The MARELITT Baltic project presents

# THE BALTIC SEA BLUEPRINT

## A step-by-step roadmap on how to approach Derelict Fishing Gear

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# EVEN IF MORE THAN 20 YEARS HAVE PASSED...

... I still vividly remember the moment that I became aware of ghost fishing. It was during a coffee break at a meeting where me and my colleagues from the Swedish fishing authority were discussing fishing gear selectivity with the fishing sector. Unexpectedly, one of the fishers asked us, “What should we do with the thousands of gill nets that are being lost while fishing?” I was shocked. Almost paralysed. I could not believe my ears as the fishers around the table started to reveal the details of this phenomenon, one more appalling than the other.

**FOR ME, AS A YOUNG FISHING ENGINEER** with 5–6 years of close cooperation with the fishing sector behind me, the gravity and magnitude of the problem appeared in the blink of an eye. I became determined to work with the problem. In 1997, thanks to a trusting relationship with a group of fishers in the Hanö Bay, we started to study the problem systematically. Almost 20 years later in the autumn of 2015, the knowledge we gained, in combination with the work initiated by WWF Poland 2011, became the foundation of the MARELITT Baltic project.

**AS THE PROJECT NOW** draws to an end, we can conclude that some questions remain to be answered. And as always, new knowledge has triggered new questions. In other words, there is more to be done. Thanks to the MARELITT Baltic project, the problem of lost fishing gear has become a more transparent and graspable phenomenon. This is important. By showing the complexity and the different aspects of the problem as well as of the solution, including mapping, retrieval, recycling and prevention, the results of the MARELITT Baltic project enable fishers, divers, decision makers, authorities, entrepreneurs, scientists and others, all over the world, to understand how they can contribute to mitigation of the addressed problem and guide them to take relevant action.

We need to remember that lost fishing nets know no borders. The loss of fishing gear during fishing operations is a global problem. This roadmap, The Baltic Sea Blueprint, is our contribution to solving the problem, one step at a time.

**VESA TSCHERNIJ, PROJECT MANAGER**
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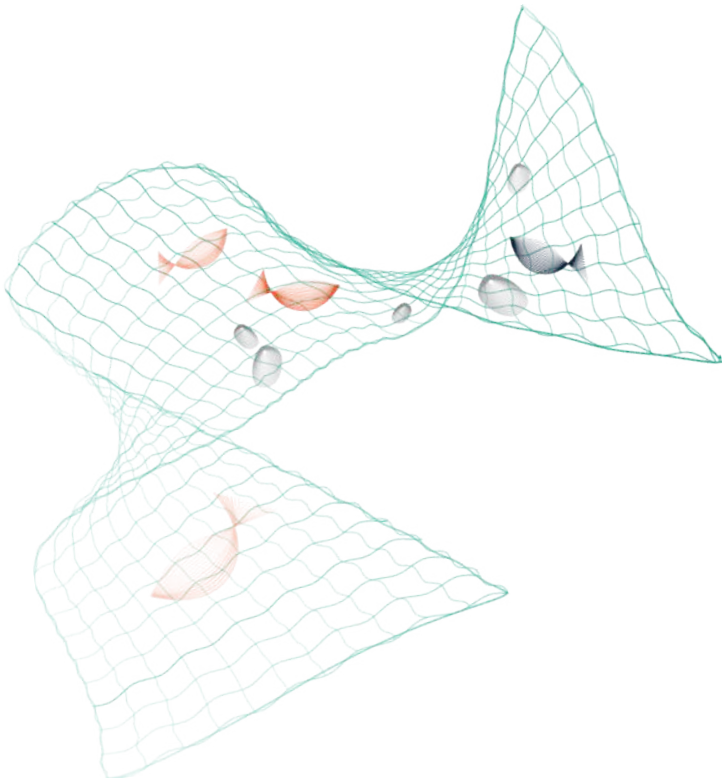
# THE GHOST FISHING CHALLENGE

In the mid-1990s, after a period of expanding fleets and intensive fishing often referred to as "the cod boom" (1980–1994), the problem of lost fishing gear in the Baltic Sea was brought to the attention of the authorities by a group of fishers. To investigate the expressed concerns, the first international project ever to study the problem of lost fishing gear in the Baltic Sea, FANTARED II (EU Study, 2002), was launched. The results of the project, covering not only the Baltic Sea but the Mediterranean and North Sea among others, were alarming. They pointed to the Baltic Sea with its turbid water as one of the potential areas where lost fishing gear can constitute a severe threat to marine life. Often called derelict fishing gear (DFG, see glossary entry), lost fishing gear becomes an unselective trap for fish, marine mammals and seabirds. It floats near the surface, in the water column or stands upright in the water column, as is the case with lost gill nets in the Baltic Sea and other shallow coastal marine regions. The extent of this impact – frequently called ghost fishing – on marine species and populations is not known. But it is clear that lost fishing gear causes unnecessary and unintended harm to marine fauna and affects hundreds of species in all investigated marine ecosystems (Werner et al., 2016).



Despite this unmistakable conclusion, no further international actions were initiated to address the problem in the Baltic Sea. During the early 2000s Sweden continued to tackle the problem from a national perspective, followed by Poland and Germany, launching activities in 2011 and 2013. Furthermore, thanks to increasing interest in and a growing concern over lost fishing gear and other sorts of marine litter among the Baltic Sea governments, HELCOM adopted a regional action plan in 2015 to address marine litter mitigation (RAP ML), including DFG. This new, clear political positioning opened up new possibilities for organisations within the Baltic Sea region to seek cooperation and apply for public funding to find solutions to the DFG problem.

Almost 20 years after FANTARED II had verified a DFG risk in the Baltic Sea, the MARELITT Baltic project began to take shape in 2015 thanks to efforts from representatives from Estonia, Germany, Poland and Sweden. At that time DFG retrieval projects in Poland and Sweden, as well as reports from a growing number of divers, had proven the risk foreseen by the FANTARED II project as a factual threat. The amount of fishing gear retrieved in national campaigns in Poland and Sweden was documented at 440 tonnes of mixed fishing gear, of which approximately 360 km consisted of gill nets from Swedish waters alone.

However, due to a lack of common knowledge and a systematic methodology, there was no way to draw any conclusions, not even in the case of Polish and Swedish waters. Both the geographical distribution and the total amount of DFG present in the Baltic Sea remained unknown. In the case of Poland and Sweden, the fishery basically consists of a combination of demersal trawling and gillnetting, whereas in the north (for example, in Estonia) demersal trawling is gradually being replaced by an increasing share of fyke net fishing. Knowledge was lacking about how factors like type of fishing gear could influence the amount and geographical distribution of lost fishing gear.

# THE MARELITT BALTIC PROJECT

In 2016, the MARELITT Baltic project was initiated. It is one of the first transnational initiatives in the world that aims to provide practical guidelines and a roadmap for approaching the DFG problem. Local and national government agencies, the fishing industry, environmental NGOs, the diving community and scientific institutions all came together to develop knowledge, methodologies and policy tools to enable mitigation of the impact of lost fishing gear in the Baltic Sea. These mitigation measures cover the following four activities: 1) mapping 2) retrieval 3) recycling and 4) prevention.

In three years, MARELITT Baltic has developed a first DFG host area map of the Baltic Sea, a toolkit of mitigation methods such as lost fishing gear retrieval from the seafloor, best practices and recommendations for land-based handling of retrieved gear and recommendations on how to prevent future problems. Overall, this has drastically improved knowledge throughout the Baltic Sea region needed to combat the severe threat DFG poses.

# THE BALTIC SEA BLUEPRINT

**THE NEW,** comprehensive knowledge generated by the MARELITT Baltic project has been condensed into this Baltic Sea Blueprint. The blueprint crystallises the most crucial requirements into step-by-step recommendations for addressing mitigation within each of the four activities.

This blueprint distils the detailed project findings, which are available in 11 reports, into recommendations, lessons learned and best practices.

All in all, the Baltic Sea Blueprint offers policymakers and harbour managers a strategic mitigation solution that can be used to both plan clean-up operations at sea for plasticizers and to create a waste management system capable of handling DFG.

The mitigation solution is grounded in a process consisting of four key activities: mapping of sea areas where DFG has accumulated, retrieval of DFG from these areas, identification of optimal recycling or waste management options for landed DFG, and prevention through the reduction of gear loss rate during fishing and improved gear marking. The practical work revealed, however, that coordination of these activities requires structured roadmaps.

Therefore, the blueprint presents so-called pillars that, for each activity, contain references to practical details from the relevant reports, step-by-step recommendations and the potential stakeholders to involve.

