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REPORT

MARCH 2013

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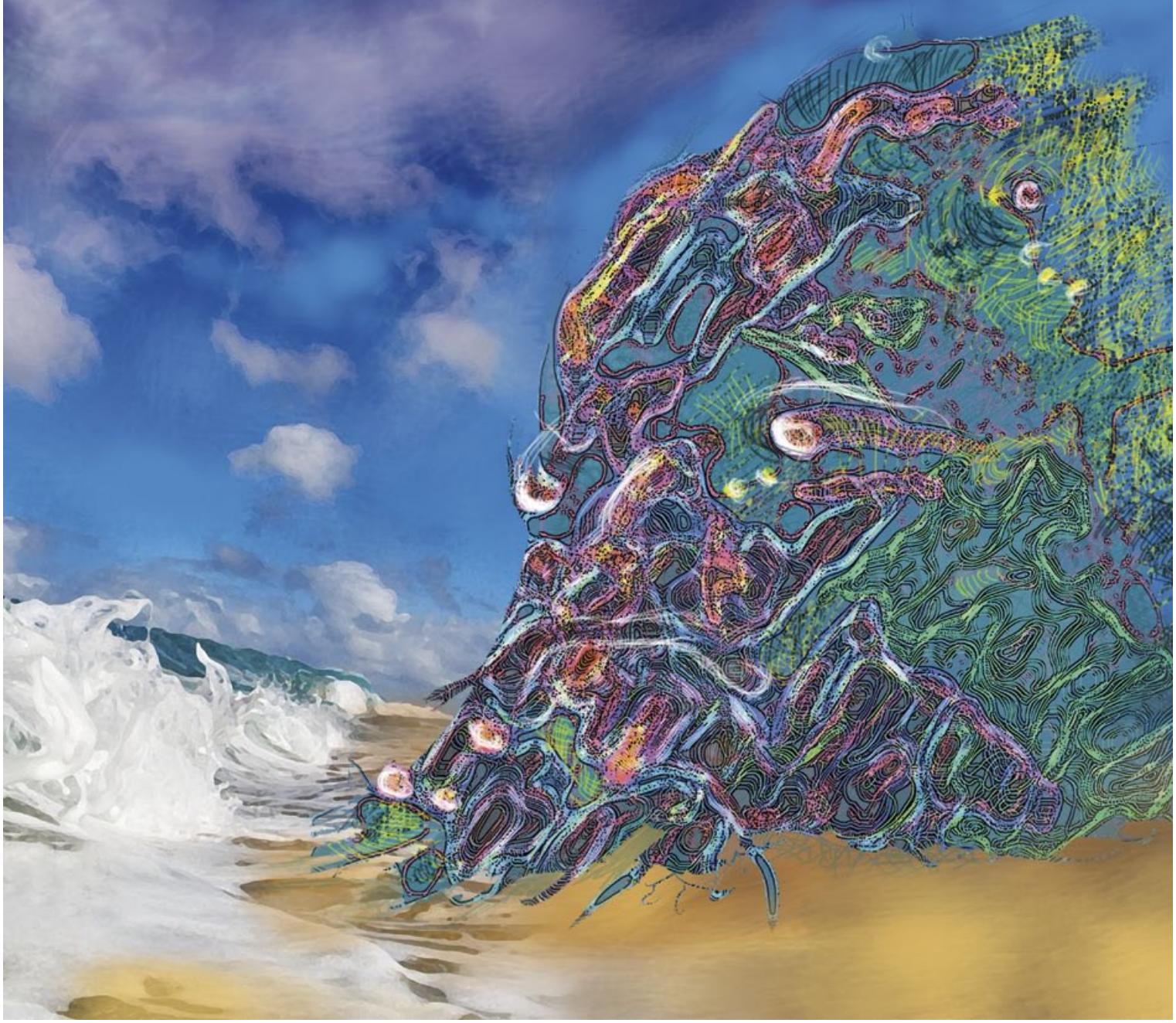
BalticSea2020

COLLECTING GHOST NETS IN THE BALTIC SEA

FINAL REPORT ON THE ACTIVITIES CONDUCTED IN 2012



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WWF Poland

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BalticSea2020

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1. Introduction

The pilot project titled "Collecting ghost nets in the Baltic Sea"[1] implemented in Poland in 2011 demonstrated beyond any doubt the need to continue the undertaking and to extend its spatial scope to include the waters of other Baltic region countries. In 2012 Lithuania joined the efforts to remove ghost nets from the Baltic Sea.

First, an international panel of experts from both countries was formed, with the intention of collecting comprehensive information on the issue of ghost nets remaining at sea beyond any control and supporting the Project Manager and national coordinators in the net removal efforts. In summer 2012, actions at sea were carried out, involving retrieving nets from the sea bottom and removing them from shipwrecks. In addition to these activities, an interactive map of "hooks" in the Baltic Sea was created, indicating the locations of shipwrecks and other objects remaining on the sea bottom that constitute obstacles for trawling.

Despite the increasingly common use of more precise fishing navigation employing the GPS system damaged net fragments, often including accessories (ropes, weights, chains etc.), continue to accumulate on shipwrecks and similar obstructions (often unmarked on nautical charts). As well as retaining their fishing capacity, thus reducing the use of fish resources by people, they constitute a danger for submarine tourism and may constitute a direct risk to life[2].

This report is an overview of the most important aspects of the phenomenon of ghost nets and legal regulations related to polluting the sea with fishing gear, based on the literature and observations made in the course of the project.

[1] WWF Poland 2011: Efekty ekologiczne działań przeprowadzonych w ramach projektu pilotażowego "Usuwanie zalegających sieci z Bałtyku" (Environmental effects of the activities in the framework of the pilot project entitled "Collecting ghost nets in the Baltic Sea"). Final report. http://www.wwf.pl.

[2] Urząd Morski w Gdyni (Maritime Office in Gdynia) 2006: *Informacja o zbiorowym wypadku śmiertelnym nurków na wraku statku „Goya" w dniu 21 kwietnia 2003 r. (Report on a collective fatal accident on the wreck of "Goya" on 21 April 2003).* http://www.umgdy.gov.pl/pium/jednostka?menuId=5991&kodJednostki=abul4zaqt2.6h27ldaqt1&id=19702.

The pilot project titled "Collecting ghost nets in the Baltic Sea" implemented in Poland in 2011 demonstrated beyond any doubt the need to continue the undertaking and to extend its spatial scope to include the waters of other Baltic region countries.

1.1. The phenomenon of ghost nets – literature review with particular regard to the Baltic Sea

Regardless of the scale on which the issue of ghost nets is considered – global, European or limited to the Baltic region – it remains in the sphere of the problem of marine debris. This issue with regard to the contamination of seas and oceans has been addressed in a report by UNEP-FAO[3], in an American study concerned with tackling marine debris in the 21st century[4], and in the European Commission study of October 2012[5]. These three major sources of information on the phenomenon of ghost nets show a comprehensive approach to the issue, beginning with the root of the phenomenon, i.e. the common use of plastics in the production of fishing gears, through a description of different types of marine fishery generating wastes that pose the greatest danger for the environment, together with an analysis of the effect of these wastes on the resources of commercially exploited sea organisms, and ending with identification of possible preventive measures, as well as methods of retrieval and disposal of net fragments and other components used by fishing fleets all over the world. In view of the universal character of the theoretical considerations contained in these studies and the proposed practical solutions, it may be assumed that a similar approach to the issue of ghost nets in the Baltic

[3] Macfadyen, G. et al. 2009: *Abandoned, lost or otherwise discarded fishing gear*. UNEP Regional Seas Reports and Studies, No. 185; FAO Fisheries and Aquaculture Technical Paper, No. 523, Rome UNEP/FAO.

[4] National Research Council. 2008. *Tackling Marine Debris in the 21st Century*. National Academy Press, Washington, DC.

[5] COMMISSION STAFF WORKING DOCUMENT SWD (2012) 365 FINAL, Brussels, 31.10.2012. *Overview of EU policies, legislation and initiatives related to marine litter*.

Sea would be entirely appropriate. The quoted sources of scientific information and legal regulations constitute a vast and comprehensive knowledge base related to the highly specific issue of ghost nets and may be referred to for further information. A more region-specific source is the report summarising the pilot project entitled “Collecting ghost nets in the Baltic Sea”.

Information on the fishing capacity of ghost nets can be also found in the “Fisheries Research” journal of 2003[6], containing studies of 8 specific examples of fishery activities using stationary fishing gear, including the Baltic Sea[7]. An especially interesting example was connected with commercial fishery above shipwrecks or in their close vicinity in the fishing grounds situated to the north-east of the British Isles – in simulated conditions, a net placed on a shipwreck displayed fishing capacity as long as 2 years after the beginning of the experiment[8].

A comprehensive presentation of the phenomenon of ghost nets in European waters can be found in a publication by Brown and Macfadyen[9], based on the results of the FANTARED project. The authors developed an analytical model in an attempt to quantify the environmental, social and economic effects of ghost nets. In terms of financial benefits, they found ghost net retrieval actions to be unprofitable. What must be taken into account, however, is the specific nature of the basin where the FANTARED project was conducted, consisting of vast open waters of the European part of the Atlantic. This assessment cannot be applied directly to the shallow and practically isolated Baltic Sea.

A new approach in terms of the theory of ghost net fishing capacity has been proposed by Takagi, Shimizu and Korte[10]. Their studies confirm that it is possible to apply numerical methods to model the changes in the shapes of set nets left for prolonged periods of time in the sea, and thus give up the conventional physical methods used in the theory of fishing gear design and obtain an accurate reproduction of the actual conditions of fishing by ghost nets.

[6] Pawson M. G. [ed.] 2003: *The catching capacity of lost static fishing gears: introduction*. Fisheries Research, 64 (003) p. 101-105.
[7] Tschernij V, Larsson, P.O., 2003: *Ghost fishing by lost cod gill nets in the Baltic Sea*. Fisheries Research, 64 (2003): 151-162.
[8] Revill A.S. and Dublin G. 2004: *The fishing capacity of gillnets lost on wrecks and on open ground in UK coastal waters*. Fisheries Research, 64 (2003): 107-113.

