Agenda Item 14.1.2

Implementation of the ASCOBANS Triennial Work Plan (2007-2009)

ASCOBANS Baltic Recovery Plan (Jastarnia Plan)

Outcome of 4th Meeting of the Jastarnia Group

Document 12

Report of the 4th Meeting of the Jastarnia Group

Action Requested

- take note of the report
- comment
- adopt the recommendations of the Jastarnia Group

Submitted by

Secretariat

UNEP ASCOBANS

NOTE:
IN THE INTERESTS OF ECONOMY, DELEGATES ARE KINDLY REMINDED TO BRING THEIR OWN COPIES OF DOCUMENTS TO THE MEETING

REPORT OF THE

FOURTH MEETING OF THE

JASTARNIA GROUP

Kolmården, Sweden

25-27 February, 2008

1. Opening of the Meeting

Mats Amundin of the Kolmården Djurpark welcomed the participants to the Dolphin Centre of the Kolmården Zoo. He explained the zoo's education policy which allowed strictly supervised close encounters with dolphins. As well as education, the zoo placed great emphasis on conservation. The zoo had a limited season for visitors (May-August with weekend opening in September). Records had been set in 2007 with 565,000 visitors.

2. Adoption of the Agenda

Sara Königson (Sweden) introduced the draft agenda. The main item of business would be the revision of the Plan. There being no comments on the draft agenda, this was adopted.

3. Election of Chair for the Meeting

Sara Königson (Sweden) was elected unopposed to the chair.

4. Presentation of the Report on Relevant EC Legislation and Policies in Respect of the Baltic Harbour Porpoise – Richard Caddell

Richard Caddell (Swansea University) gave a power point presentation explaining the legislative background relevant to the Baltic Sea Harbour porpoise [copies of slides attached as Annex 4]. Key factors were the EC Habitats Directive, the Common Fisheries Policy, the 6th Environmental Action Programme, the CBD 2010 Targets and emerging policy initiatives such as the marine strategy and developing marine policies.

The Habitats Directive with its provisions for declaring protected areas (Special Areas of Conservation) for Annex I habitats and Annex II species and protection measures for Annex IV species was the most important piece of European legislation for ensuring the conservation of biodiversity within the European Union.

Implementation of the Directive was in its early days with some matters of interpretation being discussed (e.g. whether "territory" meant that only territorial waters (12 nautical miles) were included and which activities were allowed under derogations for "overriding issues of public interest"). Some cases brought before the European Court of Justice had made interpretation clearer (e.g. the Commission's case against Ireland's inadequate monitoring provisions).

While the Common Fisheries Policy was designed to address stock management and prevent further "cod wars", it had recently been broadened to be more environmental. Regulation 812/2004 addressed bycatch by banning drift nets, introducing observer programmes and requiring the use of "pingers".

Other green policies were not aimed exclusively at the marine environment but were relevant (climate change, environment impact assessments) and mineral exploration and military activities both had a potentially significant impact.

The floor discussion raised a number of questions. The use of pingers caused a dilemma, as they were meant to prevent bycatch but were a cause of noise pollution which contravened Article 12 of the Habitats Directive which called for disturbance to resting places to be eliminated (although possibly justified in preventing the greater evil). They also seemed to attract seals.

Karl-Hermann Kock (Germany) expressed the view that Regulation 812 was not effective in the Baltic in view of the large number of vessels under the specified size meaning that a large number of nets were deployed without “pingers”.

Iwona Kuklik (Poland) commented that drift nets had been banned in EU waters in 2002 but to her knowledge they were still widely used and she wondered whether the nets used were exempt from the ban if they were less than 2.5 km in length which seemed to be the international standard. The problem appeared to lie in the fact that there was no clear definition of what a drift net was. Sara Königson said that the Swedish fisheries authorities had had to define drift nets when they were compensating fishermen for decommissioning their equipment. Richard Caddell advised that legislators faced a dilemma when deciding how precise to make definitions to avoid legal loopholes and finding the right balance was difficult. Stefan Bräger (Germany) commented that the deadlines set for the identification of offshore Sites of Community Interest (candidate SACs) may have been missed by several countries and therefore expected increasing activity to designate such marine protected areas. It was potentially a role for the Jastarnia Group to help elaborate criteria for identifying appropriate sites for Harbour porpoises in the Baltic. Guidelines had been developed for the designation of SACs in general but he felt that the numbers of Harbour porpoises remaining in the Baltic Sea were now too low for the guidelines to be valid. Karl-Hermann Kock felt that the marine SACs designated by Germany so far were far too small to have any real benefit for Harbour porpoises.