## Practical help

With the Baltic Sea Blueprint, you can easily access the detailed practical information you need including background, assumptions, developed and tested methodologies, lessons learned and recommendations. Simply follow the links provided in the blueprint to the 11 MARELITT Baltic reports.

## A blueprint for policy decisions

The Baltic Sea Blueprint offers policymakers roadmaps that aim to streamline the process across all the four pillars, both on a national and an international level. It provides a sound basis for strategic planning so that you can identify stakeholders, address legal or regulatory frameworks and plan work processes.

# ROADMAPS FOR IMPLEMENTATION

The MARELITT Baltic project has explored the ghost fishing problem from many angles. It used a methodology that divided the work into logical processes, such as how to find and retrieve nets, what happens when the nets are brought into a harbour, and how they can enter the waste stream. Because this new knowledge covers several different activities, it also involves a range of different stakeholders. Some are associated with actions at sea while others are responsible for land-based activities. Some stakeholders are already cooperating while others work independently. In theory, the solution is one process – but in practice it becomes evident that its implementation must be divided into several parallel processes instead. The logical questions then become: Who should be doing what? What order should the activities be carried out in? And other relevant questions surely arise.

This blueprint acts as a short-cut to understanding the results of the MARELITT Baltic project and to helping you implement mitigation measures across all the four activities, or "project pillars". Because this document serves as a roadmap to the MARELITT Baltic results, the four pillars do not provide a complete summary of the project reports. They instead provide the information necessary to understand the reports' content, and most importantly play a key role as one part of an all-in-one solution. By following the links to the reports in this blueprint, you can easily access the project's entire body of knowledge and achieve a smoother implementation of the plan in each pillar.

## GLOSSARY

**DFG** – Derelict fishing gear. Nets, lines, crab/shrimp pots and other recreational or commercial fishing equipment that has been lost, abandoned or discarded in the marine environment.

**ALDFG** – Abandoned, lost or otherwise discarded fishing gear.

**EOLFG** – End-of-life fishing gear. Fishing gear not in use anymore and often stored in warehouses in harbours.

**HOST AREA** – A sea area where DFG can be found.

**HOT SPOT** – A type of host area where for various reasons larger quantities of DFG tend to accumulate.

**DRAGGING** – A type of recovery or retrieval activity carried out using a creeper (a retrieval hook towed by vessel at a slow speed along the seafloor).

**BLIND SEARCH** – A dragging activity used randomly to search for and retrieve DFG.

**DIRECTED SEARCH** – A dragging activity concentrated in a designated sea area with an expected higher probability to retrieve DFG.

**MAPPING** – A procedure for locating geographical data like depth curves, nets, shipwrecks or other types of physical seabed objects on a map or geographical information system.

**DESIGNATION OF DFG HOST OR HOT SPOT AREAS** – A process for defining DFG host or hot spots areas by combining several types of knowledge, including fishing effort data from logbooks, fishers knowledge and results from search surveys (using either dragging or hydro-acoustic instrument).

**RETRIEVAL ACTIVITY** – An activity for retrieving or recovering DFG that consists of dragging (a creeper or a specific retrieval hook is towed slowly along the seafloor) or diving.

**STATIC FISHING GEAR** – Anchored or non-moving gear, such as gill nets, pots or fyke nets.

**MOBILE FISHING GEAR** – Fishing gear which is towed during fishing (e.g. trawl, seine).

# PILLAR I. MAPPING OF DFG HOST AREAS

## 1. Awareness raising and earning the trust of fishers and divers

During the MARELITT Baltic project, fishers and divers provided major input on how to retrieve lost fishing gear from the sea, interpret results and map DFG host areas. Even if survey methods like side-scan sonars are used, the knowledge of fishers and divers is crucial in identifying host areas or hot spots and understanding why lost fishing gear tends to accumulate in these locations.

### Lessons learned

Mapping of DFG host areas, developing clean-up methods and assessing the reasons why and where fishers lose fishing gear (Pillar 4) are closely related.

So, consider performing data collection activities jointly for Pillar 1 and Pillar 4 prevention methods for further reducing fishing gear loss (report 1 see list on page 34).

Successful cooperation and good results are most likely to be achieved within Pillar 1 while mapping DFG host areas and planning retrieval activities in collaboration with fishers at sea. This motivates the fishers to further engage in the work and helps to earn their trust.

Through a deeper involvement of fishers while utilising their expertise in Pillars 1 and 2, you can lay the groundwork for a change in attitude towards more sensitive topics, such as prevention methods (Pillar 4).

### RECOMMENDATION

*Contact local fishers and divers to involve them in the planning process for practical operations at sea. Inform or contact national and regional organisations of fishers, divers and recreational fishing organisations.*

*Organise roundtable or face-to-face meetings with fishers and divers to initiate cooperation. Present the negative impacts of DFG on both the environment and the economy and discuss how to reduce them.*

*Motivate the target groups by highlighting the crucial role of practical knowledge. Address the benefits that fishers and divers will gain if nationally financed clean-up projects are launched.*

## 2. Collecting data and information about DFG host areas

This step focuses on collecting official statistics and practical knowledge through interviews with fishers and divers, as well as information about typical environmental factors present at the identified DFG host areas.

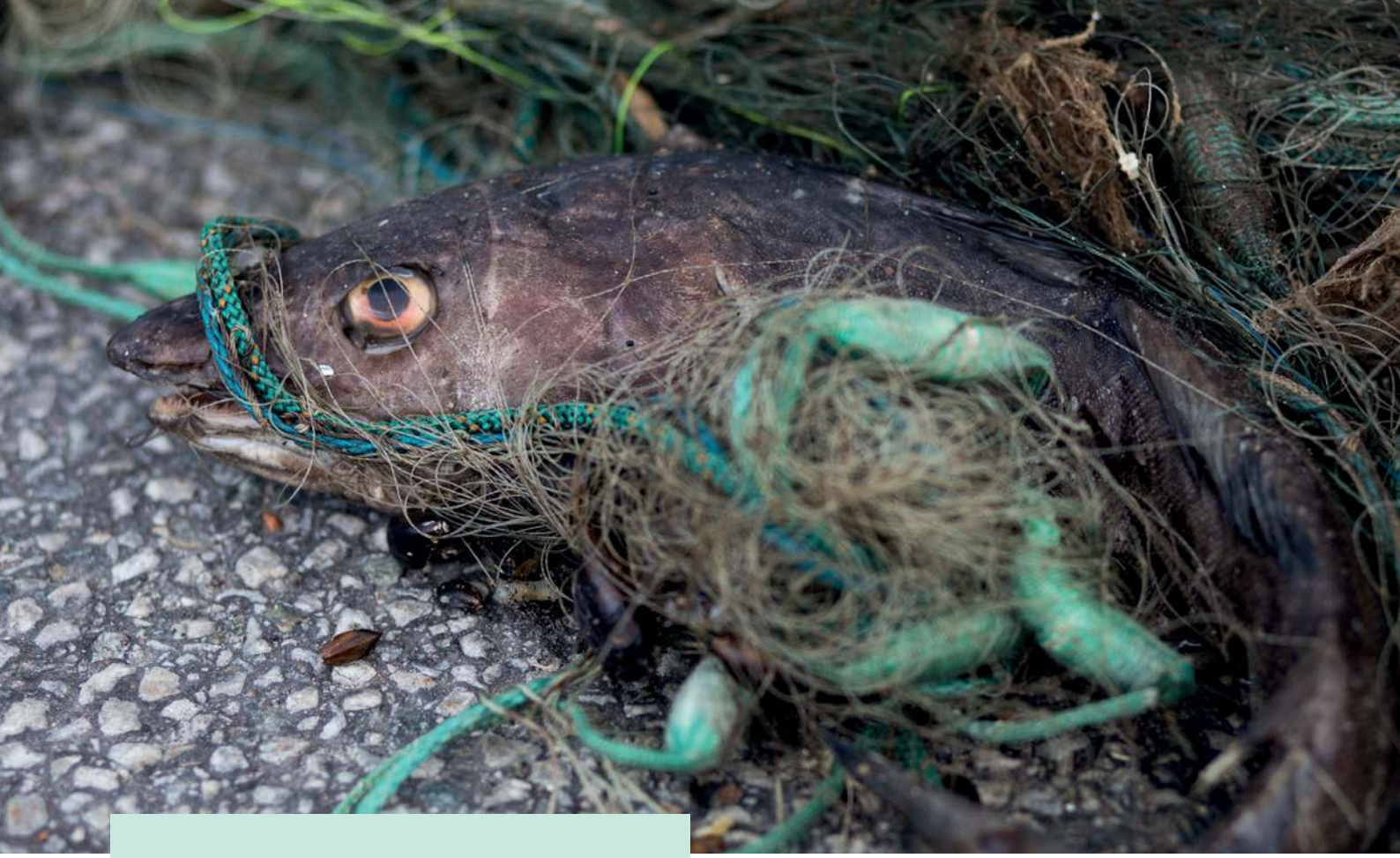
### Lessons learned

Official fishing logbook (effort) data is not homogenous. The format and accessibility vary greatly between countries.