[9] Brown J., Macfadyen G. 2007: *Ghost fishing in European Waters: impacts and management responses*. Marine Policy 31 (2007) 488-504.
[10] Takagi T., Shimizu T. and Korte, H. 2007: *Evaluating the impact of gillnet ghost fishing using a computational analysis of the geometry of fishing gear*. ICES Journal of Marine Science, 64: 1517-1524.

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Sport and recreational fishing may present a danger for marine ecosystems in the littoral zone.

The recently published NOAA technical memorandum[11] is concerned with optimising the strategy of locating lost fishing gear and the choice of appropriate fishing management methods. Although it refers to specific basin and trap devices, the report is noteworthy in view of the hydroacoustic equipment used, the choice of search areas in cooperation with fishermen and on the basis of the information provided by them concerning the location of traps and the most likely reason for their loss (with theft and vandalism mentioned as some of the most important reasons). Meanwhile, a recent publication by Korean authors indicates that also sport and recreational fishing may present a danger for marine ecosystems in the littoral zone.[12]

In addition to the above examples from the academic and practical spheres, another important source of information on the issue of ghost nets as marine debris is educational materials, including publications of a more popular character. An example of such literature is the report by the London-based World Society for the Protection of Animals.[13]

1.2. Summary of the pilot project "Collecting ghost nets in the Baltic Sea" conducted in 2011

The principal goals of the pilot project implemented in 2011 were as follows:

- estimating the quantity of ghost nets in the Baltic Sea and other basins and evaluating the role of shipwrecks as locations where lost fishing gear accumulates;
- assessing the feasibility of estimating the fishing capacity of ghost nets and their impact on the Baltic fish populations;
- listing the main causes of the presence of ghost nets;
- presenting information on the national and EU regulations concerning abandoned and lost fishing gear, its removal and disposal;
- conducting open sea operations involving searching the sea bottom for ghost nets;
- trial diving operations to retrieve ghost nets from shipwrecks.

To attain the established goals, a method was developed in order to estimate the quantity per year of lost fishing gear that is most likely to turn into ghost nets, i.e. set nets used in cod and flounder

[11] Clark, R., S.J. Pittman, T.A. Battista, and C. Caldow (eds.). 2012. *Survey and impact assessment of derelict fish traps in St. Thomas and St. John, U.S. Virgin Islands*. NOAA Technical Memorandum NOS NCCOS 147. Silver Spring, MD. 51 pp

[12] Macfadyen, G. et al. 2013: *Impacts of marine debris on wild animals in the coastal area of Korea*. Marine Pollution Bulletin 66 (2013) 117-124.

[13] Butterworth, A., Clegg, I., Bass, C. 2012: *Untangled – Marine debris: a global picture of the impact on animal welfare and of animal-focused solutions*. London: World Society for the Protection of Animals.

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fishery, which yielded the result of 5 500–10 000 pieces/year for 2005–2008 (the unit of measure was a single net constituting an element of a fishing setup). Based on divers' observations and data concerning the number of shipwrecks, the quantities of towed fishing gear (pair trawls) lost when entangled in obstacles and remaining on the bottom of the Baltic sea were estimated at between 150 and 450 tonnes of netting, depending on the assumed number of shipwrecks – these results only apply to the Polish territorial sea and Polish exclusive economic zone.

The final report on the pilot project describes the main causes of the phenomenon of ghost nets abandoned in the sea and gives an overview of the EU and Polish legal regulations applying to marine fisheries in terms of prevention of fishing gear damage or loss and intended to deter fishermen from abandoning them deliberately.

A commercial fishing vessel KOŁ-111 was chartered for 24 days of sea action with the intention of scanning the sea floor for ghost nets: 15 days of open sea actions aimed at retrieving ghost nets from the sea bottom and 9 days of actions using the cutter as a base for divers cleaning two shipwrecks of ghost nets. All the activities involving the vessel were carried out between July and September 2011. When choosing the vessel, its skipper's and owner's excellent knowledge of the fishery area selected for the operations was taken into account, as well as the vessel's seakeeping ability and equipment. As part of the charter, the cutter was additionally equipped with a gate on the starboard side, a gangway and a dinghy with an outboard motor to serve the divers in the course of the shipwreck cleaning operation. The search area was located north of the Kołobrzeg port and covered 2 so-called divisions of statistical rectangles[14] designated with symbols G-3 and G-4, where the sea floor is largely covered with large stones and rocks and where derelict fishing gear was likely to be found. During the operation, the equipment for scanning the sea floor was modified and the optimum towing speed was established (1.0–1.2 knots). The operation yielded 4 288 kg of retrieved fishing nets, 93% of which were set nets.

The operation yielded 4 288 kg of retrieved fishing nets, 93% of which were set nets.

[14] In the Mercator projection they consist of rectangles with a base equal to 20 minutes longitude and sides of 10 minutes latitude.

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Eventually, 2 shipwrecks were selected and a team of 4 divers from DALBA – a specialist company – using the KOŁ-111 cutter as the diving base, retrieved 1,807 kg of entangled unmarked fishing gear from them, mainly set nets and trawl nets.

Even though the retrieved fishing gear showed varying degrees of deterioration, most of the nets contained caught fish – mainly flatfish and cod. Numerous signs suggesting that angling equipment had been lost were also observed. It was difficult or even impossible to scan the areas where the likelihood of finding ghost nets was the highest due to the presence of nets legally set in these locations, which shows the necessity of arranging in advance the locations and dates of actions with fishermen and their organisations, in cooperation with the Fisheries Inspectorates. Similar cooperation is also required with respect to the removal of ghost nets from shipwrecks by divers. These actions were additionally restricted by a technical factor, i.e. the 20-metre maximum depth of diving work. Eventually, 2 shipwrecks were selected and a team of 4 divers from DALBA – a specialist company – using the KOŁ-111 cutter as the diving base, retrieved 1,807 kg of entangled unmarked fishing gear from them, mainly set nets and trawl nets. The nets showed a significant degree of deterioration; nevertheless, fish were also found in them. Based on the experience acquired, it was established that the time allocated for cleaning each shipwreck should be increased to 8 working days in the case of shipwrecks situated at a depth of up to 20 metres. For shipwrecks at greater depths the duration of underwater work should be determined separately in each case, based on a prior inventory of the shipwreck. The samples obtained from the retrieved gear were analysed to determine the waste category into which they may fall in accordance with applicable Polish regulations. The samples were found to contain an elevated mineral oil (C_{10}-C_{40}) content, which shows the need for measures with a view to creating an appropriate waste code for fishing nets contaminated with mineral oil.

Evaluation of the fishing capacity of ghost nets and their impact on Baltic fish populations is of special importance since the absence of any information on this phenomenon leads to a situation where scientists disregard it altogether when estimating the overall fishing mortality, which leads to less efficient resource management. For this purpose, an analytical method was employed, taking into account the results of Swedish research (the only one of that type available for the Baltic region), as well as the necessity of adopting a number of restrictions and additional assumptions as to the probability of specific events, e.g. the method was limited to set nets and a single species (cod). The most probable result obtained, related to the damage caused by ghost nets with respect to the Baltic cod population in 2009-2011, was 20.8 tonnes per year for nets lost in 2009.

1.3. Information on the project titled “Collecting ghost nets in the Baltic Sea” conducted in 2012

To reduce the incidence of equipment loss, an interactive database of obstacles (“hooks”) present on the sea bottom was created and is now available in three languages on the website ***sieciwidma.wwf.pl***.

The basic assumption of the 2012 edition of the project was to make it international by extending the range of operations to the territorial waters of the Republic of Lithuania and using a vessel for towing the retrieval equipment and divers for cleaning shipwrecks of ghost nets. The scope of operation of retrieving ghost nets remaining on the sea bottom of Polish waters was extended by deploying three additional Polish fishing vessels and a research and training vessel belonging to the Maritime University of Szczecin – M/V “Navigator XXI” – thus increasing the number of days of sea actions accordingly. To reduce the incidence of equipment loss, an interactive database of obstacles (“hooks”) present on the sea bottom was created and is now available in three languages on the website sieciwidma.wwf.pl. The database has an open character, new items may be added by all sea users, which should result in greater accuracy of the map. Magnetic badges advertising the database were distributed among fishermen and other sea users.

The activities summarising the individual stages of project implementation and aimed at education were organised in Poland and Lithuania in the form of seminars combined with press conferences; the publications included the report for 2011 and, in Lithuania, an information brochure for tourists, fishermen and students. To gain more comprehensive knowledge on the scale of the problem of ghost nets in Lithuania, a survey was conducted among the fishermen, including 79% of vessel owners from that country. During the preparation of this report, information was obtained concerning the waste handling procedures in Polish ports and fishing harbours and the possibilities of recycling of the nets retrieved from the sea using innovative technologies with a minimum environmental impact. Specific data are presented in the following part of this report.

2. Description of Polish and Lithuanian Baltic fishery in the context of the 2012 project implementation

2.1. Basic economic data

Both Polish and Lithuanian fisheries underwent profound changes in the period leading up to the countries' accession to the European Union and in the first years following the implementation of the Common Fisheries Policy in these states.
The changes involved, above all, the restructuring of both fishing fleets. In 2004–2008 the number of Polish fishing vessels on the Baltic Sea was reduced by 33%, and Lithuanian vessels by 26%; in Poland more vessels with a greater tonnage [GT] were scrapped, with a 45% reduction in this parameter (39% in the Lithuanian fleet)[15]. According to the EC Fishing Fleet Register[16], at present, the Polish fishing fleet in the Baltic consists of 792 vessels[17], and the Lithuanian fleet consists of 141 vessels.
In 2009, slightly more than 1,300 people were employed in the sea fishing sector in Poland, compared to 529 in Lithuania[18].

