in 2020 by the same organization with instructions on how the rest of the seal should be cared for and how hunting is conducted.

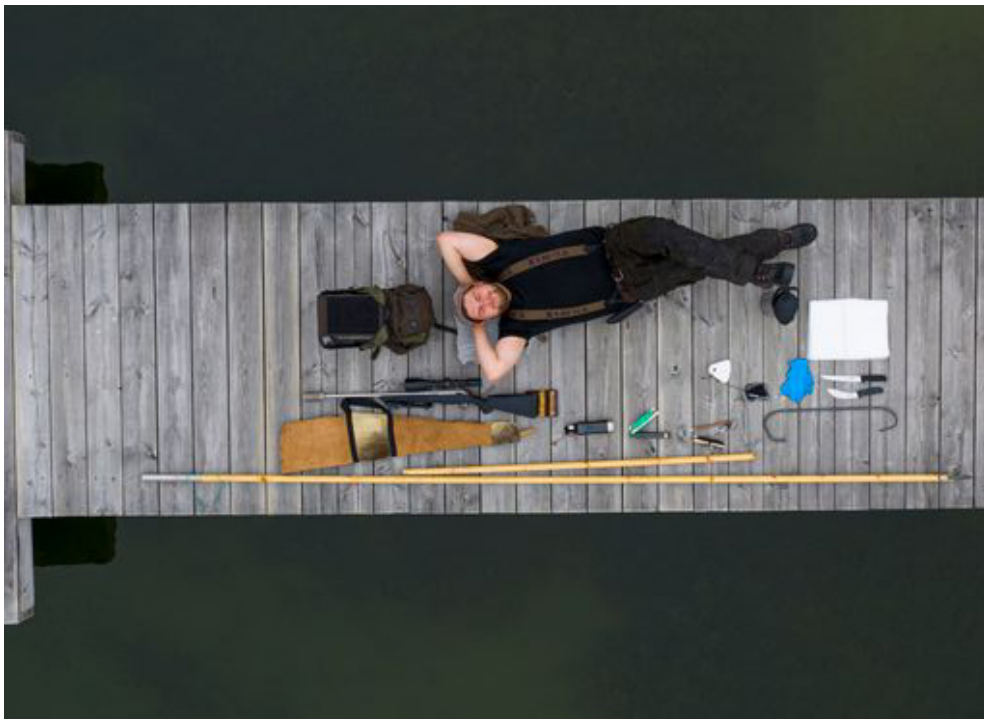


Figure 1 appendix The seal hunter. Photo: Therese Andersson/Archipelago Pares

Regarding environmental pollutants that would restrict the use of seals as food, very little research has been done, so a word of caution should be mentioned and especially for young women and children not to eat Baltic seal too often and not to eat offal. There is growing interest in the conservation of old buildings in Åland, and many of them were painted with paint composed of seal oil a hundred years ago. Within the trade ban, it is possible to make use of seal blubber in this way or give it away to someone else. It is also possible to have the skin tanned and made into various products. Seal skin is beautiful and fairly water resistant, so it is ideal for making outdoor clothing and hunting equipment as well as in art and jewellery.

Major challenges to making seals valuable in the hunter's household include the fact that seal hunting is a costly and time-consuming affair. Since hunters are not able to convert their catch into necessities, hunting trips are rare during a year, and their time is spent on other occupations. This leaves seals underutilized and considered a pest by fishers instead of a valued resource, such as fish or other game. Acceptance of hunting in Åland is very high, with over 10% of the population being active hunters.

You find more information about Archipelago Pares r.f. on their webpage

<https://www.aprf.ax/>.

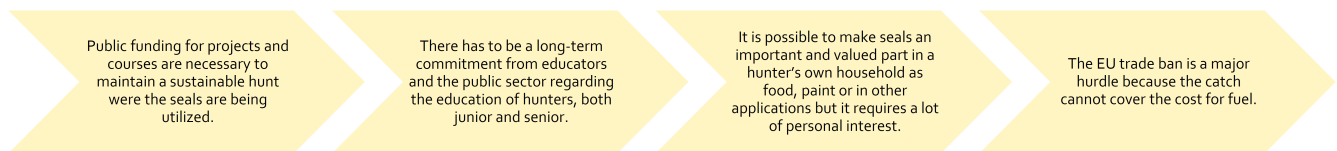


Figure 2 appendix Case Åland (see case summary in Table 1 Appendix)