It can be helpful to use historical fishing effort data while identifying potential DFG host areas and hot spots because fishing effort may have decreased, fishing areas in active use have shrunk or fishing has become concentrated to new areas. Fishing effort and environmental data should be combined with an assessment of the causes of gear loss during fishing operations to identify potential DFG host areas and hot spots.

Mapping wrecks and assessing the extent of DFG cover can be done with modern technologies, such as multi-beam/side-scan sonars, before engaging a diving team. This increases the efficiency of retrieval actions using divers.

When planning a survey and clean-up activities in protected, sensitive (report 9 see list on page 30) or coastal/rocky areas, which might be negatively impacted by dragging operations, side-scan sonars and diving teams have proven to be preferable methods for DFG search and retrieval (report 1 see list on page 34).



### RECOMMENDATION

*Initiate cooperation with national institutions, such as fishery monitoring centres, fisheries, and marine and maritime water management authorities to obtain the required data.*

*Combine information from fishers, divers and other interviews about environmental factors (seabed morphology, underwater obstacles, etc.) that affect DFG occurrence, with the results of analysed fishing effort data (interactions between static and mobile fishing gears and high-density fishing areas) and cultural heritage data (wreck distribution) to identify conflict zones (report 1 see list on page 34).*

## 3. Mapping of DFG host areas

To improve transparency around the ghost fishing problem, the collected and analysed data from step 2 should be used to develop a DFG host area map.

### Lessons learned

A regional DFG host area map is an efficient, practical tool for visualising the problem.

The map substantially improves the strategic planning of several crucial activities. Knowing the DFG concentrations will help you determine cost-efficient retrieval actions, select appropriate harbours for DFG landing, and subsequently (or on a needs basis) improve the reception capacity at strategic harbours.

Through improved transparency, the map helps during spatial planning of marine activities. For example, you can avoid DFG clean-up actions in cultural heritage sites.

### RECOMMENDATION

*Use GIS platforms to ensure the best technological preconditions.*

*Consider developing two maps, a showcase version for the general public and a more detailed version for planning clean-up actions, collecting new data and further analysing the results.*

*The result of mapping activities (the relevance of identified DFG host areas) can be verified with a randomised dragging or side-scan sonar survey. A map with a grid can be used to plan, direct, analyse, document and showcase search and clean-up operations (report 1 see list on page 30).*

*Local fishers have the knowledge needed to carry out cost-efficient search and dragging/retrieval campaigns.*

# PILLAR II. RETRIEVAL OF DFG

## 1. Environmental impact assessment tutorial and cultural heritage analysis during planning of cleaning actions

The MARELITT Baltic project has assessed options for the ecologically sound retrieval of DFG from the Baltic Sea that takes into account cultural heritage values prior to a retrieval decision (report 1 see list on page 34).

### Lessons learned

By using the recommended tools and method developed during MARELITT Baltic, dragging is possible in most of the Baltic Sea, except for certain sensitive areas or on very rough or rocky seafloors (report 1 see list on page 34).

When cleaning shipwrecks from DFG, there are conflicting environmental, cultural heritage and business interests. These lead to overcautiousness or uncertainty about the action measures.

### RECOMMENDATION

*Draw attention to the environmental impact assessment (EIA) report when planning various DFG search and retrieval operations. Use a decision tree from the EIA report.*

*Always involve underwater archaeologists and other experts when planning and conducting clean-up actions on shipwrecks to minimise damage to their cultural heritage values.*

*MARELITT Baltic has developed a shipwreck-friendly clean-up approach to ensure minimal damage to selected underwater objects (report 1 see list on page 34).*

*To avoid conflicts of interest with regards to wreck clean-up (see lessons learned), the EU should consider developing an international strategic approach to define priorities for these interests.*

## 2. Clean-up activities at sea

This step involves the practical execution of clean-up operations at sea, in cooperation with fishers and divers involved in the process (report 1 see list on page 34).

### Lessons learned

Retrieved DFG might not be appropriately regulated by law. Existing legislation may consider a retrieved net as lost property and presuppose a right for the owner to collect it.

Clean-up and dragging actions are a practical and – from a national economic perspective – justified way to both diversify income for small-scale fishing companies and to improve the environmental status of the marine ecosystem.

Legal and safety requirements for diving work in each country must be clarified. Examples of legislation can be found in (report 1 see list on page 34).

### RECOMMENDATION

#### CLEAN-UP BASED ON DRAGGING

*DFG dragging operations should be carried out by local fishers, preferably with previous experience of DFG search and retrieval projects.*

*Create a quality assurance system to standardise practical operations at sea and globally harmonise the documentation of results.*

*The European Maritime and Fisheries Fund (EMFF) or other financial schemes must be optimised to enable smooth financing of clean-up and other activities associated with DFG mitigation actions.*

#### CLEAN-UP EXECUTED BY DIVERS

*Initiated diving operations should be carried out by professional or specifically trained retrieval divers, in compliance with all applicable legislation. Long diving experience and awareness of the risks of deep-water operations or in habitats with fishing nets are key to ensuring diver safety, efficient operations and a positive outcome.*

# PILLAR III. WASTE MANAGEMENT OF RETRIEVED DFG

The MARELITT Baltic harbour survey (report 4 see list on page 34) revealed that fishing gear waste facilities are only available on a regular basis in 28 % of fishing harbours for end-of-life gears, and no facilities are available for DFG. At the same time, the EMFF explicitly encourages the fishing sector to conduct marine litter removal, including lost fishing gear. To continue improving the Baltic Sea seafloor ecosystems, collection facilities and pre-processing areas must be established in strategically located fishing harbours along the Baltic Sea cost. In addition, an efficient collection and transport system to centralised waste sorting, as well as thermal and material processing facilities capable of treating DFG, must be established.

During the practical activities in the MARELITT Baltic project, it became evident that the waste management pillar includes two distinct yet intimately related processes: the reception of retrieved fishing gear in fishing harbours and the subsequent waste treatment and management of collected DFG.

## III a) Reception of retrieved fishing gear in fishing harbours

### 1. Raise awareness of DFG handling among fishers, divers, harbour users, harbour managers and personnel, waste companies and recycling companies

#### Lessons learned

DFG retrieved from the sea is often hazardous waste, containing objects like lead weights embedded in sink lines or copper coating.

The mix of different types of plastics, metals and organic material renders treatment of DFG technically challenging in existing waste sorting and treatment facilities.

#### RECOMMENDATION

*Fishers, divers and DFG retrieval authorities must be made aware that DFG cannot be disposed of as household waste or as commercial waste. In order for incineration plants to process trawl netting and ropes, large pieces must be cut into smaller fragments. The sink lines containing lead must be removed from gill nets and sent to metal recyclers or be collected as hazardous waste. These are the minimum requirements for DFG to enter existing waste streams.*

### 2. Take inventory of generated waste in harbours: legal and regulatory framework

Waste can be generated in harbours by mercantile, fishing or recreational fleets or by other harbour users. Fishing gear waste can consist of retrieved nets (DFG) or end-of-life fishing gear (EOL FG). The inventory step can be used to educate harbour users, managers and personnel on various material components and the requirements for their disposal. The waste can be grouped as follows:

1. **Bulky items** (anchors, cables, etc.)
2. **Netting with** toxic or hazardous material (lead lines, etc.)
3. **Single-material DFG or DFG** that can be sorted into individual polymer fractions
4. **Mixed DFG** (and other marine litter) to be delivered to thermal processing plants

#### Lessons learned

The MARELITT Baltic harbour survey (Press 2017 (report 4 see list on page 34) in the Baltic Sea region revealed that fishing gear waste facilities are only available on a regular basis in 28 % of fishing harbours for end-of-life gears, and no facilities are available for DFG.

Most harbours provide containers for sorted waste. However, the number of containers for separately collected waste was considered insufficient.

Under the current EMFF period (2014–2020), storage, transport and disposal fees are eligible for EMFF support, in addition to DFG and marine litter retrieval costs.

## RECOMMENDATION

*Clarify responsibilities regarding present waste management on national and local levels.*

*On the national level, decide whether DFG reception and handling capacity should be improved in all fishing harbours or in selected harbours at an adequate level.*

*The DFG host area map can be used to identify strategically located harbours to become main landing sites for larger volumes.*

## 3. Diversify the existing waste management system in harbours

Mixed DFG including gill nets with lead lines cannot be processed in the existing waste management system (report 4 and 6 see list on page 34).