Before the accession of both countries to the EU, the catch size depended primarily on the availability of resources in their own exclusive economic zones, but since the implementation of the Common Fisheries Policy the determining factor has been the catch quotas applicable to cod, sprat, herring, salmon and European plaice, while the species of significance not subjected to catch limits include: the European flounder, sea trout and certain freshwater species living in the estuarine waters of large rivers flowing into the Baltic Sea. The catch quotas allocated to both countries in 2012 (initial numbers, not including possible quota exchanges with other countries) are shown in Table 1:

Table 1 *Catch quotas of species limited in the framework of the Common Fisheries Policy granted for 2012*

Species	Poland [tonnes]	Lithuania [tonnes]
Cod (total eastern and western stock)	20434	4317
Herring (total)	22256	2289
Sprat	66128	11272
Salmon (pieces)	7704	1899
European plaice	433	–

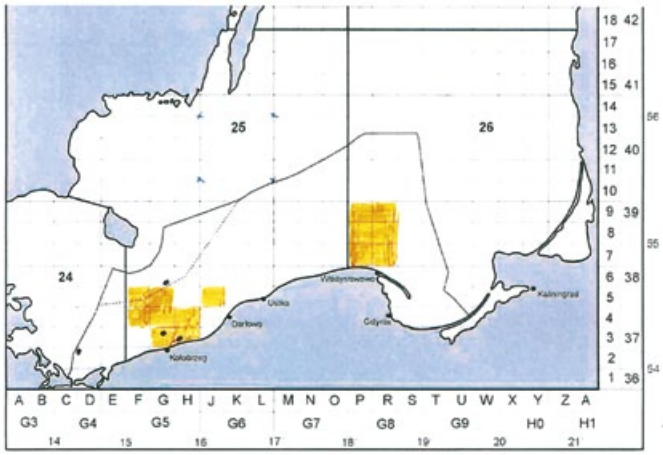
The degree to which the fishing quotas have been utilised by Polish Baltic fleet in recent years is related to the fact that part of the fleet has begun to specialise in catching small pelagic fish, which has resulted in an increased fishing pressure on the sprat, as well as central and western stock of herring. An increased degree of use of the fishing quota for pelagic species has been a consequence of these changes. The quota for cod has not been fully used for the past several years. According to the initial statistical data published by the Ministry of Agriculture and Rural Development based on the data kept by the Fisheries Monitoring Centre, 50% of the quota for cod had been utilised by 3rd of the January 2013. Similarly, the fishing quotas have not been fully used by Lithuanian fishery in the past few years: the cod catch has been around 3,000 tonnes (69%), the quotas for sprat and herring have not been fully used (except in 2007 and 2009), while the amount of European flounder caught has been of no economic significance (below 500 tonnes per year, compared to nearly 9,000 tonnes in Poland in 2012).

According to the EC Fishing Fleet Register, at present, the Polish fishing fleet in the Baltic consists of 792 vessels, and the Lithuanian fleet consists of 141 vessels.

[15] Kuzebski E., Marciniak B. 2009: *Mniej statków – więcej ryb? Społeczno-ekonomiczne skutki redukcji floty rybackiej na Morzu Bałtyckim. (Fewer vessels – more fish? Socio-economic effects of the reduction in the fishing fleet on the Baltic Sea)* WWF Poland www.wwf.pl/raportnzp.
[16] http://ec.europa.eu/fisheries/fleet/index.cfm.
[17] including vessels operated exclusively on internal waters
[18] European Commission 2012: *Facts and figures on the Common Fisheries Policy*. Publications Office of the European Union, 2012. [the data also include deep-sea fishery].

2.2. Description and comparison of the areas of operation as part of the project implementation in Poland and Lithuania

The exclusive economic zone of Poland has a far larger area than that of Lithuania (Poland – 29,797 km^2, Lithuania – 7,031 km^2); the same applies to the territorial sea area, because of the length of the coastline (Poland – 10,632 km^2, Lithuania – 2,018 km^2)[19]. Therefore it was necessary for the Polish partner to use the experience acquired in the course of the pilot project in 2011 in order to establish the areas of operation involving the retrieval of ghost nets remaining on the sea floor, which also depended on the location of the base ports for the vessels taking part in the operation. The area of operation of WŁA-11 cutter on 05–14/07/2012 was delimited by the meridians 17°58' E and 18°40' E and stretched between the coastal zone in the south to parallel 55°12' N in the north. The remaining 3 Polish cutters operated between 18/06 and 31/08 in the area stretching between meridians 15°00' E and 16°20' E and from the coastal zone to parallel 54°50' N. The divisions of statistical rectangles where the operation of ghost net retrieval was carried out are marked with a coloured line on the reference map above. The black dots in divisions D-2, G-3, G-6 and H-3 mark the locations where ghost nets were retrieved from shipwrecks by divers (the one in division D-2 was the previously identified and prioritised[20] wreck of "Memel", situated at an appropriate depth (18 m) and not very far from the port of Świnoujście[21]).

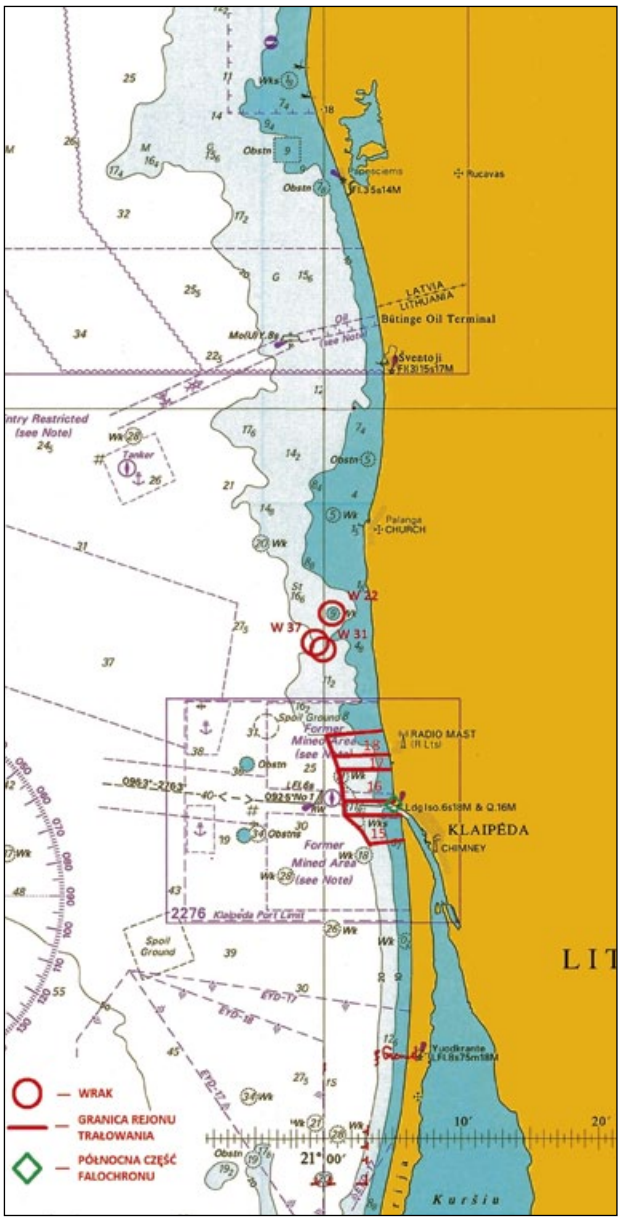


On the Lithuanian side, the areas where ghost nets were to be retrieved depended on the distribution of the fishing effort of the Lithuanian fleet using set nets, whereas the shipwrecks selected are situated in the vicinity of the Klaipeda port. In addition, ghost nets were retrieved from the underwater area of the breakwater protecting the entrance to that port.

[19] Suarez de Vivero, J.L. and Rodriguez Mateos J.C., 2007: *Atlas of the European Seas and Oceans*. Ediciones del Serbal, 146 p.

[20] Hac B., 2011: *Wraki na wodach wewnętrznych i terytorialnych oraz w polskiej strefie ekonomicznej. Raport z Seminarium lokalizacyjnego*, Warszawa 20 kwietnia 2011 r. w ramach Projektu pilotażowego. WWF Poland – Baltic Sea 2020.

[21] Szulc M., 2012: *„Sieci widma" na pokładzie „Nawigatora XXI" (Ghost nets on board "Nawigator XXI")*. Aktualności Akademii Morskiej w Szczecinie No 3 (75)/2012.



The operations in Lithuania are presented on the map above. This choice of locations is understandable in view of the different proportions between the amount of labour for net retrieval (16 days of diving and only 6 days so far for operating towed equipment due to adverse weather conditions; the remaining days will be used in March 2013, but the results will not be included in this report).

2.3. An attempt at estimating the difference in the number of ghost nets between Polish and Lithuanian waters

As part of the pilot project titled "Collecting ghost nets in the Baltic Sea" conducted in Poland in 2011, the amount of fishing gear remaining on the sea bottom was estimated separately for set nets (as a total of single nets, i.e. 5,170 pieces for 2009) and for pair trawls, relative to the number of shipwrecks, assuming the proportion by weight of pair trawls to set nets found on shipwrecks was 50%. As suggested by the register of nets retrieved during the open-sea operations of cleaning the Baltic of lost or abandoned fishing gear in 2012, the proportion of pair trawls entangled in shipwrecks is likely to be much higher – even as high as 90% in Poland (it was 100% in Lithuania for the diving operations).

Therefore it may be assumed that the probable number of set nets lost in 2009 is ca. 1,500 pieces for Poland and ca. 150 pieces for Lithuania.

The difference in the number of ghost nets may be estimated by a similar method as in the 2011 project, based on the fishing effort data for 2009[22]. Assuming the joint fishing effort of EU member states using set nets to be 100%, the number of set nets lost by the Polish fleet in 2009 may be estimated at 1490 pieces, compared to 140 pieces on the Lithuanian side. These results do not directly correspond to the quantities remaining in the zones of both countries, since only a certain proportion of the fishing effort was used in the economic zones of both countries, in accordance with the opportunities granted by the Common Fisheries Policy. The above results should be considered close approximations in view of the fact that the Lithuanian fleet uses set nets mainly in its own zone and to a certain insignificant degree in the Polish zone, whereas the Lithuanian zone may also be used by Latvian fishing vessels. Therefore it may be assumed that the probable number of set nets lost in 2009 is ca. 1,500 pieces for Poland and ca. 150 pieces for Lithuania. According to the data for Lithuanian fishery in the Baltic Sea obtained by means of a questionnaire survey[23] (answers were provided by 79% of those surveyed), the quantity of set nets lost per year is ca. 47,000 m, a significant proportion of which (38,810 m) is retrieved by the fishermen unaided. The quantity of irretrievably lost set nets (8,190 m)

[22] Bailey N., Mitrakis N., 2011: *Evaluation of Fishing Effort Regimes in the Baltic Sea (STECF-11-11)*. European Commission – Joint Research Centre, Ispra, Italy.