2. Seal hunter Anna-Carin Westling in the Swedish Bothnian Bay coast - utilization of the whole seal

Ms. Anna-Carin Westling on the Swedish coast of the Bothnian Sea ended her career in the cosmetics industry in 2015 to devote herself full-time to the seal fishery situation. While she has always been interested in hunting, she later became involved in seal hunting. This led her to undergo diving training and to acquire equipment to be able to retrieve sunken seals. The next step was to invest in a boat suitable for seal hunting. She made early contact with commercial fishermen in the area to help remove seals that were causing damage, and this work involved many hundreds of hours and countless kilometres of boat trips along the coast. A study on the effects of her hunt, which is unique along the Swedish coast, shows that seal damage has not decreased according to log-book reports, but a comparison to another area with the same number of seals (without hunting) shows that the damage has been significantly lower (Lunneryd et al., 2022). The fishermen in the region are convinced that the hunt has had a very positive effect on them. Hunting close to gear in deep water often means that seals are impossible to salvage, but in this case, the positive effect results from removing them. Anna-Carin also hunts in shallower water, where it is easier to catch and bring seals to shore. She has directly encountered the problems caused by the EU's trade ban on seals (EC, 2009).

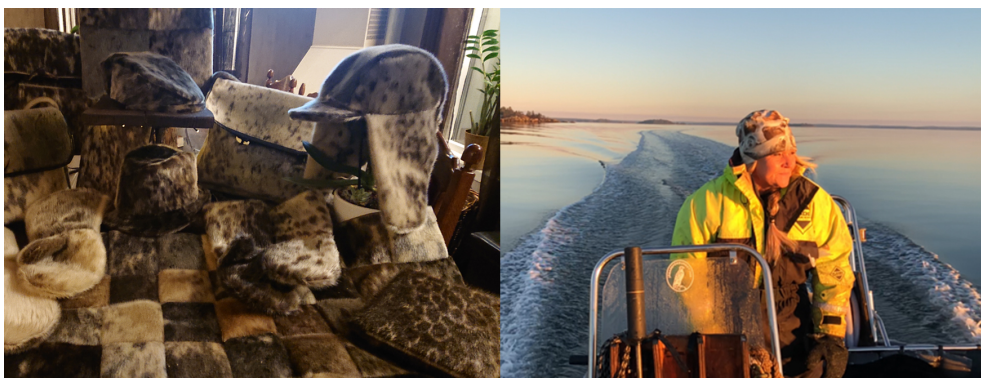


Figure 3 appendix Products made by the hunter herself. Phot: AC Westling

Part of the cost of the hunt has been covered by Anna-Carin, who has been diligent in co-operating with researchers by submitting scientific material from shot seals. This is very important to determine the status of seals in the region. Another source of income pertains to the role of instructors providing education in seal hunting. According to requirements from the Swedish authorities, it is mandatory to attend a course to hunt seals from a boat. She also allows other hunters to come along for a fee to hunt seals as experiential tourism.

The utilization of seals as a resource has been important for Anna-Carin. That is why she has started to tan sealskins, both her own and others. She is also sewing products such as mittens, hats, vests, etc. for other seal hunters since she cannot sell her own skins. Meat from seals is a resource, but due to legislation, she can only offer it for free to her guests. She has also built a house that is heated with seal oil that she extracts from seal blubber.

With her commitment to addressing the seal-fishing conflict and to showing that seals are an important positive resource, Anna-Carin has become an important symbolic figure in the preservation of a living coastal culture. There have been many articles and TV features about Anna-Carin. She has her own website, www.sealhunt.se, in Swedish where you can follow her work.