Mr Caddell agreed to work on key bullet points, which it was agreed would be included in the final report to be presented to the forthcoming Advisory Committee (see Annex 5).

5. Implementation of the Jastarnia Plan

a. Bycatch Reduction

Reduced fishing effort in certain fisheries.

Bartłomiej Przesmycki (Poland) reported that no more licences were being issued for the use of drift nets, although the use of such nets was historically well entrenched and Polish fishermen were resisting the new regulations. The Ministry was planning to provide pingers for use in ICES areas 25 and 26 and had to identify the fisheries which would be required to use them. Sara Königson (Sweden) reported that there were no more drift net salmon fisheries in Swedish waters. The situation was less clear with recreational fisheries, where sometimes nets anchored at one end were used in shallow waters. Using the measure of the metres of nets deployed per day, fisheries effort by boats exceeding 10 metres in length had reduced over the period 1997-2004. Quotas had been reduced. However, if there were fewer fish to catch, one might expect more fisheries effort.

Jarmo Vilhunen (Finland) reported that there had been a certain reduction of fisheries effort in Finland. Finnish salmon quotas were not being taken up. Trawlers in the North Baltic fishing for herring and sprat did show a higher take-up of the quota. Following the EU driftnet ban no licences had been issued for salmon driftnet fisheries. Finnish authorities had issued only 14 special permits for cod fisheries. He commented that fishermen were finding recruitment difficult and their average age was rising. Grey seals were a major problem for fisheries, whereas Harbour porpoises were very rare visitors to Finnish waters. Finnish Ministry of Environment and Ministry of Agriculture and Forestry had agreed with a local warning system whereby if there were sightings of Harbour porpoises, fishermen were notified of the porpoises' presence and fishing could be suspended on a voluntary basis until the animals left the area.

Sara Königson referring to the recommendation contained in the previous version of the Plan said that Germany had the highest number of part-time fishermen, but even their infrequent use of nets posed a threat to Harbour porpoises. Karl-Herman Kock pointed out that even part-time fishermen in Germany had to pass examinations and licences were not issued simply against payment of fees. Unlike in Denmark or Sweden, recreational fishermen in Germany were not allowed to set nets. Sara Königson added that one reporting criterion under the legislation was the size of the boats used (those under 10m did not have to report daily) and these vessels were unlikely to deploy pingers. The actual impact on Harbour porpoises was unknown and more studies were being undertaken on both the west and east coasts to determine the by-catch of harbour porpoises and birds in recreational fisheries. This might depend heavily on voluntary reporting of effort supported by some observations in the field. The length of the nets would mean that one pinger per net would suffice. Jan Erik Holmberg said that there was limited control over recreational fisheries; the target fish species were known but not the intensity of the effort. Stefan Bräger questioned whether there was any justification in believing that non-commercial nets were, metre for metre, any safer than commercial ones or that their impact was any less. Mats Amundin said that the two basic requirements were to investigate further the fishing effort of leisure fishermen and impose a blanket ban on their use of nets. Stefan Bräger said that this would approximately halve the nearshore fishing effort in Germany and Karl-Hermann Kock added that fishermen in Schleswig-Holstein and Mecklenburg-Western Pomerania would resist such changes to their historic practices. Not issuing any further licences would however mean that the practice would be eliminated over time. Mats Amundin added that in Sweden, Denmark and Finland there was growing interest in line fishing. In conclusion, Sara Königson suggested that the Jastarnia Plan should place greater emphasis on leisure fisheries.

Valdis Pilats (Latvia) had no official figures available but anecdotally had heard reports from fishermen that they were reducing their effort, blaming EC regulations. Seals were blamed for eating too much fish. Decommissioning programmes were leading to a smaller fleet and quotas were making the industry less profitable.

For Germany, Karl-Hermann Kock reported little reduction in effort over recent years, but assessing non-commercial effort was difficult. Policing part-time fisheries was not high on the authorities' agenda. Most part-time fishermen were retired or former full-time fishermen, who had taken their exams and earned their licence. New fishermen were joining and few obsolete vessels were being decommissioned.

The meeting agreed that the recommendations from the Group's discussions should be maintained separately from the annex of the Plan. The recommendations should be immediate and tactical, while the annex should be longer term and strategic.