[23] Toliušis Š., Staponkus R., Kairytė, L. 2013: *Rybołówstwo morskie w litewskiej wyłącznej strefie ekonomicznej i wydobywanie sprzętu rybackiego z Morza Bałtyckiego (Sea fishing in the Lithuanian exclusive economic zone and retrieval of fishing gear from the Baltic Sea. A study commissioned by WWF (unpublished)*.

corresponds to 109 nets per year, assuming a standard net length of 75 m; when adjusted proportionally to the number of respondents who failed to answer the questionnaire, the number is 138 set nets per year, which is very close to the result of computational methods.

The differences for nets entangled in shipwrecks may by estimated based on the proportions of the economic zones of both countries and assuming a similar distribution of shipwrecks (in common with the ports on the Polish coastline, the Klaipeda region experienced intensified marine traffic during the war and particularly fierce battles during the evacuation from East Prussia). The area of the Polish exclusive economic zone together with the territorial sea is 40,429 km^2; in the case of Lithuania the area is 9,049 km^2, which would suggest that, assuming 150 to 450 tonnes of ghost nets (depending on the assumed number of shipwrecks), the quantity for the Lithuanian waters would be proportionally smaller. Upon correction of the data according to the results of diving operations in 2012, it may be assumed that the quantity of nets entangled in shipwrecks is ca. 270–810 tonnes in the Polish economic zone and ca. 67–100 tonnes in the Lithuanian economic zone. It should be emphasised that the shipwrecks have not been thoroughly investigated in terms of the deposited nets and many wrecks may have accumulated great quantities of nets and, especially in the case of large pelagic pair trawls, the weight of an entire net with accessories may exceed 2,000 kg, as observed on 01/08/2012 on the vessel KOŁ-40.

2.4. Fishermen's involvement and interest in the tasks carried out as part of the project

The fishermen working on the Polish boats showed full commitment during the implementation of the project, as well as awareness of its purpose, and performed their duties with great care. Over time, with increasing experience (3 vessels participated in this type of operation for the first time), the results were improving and any practical conclusions reached on completion of sea operations will serve as valuable assistance when the operations involving the removal of ghost nets from the sea are resumed. Since a different type of vessel (a fishing yacht) was used during the actions conducted

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The quantity of nets entangled in shipwrecks is ca. 270–810 tonnes in the Polish economic zone and ca. 67–100 tonnes in the Lithuanian economic zone. It should be emphasised that the shipwrecks have not been thoroughly investigated in terms of the deposited nets and many wrecks may have accumulated great quantities of nets.

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in the Lithuanian waters (and such operations were carried out for the first time, the implementation of the technique of handling the searching equipment proved to be more demanding. Nevertheless, when evaluating the results of the operation, account should be taken of the specific character of the Lithuanian waters and relatively lower chances


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of retrieving large amounts of nets. Other important factors included:

- Lithuanian regulations stipulating that the zone between the shore and 20 m depth contour is excluded from trawl fishing to eliminate the risk of equipment collisions, constituting one of the causes of net loss during inshore fishing;
- the significant proportion of nets retrieved independently by Lithuanian fishermen.

The following conclusions may be drawn from interviews with local project coordinators, vessel owners participating in the project as well as vessel owners and fishermen involved in earlier research conducted by the Maritime University of Szczecin (with respect to the techniques of salmonid fishing, "Natura 2000" areas and other subjects; the participants were based in Kołobrzeg, Darłowo, Ustka and Jastarnia):

1. Last year's project titled "Collecting ghost nets in the Baltic Sea" generated a very positive response among Baltic fishermen, as expressed in direct contacts with the vessel owners participating in the project and numerous inquiries about the possibility of joining the search for ghost nets.

Representatives of local governments in the individual ports also expressed their interest in the project, especially with respect to the solution to the problem of disposal of the retrieved nets, as well as debris and litter from docks and sections of the coast serving as bathing beaches.

2. Vessel owners and fishermen expressed their intention to participate in future actions involving the removal of ghost nets from the sea for the following reasons:

- opportunity for additional income during the fishing bans (especially in summer) imposed by regulations;
- owners of vessels used for angling see the removal of nets entangled in shipwrecks as beneficial (fewer fishing lures lost in the nets and an increased appeal of angling trips);
- owners of vessels used as bases for recreational wreck diving are interested in removing nets from shipwrecks because it improves the safety of divers and increases the appeal of the services offered.

Last year's project titled "Collecting ghost nets in the Baltic Sea" generated a very positive response among Baltic fishermen".

3. Description of the activities conducted in Poland and Lithuania in 2012 and their beneficial effect on the environment

As part of the project conducted in 2012, a total of 21,275 kg of nets were removed from the sea. 14,429 kg of nets were retrieved during the operations conducted by crews of four fishing vessels and M/V “Nawigator XXI” from Poland and one fishing vessel from Lithuania, aimed at cleaning the sea floor of lost or abandoned fishing gear.

In the course of the net removal actions carried out by divers, targeting the shipwrecks previously selected based on the materials collected by ROV robots, seven shipwrecks were cleaned of nets, including four in Poland and three in Lithuania. An additional attempt was made at cleaning the breakwaters at the entrance to the Klaipeda port. As a result of these operations 2,826 kg of ghost nets were retrieved.

The Maritime Office in Gdynia joined in the actions, handing over 4,020 kg of unmarked fishing nets retrieved from the sea to be disposed of in the framework of the project.

As part of the project conducted in 2012, a total of 21,275 kg of nets were removed from the sea.

3.1. Retrieval of ghost nets from the sea bottom using towed equipment

Comprehensive information on the scope and results of the operations using equipment towed by Polish fishing vessels is presented in Table 2 attached to this study. The areas in which the operations were conducted is described in point 2.2 of this study. The technical parameters of the vessels participating in the operations of ghost nets retrieval from the Baltic Sea floor in 2012 are listed in Table 3.

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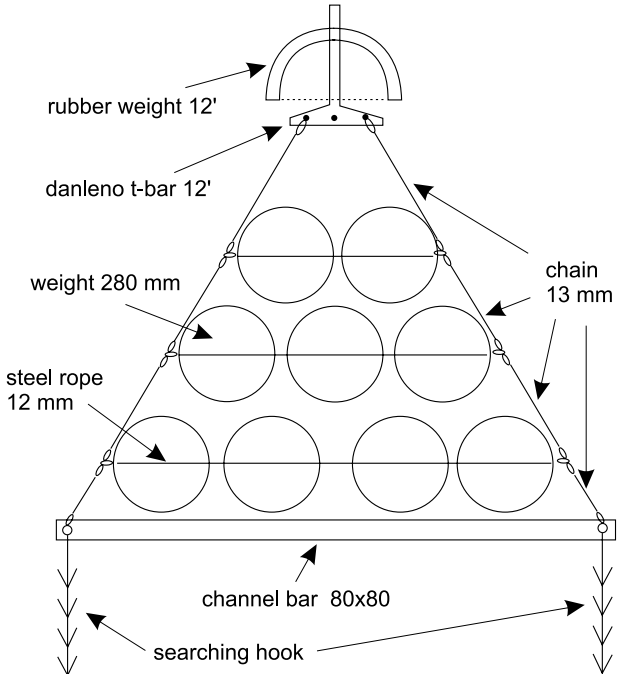
Table 3 *Technical parameters of the vessels involved in the operations using towed equipment*

Name or identifier	Total length [m]	Tonnage [GT]	Main engine power [kW]	Intended use
KOŁ-111				
 © WWF / M. Szulc	18,03	37,00	121,4	Pair trawl fishing
KOŁ-43				
 © WWF / M. Szulc	13,16	22,66	110,0	Pair trawl fishing
KOŁ-40				
 © WWF / M. Janeczko	14,56	33,50	183,0	Longline and bottom trawl fishing
WŁA-11				
 © WWF / M. Szulc	20,54	66,00	297	Pair trawl or bottom pair trawl fishing
Romastė				
 © Lithuanian Fund for Nature	16,6	No data available	183	Fishing tourism

The device towed by the vessels involved in retrieval operations consisted of 2 “searching hooks” attached to a bar connected to a 12’’ rubber weight and of 9 steel weights between the bar and the rubber weight (Figure 1).

***Fig. 1** Construction of the device for retrieving ghost nets from the sea bottom*



Interviews with the captains of the Polish vessels participating in the project brought the following findings:

- most draughts were very short because of the rocky substrate;
- the proportion of towing time to the time taken to pull up the device is often unfavourable. To prevent the nets escaping from the “searching hooks”, the device must be pulled up very carefully, which often takes two to three hours and requires constant attention. Any haste leads to the loss of the nets caught;
- the “searching hook” was severely damaged twice on vessel KOŁ-40, and was lost on WŁA-11, which forced the crew to return to the port on one occasion and after the next failure a whole day was wasted on repairs;
- perfect weather is conducive to good search results; any waves, even slight, cause the nets to break off the hooks;
- some nets contained healthy fish apart from a large quantity of bones and skeletons, which proves that the gear continued to catch fish.

On the Lithuanian side, the comments related to the following issues:

- any retrieval activities should be preceded by investigation of the terrain – preferably, scanning the regions with the greatest potential density of ghost nets on the sea floor using a side-scan sonar[24];
- only vessels equipped with winches of sufficient power should be used because of the considerable resistance encountered when pulling up fishing gear buried in sand, especially large pair trawls;
- no fish were found in the nets recovered from Lithuanian waters apart from the shallowest ground, which indicates that the operations should be aimed at Lithuanian coastal waters and suggests that ghost nets are potentially more dangerous for the natural ecosystems in shallower waters.

Some nets contained healthy fish apart from a large quantity of bones and skeletons, which proves that the gear continued to catch fish.

[24] According to a Polish expert on the use of electronics in fishing, Z. Markowski (ESCORT company based in Sopot), it is necessary to select the frequency correctly in order to find the right balance between the sensitivity of the device and its range (the higher the sensitivity, the smaller the range).

3.2. Removal of nets entangled in shipwrecks by divers using the ROV robot – Polish and Lithuanian experience

The principal application of a ROV (remotely operated vehicle) is during the operations on shipwrecks, where it proves to be very useful. It makes it possible to carry out an initial inventory of shipwrecks with respect to the amount of nets entangled on them, to plan future operations efficiently and to facilitate divers' work and increase their personal safety by providing updated information on the situation on the wreck before divers go underwater.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However, the situation is different in the case of searching for and removing nets lying on the sea bottom, where, according to the Lithuanian partners, a side-scan sonar proves to be more effective, especially where a large area has to be scanned. The effects of the divers' operation are described in Table 4.