Figure 4 appendix Case Sweden (see case summary in Table 1 Appendix)

3. Feasibility and effectiveness of seal deterrents in coastal trap net fishing – development of a novel mobile deterrent in Finland

With the rapid growth of the grey seal (*Halichoerus grypus*) population in the Baltic Sea, seal-induced catch losses have increased dramatically across coastal fisheries. There have been various attempts to mitigate this damage, such as through the modification of fishing gear. Solutions have shown useful but inadequate with the growing grey seal population. Promising research results have recently been

obtained by using acoustic deterrent devices (ADDs) to keep seals away from the immediate vicinity of pontoon traps. The feasibility and effectiveness of ADDs used in trap net fisheries targeting Baltic salmon along the Finnish coast was tested in collaboration with 13 commercial fishers (Lehtonen et al., 2022). Fishers operated pontoon traps equipped with and without an ADD. The deployment of ADDs over the two-year testing period indicated an average 64% increase in salmon catches. The results suggest that in salmon trap net fisheries, an ADD is a useful and economically viable mitigation tool for reducing seal-induced catch losses when fishers use pontoon traps if the investment is subsidized. Furthermore, the mobile ADD developed in this study provides unique practical opportunities and notable potential for a wider use of ADDs. The study was funded by EMFF funds and was conducted by Luke in close collaboration with commercial fishers.



Figure 5 appendix Battery change in the autonomously moving deterrent. Photo: E. Lehtonen

The economic benefit of the use of ADDs can be roughly assessed by comparing the increase in catch value to the costs of an ADD. The total initial investment of a fully equipped raft-mounted ADD is € 16,500, whereas the cost of a fully operational mobile ADD is € 12,700 (with Otaq ADD in both). When the value of catch is calculated from the average first-hand sale value for salmon in Finland (7 €/kg) and with an average weight of salmon of 6 kg, the gross return for a trap net equipped with an ADD is € 10,920 for a fishing season with 260 salmon caught, corresponding to the expected catch in a median location. For a trap net without an ADD, the gross return is € 6,636, with 158 salmon caught. It is noteworthy that these numbers do not take into consideration the costs of ADD maintenance or the extra time needed to operate the device; however, these are likely not very significant costs. In Finland,

commercial fishers receive 50% investment support for purchasing seal deterrents. Therefore, the mobile ADD pays for itself in one and half seasons given the examples above. To our knowledge, fishers in Sweden, Åland Islands and Estonia have access to similar types of subsidies through the European Maritime and Fisheries Fund (EMFF).

There may be additional benefits of using an ADD, allowing a fisher to visit gear less frequently in periods when catches are small, thereby saving time and fuel. Furthermore, if seal-induced gear damage is reduced with the help of an ADD, a fisher needs less time to repair the gear and has more time for fishing-related work. Grey seals also tend to wait in the entrance of the trap net and disturb the capture process (Fjälling et al., 2006), and an ADD limits this behaviour. ADDs may also reduce seals' interest in finding food in fishing gear with the additional advantage of preventing seals from becoming entangled and drowning in the gear. With all this said, seal deterrents do not completely prevent seal-induced damage. Individual seals, especially older seals, may not respond to the sound of an ADD. This could be because they are used to the sound or due to age-related hearing impairment (Madsen, 2005; Götz and Janik, 2010, 2013).



Figure 6 appendix Case Finland (see case summary in Table 1 Appendix)

4. Estonian experiences with acoustic harassment devices

The first acoustic harassment devices (AHDs/ADDs) were used in Estonia within the framework of a research project funded by the European Fisheries Fund in 2011. Three units produced by Lofitech AS were tested in co-operation with commercial fishermen in the Gulf of Riga and Gulf of Finland. Different power sources were tested, and finally, solar panels were chosen as the best option. The units were in operation in 2011–13, and after the end of the project, fishermen continued to use AHDs in their everyday work.

Based on the positive experience gathered from the project, several other fishermen purchased AHDs. A very important motivation is the fact that in Estonia, the purchase of AHDs is an eligible cost for EMFF (European Marine and Fisheries Fund, 2014–2021) support. A total of 24 units were obtained: 11 in the Gulf of Finland, 10 in Pärnu Bay and 3 in the waters around Hiiumaa Island. The total cost of these units was € 297,950, and 78% of the cost was covered by EMFF funds.



Figure 7 appendix Estonian seal scarers. Photo: Markus Vetemaa

In recent years, however, initial optimism related to AHDs has started to fade. The AHDs, such as Lofitech's 'Seal scarer', have been designed to work in typical oceanic salinity, not in the brackish waters of the Baltic Sea. Due to the lower water density, the functional lifetime of the units seems to be shorter. Estonian coastal waters are also very shallow, and sound echoes from the bottom and surface, further decreasing the longevity of the speakers. Yearly costs related to the use of AHDs are therefore high, and at the same time, revenues of coastal fisheries are declining. Since the number of seals is increasing, pressure on fishing gear and catches shows the same trend. As some old seals seem to have hearing impairments, AHDs do not help scare off these individuals. There is growing consensus that the only long-term solution to the problems that fisheries are experiencing is more hunting pressure on the grey seal population.