<u>Replace fishing methods known to be associated with high porpoise bycatch (i.e. bottom set gill nets) and introduce alternative gear that is considered less harmful</u>

Stefan Bräger was not enthusiastic about blanket bans on part-time or leisure fisheries and felt that range states should increase efforts to develop alternative gear. Karl-Hermann Kock did not want to discriminate against part-time fishermen and favour full-timers; both were important. Regarding alternative gear Mats Amundin thought that cod traps were more expensive and less efficient, but one incentive could be to give cash discounts when purchasing new gear if old gear was handed in. Karl-Hermann Kock said that there would be objections to subsidising the transition from old gear to new, while

Sara Königson thought the system could be abused with people digging out old nets from their garages. Mats Amundin warned that fishermen were set in their ways and needed some financial enticement and asked what market mechanisms could operate to reduce the cost of safer equipment.

Stefan Bräger thought that once the SAC network had been established, local prohibition of fishing in sensitive areas could be enforced. Karl-Hermann Kock pointed out that the designation of SACs was running behind schedule, while Iwona Kuklik said that fishing was not prohibited in Poland's SACs. Penina Blankett (Finland) said that management plans established for particular sites could regulate fishing activities and that could mean a total ban. Richard Caddell agreed that it would depend on the particular requirements and conditions of individual sites. Jarmo Vilhunen thought that the Jastarnia Plan could help set priorities, with highest risk areas given most attention and strongest protection (e.g. high risk gear being withdrawn from sensitive sites). Fishermen should also be engaged and new fishing gear developed. He felt that it would be difficult to develop standardised data.

Stefan Bräger suggested the Group might want to concentrate on making recommendations on how the Plan as it stood could be implemented. In the end, it was the task of the Advisory Committee or the MOP to revise the Plan. The Group's recommendations reflected the action points in the Plan. Mats Amundin suggested that shortcomings (points which had not been implemented) should be identified together with the factors that prevented implementation. It was important to engage fishermen and persuade them to cooperate. A draconian approach of setting deadlines for them to clean up their act and threatening to close down fisheries was unlikely to win hearts and minds. The Regional Advisory Councils (RACs) relevant for the ASCOBANS Area as well as the European Commission's DG Fish had been invited to the Jastarnia Group and the Advisory Committee, but Heidrun Frisch (Secretariat) reported that to date no representative from these organisations had registered. Sara Königson had contacted the Baltic RAC and ASCOBANS had been granted observer status to that organisation. RACs already had species working groups and the Jastarnia Group should try to persuade them to establish bycatch working groups too. Mats Amundin said that the fisheries interests always contested any proposals for quotas and tended to be sceptical. Penina Blankett suggested that stakeholders should be engaged on a national basis, because they needed to be addressed literally in their own language. The Jastarnia Group could the act as a clearinghouse.

In the draft revision document, Stefan Bräger questioned the reference to "interactive pingers" as they had yet to be developed and deployed. Mats Amundin said that they were being developed. Sara Königson pointed out that there were other design developments being pursued, such as cod traps which were being trialled along the Swedish coast. In one pilot scheme, three fishermen were using different numbers of traps of Norwegian design. These traps floated in the currents and the target fish were attracted by bait. Results were inconclusive with the trials working well in some places and less well in others, in part depending on what bait was used. More trials were needed with fishermen using 25 traps each, but even at this level of intensity, the fishery was unlikely to be viable, especially as it required two people to handle the nets. Collapsible traps helped save space on small vessels but at least 100 traps were needed to replace a traditional net. Traps had the advantage that they cause less damage to the fish but they were less selective regarding size. Jarmo Vilhunen asked whether the traps were seal proof and whether this equipment was ever likely to be viable. Mats Amundin said that another advantage was that the traps did not have to be returned to port; once emptied they could be reset immediately and could be cleaned at sea using a hose. Traps were more durable and at €100, the typical cost for a fisherman deploying 100 traps would be €10,000. Sara Königson commented that less bycatch would enhance efficiency and the industry could promote its "greenness" in the same way as dolphin-friendly tuna fisheries. Some fishermen were open to new ideas and were willing to assist trials. An academic thesis had been written in English by Ljungberg on the use of the traps and a copy is attached as an annex to this report (see Annex 6).