3.3. The relationship between the operation conditions and intensity and the amount of nets recovered in the individual areas

Information on the net removal output of the individual vessels is presented in Table 5.

The data on the net removal output confirms earlier analyses. The differences between the results of the vessels from Kołobrzeg and vessel WŁA-11 may be accidental. However, a certain effect of the type of fishery and technical characteristics of vessels can be observed. WŁA-11 was the largest (large weight – great inertia) and most powerful vessel used and consequently it showed the greatest tendency to tear the nets off the "searching hooks". Considering the relatively small amount of data collected, isolated events have to be taken into account when evaluating the results; one example is the result produced by vessel KOŁ-40, which had retrieved an entire pelagic pair trawl.

It should also be emphasised that, due to adverse weather conditions, the Lithuanian vessel spent only 6 days at sea although it had been chartered for 20 days. The remaining days will be used in March 2013, but the results will not be included in this report.

Table 4 *Removal of ghost nets from shipwrecks by divers in 2012 – duration and results of the operation*

Parameter	Poland	Lithuania	Operation start/end, comments
Days	8	10	27.07 – 13.08.2012
Number of shipwrecks	4	4	Operation at the breakwater was included as shipwreck work
Quantity of nets retrieved [kg]	1760	1066,5	Lithuania – 100% pair trawls, Poland – 90% pair trawls
Quantity of nets [kg/day]	220	106,6	
Quantity of nets [kg/shipwreck]	440	266,6	Maximum amount on the wreck of Memel – 1,100 kg for 3 days' work

Table 5 *Output [kg/day at sea] of vessels using towed equipment during operation*

Name or identifier	Days spent at sea	Quantity of nets retrieved [kg]	Output [kg/day at sea]	Operation start/end, comments
KOŁ-111	29	8150	281	18.06 – 31.08.2012
KOŁ-43	8	1846	231	29.07 – 25.08.2012
KOŁ-40	9	3540	393	22.07 – 16.08.2012
WŁA-11	9	633	79	5.07 – 9.07.2012 – implementation stage 10.07 – 14.07.2012 – effective operation
Romasté	12	260	21	27.07 – 29.08 i 12.10.2012

3.4. Recommendations concerning the safety and efficiency of operations conducted by fishermen (retrieving ghost nets from the sea bottom) and by divers (on shipwrecks)

The Polish team did not observe any dangerous situations significantly different from normal conditions of work on fishing vessels. However, the time taken to implement the retrieval technique varied from vessel to vessel, which may have been related to a number of factors, such as:

- the captains' and their crews' knowledge of techniques and fishing grounds other than those used on a daily basis;
- the specific nature of the fishing grounds where the operations of retrieving ghost nets were conducted (chiefly the type of sea floor and the presence of wrecks, but also navigation restraints related to the presence of sailing routes, the fishing gear set in a particular area, currents and the depth at which the ghost nets were found).

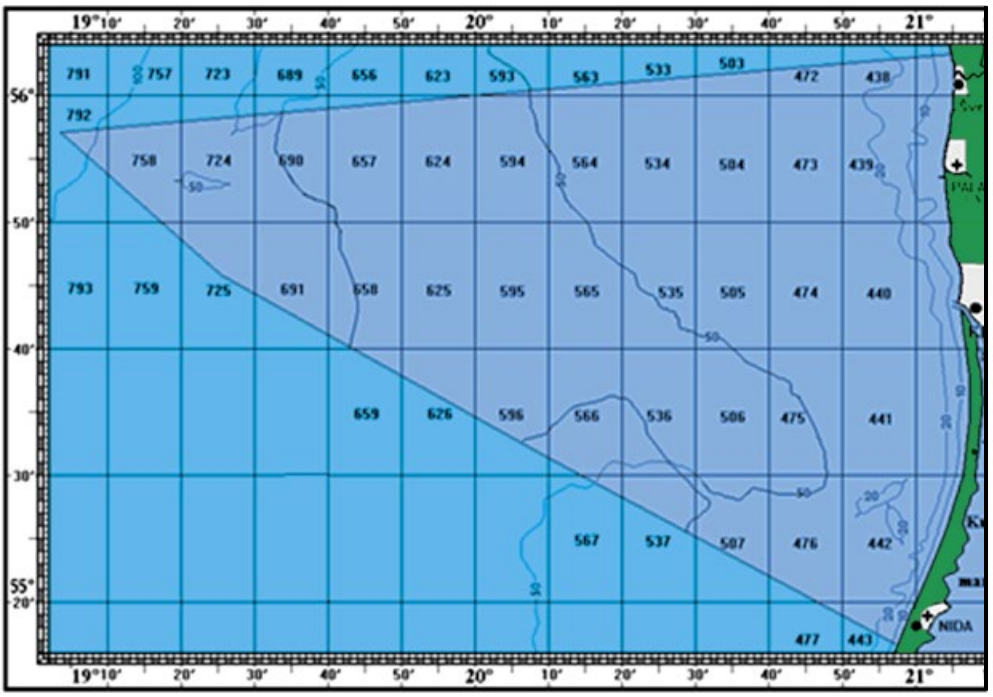
Practical recommendations put forward by the Lithuanian partners:

- operations should be conducted in April and May, when underwater visibility is far better than during the summer;
- for diving operations at depths exceeding 20 m it is recommended to use diving equipment feeding the air directly from the surface to extend the time that can be spent underwater;
- it is necessary to use plumbing tools for cutting steel ropes and other specialist equipment for underwater work.

3.5. Conclusions and recommendations arising from the comparison of operations in Lithuania and Poland

The activities of the Polish and Lithuanian teams were conducted in specific conditions due to the character of waters and sea bottom in Polish and Lithuanian zones (Figure 2 – the Lithuanian zone with depth contours), intensity of use of living resources, different fishing traditions and a number of other factors.

Fig. 2 *A reference map of waters within the jurisdiction of the Republic of Lithuania*



The most important conclusions and recommendations based on the experience and data acquired:

1. The results of operations using towed equipment are distinctly different. Apart from the obvious dissimilarities related to the amounts of fishing gear remaining on the sea bottom, it is also connected with the selection of the vessel in Lithuania and experience of the hired crews.
2. To achieve better effects in terms of environmental protection, operations in Lithuania should focus on shipwrecks.
3. It is necessary to further analyse the issue of recycling the retrieved nets in Lithuania. It does not seem feasible to use all of them as museum exhibits or decorations in the future.
4. It would be worthwhile to analyse the demand for the disposal of nets (and other plastic waste) in Lithuania using technologies employed in Poland, including pyrolysis.
5. The results of the survey conducted in Lithuania show that Lithuanian fishermen put much effort in recovering the lost (broken) nets by themselves. Many Polish crews use different devices of their own invention (“searching hooks”), but it is necessary to popularise the most useful solutions, tailored to the size and equipment of each vessel.
6. Polish crews participating in the project have already been thoroughly trained. It is recommended to organise another face-to-face meeting with Lithuanian fishermen.

The results of the survey conducted in Lithuania show that Lithuanian fishermen put much effort in recovering the lost.

4. Disposal of the retrieved material

Administrators of ports and harbours are obliged to develop and implement waste management plans for waste generated by vessels.

4.1. The obligation of reporting cases of net loss in the light of regulations concerning sea fishing and the procedures applying to ghost nets retrieved from the sea

The formalities connected with reporting cases of net loss have been regulated by EU sea fishing regulations and discussed in detail in the pilot project report. This also applies to the procedures for handling nets recovered from the sea. Nevertheless, it is also necessary to take into account the provisions of the Act of 12 September 2002 on port facilities for the reception of waste and cargo residues from vessels. Pursuant to this act, administrators of ports and harbours are obliged to develop and implement waste management plans for waste generated by vessels. In areas falling within the jurisdiction of the Maritime Office in Szczecin, such plans are developed for all non-communal ports and harbours, including beach harbours.

For example, the plan for the harbour in Niechorze contains a detailed description of procedures for the reception, transport, recycling, treatment and disposal of waste. The plans for ports and harbours of the central coast (under the authority of the Maritime Office in Słupsk) were developed with a considerable delay (e.g. the plan for the port in Rowy was not consulted with port users until the 8th of February 2013).

The section below describes the current situation with respect to vessel-generated waste management in Polish fishing ports, with particular emphasis on fishing nets retrieved from the sea (recovered by fishing vessels or supplied by the Border Guard or Fisheries Inspectorate officers). The information was obtained from interviews with masters of ports under the authority of Maritime Offices or, in the case of communal ports, with the chairmen or environmental officers of Port Authorities. Apparently, all ports have developed plans for the management of vessel-generated waste, including fishing gear; so far fishing gear has only been disposed of at landfills, rather than recycled.

All ports have developed plans for the management of vessel--generated waste, including fishing gear; so far fishing gear has only been disposed of at landfills, rather than recycled.

The procedures for handling the above-mentioned gear in the individual ports are as follows:

Świnoujście

Fishing gear recovered from the sea is received by the port master, officially recorded and stored in a dedicated container in the Navigation Aids Base. Completely filled containers are transferred to a landfill by municipal services at a charge.

Dziwnów

The procedure is similar to the one in Świnoujście. Nets retrieved from the sea are collected in a separate facility (a portable metal garage) and transferred to a landfill once the garage fills up. The photograph below shows the net storage facility on the premises of the Port Master's Office in Dziwnów.

Niechorze

A detailed "Vessel-Generated Waste and Cargo Residue Management Plan in Sea Fishing Area In Niechorze" (only in the Polish language) is available on the website of the Maritime Office in Szczecin at http://www.ums.gov.pl/odpady/Plan%20Niechorze%202010.pdf.

Kołobrzeg

The communal port is administered by the Port Authority, which has signed a contract with the Fire Services. Under this contract, the Fire Services clean the docks of waste generated by vessels or deposited by the River Parsęta (including dead farm or wild animals), at a charge. The waste is transferred to an authorised landfill.

Darłowo

Waste generated by fishing vessels and manufacturers of fishing gear is collected in containers together with other types of waste (there are no separate containers for nets) and transferred to a landfill by municipal services.