Figure 8 appendix Case Estonia (see case summary in Table 1 Appendix)

5. The case of Denmark: derogation shootings around Bornholm Island

Fishers around Bornholm are experiencing increasing problems with grey seals that partly eat from their catch and partly destroy fishing equipment. Between 2016 and 2021, it was possible to cull up to 40 grey seals per year, and in 2021, the number increased to 80. Seals could only be hunted within 500 m of active fishing gear.

As an experiment, the Danish Environmental Protection Agency paid seal hunters during this period to oversee the culling with DKK 300,000 dedicating to culling itself and DKK 200,000 for monitoring seals. The scheme depended on derogation from the protection afforded to grey seals by virtue of the Habitats Directive. However, this was only possible as long as seal damage to the fishery had significant economic significance.

However, after the EU's latest quota settlement significantly reduced quotas on salmon and cod, the Danish Environmental Protection Agency assessed that this condition is no being longer met. Therefore, the scheme is being put on hold. In 2022, fishermen primarily have the opportunity to catch flounder and other flatfish in the waters around Bornholm, and there is currently insufficient evidence that grey seals significantly harm this fishery.



Figure 9 appendix Grey seals at Christiansø, near Bornholm Island, Ertholmene Archipelago (Denmark). Photo: Miljøstyrelsen

In the spring of 2022, the Danish Environmental Protection Agency, in collaboration with DTU Aqua, investigated seal damage to flatfish fishing activities. The purpose was to provide a necessary basis for assessing whether the damage was so significant that the regulation of grey seals could be resumed in the autumn. The Danish Environmental Protection Agency also encourages fishers to report seal-damaged catch to the Danish Fisheries Agency, as this information is also being included in the assessment (Danish Environmental Protection Agency, 2020).



Figure 10 appendix Case Denmark (see case summary in Table 1 Appendix)

Table 1 appendix Summary of five seal management case studies from the Baltic Sea

Åland	Sweden	Finland	Denmark	Estonia
Public funding for projects and courses are necessary to maintain a sustainable hunt were the seals are being utilized.	Devoted people can make a big difference in their local community and good collaborations between hunters and fishers are possible.	Acoustic seal deterrents can be an effective mitigations method in certain types of fishing and might free more time for fishing instead of repairing and protecting gear.	Seal induced catch loss and gear damages are increasing in the southern parts of the Baltic Sea with a growing number of seals.	Acoustic deterrents can be an accepted tool for fishers to reduce catch loss and gear damage.
There has to be a long-term commitment from educators and the public sector regarding the education of hunters, both junior and senior.	Scientific institutions can help fund effective hunters by asking for professionally collected samples from seals. A win-win in certain situations but not applicable in a larger scale.	Major public funding to both researchers and fishers are needed for the method to be applicable.	If the income from fishing decreases, it might be considered a reason to stop protective hunting by fishers.	Major public funding is needed for it to be viable since the devices are expensive and coastal fishing is a low-income line of work.
It is possible to make seals an important and valued part in a hunter's own household as food, paint or in other applications but it requires a lot of personal interest.	There is demand and a market for seal products yet a legal hinderance that makes them impossible to sell.	Smaller, or movable deterrents, are much easier to use and more easily accepted by the fishers. If the time to operate the deterrent is very high, then the time is better spent fishing and repairing gear.	Protective hunting on derogation permits can be difficult to adapt if the target species in fisheries change due to changed quotas. This is because new research and laws might be needed which takes a long time.	Devices that are designed in other places outside the Baltic Sea might not work well in the brackish and shallow Baltic waters and might mean that the investment is not paying off to the fisher as intended.
The EU trade ban is a major hurdle because the catch cannot cover the cost for fuel.	A good craftsman can make part of their living from creating seal products for hunters that provide their own skins.	There are always seals that do not respond to or get used to the noise of the acoustic deterrents. AHDs/ADDs cannot be the only solution.	Researchers and fishers need to collaborate in order to establish the magnitude of seal induced damages.	AHDs/ADDs cannot be the only solution to mitigate the conflict. Population management is considered a more viable and long-term solution

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