Sara Königson referred to another project being undertaken with Swedish funding concerning seal-safe fishing gear, which had been operating for three years and seemed to be successful. Although not directly relevant to Harbour porpoises, some read-across might be possible and seal-safe traps were suitable to replace gillnets. Fishermen were receiving 80% grants to replace gillnets with traps in salmon, whitefish and pike-perch fisheries. Mats Amundin asked whether the increasingly popular longline fisheries would ever be viable. They were vulnerable to seals and Sara Königson commented that success depended on many factors, such as seasonally variations in the likelihood of the cod biting. With drift nets being phased out, fishermen in the Baltic were showing growing interest trials to fish with longlines. Setting the bait could be labour intensive although machines did exist to do this task. In Sara Königson's experience, fishermen wanted reliable equipment. Jan Erik Holmberg confirmed this view, saying fishermen wanted to ensure that the days they were allowed to spend at sea should be productive.

Compilation of standardised data

Karl-Hermann Kock advocated the deletion of the associated recommendation and its replacement. New research was taking place in the North Sea and parallel projects should be encouraged in the Baltic. National level research seemed to work well and results from different countries could be collated to determine the wider position. The North Sea research was using "black box" data which showed where vessels were operating, so it was commercially sensitive. It was also restricted to vessels longer than 12 metres. Jarmo Vilhunen said that similar technology was used in the Baltic in the control of fisheries where it was known as VMS-system. The "blue boxes" had been installed onboard fishing vessels recording positions and speed. A rough estimate of the fishing effort could be calculated from the VMS-data. The minimum length of vessels covered by the EU legislation was however 15 metres in Community waters, meaning that data on the movements of vessels under 15 metres would not be available. Jarmo Vilhunen thought that extensive fishing effort surveys covering the whole Baltic could be laborious and expensive and needed to be focused on key areas. Mats Amundin was keen for such work to be carried out in the Baltic, while Stefan Bräger challenged the validity of the notion of "hot spots" or key areas, when populations were thought to be so low. Karl-Hermann Kock did not rule out the possibility that much of the necessary data was already available and just needed collating. The recommendation from the Advisory Committee's previous meeting suggested that ICES be asked, as Mark Tasker suspected that ICES might have the information. It transpired however that ICES only collated landing and discard data and collecting the data the Jastarnia Group needed would be costly.

Implement a pinger programme on a short-term basis

Karl-Hermann Kock observed that 80% of vessels fishing in the Baltic were exempt from the requirement to use pingers. Sara Königson reported that nine larger vessels in Sweden reported the use of pingers. She was not sure whether any eligible vessels were not using them. Iwona Kuklik was certain that the requirement to use pingers in ICES area 24 was being flouted. Mats Amundin said that stakeholders were not taking their responsibilities seriously and EC Regulation 812/2004 was not being properly enforced.

Stefan Bräger pointed out that the Jastarnia Plan supported the short-term use of pingers. Sweden had introduced pingers in 2005 in fisheries concerned by Regulation 812 and had started developing alternative fishing gear. Karl-Hermann Kock praised Sweden's example of adhering to the letter and spirit of the Jastarnia Plan. Stefan Bräger reminded the Group that according to the Jastarnia Plan, pingers were only ever considered a temporary solution to buy time while safer gear was developed. Some countries had still to start using and introducing pingers with old gear. He suggested that the European Commission should be made aware of the poor compliance with its legislation in some places and parties reminded of their agreed policy on pingers, namely that they be phased out after three years as new gear was developed. Iwona Kuklik thought that the Group should concentrate on the commitments under the Plan and not preach to parties about their EU obligations. Mats Amundin thought that the emphasis should be placed on the Jastarnia Plan but in a wider context of other legal frameworks and pointed out that ICES area 24 was not the most heavily fished.

Stefan Bräger and Iwona Kuklik were asked to work on the wording of a revised Recommendation.

b. Research and Monitoring

Analyse stock affinities of Harbour porpoises in the "transition zone" of the south-western Baltic

Stefan Bräger reported on the 10 October 2007 workshop on behalf of Jonas Teilmann. A copy of the report had already been circulated. He explained that it had long been shown that there were two populations but the precise boundary had not been determined. At the first Jastarnia Group meeting Jonas Teilmann suggested holding the workshop, which was funded by Sweden. Unfortunately Ralph Tiedemann had been unable to participate, but he had presented the project study at the German Year of the Dolphin meeting in Stralsund (October/November 2007) and the findings showed that the "transition zone" did not follow the ICES area boundaries (which follow the Darß Ridge). A line between Rügen and Öland seemed to be a more likely demarcation line, so it was possible that southern Swedish Harbour porpoises belonged to the Belt Sea population. The genetics project contained in the Bonn meeting's terms of reference had still not been undertaken; this would be a significant step forward for the Jastarnia Group as it would help define the Baltic Harbour porpoise. Mats Amundin did not think that the genetic uniqueness of the Baltic Harbour porpoise was significant in determining efforts to protect it. It was important to make as much of the Baltic as inhabitable for the species as possible. The genetic differences would however help understand behaviour, such as site fidelity, at least among female animals, and mating sites and calving grounds, which would have implications for how recovering populations might spread.