### Lessons learned

One of the common ways to process household and commercial waste from harbours in EU countries is by incineration.

Materials with a high calorific value, such as plastics, are used as input waste streams for concrete production plants needing high-energy fuel materials, for example.

## RECOMMENDATION

*According to waste managers, the following steps are needed to process DFG in existing sorting and thermal processing facilities:*

1. ***Lead lines** must be removed.*
2. ***Bulky items** must be removed.*
3. ***Nets and ropes** must be cut into 50-100 cm fragments.*
4. ***Automated sorting facilities** are presently unable to treat DFG.*

*To avoid unnecessary transport volumes and costs, these steps are best carried out by fishers or trained retrieval teams in dedicated areas in the receiving harbours.*

*DFGs do not provide a large-scale waste volume on a regular basis because of the mix of different materials and the irregularity of retrieval. Also, as prevention of new gear loss gains ground, the total amount of additional DFG in the Baltic Sea is expected to decrease.*


## 4. Improve harbour reception and enable pre-processing

A collection system for end-of-life fishing gear and DFG at municipal harbours and fishing harbours administered by private companies must be implemented.

### RECOMMENDATION

**Provide separate collection points** *and containers for differentiated waste collection. This must be accompanied by suitable supporting waste management services.*

*Provide pre-processing areas for fishers in harbours. Some pre-processing of retrieved DFG would be beneficial (see step 3 above).*

*To increase the incentive to bring end-of-life and retrieved fishing gear to port, promote full implementation of no-special-fee systems at fishing harbours.*

*Information should be available and clearly visible at harbours about proper lost gear reporting and retrieval procedures.*

*Put in place port waste management plans including descriptions of sorting procedures for DFG and end-of-life fishing gear. Provide educational materials regarding the requirements of DFG disposal.*

*Harbour authorities are urged to communicate up-to-date information about available reception facilities. This information should be online and indicate when and where fishing gear is collected, together with contact information for responsible harbour personnel.*

*There should be clear information online about whether a harbour supports a DFG landing, fishing for litter scheme, or is part of a larger network of "harbours in action against marine litter".*

*Harbour authorities should work with national and local government officials, regional administrators and local waste managers to develop environmentally friendly waste management procedures (IMO 2014 Consolidated Guidance for PRF providers and users) (report 7 see list on page 34).*

## III b) Waste management and treatment of retrieved DFG

In most cases, lost fishing gear retrieved from the sea is hazardous waste. The mix of different types of plastics, metals and organic matter makes treating DFG technically challenging in existing waste sorting and processing facilities.

In view of future DFG retrieval activities, MARELITT Baltic has developed a DFG treatment scheme (report 6 see list on page 34). This scheme contains a detailed set of recommendations for harbour reception facilities, pre-processing requirements, waste management and recycling options for retrieved fishing gear. If we do not develop a collection and disposal pathway for DFG, gear retrieval from the sea will remain challenging for fishers and divers as well as for harbours and municipalities.

### 1. Supply information about DFG/EOL FG properties and waste management requirements

Successful recycling begins in harbours, which provide specific treatment for various waste components and dedicated reception facilities (see Pillar IIIa, step 2).

#### Lessons learned

Pre-processing in harbours by fishers is the best way to start the sorting process. Bulky rocks and scrap metals can be removed to avoid unnecessary transport costs (compare to Pillar IIIa).

Lead lines and other hazardous waste must be removed in harbours or in a centralised waste sorting facility.

Sorting of heavily mixed DFGs, including a collection of other marine waste, is labour-intensive and might be ineffective.

Because of the material mix, including toxic lead and long nets, existing thermal or polymer processing facilities are currently not capable of managing fishing gear retrieved from the sea.

#### RECOMMENDATION

*Where pre-processing in harbours (see Pillar IIIa) is not feasible, centralised sorting facilities must be enabled to process fishery waste, including retrieved and end-of-life fishing gear. This will also foster end-of-life gear recycling.*

*Mixed DFGs must be cut either in harbours or in centralised waste sorting facilities to allow processing in incineration or other thermal processing plants.*

### 2. Form local enablement teams with port authorities, fishing associations, municipalities and waste companies

Gaps in reception facilities in harbours are identified in Pillar IIIa. For DFG retrieval activities at sea to continue, these gaps must be filled. The EMFF supports storage, transport and disposal of fishing gear retrieved from the sea, in addition to funding marine litter retrieval costs. Waste management options for DFG must be identified by waste companies in close collaboration with the fishing sector and fishing harbours.

#### Lessons learned

Reception at harbours, as described in Pillar IIIa, is a prerequisite for continued clean-up activities at sea. It is also necessary for controlled processing of DFG as a special, small-volume waste stream.

Financial support is required to establish handling infrastructure for both DFG and end-of-life fishing gear in order to allow entry into the existing waste management system on a regular basis.

### RECOMMENDATION

*Facilitating financial support through the EMFF for the retrieval and disposal of lost fishing gear encourages continued clean-up actions at sea and raises fisher awareness of the sensitivity of the marine environments in the Baltic and other European seas.*

*Local teams ensure that local fishers knowledge is used during retrieval campaigns and when handling fishing gear. Waste companies contribute with requirements for DFG to enter the regional waste facilities. A joint working body can help bring together the local knowledge of fisheries, ports and waste management structures and stimulate project proposals to finance implementation as well as create political momentum to support these projects.*

## 3. Extend the existing waste management system to enable DFG handling

The existing waste management systems in MARELITT Baltic partner countries are not capable of managing DFG. Fishing net and rope fibre recycling requires dedicated facilities. For end-of-life fishing gear, facilities are available only in selected locations and will most likely not be built in each country.

### Lessons learned

Companies currently processing individual fishing gear material streams are Plastix A/S in Denmark, Aquafil in Slovenia, Antex in Spain and Bureo in Chile. None of these companies can presently manage mixed fishing gear retrieved from the sea.

MARELITT Baltic trials of material recycling suggest that the recycling of mixed DFG into new products is very challenging and might not be economically viable in most cases.

### RECOMMENDATION

*Clean, uncontaminated, single-polymer DFG can be recycled together with end-of-life fishing gear. "Ghost gear material" has received substantial marketing attention during the past few years. Small-scale recycling batches can therefore have economic value.*

*A combination of decentralised and centralised facilities is recommended to allow for efficient DFG waste management (report 5 see list on page 34). Decentralised collection in harbours and pick-up by regional waste companies minimises transport costs. Centralised sorting and recycling or thermal processing ensures materials of equal quality and continuous waste streams.*

*Centralised waste management sorting facilities, such as Nofir in Lithuania, must be established for fishing gear. Sorted gear can be forwarded to fishing gear recycling manufacturers (such as Plastix A/S in Denmark for PP or PE, Aquafil Slovenia for nylon/PA).*

## 4. Mobilise policymakers to address the treatment of DFG

Alongside the EU plastics strategy, legislation must incorporate the processing of DFG and other marine litter retrieved from the sea.

### Lessons learned

Awareness of the fishing gear life-cycle is reflected in current policy updates, such as the Directive on Port Reception Facilities and the EU Plastics Strategy. Extended producer responsibility for fishing gear producers is suggested and would be a good way forward.

### RECOMMENDATION

*Consult the policy documents on waste handling which should be adapted to cover DFG treatment as proposed in the MARELITT Baltic DFG treatment scheme (report 6 see list on page 34).*

Establish national round tables with policymakers, national centralised waste management authorities and companies and local sorting facilities.

Adopt a regulatory framework for handling end-of-life and retrieved fishing gear.

Identify facilities that can handle the different DFG/EOL FG fractions or can be adapted to do so. Prepare contracts between harbours and companies.

Establish a network of "net-friendly" fishing harbours accepting DFG.

## 5. Secure funding for innovative waste management solutions, including DFG treatment

Mixed fishing gear retrieved from the sea, including gill nets, is contaminated with toxic lead and potentially absorbed hazardous chemicals from the sea. Contaminated DFG must be treated in facilities capable of handling hazardous waste.

### Lessons learned

Steam reforming and pyrolysis are alternative thermal processing technologies that allow for the extraction of lead for metal recycling and the use of energy from plastics and organic contaminants.

Small-scale thermal processing facilities can be installed near ports and provide decentralised or centralised alternatives for small-volume waste streams.

Where sorting and incineration are not available or are economically inefficient, small-scale thermal processing might be a viable alternative for DFG treatment, diverting DFG from landfills.