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Ustka

The docks are periodically cleaned by a motor boat of the Port Master's Office, and nets are stored in a separate container and transferred to a landfill when the container fills up.

Łeba

The retrieved fishing gear is received by the Sea Fishing Inspectorate and handed over to the Port Master's Office that collects the waste, which is then transferred to an authorised landfill. In the port of Łeba glass and plastic waste is collected separately.

In accordance with the waste management plan developed by the Maritime Office in Słupsk (available on the website of the Maritime Office in Słupsk), all small fishing harbours are provided with containers or bags for the above-mentioned waste. The waste periodically transferred to a landfill by third party companies.

Władysławowo

The port is administered by the company "Szkuner", which has its own waste management plan but does not handle the recovered fishing gear, which is received by Fisheries Inspectorate officers (according to an employee of "Szkuner" overseeing the environmental protection in Władysławowo this is not an issue, since the Border Guard does not search for unmarked nets in that region).

Hel

The port is administered by a municipal company of the town of Hel. The president of the company informed that "there is no problem with recovered fishing gear – it is brought by neither the Border Guard nor by vessels". Solid waste is placed in containers on the port premises, collected by municipal services and transferred to a landfill.

It should be stressed that maritime administration bodies (Maritime Offices and Port Master's Offices) are very interested in transferring the collected fishing gear for disposal, since they are obliged to receive property retrieved from the sea, but no solutions are available as to further transfer of property classified as useless and persistent waste.

4.2. Legal regulations concerning the possibilities of disposal of ghost nets

One of the principal objectives of sustainable development is to limit the depletion of raw material and fuel resources, as well as irreversible changes in the natural environment.

This essential requirement of modern civilization must be fulfilled through a number of measures, the most important of which are:

- increasing the share of renewable sources in the production of energy and acquisition of materials to offset the increasingly unfavourable energy balance in the world;
- aiming at multiple use of materials and energy.

At present, there are no legal regulations in Poland that would apply to the possibility or obligation of disposal of ghost nets. However, it is impossible to accept the current situation, where significant amounts of fishing gear made of valuable polymers are retrieved from the sea every year and then end up in landfills as useless waste.

The legal act currently in force, regulating the problem of waste disposal, is the Act of 14 December 2012 on waste. Article 18 paragraph 1 thereof stipulates that "*whoever engages in activities that generate or may generate waste... should primarily prevent the generation of waste and its adverse effect on human life and health and on the environment*… Paragraphs 2 and 3 of this article are of particular significance:

- Paragraph 2: *If generation of waste could not have been prevented, the waste holder is primarily obliged to recover the waste*;
- Paragraph 3 – *The recovery referred to in paragraph 1 involves, in the first place, preparation of waste, by the waste holder, for reuse or recycling, or, if it is not possible for technological reasons or unreasonable for environmental or economic reasons, the waste should be disposed of in a different manner*.

Article 19, point 1. *Public administration bodies undertake measures, in the scope of their competences, supporting the reuse of waste and preparation of waste for reuse, in particular by:*

- *encouraging the creation of and supporting multiple use and repair networks*;
- *creating economic incentives*.

It is noteworthy that article 18 stipulates the obligation to recover waste, and article 19 imposes the obligation on public administration to create economic incentives to reuse waste. These are important provisions in terms of the possibility of ghost net disposal mentioned above (and in point 4.4).

At present, there are no legal regulations in Poland that would apply to the possibility or obligation of disposal of ghost nets.

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A regulation indirectly applicable to ghost nets is the latest Ordinance of the Minister of Economy of 8 January 2013 on the criteria and procedures for permitting the disposal of waste at landfills for particular types of waste (with 3 appendices).

4.3. Practical possibilities of collecting and storing fishing nets worn out through use or recovered from the sea

Pursuant to applicable Polish regulations regarding property retrieved from the sea (including fishing gear), a vessel calling at a port should hand over such property to a representative of marine administration, i.e. the competent officer of the Port Master's Office.

The Maritime Offices having authority over the port to which property retrieved from the sea has been brought, are obliged to identify the owner of the property. Since nets are unmarked and it is impossible to identify their owner, after the period specified in regulations their ownership is transferred to the State Treasury, i.e. to the Maritime Offices, which collect the nets in separate containers or storage facilities, as described above. Periodically, once the storage facilities fill up, the nets are collected and transferred to landfills by specialized third party companies, at the cost of the Maritime Offices.

It should be emphasised that, in practice, if unmarked fishing gear is pulled up onto the deck e.g. of a fishing vessel using trawls, the gear is normally cut off and thrown back overboard. This happens because such ghost nets are inconvenient to store on vessels (and have to be placed in sacks because of their "clinginess") and vessel owners have no motivation to deliver them to the port.

The situation could be changed if legal solutions were introduced, encouraging fishermen (in the form of compensation) to deliver the retrieved nets to the port.

The capacity for collection and storage of ghost nets in ports is virtually unlimited, since both Maritime Offices and Port Authorities can provide appropriate facilities for the reception and storage of ghost nets in the areas under their authority (as explained in the descriptions of the individual ports). What remains to be solved is the issue of collection and disposal of the nets (e.g. in pyrolysis or incineration plants).

Maritime Offices and Port Authorities can provide appropriate facilities for the reception and storage of ghost nets in the areas under their authority.

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A vessel calling at a port should hand over such property to a representative of marine administration, i.e. the competent officer of the Port Master's Office.

4.4. Recycling methods that may be suitable for retrieved ghost nets — material recovery, processing, clean energy production

Contemporary fishing gear is made of synthetic fibres, named according to the chemical composition of the low-molecular-weight compounds called monomers, which, in the process of polymerisation, combine into high-molecular-weight compounds called polymers. For example, polymers containing amide groups are referred to as polyamides, and those containing ethylene groups are polyethylenes. Nowadays the polymers most commonly used in the production of fibres for fishing purposes are polyamide, polypropylenes, polyethylenes and polyesters.

All polymer materials are characterised by excellent functional properties due to their low density, high mechanical strength and resistance to corrosion, including bacterial corrosion. Due to these properties, polymers have multiple applications and their production has been rapidly increasing, from 1.3 million tonnes in 1950 to 245 million tonnes in 2008. Another advantage of polymeric materials is their capacity to store energy, so they are suitable for recycling and energy recovery; this is especially important in the situation where the rapid increase in their production and consumption leads to an equally rapid increase in the amount of waste. Depending on their source, polymer waste may be divided into municipal and industrial.


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Industrial waste is generated mainly as by-products in manufacturing and in the production of packaging and is clean, homogeneous and may be available in large quantities.

Municipal polymer waste is a mixture of ca. 80% thermoplastic polymers used in packaging and epoxide resins. This waste is mixed with organic waste, glass, paper, metal, etc. To be reused, they must be separated from other types of waste, so the most convenient disposal method is their incineration with other flammable types of municipal waste, which makes it possible to reduce the problem of municipal waste, which scale is enormous – in 2008 there was 320 kg of municipal waste for one Pole and as much as 524 kg for an EU citizen. In Poland, 90% of this waste is disposed of at 1000 authorised landfills and nearly three times as many illegal dump sites.

The most important methods of polymer recycling and recovery are: energy recovery, chemical recycling and material recycling.

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Energy recovery and chemical recycling

Polymer waste has a high energy value, comparable with the calorific value of coal (30 MJ/kg).

Burning polymer waste together with municipal waste is convenient, as it does not require additional fuel.

Energy recovery from municipal waste containing polymers is usually conducted in waste incineration plants and cement kilns. In EU countries energy recovery from polymer waste exceeded 40% in 2005 and 60% in Switzerland, Denmark, Sweden and the Netherlands. In Poland only one incineration plant located in Warsaw is in operation at present, while the launch of the process in a cement plant in Opole has been delayed for several years for social reasons.

Because of its high energy value, polymer waste can also be used in the production of so-called alternative fuels. The production potential of these fuels in the EU reached 1 billion tonnes per year in 2009.

Organisational obstacles and the absence of social approval have led to the situation where the predominant form of polymer waste management is storage. At the beginning of the 21st century, ca. 65% of polymer waste in Europe was disposed of at landfills, only 25% was incinerated and ca. 10% was recycled. No data are available with regard to the current situation in Poland, but it is likely that more than 90% of polymer waste is disposed of at landfills, including 100% of the fishing nets, ropes and metal accessories delivered to ports.

One of the forms of energy recovery is chemical recycling of polymer waste, i.e. thermal decomposition producing fuel fractions and the so-called alternative fuels. It would be worthwhile to analyse the changes occurring in Poland in this respect, considering the need to import fuels and their rising prices on the one hand and polymer waste “management” on the other.[25]

Towards the end of the 20th century small private enterprises began to operate, thanks to the Polish patents amongst other things, using polymer waste to obtain crude fuel fractions. These were initially

One of the forms of energy recovery is chemical recycling of polymer waste, i.e. thermal decomposition producing fuel fractions and the so-called alternative fuels.

added to fuel oils because of their high energy value, and later sold to Plastic Processing Plant (Zakład Przetwarzania Tworzyw Sztucznych) in Jasło, belonging to the LOTOS S.A. group, where these intermediate products were distilled to produce petrol and diesel oil fractions. It should be pointed out here that the process of obtaining the raw material for the production of commercial fuels from polymer waste is unprofitable (as explained below).

It was economically viable only because of the excise duty exemption pursuant to the Ordinance of the Ministry of Finance of 26 April 2004 (Journal of Laws of 2004, No. 97, item 966). The amount of exemption for petrol was PLN 180 (2004), PLN 144 (2005), PLN 90 (January 2006) and PLN 144 until

[25] The information contained in point 4.4. was taken from the publication: Kijeński J, et al. *Odzysk i recykling materiałów polimerowych (Recovery and recycling of polymer materials).*

the end of 2006, and for diesel oil, respectively, PLN 300 (2004), PLN 240 (2005), PLN 150 (January 2006) and PLN 240 until the end of 2006. On the 1st of January 2007 this practice became unprofitable because of the decision on excise duty exemption (Journal of Laws of 2006, No. 16, item 120) and the Ministry of Environment's failure to timely introduce the obligation to implement an appropriate system of compensations pursuant to the Act on the product fee and deposit fee (Journal of Laws of 2001, No. 63, item 639). An important question is why the excise duty exemption was cancelled – quoting the above-mentioned Ordinance of the Ministry of Finance of 26 April 2004:

- diesel oil had to contain at least 10% of the component obtained by processing OPOs (waste polyolefins – components accounting for ca. 70% of plastic waste (§17 point 2);
- for leaded and unleaded petrol the minimum content of the component was 5% (§17 point 3).