Iwona Kuklik regretted Ralph Tiedemann's absence from the Bonn workshops as his data for the key transitional zone was not presented. She referred to the discussion after the genetic workshop that genetic analysis for Baltic porpoises would not be possible because of the small number of data samples available. Penina Blankett said that bone and tissue samples were available in museums and academic institutions in some countries. It remained to be seen whether the DNA in older specimens was stable enough to be of value. Sara Königson said that Sweden had funds available to pay for research and suggested that the Group recommend that collaboration between researchers should be encouraged. Jarmo Vilhunen said that a condition for funding should be sharing data. Sara Königson said that speed was of the essence in getting the work started. Stefan Bräger however felt that it had taken three years to arrange the workshops and the research findings would be in the public domain within a further two. It was thought that tissue from 500 animals would represent a reasonable sample, but it was thought that most available data would come from Sweden and the Inner Danish Waters rather than the Baltic. Iwona Kuklik reported that all samples collected in Poland had already been used for a genetic study within the Jastarnia Project and most of them were therefore no longer available for other projects

Sara Königson, Robert Vagg and Richard Caddell were asked to work on rewording the recommendation after Per Pallsböll's presentation. This presentation was however cancelled.

Develop interactive pingers or pingers using frequencies not audible to seals

Academic research was being undertaken to establish whether Grey seals used pingers to locate nets (see Annex 7). The report of the study should be added to the report as an example of the sort of research that should be conducted. It was suggested that the study should be posted on the ASCOBANS website (or at least the executive summary, if the report itself were too long).

Investigate the possible detrimental effects of different types of sound

Stefan Bräger reported that a study done by the University of Hamburg showed that Harbour porpoises avoided the area near Nysted wind farm even years after construction, so the effects were long term (similar results were obtained by Teilmann et al. 2006 in a report of the Danish Ministry of the Environment). In an attempt to reduce disturbance from leisure boats, a phenomenon prevalent in the summer, Sweden was conducting awareness-raising campaigns with funding from the Swedish EPA in a collaborative effort with Denmark. Unfortunately, Odense Zoo had withdrawn but Norrköping University, with its expertise in simulations, was participating. It was being shown how surface noise carried down to depths, and partners from the motor construction industry were being sought to work on silent, solar powered engines to earn the "Silent Sea" label, as a great deal of additional funding was needed. Germany too had an interest on investigating underwater noise. Sweden was also collaborating with Barcelona University regarding the position in the Mediterranean.

Monitor bycatch in fisheries known to be harmful to Harbour porpoises

Jarmo Vilhunen reported that Finland was operating a two-year observer programme in order to meet its commitments under Reg. 812/2004. Two observers had been engaged specifically for the task. The report had been sent to the Commission in Finnish and was probably with the translation services. No bycatch was witnessed, but important data on fisheries practices was obtained, e.g. on discards. Coastal communities were against the observer programme which was seen as needless meddling from Brussels. Although Finland had been present at the negotiations, the atmosphere had been strained. Finland's attempts to be exempted from observer programmes were unsuccessful, as the Commission seemed convinced that there were large numbers of Harbour porpoises in Finnish waters, although this was not the case. Sara Königson said that Sweden was trying to persuade smaller boats to accept cameras on board. This could help prove that smaller boats were not a problem (or at least not a major one). Unfortunately, the proposal had not been welcomed by the fishermen (it seemed too much like "Big Brother" to them). To date Sweden had managed to observe a sample of 4.6% of the fishing effort for boats > 15 metres using pelagic trawls and 9% of the fishing effort for boats > 15 metres fishing with gillnets during 2007 under Reg. 812/2004.

For the recommendation, Stefan Bräger suggested that parties be reminded of the need for observer programmes for smaller boats and to note Sweden's efforts. Penina Blankett pointed out that the observations data was needed both for the Jastarnia Plan and by the Commission to assess implementation of the Habitats Directive. Sara Königson and Robert Vagg would work on the wording of the recommendation.

c. Marine Protected Areas

Karl-Hermann Kock said that little progress had been made and this section should therefore be retained. Mats Amundin did not think that small SACs served any useful purpose for wide ranging species like Harbour porpoise and ”hot spots” needed to be identified and given strong protection. The logical conclusion of the requirements under Annex II and IV was for the entire southern Baltic and the Inner-Danish waters to be designated. Richard Caddelll said that derogations could be possible in larger SACs.