### RECOMMENDATION

*Secure funding for waste handling pilot facilities to allow for alternative treatment pathways for contaminated, mixed DFG.*

*After a 5-year pilot phase with necessary adaptations, implement the new scheme in the Baltic Sea and European countries as regular practice for the treatment of mixed fishing gear waste.*

*Adopt national regulatory waste management frameworks including fishing gear management.*

*Include these findings into EU regulations and national implementation law on port reception, single-use plastics strategy, EU Waste Directive, the EMFF and other relevant frameworks.*

*Advice to EU: open a budget line to support the single-use plastics strategy with investment options for implementing an according system.*

## 6. Promote innovation and new net materials for net makers and foster producer responsibility schemes

Innovative solutions for the production of single-material and non-hazardous fishing nets will increase producer responsibility and decrease the complexity of the sorting problem. This will also increase recycling options for fishing gear.

### Lessons learned

Fishing gear consists of a large variety of different materials: a single gill net can contain nylon, PET, polypropylene and polyethylene along with metals and lead weights. This mix is the largest obstacle to fishing gear recycling.

### RECOMMENDATION

*Incentivise innovative new net materials and net structures using single polymer, non-hazardous weights. Innovation can foster extended producer responsibility and be part of EPR schemes. New nets with less material fractions will facilitate the complex sorting process and are easier to recycle.*

# PILLAR IV. PREVENTION

The loss of fishing gear is a severe problem worldwide. In the Baltic Sea alone, it is estimated that between 5,000 and 10,000 nets disappear during fishing operations every year (Kasperek S., Predki P., 2011). A crucial part of a sustainable, long-term solution to the DFG problem is to reduce the number of nets lost during fishing. MARELITT Baltic has used an approach that assesses the methods for reducing gear loss from the perspective of strategic fishing. This has resulted in more diverse views of efficient design and prevention solutions.

## 1. Awareness raising among all stakeholders including market players and earning fishers trust

Motivate all stakeholders to cooperate and strengthen the involvement of the fishing sector.

### Lessons learned

It is beneficial to jointly run the first steps (initiation and data collection activities) within Pillar I (mapping) and Pillar IV (prevention) (report 1 and 2 see list on page 34).

Through a joint implementation of Pillars I and IV, you can leverage the positive cooperation with fishers during mapping to achieve success. This can then be used to earn the trust of the fishing sector and thereby lay the groundwork for a change in attitude towards prevention, which is an often a complicated and delicate topic for fishers.

Fishers play a major role in the development of methodologies, interpretation of results, mapping of DFG host areas and assessment of gear loss causes.

The results of MARELITT Baltic reveal differences in fishers attitudes towards gear loss reduction. It is important to understand and accept the reasons for these differences. The longer the fishing sector has been aware of the need to mitigate ghost fishing, the more open it is to prevention (report 2 see list on page 34).

### RECOMMENDATION

*Contact local fishers to involve them in practical efforts. Inform fishers and recreational fishing organisations, authorities and other stakeholders considered crucial to policy building.*

*Organise regional or local roundtable or face-to-face meetings with the key target groups to present and discuss the entire Baltic Sea Blueprint mitigation plan as well as the role of the plan summarised in Pillar IV.*

## 2. Adjustment of methodology and collection of data

Draft a plan and adjust the methodology presented in (report 2 see list on page 34) to reduce gear loss during fishing operations.

The proposed method includes two phases: the assessment of strategic fishing and the development of methods to reduce gear loss.

The plan should address the following steps and, if needed, include changes based on input from the target groups (fishers, authorities, experts, etc.):

1. **Analyse criteria and assumptions.**
   a. **Changes** in fishing effort.
   b. **Causes** of gear loss.
   c. **Merge the results** of a and b with information on DFG host areas from Pillar 1.
2. **Define** the context for efficient prevention methods.
3. **Design** relevant prevention methods.

For more information on methodology (report 4 see list on page 34).

### Lessons learned

Fishing operations, interactions between fleets, conflicts with other sea users and non-fishing vessels, seafloor morphology and water currents can, independently or in combination, cause gear loss during fishing (report 2 see list on page 34).

Analysing all the data jointly helps you understand the nature of the ghost fishing problem in the studied areas. This can provide the necessary or crucial information about the type of prevention methods that can improve the situation.

### RECOMMENDATION

*When this step (adjusting the methodology and collecting data) is jointly undertaken with mapping, you can more profoundly engage the fishing sector and thereby better understand the ghost fishing problem.*

*We highly recommend the collection and wide application of fishers knowledge, as it strengthens their dedication to the process and helps to establish a common view of ghost fishing.*

## 3. Analysis of criteria and assumptions for relevant prevention

Over the past 30–40 years, the fishing sector worldwide has undergone major technological and strategic fishing changes. Assessing the present status is crucial, as it how it might impact the potential to develop relevant prevention methods.

### Lessons learned

Changes in fishing operations, as well as the technological and strategic evolution within fisheries, were observed to influence the causes of gear loss.

Great regional variations in the nature of ghost fishing thus likely underlie the causes of gear loss.

### RECOMMENDATION

*We recommend studying changes in fisheries (effort, fishing gear composition, etc.) and assessing their potential impact on gear loss.*

*Information derived from pillar 1 providing a description of prevailing environmental factors (type of seabed, water current, water depth) in the designated DFG host areas can also help to deepen the fishing technological and strategic understanding of what type of prevention methods could be relevant and efficient.*

## 4. Definition of criteria and assumptions for prevention methods

Using the outcome from step 3, define the assumptions by discussing the following:

1. **Is gear loss** still a problem? What type of fishing gear is being lost?
2. **Are there** regional differences in gear loss rate?
3. **Are there** regional differences in the causes of gear loss?
4. **Are there** alternative approaches to minimising gear loss?

### Lessons learned

Some countries already provide more information and education about the negative ecosystem impacts of DFG to key fishing gear user groups in order to decrease gear loss.

Based on the MARELITT Baltic results, it is likely that marked regional differences can be identified regarding fishing effort (amount of fishing gear used per year), the prevailing gear combination and causes of gear loss rate (report 2 see list on page 34).

Attitudes among fishers towards reducing gear loss during fishing can vary substantially. Swedish fishers have been aware of the need to mitigate ghost fishing for 23 years, whereas Polish fishers have been aware of the problem for 8 years. Swedish fishers were found to be more open to discussing prevention. It is not clear whether this longer period of awareness on the part of Swedish fishers is the reason behind their more positive attitude. The markedly lower fishing effort in Sweden could be an important aspect in addition to a more positive attitude towards reducing gear loss during fishing.

### RECOMMENDATION

*Discuss several alternative approaches to reducing gear loss.*

*Improved gear marking systems or enhanced legislation and enforcement of an existing gear marking system should be consider a baseline for improved prevention (report 3 see list on page 34).*

*A potential method can be developed by, for example, changing the fishing strategy (avoid areas including risk for conflict, avoid bad weather, avoid risk for snagging on wrecks, etc.).*

*An economic incentive that rewards responsible fishing operations can be an option, but this requires compliance from fishers and supportive market players.*

## 5. Design of prevention methods

Relevant prevention methods are linked to an identified existing problem, whether common or regional. Furthermore, the method must be accepted by the target groups.

### Lessons learned

If gear loss reduction uses methods that imply the risk of fewer catches, the fishing sector might be reluctant to implement them.

High awareness and a positive attitude toward the environment are important for developing prevention methods. The question is, how fast can attitudes change, and how can we enable such a change? Economic incentives, such as a fishing market that prefers catches from environmentally responsible fishers, can offer one option.

A high level of acceptance is gained when the method is practical and economically justified and when the implementation involves only minor drawbacks.

Improved gear marking is probably one of the most acceptable prevention methods around the world. This is despite the lack of common agreement about whether electronic gear marking will work as intended or guarantee better compliance than traditional marking (such as by metal tags).

Moreover, the results of MARELITT Baltic indicate that an active reduction of gear loss (based on an intentional change in e.g. fishing strategy leading to a reduced risk for gear loss) is a sensitive, complicated topic.

Generally, fishers select their fishing grounds primarily to maximise their catch, not to intentionally lose their nets. However, some fishers are prepared to take a higher risk of losing their gear by takin actions like targeting a shipwreck to get more or larger fish. In these cases, the fishers usually use cheaper nets.