According to the quoted regulation, to be granted excise tax exemption it was necessary to add the required minimum quantities (5–10%) of processed KTS-F (component obtained from plastics – fractions) to typical motor fuels (petrol, diesel oil) during the blending process. The possibility to combine conventional fuels from a refinery with fuel components from waste resulted in increased effectiveness of the plant – paraffin oil of low value was processed into more valuable products while disposing of waste (OPOs).

Pursuant to the Treaty of Accession signed by Poland, the proportion of recycled waste has to reach 60% by 2014 .

Thus, on the 1st of January 2007, the entire activity involving the use of components obtained from waste in fuels was suspended.

Pursuant to the Treaty of Accession signed by Poland, the proportion of recycled waste has to reach 60% by 2014. In 2009 the share of recycled waste was ca. 5%. If this requirement is not fulfilled, Poland will have to pay a penalty of EUR 200,000 daily for each percentage point below 60%. By 2014 Poland has to achieve a 55% rate of packaging waste recycling. It is assumed that by that time only ca. 25% of packaging waste will be recycled, so it seems impossible to achieve the 55% minimum. If this level of recycling is supposed to be achieved through the development of professional incineration plants for plastic waste, the idea seems quite unrealistic.

The poorly designed organisational and legal system, where previously introduced excise duty exemptions were reduced with no possibility of taking advantage of the provisions of the Act on the Product fee and deposit fee, eliminated the grass-roots initiative of recycling waste polyolefins (OPOs) enabling the production of high quality liquid fuels. On the one hand, the 3×20% programme has been implemented (20% savings in the consumption of energy, reduction in greenhouse gas emissions, including CO_2, and increase in the use of renewable sources of energy, biomass and biogas) and new clean carbon technologies have been developed, but on the other hand unwise decisions have led to the bankruptcies of companies engaged in advanced chemical recycling for the production of fuels.

That is why it is worth analysing and considering other technologies which may be used to revive the grass-roots initiative that emerged in Poland in 2002–2006 with regard to the production of fuel by recycling waste polyolefins. One of the most interesting options is pyrolysis.


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In search of the possibilities of disposal of ghost nets for the purpose of this project, the Department of Polymers at the Faculty of Chemical Engineering of the West Pomeranian University of Technology in Szczecin was contacted, as well as several establishments engaged in waste disposal in Poland (e.g. EkoVita in Brzeg Dolny, Eko-Green in Poznań and PMS Bartnicki in Warsaw). The most promising was the contact with “Dagas” from Warka, owner of a plant for pyrolysis of rubber and polymer waste, which agreed to take a batch of ghost nets for trial processing. A 35 kg batch of nets retrieved from the sea by the Border Guard was collected from the Port Master’s Office in Dziwnów and delivered to the Warka plant in early February of this year. Due to low temperatures, the pyrolysis plant was shut down temporarily, but it was agreed that, after the commencement of its operation, WWF Poland would receive a report with results of the experiment. Since “Dagas” activities include design and manufacture of pyrolysis plants, it would be advisable and desirable to install such plants in selected fishing ports. The operation of the pyrolysis plant owned by “Dagas” is described at: http://prima-warka.home.pl/fum/Pyrolysis.pdf.

it would be advisable and desirable to install such plants in selected fishing ports

Material recycling

Material (mechanical) recycling involves the treatment and processing of polymer waste to obtain new products. To ensure good results of the process, it is necessary to use clean, homogeneous polymer material waste. Therefore, this method is unsuitable for recycling retrieved ghost nets, which usually contain organic impurities in the form of remains of organisms attached to the nets; moreover, the nets are not homogeneous (they contain a combination of different materials, fibre and steel ropes and metal parts).


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5. Funding opportunities for further operations of ghost net retrieval

5.1. Operation costs and possible improvements

Because of the specific nature of tasks involving the removal of nets remaining on the sea floor or entangled on different obstacles (shipwrecks, rocks, remains of hydroengineering structures, etc.), the operations require a number of steps generating different costs arising from the use of different technical resources (vessels, auxiliary boats, remote-controlled underwater vehicles, “searching hooks”) and human resources (vessel crews, divers, ROV vehicle operator).

The top item on the expenses list is the charter of fishing vessels (during operations at sea they are completely excluded from fishing). Lower costs (considering the size of the vessel and its equipment) were involved in hiring a research and training vessel, where a group of students were engaged in normal practice at sea during that period.

Based on the experience gained during the implementation of the project in 2011 and 2012, it is possible to establish the possibilities to reduce the costs of future operations. Beside the costs of vessel fuel, ghost net retrieval operations may be streamlined in the following ways:

- improved organisation and efficiency of retrieval operations at sea by selecting appropriate shipwrecks (based on underwater vehicle findings) and determining their exact location. In the case of searching for set nets, the areas where they can be found in the largest amounts should be determined based on information obtained from crews of vessels that fish using this fishing gear and (as pointed out by Polish and Lithuanian divers) from owners of vessels – bases for “recreational diving” as well as from professional divers;
- earlier (before searching operations), more comprehensive and better training of crews of the vessels participating in the project operations at sea for the first time. It is especially important to train the fishermen who are to be in charge of the “searching hooks” (based on the experience of the “WŁA-11” crew);
- hiring divers who participated in earlier underwater works (in order to take advantage of their experience);
- making the most of weather conditions (direction of wind and current, water clarity).

5.2. Funding opportunities provided by European Union funds

The current Operational Programme „Sustainable Development of the Fisheries Sector and Coastal Fishing Areas 2007-2013" specifies, as part of Priority Axis 3 – Measures of common interest, point 3.1 – Collective actions, the main types of investments, stating that they may involve:

- promotion of selective fishing methods and equipment, reducing the catches of undesirable species and popularising better practices related to safety and health and disposal of lost fishing gear.

The beneficiaries of this measure may include producer organisations, associations from the fishing sector, private and public enterprises and research institutes. The investment is 100% financed from public sources, and 75% of the eligible amount is contributed by the European Fisheries Fund. However, the procedures are complicated and earlier attempts by WWF Poland to obtain a subsidy were unsuccessful.

There is an opportunity for Local Fisheries Groups to apply for funds for the recovery of ghost nets from both Axis 3 and Axis 4 – "Sustainable development of fisheries areas". For example, the strategy of the resourceful Association Local Fishery Group in Kołobrzeg includes activities aimed at attracting investments in the sector of fishing tourism, environmental protection and continued sustainable development, as well as active environmental protection and development of pro-environmental attitudes. Having contacted the Board of the organisation personally, the author of this report received a promise of support in the future actions of ghost net retrieval.

5.3. Other possible sources of funds

Beside the EU funds, other possible sources of financing of ghost nets removal operations are state funds, via the National (or Voivodeship) Fund for Environmental Protection (NFOŚ). However, the application procedures are complicated, and earlier attempts to obtain NFOŚ subsidies for operations on M/V "Nawigator XXI" by the Maritime University of Szczecin were unsuccessful.

Apart from the state funds, further operations involving ghost nets removal may be financed as part of the annual call for proposals financed from EEA / Norway Grants until 2014.

The programmes supported by these grants in 2013 include:

- protection of biodiversity and ecosystems;
- tightening of environmental monitoring and control measures;
- funds for NGOs.

Attractive financing possibilities were provided in the framework of a programme titled "BONUS – Science for a better future of the Baltic Sea Region", whose research strategy included, amongst others, "*Natural and human-induced changes in catchment land* …". Unfortunately, the deadline for submitting proposals for 2013 was 14/02/2013.

Certain limited funding possibilities exist within universities (in recent years the Maritime University of Szczecin partly financed activities as part of its own research), as well as NGOs and environmental foundations.


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6. Final conclusions and recommendations

The research carried out in 2011–2012 that focused on the lost fishing gear remaining in the sea and the possible methods for its removal, disposal and recycling has clearly demonstrated the complexity and importance of this problem in many aspects. To sum up the actions completed so far, it should be pointed out that:

1. Ghost nets have a negative effect on the living resources of the sea, especially on the ichthyofauna.

   A review of the available foreign literature, as well as the results of the actions carried out at sea in the framework of the project, has shown an effect on the fishing mortality of commercially caught fish species, particularly cod and flatfish, that is significant but difficult to estimate in terms of environmental and economic impact.

2. It is necessary to continue to extend the scope of programmes aimed at cleaning the Baltic Sea by the recovery of ghost nets remaining in the sea, as these activities have a real, considerable and measurable effect on the protection of the environment and living resources.

3. The involvement of Polish and Lithuanian fishermen (and, in the future, fishermen from other countries of the Baltic region) in the operations of ghost nets retrieval is a key factor in ensuring success of these activities;

   The participation of 4 Polish vessels in the ghost nets removal operations in 2012 demonstrated the commitment of vessel owners and their crews, as well as strong interest among the entire fishing community. A number of vessel owners expressed their willingness to take part in the operations. Undoubtedly, the implementation of the pilot programme had an effect of increasing fishermen's environmental awareness and understanding of the problem that is hard to overestimate.

4. Today no solutions exist that would encourage fishermen to transport the ghost nets retrieved while fishing. It is necessary to work together with fishermen and other parties to develop effective solutions in this respect.

   The regular practice described in the report of discarding the ghost nets collected during fishing operations by throwing them back into the sea should be eliminated as soon as possible by offering compensation to fishermen who deliver ghost nets to the port. This problem should be publicised and pressure should be put on fishery administration (at the domestic and European level) to develop a solution.


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It is necessary to continue to extend the scope of programmes aimed at cleaning the Baltic Sea by the recovery of ghost nets remaining in the sea, as these activities have a real, considerable and measurable effect on the protection of the environment and living resources.

5. Today no systematic solutions exist that would ensure reception and recycling of ghost nets retrieved from the sea. No effort must be spared to develop effective solutions in this respect.

   The current practice, described in this report, of disposing of ghost nets at authorised landfills and illegal dump sites is a waste of valuable polymer materials. In view of the threat of severe financial penalties for Poland for the lack of appropriate solutions and non-compliance with EU waste management requirements, the problem should be publicised and pressure should be placed on the government (Ministry of Environment, Ministry of Transport, Construction and Maritime Economy) to develop an effective solution.