## RECOMMENDATION

*Improve and enforce fishing gear marking and reporting of gear loss during fishing. Generally, both systems are in place in many countries but are not working properly.*

*Increase education and targeted information to the key fishing gear user groups about the negative impacts of DFG on the marine ecosystem.*

*In MARELITT Baltic, a reduction of gear loss during fishing using a voluntary "responsible fisheries scheme" was recommended as a solution in one of three cases studied. Besides little fishing effort (less competition on good fishing grounds) leading to almost no conflicts, this requires a positive attitude among fishers towards the environment and a market that is willing to offer economic benefits to fishers prepared to commit themselves to reducing gear loss.*

*On the other hand, MARELITT Baltic identified regions where reduction of gear loss during fishing was considered impossible or very complicated. The primary reason was environmental factors (seafloor objects) that cause frequent, unexpected net snagging in combination with higher efforts and thus more conflicts between passive and active gear. If gear loss reduction during fishing, for example by closing or avoiding areas with high gear loss probability, is not efficient or economically viable, an alternative approach aimed at minimising the impact of lost gear on the marine environment. This can be achieved through improved gear loss reporting in combination with regular annual retrieval campaigns to collect the reported (mapped) lost gear. Since the mid-1990s, Norway has had a successful regime based on obligatory reporting of gear loss in combination with regular retrieval (see Best Practice 2, page 28).*

*Also include other fishing gear user groups besides commercial fishers in the scope of planned mitigation actions.*

# POLICIES AND LEGISLATION

**1 EU PORT RECEPTION FACILITIES DIRECTIVE (PRFD),** revised version, significantly reduces the cost and burden disincentive for fishers to bring gear and other litter back to port. The PFRD aims to improve collection of waste from ships (including fishing vessels) in general, i.e. handling of fishing gear waste is not targeted specifically. The directive assumes that further steps to improve the collection and treatment of fishing gear will be considered under the European Plastics Strategy.

The PRFD is relevant for all recommendations regarding harbour reception of DFG, collection, sorting and waste management of retrieved and end-of-life fishing gear.

**2 THE EUROPEAN PLASTICS STRATEGY** envisions an EPR scheme for fishing gear that is meant to fund awareness raising among fishers, educational materials, retrieval actions at sea, and improved waste management and recycling schemes. Although artisanal net manufacturers are excluded from extended producer responsibility, collaboration between waste managers and net producers should be fostered to allow for a higher percentage of recyclable materials in fishing gear and easier processing. This development is easier with local manufacturers than with international companies on the global fishing gear market.

Because the European Plastics Strategy explicitly addresses fishing gear as a source of marine litter requiring mitigation measures, this strategy is particularly relevant for all MARELITT Baltic recommendations related to the fishing gear life cycle and waste management.

**3 AN EXTENDED PRODUCER RESPONSIBILITY (EPR) SCHEME** for fishing gear containing plastic should be introduced. A deposit scheme and a recycling target should be added to further enhance the return levels for fishing gear. Challenges involve high implementation costs, even for the fishing and net manufacturer sectors, and greater administrative burdens and handling efforts. An EPR scheme is potentially the most effective tool to diminish the amount of DFG by ensuring return of all fishing gear to port and an even more responsible handling of fishing gear at sea. According to the EU's proposed strategy for single plastic use, it builds on and supplements the Control Regulation and the proposed revised Port Reception Facilities Directive by adding a dedicated mechanism facilitating separate collection and return of fishing gear to collection systems and treatment of waste fishing gear, especially where recycling is feasible.

**4 COMMON FISHERIES POLICY (CFP).** Reporting of lost gear is already included as an obligation in the control regulation under the CFP. Fishers are required to attempt to retrieve lost gear and are only obliged to report gear loss if their retrieval efforts fail. However, neither reporting nor any form of retrieval at sea is controlled, and reports of gear loss are the exception in MARELITT Baltic partner countries. Incentives for reporting lost gear and a financing system for retrieval activities will be required to enforce the legal requirements in the CFP.

**5 MARPOL 73/78 (**International Convention for the Prevention of Pollution from Ships). The revised MARPOL Annex V prohibits the discharge of all garbage into the sea. The ability to comply with the MARPOL requirements depends largely on the availability of adequate port reception facilities, especially within special areas. The Baltic Sea is considered a Special Area established under Annex V. The Annex obliges governments to ensure the provision of adequate reception facilities at ports and terminals for the reception of garbage.

**6** **THE WASTE DIRECTIVE** The revised Waste Directive sets clear targets for waste reduction. Key elements of the revised proposal include: concrete measures to promote re-use, by turning one industry's by-product into another's raw material; economic incentives for producers to put greener products on the market and support recovery and recycling schemes; for the first time, Member States must identify which products are the main sources of littering in the natural environment and take measures to reduce them; for the first time, producers will be required to pay for public information and communication campaigns on litter prevention. *Source: CEN web bulletin*

**7** **AN EU ACTION PLAN FOR THE CIRCULAR ECONOMY** Part of the EU's shift to a circular economy involves preventing the littering of resources which could be used again instead of polluting our environments. Parliament is considering various ways to finance greater litter prevention efforts. These include imposing part of that cost on producers of items that end up as litter, for example, by making the cost of participating in extended producer responsibility schemes (EPRS) vary in proportion with a product's occurrence as litter. Generally, litter prevention measures under discussion are becoming increasingly specific, with some even proposing to require that EU countries develop specific measures to target items that "are the main source of littering", including the top ten items found littered on beaches.

Proposal for a circular economy approach for fishing gear, including recycling into different products as carried out for end-of-life fishing gear today, promotes an economically viable and ecologically sustainable treatment of fishing gear. A circular economy of fishing gear would be a way of ensuring regular recycling and minimising future losses due to the rising material value. This has relevance to all aspects of DFG treatment and recycling. *Source: CEN web bulletin*

**8** **THE EUROPEAN MARITIME AND FISHERIES FUND (EMFF)** supports marine litter and DFG retrieval actions by the fishing sector. Application procedures are complex and must be simplified to enable access by individual fishers and small-scale fishery associations. The upcoming 2021 EMFF is currently being debated at the EU level. Continued support of ecosystem improvements, such as DFG and marine litter retrieval, storage, transport and disposal, is highly desirable to encourage the involvement of the fishing sector and leverage fishers' expertise during DFG mitigation measures.

Depending on the opportunities provided in the coming EMFF period, funding can be relevant for all aspects of DFG retrieval, landing, reception facilities/containers and storage, as well as waste management.

**9** **FAO 1995 CODE OF GOOD PRACTICE** defines a homogenous gear-marking system to be implemented worldwide. As early as 1995, the Food and Agriculture Organisation of the United Nations began investigating gear marking as a tool for mitigating loss and the impact of derelict fishing gear in all seas. If implemented as obligations into international and national legislation, the recommended marking systems can prevent the discarding of fishing gear at sea thanks to owner awareness, and can increase incentives to act responsibly.

**THE FAO'S 2018 TECHNICAL CONSULTATION REPORT** on fishing gear marking presents recommended gear-marking systems for fishing gear commonly used throughout the world.

A universal gear-marking system is relevant for the prevention of fishing gear loss and impact mitigation.

# BEST PRACTICES

## Best Practice 1

### ICELANDIC RETURN SYSTEM IN PLACE

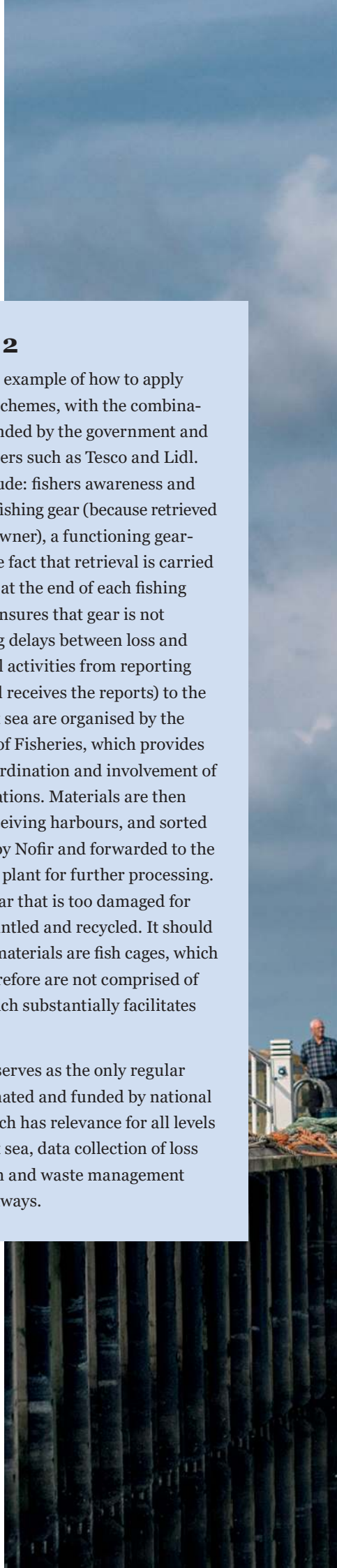
A refund system is in place for each discarded end-of-life net or net segment returned to the manufacturer. The manufacturer will repair nets when possible and sort non-repairable nets for recycling. This increases the number of nets kept in good condition and the regular use-time of nets. Non-repairable, sorted materials are then sent to Nofir in Lithuania for further processing and are likely recycled at Plastix in Denmark or Aquafil in Slovenia. The return system allowed for more than 90% of all discarded and collected fishing gear in Iceland to be shipped for recycling, or a total of 8,400 tonnes in the 11-year period 2006–2016. The key to the success of the recycling system is the availability of local collection points, financial incentive and awareness of fishers to enable material sorting, as well as the availability of receiving companies to manage fishing gear as recycling materials.