6. It is essential to apply the experience acquired in the organisation and implementation of future ghost nets retrieval projects.

   The operations carried out in 2012 showed the need for exchange of experience and closer cooperation between Polish and Lithuanian fishermen (e.g. using the Lithuanian experience with the side-scan sonar for locating ghost nets and Polish experience in the construction and operation of "searching hooks"). This also applies to teams of divers.

7. It is necessary to involve other Baltic region countries in the actions of ghost nets retrieval. The Baltic Sea belongs to all its bordering countries and must be protected by their joint effort.

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Table 2 *Detailed information on the scope and results of the actions at sea*

Vessel identification or name	Date of retrieval	Geographical position or division of statistical rectangle	Parameters of retrieved fishing gear			Weight of fish found in nets retrieved [kg]	Fish species	Other species	Notes
			Type of fishing gear	Mesh size [mm]	Weight [kg]				
KOŁ-111	18.06.2012	54°19'300" N 15°28'600" E	set nets	55	80	6	flounder, cod	shells	–
	20.06.2012	54°32'100" N 15°10'300" E	set nets	52,5	300	20	flounder, cod	shells	–
	20.06.2012	54°32'100" N 15°10'300" E	pelagic pair trawl	25	200	–	–	shells	–
	21.06..2012	54°32'100" N 15°10'300" E	set nets	52,5	120	5	flounder, cod	shells, ducks	–
	29.06.2012	54°33'000" N 15°10'400" E	set nets	60	600	30	flounder, cod	shells, 3 ducks	–
	04.07.2012	54°15'164" N 15°34'890" E	set nets	55	15	–	–	shells	–
	05.07.2012	54°16'675" N 15°28'498" E	set nets	130	95	5	flatfish	shells	–
	05.07.2012	54°16'790" N 15°28'850" E	bottom pair trawl	50	30	–	–	shells	–
	11.07.2012	54°16'700" N 15°27'800" E	set nets	130	210	10	flatfish	–	–
	24.07.2012	54°16'700" N 15°28'850" E	set nets	55	150	–	–	shells	–
	26.07.2012	54°17'200" N 15°22'800" E	set nets	55	200	–	–	blue mussels, barnacles	–
	27.07.2012	54°17'200" N 15°29'800" E	set nets	55	150	5	European flounder	–	–
	31.07.2012	54°17'800" N 15°20'000" E	set nets	55	350	–	–	shells	–
	01.08.2012	54°21'072" N 15°20'300" E	set nets	55	400	10	European flounder	–	–
	03.08.2012	54°29'950" N 15°14'379" E	trawl nets	24	80	–	–	shells	–
	04.08.2012	F-4	set nets	60	650	–	–	shells	–
	10.08.2012	G-3	trawl nets	20	150	–	–	shells	–
	12.08.2012	G-3	trawl nets	20	200	–	–	shells	–
	13.08.2012	G-3	trawl nets	100	200	–	–	shells	–
	16.08.2012	H-4	set nets	65	260	5	flounder	–	–
	16.08.2012	G-4	trawl nets	50	400	–	–	shells	–
	17.08.2012	G-4	trawl nets	40	540	–	–	shells	–
	18.08.2012	F-4	set nets	60	150	3	flounder	–	–
	20.08.2012	F-4	set nets	60	250	4	flounder	–	–
	21.08.2012	F-4	set nets	60	200	2	flounder	–	–
	24.08.2012	G-4	trawl nets	20	290	–	–	shells	–
	25.08.2012	G-4	trawl nets	30	330	–	–	shells	–
	26.08.2012	G-4	trawl nets	20	60	–	–	shells	–
	28.08.2012	G-4	trawl nets	50	240	–	–	shells	–
	29.08.2012	H-4	set nets	60	300	–	–	shells	–
	30.08.2012	J-5	trawl nets	50	330	–	–	shells	–
	30.08.2012	J-5	set nets	60	120	–	–	shells	–
	31.08.2012	J-5	trawl nets and ropes		500	–	–	–	–
WŁA-11*	10.07.2012	54°53'800" N 018°04'450" E	set nets	50	110	–	–	shells	–
	11.07.2012	54°46'200" N 018°38'500" E	debris	–	23	–	–	–	–
	12.07.2012	54° 58' N 018° 35' E	sisal ropes	Æ 20	120	–	–	shells	–
	12.07.2012	54° 56' N 018° 34' E	debris	130	40	–	–	shells	–
	14.07.2012	54° 57' N 018° 35' E	set nets	110	150	–	–	shells	–
	14.07.2012	54° 57' N 018° 35' E	net weights	_	40	–	–	shells	–
	14.07.2012	54° 57' N 018° 35' E	parts of pair trawl	100	100	–	–	shells	–
	14.07.2012	54° 57' N 018° 35' E	steel ropes	Æ12	50	–	–	shells	–

	29.07.2012	54°13'800" N 15°54'500" E	set nets	–	75	–	flounder	–	–
	29.07.2012	54°13'800" N 15°22'550" E	set nets, ropes	–	80	–	flounder	–	–
	05.08.2012	54°34'513" N 15°07'929" E	set nets, hooks	–	160	–	–	–	–
	05.08.2012	54°32'400" N 15°13'530" E	trawl net	–	20	–	fish skeletons	–	–
	12.08.2012	54°30'690" N 15°06'288" E	set nets	–	45	–	–	–	–
	12.08.2012	54°31'511" N 15°05'717" E	set nets	–	65	–	flounder, cod	–	–
	12.08.2012	54°30'560" N 15°15'850" E	trawl netting	–	15	–	–	–	–
	12.08.2012	54°29'600" N 15°19'250" E	set nets	–	75	–	–	shells	–
	13.08.2012	54°14'500" N 15°43'400" E	set nets	–	30	–	–	duck	–
	13.08.2012	54°15'745" N 15°27'495" E	trawl net	–	120	–	–	–	–
	17.08.2012	54°24'100" N 15°43'210" E	set nets	–	8	–	flounder	–	–
	17.08.2012	54°24'700" N 15°44'370" E	set nets	–	47	–	flounder	–	–
	17.08.2012	54°25'130" N 15°46'330" E	set nets, trawl rope	–	65	–	–	–	–
	17.08.2012	54°25'800" N 15°46'032" E	set nets	–	11	–	–	–	–
	17.08.2012	54°24'670" N 15°48'500" E	set nets	–	23	–	fish skeletons	–	–
	19.08.2012	54°30'180" N 15°10'160" E	set nets	–	15	–	–	–	–
	19.08.2012	54°31'040" N 15°10'269" E	trawl net	–	45	–	–	shells	–
KOŁ-43	19.08.2012	54°31'210" N 15°09'928" E	set nets	–	18	–	–	–	–
	19.08.2012	54°32'061" N 15°10'460" E	set nets	–	24	–	flounder	–	–
	19.08.2012	54°30'900" N 15°10'630" E	set nets	–	130	–	–	–	–
	19.08.2012	54°21'550" N 15°22'111" E	set nets	–	70	–	–	–	–
	19.08.2012	54°22'650" N 15°25'320" E	trawl net	–	190	–	–	–	–
	21.08.2012	54°29'100" N 15°48'850" E	set nets	–	15	–	cod	–	–
	21.08.2012	54°22'350" N 15°52'300" E	set nets	–	10	–	–	–	–
	21.08.2012	54°24'400" N 15°51'800" E	set nets	–	45	–	flounder, cod	–	–
	21.08.2012	54°25'500" N 15°53'660" E	set nets	–	50	–	–	–	–
	21.08.2012	54°23'400" N 15°50'614" E	set nets	–	35	–	–	–	–
	21.08.2012	54°20'900" N 15°47'210" E	set nets	–	40	–	–	–	–
	25.08.2012	54°29'900" N 15°29'900" E	set nets	–	20	–	flounder	–	–
	25.08.2012	54°30'830" N 15°20'170" E	set nets	–	30	–	–	–	–
	25.08.2012	54°31'950" N 15°19'250" E	trawl net	–	60	–	–	–	–
	25.08.2012	54°32'480" N 15°22'100" E	set nets	–	70	–	flounder	–	–
	25.08.2012	54°29'830" N 15°20'955" E	trawl net	–	10	–	–	–	–
	25.08.2012	54°28'100" N 15°25'600" E	set nets	–	15	–	–	–	–
	25.08.2012	54°27'320" N 15°26'100" E	trawl net	–	115	–	cod	–	–
	22.07.2012	54°19'800" N 015°33'800" E	set nets	105	80	single live	European flounder	shells	–
	24.07.2012	54°30'750" N 015°17'040" E	trawl net	105	350	20 kg	European flounder, European plaice, small cod	shells	–
	29.07.2012	54°31'750" N 015°16'500" E	trawl net, set nets	–	280	–	–	single eelpouts	–
	01.08.2012	54°33'276" N 015°12'210" E	pelagic net with a cod-end	28	2000	–	–	shells	–
	03.08.2012	54°30'032" N 015°14'635" E	set nets	105–180	110	5 kg	European flounder	shells	–
KOŁ-40	03.08.2012	54°30'280" N 015°15'544" E	cod-end	105	70	–	–	shells	–
	04.08.2012	54°31'563" N 015°12'832" E	set nets	105	80	several flatfish	European flounder, European plaice	shells	–
	12.08.2012	54°31'40" N 015°05'96" E	set nets	–	80	single fish	European flounder, cod	–	–
	12.08.2012	54°30'315" N 015°08'82" E	set nets	–	40	–	–	–	–
	16.08.2012	54°30'70" N 015°09'14" E	set nets	–	350	–	fish skeletons	–	–
	16.08.2012	54°30'15" N 015°13'90" E	steel rope and rubber gear	–	100	–	–	–	–
Romasté	27.07–29.08 & 12.10.2012	–	–	–	250	288 kg	–	–	–
Shipwreck cleaning – PL	27.07–13.08.2012	–	–	–	1760	–	–	–	–
Shipwreck cleaning – LT	27.07–13.08.2012	–	–	–	1066	–	–	–	–

* In addition, between 05/09 and 09/07 WŁA-11 vessel performed 8 search draughts using the search equipment. These were for the training and implementation purpose; only trace amounts of ghost nets were retrieved.

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