The Icelandic fishing gear return system serves as an excellent example in which a financial incentive for gear return created a waste management system that supports long-term use, return to port, and recycling of fishing gear. This system is therefore a relevant case study for all aspects, from harbour reception, pre-processing and sorting through to material recycling.

## Best Practice 2

Norway provides a good example of how to apply national DFG retrieval schemes, with the combination of DFG retrieval funded by the government and the engagement of retailers such as Tesco and Lidl. The keys to success include: fishers awareness and incentives to report lost fishing gear (because retrieved gear is returned to the owner), a functioning gear-marking system, and the fact that retrieval is carried out regularly every year at the end of each fishing season. This last point ensures that gear is not disposed because of long delays between loss and retrieval. In addition, all activities from reporting (The coast guard central receives the reports) to the retrieval organisation at sea are organised by the Norwegian Directorate of Fisheries, which provides the required level of coordination and involvement of fishers in retrieval operations. Materials are then pre-processed in the receiving harbours, and sorted materials are collected by Nofir and forwarded to the Lithuanian dismantling plant for further processing. This ensures that the gear that is too damaged for re-use is properly dismantled and recycled. It should be noted that retrieved materials are fish cages, which do not entangle and therefore are not comprised of mixed marine litter, which substantially facilitates material recycling.

The Norwegian system serves as the only regular retrieval system coordinated and funded by national authorities. This approach has relevance for all levels from retrieval actions at sea, data collection of loss areas, harbour reception and waste management including recycling pathways.

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# THE BALTIC SEA BLUEPRINT – PRACTICAL ADVICE FOR IMPLEMENTING DFG MITIGATION

## Integration of activities at sea and on land is crucial

MARELITT Baltic provides crucial findings for avoiding inconvenience during DFG mitigation. One is the need to run several parallel activities, which can also be carried out by different stakeholders. A case in point is the need to perform two steps before kicking off large-scale clean-up actions at sea.

The first step is securing adequate DFG waste reception and pre-handling capacity in the harbours where nets are expected to be landed. The second is planning collection and further transport of DFG waste from harbours to a contracted waste or recycling company. Namely, successful clean-up actions require good weather. In practice, this means that most of the clean-up campaigns will likely take place during the summer. Recycling companies and sorting facilities must be prepared to receive irregular waste streams with a peak during the summer months. Processing capacity must be available in the peak retrieval season.

Huge heaps of nets filled with dead fish, along with tourists enjoying the sun and sea, are not an optimal combination. Clearly, coastal municipalities or harbour administration companies responsible for waste management must play a central role in national policy building.

## DFG host area map – a cornerstone for strategic planning

The results of MARELITT Baltic strongly suggest that DFG, at least when originating from commercial fisheries, is seldom evenly distributed geographically. Lost fishing gear tends to concentrate in certain hot spot areas. Identifying these hot spots with higher DFG densities provides the potential for better cost efficiency (more retrieved netting per invested money) and eventually in relative terms faster DFG mitigation. To achieve a high retrieval rate, hot spots with high DFG densities must be identified before operations at sea are commissioned.

Furthermore, geographically concentrated clean-up actions provide the opportunity to select harbours with the best locations or reception facilities for the efficient handling of retrieved DFG. They can also help to improve DFG handling capacity in strategically selected harbours instead of general investments in all coastal fishing harbours. Necessary infrastructure investments in harbours can be weighed against logistics costs, such as the cost of longer transport distances from retrieval site to harbour and onwards to the waste management/recycling company.

A DFG host area map can be used to improve long-term strategic planning of DFG clean-up actions. For example, conflicts can be avoided with marine archaeological conservation plans for underwater sites or objects with a high cultural heritage value.

## DFG treatment scheme

The DFG treatment scheme is intended for policy makers, as it provides recommendations for expanding existing waste management systems to build up capacity for managing DFG and other mixed marine litter. The DFG treatment scheme also contains advice for harbours and retrieval teams on existing disposal pathways for DFG, and on how to process retrieved gear for acceptance by thermal processing or recycling facilities.

Hence, the DFG treatment scheme provides advice on the national, European and broader international levels on promoting extended waste management options and facilitating DFG retrieval actions in the future. In the long term, the implementation of the recommended treatment options for fishing gear might prove to be valuable even for other materials, such as textiles, shipping ropes, packaging and other fibres.

# EXECUTIVE SUMMARY OF KEY FINDINGS

## Key findings from Pillars I and II

To facilitate future mapping of DFG host areas and retrieval operations at sea, the MARELITT Baltic project provides the following summary of recommendations:

1. **Established or improved cooperation** with fishers and divers is a crucial step for both the development of DFG host areas maps and the proper execution of retrieval operations.
2. **Collection of practical knowledge** from fishers and divers, together with current and historical official statistical data and cultural heritage information, can improve the process of DFG host area mapping and identifying zones with conflicts between active and passive fishing gear.
3. **Using modern techniques,** such as multi-beam or side-scan sonar, to map wrecks and potential DFG host areas, is both a cost-efficient and more environmentally friendly survey method than "blind search" with towed hooks (a creeper).
4. **DFG host areas map** can be used as a tool to determine cost-efficient retrieval actions, to select appropriate harbours for DFG landing, and subsequently to improve reception capacity at strategic harbours.
5. **Draw attention to knowledge** presented in the Environmental Impact Assessment report developed within the MARELITT Baltic project, to ensure an ecologically sound retrieval of DFG.
6. **Involvement of underwater** archaeologists and other experts when planning and conducting retrieval operations can help minimise the risk of damage to underwater objects and cultural heritage values.
7. **A quality assurance system** and an internationally harmonised documentation of results should be developed to ensure the standardisation of practical operations at sea and documentation of the retrieval results.
8. **EMFF or other** financial schemes must be optimised to enable efficient financing of clean-up and other activities connected with DFG mitigation actions.
9. **Initiated diving operations** should be carried out by professional or specifically trained retrieval divers, in compliance with all applicable legislation.

## Key findings from Pillars IIIa and IIIb

To facilitate future DFG retrieval operations, the MARELITT Baltic DFG treatment scheme provides the following summary of recommendations:

1. **Collection facilities** in fishing harbours, with separate containers/areas for end-of-life and retrieved fishing gear.
2. **Pre-processing areas** in fishing harbours where nets can be laid out and bulky items and lead lines removed.
3. **Regular collection tours,** 2–4 times per year depending on fishing gear waste amounts, along each country's coastline from harbour to harbour to minimise collection costs and to avoid empty hauls.
4. **Establishing a sorting system** with existing waste sorting companies that allow for DFG processing.
5. **Supporting alternative** thermal processing technologies at existing incineration or other waste treatment plants, e.g. a small-scale steam reforming or pyrolysis system for electronic and hospital waste that can also process DFG.
6. **Awareness-raising and education** of fishers and other retrieval parties about the environmental hazards of lead and the necessity to pre-process both DFG and end-of-life fishing gear before disposal.
7. **Create a network** of "harbours against marine litter", with collection facilities for marine litter retrieved during fishing activities at sea and fishing gear; the harbour locations can become part of the hot spot map depicting high-gear loss areas, and a label similar to the "green deal for harbours" label in the Netherlands might be used to promote harbours supporting the marine litter initiative.

## Key findings from Pillar IV

A sustainable long-term mitigation of the DFG problem requires actions that reduce the number of nets lost during fishing operations. MARELITT Baltic has assessed relevant methods to achieve this goal using a strategic fishing approach and provides the following conclusions and recommendations:

1. **Prevention is** a delicate issue for fishers. It is important to earn the trust of the fishing sector. One way to do this is to involve fishers more in this work.
2. **Because of** their extensive practical knowledge, fishers can play a major role in mapping DFG host areas (Pillar I) and in assessing the causes of lost fishing gear (Pillar IV).
3. **By implementing** Pillars I and IV in parallel, together with the fishing sector, you can build a mutual understanding of the DFG problem and its mitigation.
4. **The three main causes** of gear loss in the Baltic Sea areas studied were 1) conflicts between trawlers and passive gear fishing fleets, 2) seabed obstacles (including shipwrecks) causing net snagging, and 3) environmental factors (strong currents, ice, wind or waves).
5. **Fishers cannot always** take strategic decisions (like selecting fishing grounds) to manage the risk of gear loss. Profit in terms of maintained catch rate is a consideration that must be weighed.
6. **A reduced** fleet size and fishing effort contribute to a lower gear loss rate. Thus, in some areas DFG was considered mainly a historic problem while in other areas due to higher fishing effort and morphologic characteristics, gear loss reduction was found to be difficult.
7. **Generally, it seems** that variations in how fishing is strategically conducted, seabed morphology and characteristics (rocky or smooth), and environmental factors (water currents, storm events or ice cover) contribute to regionally differentiated gear loss patterns.
8. **Improve and enforce** fishing gear marking and reporting of gear loss during fishing. Generally, both of these actions were the foundation of prevention and are currently in place in many countries but are not working properly.
9. **Today's coastal fishing** sector is facing severe economic challenges. Raised environmental awareness and a positive attitude towards DFG mitigation alone will not likely change fishers behaviour, because replacing common practices with alternative fishing technologies entails costs. The fishing sector must be able to offer financial incentives to reward more responsible fishing practices that use sustainable gear and avoid wreck fishing, for example.
10. **The project** observed large differences in the fishers ability to commit to implementing methods for reducing gear loss. In some cases, they refused to discuss prevention. At the other extreme, some were prepared to use methods that would reward responsible fishers according to a responsible fisheries scheme. We recommend moving forward when there is broad regional acceptance for and interest in implementing a responsible fisheries scheme.
11. **The commercial** fishing sector is not solely responsible for gear loss. Recreational fishers and illegal fishing have been addressed as potential major contributors of gear loss in countries like Estonia and Sweden.

# MARELITT BALTIC REPORTS

## 1. Derelict fishing gear mapping and retrieval methodologies

This report presents the methodologies used to map the host and hot spot areas and select retrieval areas as well as analyse the data from retrieval activities carried out in the project. It also contains recommendations related to future activities aimed at reducing the impact and the amount of derelict fishing gear deposited in the Baltic Sea.

*Sylwia Migdał, Marta Kalinowska & Piotr Prędki, WWF Poland Foundation*

## 2. Strategies for preventing gear loss during fishing in Baltic Sea

A sustainable long-term mitigation of the DFG problem requires a reduction of the number of nets that are lost during fishing operations. This study is assessing potential solutions using a fishing strategic approach to achieve the goal.

*Vesa Tschernij, Municipality of Simrishamn*

## 3. Development of a fishing gear marking system based on passive RFID technology

Objective of this study was to develop a modern, practical high-tech solution for fishing gear marking allowing automatic identification and processing of recorded "in situ" data. The developed solution is a low-cost "smart tag" based on UHF RFID technology. The tag can be used with both new and existing fishing gear. Report contains results of both laboratory and field tests during authentic fishing operation and discusses a large-scale implementation in practical fishing.

*Michał Grabia, Dr. Eng., Tomasz Markowski, Piotr Sitarz, Bartosz Kaczmarek, Klaudiusz Borowiak, Institute of Logistics and Warehousing*

*Piotr Gruszka, Ph.D. Maritime Institute in Gdansk*

## 4. Harbour Reception Survey

This survey aimed to assess the readiness, capability and capacity of the Baltic Sea fishing harbours to receive, separately collect and sort the derelict fishing gear (DFG) collected from the sea as well as end-of-life fishing gear.

*Marek Press, Keep Estonian Sea Tidy*

## 5. Recycling Options for DFG

This technical feasibility report describes in detail the results of all DFG recycling trials and the physical and chemical properties derived to evaluate the material quality of lost fishing gear retrieved from the Baltic Sea.

*Dr. Andrea Stolte, WWF Germany & Falk Schneider, University of Bath, UK*

## 6. DFG treatment scheme

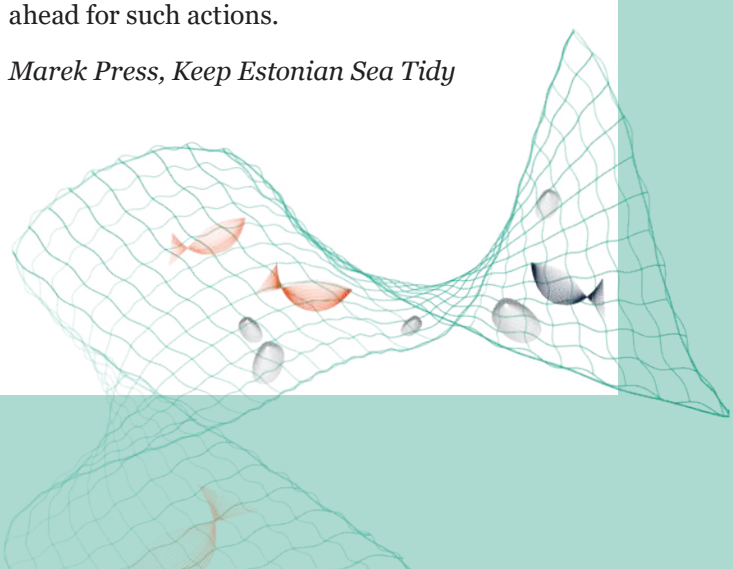
This report provides a roadmap for the processing of DFG after it lands in port. The DFG treatment scheme covers practical and policy recommendations for all DFG management stages, from harbour reception to recycling or disposal.

*Dr. Andrea Stolte, WWF Germany*

## 7. Practical guidance on DFG pre-processing

The report describes the practical requirement and needs of how to pre-process DFG in the ports, which tools needed and what to plan ahead for such actions.

*Marek Press, Keep Estonian Sea Tidy*



# EXTERNAL REPORTS

## 8. Prestudy on Sonar Transponder

One of the critical challenges of the MARELITT Baltic project is to identify more cost-efficient techniques – enabling more environmentally friendly, smoother and more accurate ways to detect and locate lost fishing gear. This literature study looks at different ways to strengthen the echo from sonars to assess the possibility to "better see DFG in future".

*Dag Lindahl & Leigh Boyd, Avalon Innovation Sweden*

## 9. Environmental Impact Assessment – Retrieval of derelict fishing gear from the Baltic Sea

This EIA evaluates DFG retrieval methods used in MARELITT Baltic and in other marine areas with respect to their ecological viability. An assessment is provided of the risks for characteristic and sensitive Baltic Sea habitats originating from DFG retrieval operations and from leaving DFG on the seafloor. The EIA recommends non-invasive search and removal methodologies for sensitive areas and provides a decision tree facilitating future retrieval operations in the Baltic Sea and similar marine ecoregions. The EIA was commissioned to WSP Stockholm, Sweden, and was conducted by Jonas Sahlin and Ingrid Tjensvoll.

*Jonas Sahlin & Ingrid Tjensvoll, WSP Sweden*

## 10. Ammunition risk assessment (ARA)

The Baltic Sea is a hot spot for ammunition remains from World War I and World War II. Ammunition bodies and fragments are omnipresent throughout the southern Baltic all the way to Bornholm Bay. The ARA evaluates the risk to retrieval and diving teams during the search and removal of DFG from the Baltic Sea. The ARA presents the health hazards of ammunition and chemical warfare and provides medical first-aid mitigation measures. It also contains maps to facilitate avoiding ammunition risk in order to plan future retrieval operations. The ARA was commissioned to EGEOS GmbH Kiel, Germany, and was compiled by Jann Wendt and Ezra Eisbrenner with support from ammunition, chemical and ecotoxicological experts.

*Jann Wendt, Ezra Eisbrenner et al. EGEOS GmbH*

## 11. Study on logistics and infrastructure required for DFG treatment

The logistics study is an external investigation providing recommendations on the infrastructure required to allow for DFG and end-of-life fishing gear to enter the existing waste management system. The study also incorporates an economic analysis of the expected costs for regular waste management of both retrieved and discarded, end-of-life fishing gear (economic viability). The logistics recommendations were compiled by Fraunhofer Institute UMSICHT in Oberhausen, Germany, and served as input to the DFG treatment scheme.

*Jochen Nühlen, Ralf Bertling, Fraunhofer UMSICHT Oberhausen*

## Literature

*FANTARED 2, Final report, EU Study contract FAIR CT98-4338, 2002.*

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