The recommendation about the designation of the Flensburg Fjord had not been accepted by the Advisory Committee as it was deemed too interfering with Denmark’s national processes, and in any case, the Fjord lay outside the Jastarnia Group’s geographic area.

Mats Amundin thought that the recommendation concerning guidelines needed to be implemented. Richard Caddell pointed out that the 90-page guidance which had been produced contained one and a half pages on Harbour porpoises. Later on Signe Sveegaard was to present the findings of her and Jonas Teilmann’s project, which also sought to establish some environmental parameters for Harbour porpoises’ habitat selection based on a sample of some 60 animals. Peter Evans was still working on his paper with the results of the San Sebastian meeting.

d. Public Awareness

The FTZ (Forschungs- und Technologiezentrum – Research and Technology Centre) wanted to continue supporting the Baltic harbour porpoise database (recommendation 6) but the funding was not in place. It was also noted that the words “information material for the” had been omitted from recommendation 9.

Heidrun Frisch (Secretariat) explained that part of the German voluntary contribution had been used to translate the updates of the ASCOBANS leaflet into Baltic languages. She was also working on material aimed at fishermen and the terms of reference for a consultancy on a needs analysis. Stefan Bräger suggested that parties compile a prioritised list of projects and try to find funding for the top projects. Sara Königson felt that ASCOBANS had enough leaflets and it was difficult to know how to distribute them. Stefan Bräger suggested a collaborative effort with HELCOM, e.g. to produce a film which could be shown at zoos. Iwona Kuklik said that a film about Harbour porpoises would be produced in Poland as a part of the project on “Active Protection of Harbour Porpoises” and it could be useful for other countries. Mats Amundin said he would enquire whether the information film shown at the dolphinarium could be adapted and translated.

e. ASCOBANS’ Cooperation with Other Bodies

The recommendation concerning participation in the Baltic RAC had to be revised as the approach had now been made. Penina Blankett said that the HELCOM seal group wanted to broaden its remit to include Harbour porpoises. The Secretariat would need a mandate to participate and Stefan Bräger asked how the seal group could overlap with Harbour porpoise conservation, as the seal group basically regulated hunting. Iwona Kuklik suggested that HELCOM should be invited to the Jastarnia Group instead. Stefan Bräger suggested a joint public awareness raising campaign.

It was agreed to delete the last recommendation on dissemination of the recommendations, as the report and the recommendations would be posted on the ASCOBANS website.

6. Reviewing Council Regulation 812/2004

The Commission was reviewing Reg 812/2004 and this was the Jastarnia Group's opportunity to make an input. Jarmo Vilhunen asked whether the timetable and procedure was (the deadline for submissions was May 2008). Iwona Kuklik reported that the ICES Study Group on Bycatch had been asked by the EU to make an evaluation, but unfortunately there had been few Baltic representatives at the meeting, which had been dominated by fisheries institutes. Karl-Hermann Kock had known nothing of the meeting and none of the German delegates who registered attended. The final report of the ICES Group would be available on the ICES webpage.

Jarmo Vilhunen's assessment was that the Regulation was a compromise of the EU Council negotiations and nobody was entirely happy with it. The three key points for the analysis of the Jastarnia Group were the usefulness of the ban on drift nets in the Baltic Sea; the EU member countries' experiences with the pingers and the results of the observer programmes.

Karl-Hermann Kock thought that the Jastarnia Group's view was straightforward: the Regulation had weaknesses as it applied in the Baltic. There was no need for a protracted procedure, as appeared to be the case with ICES which would produce a report some time in the future. ICES should also liaise with the Jastarnia Group to benefit from its specific, local knowledge. A working group of three or four members should be established to summarise the case for reforming the Regulation. Stefan Bräger read out the conclusions of the Stralsund conference (Year of the Dolphin in Europe – conservation of small cetaceans and marine protected areas). Sara Königson asked whether it was worthwhile increasing observer efforts in the Northern Baltic. Karl-Hermann Kock said that this had been discussed at length before. Monitoring all the smaller vessels would cost a disproportionate amount and a more economical method needed to be found. Stefan Bräger said that the regulation highlighted one of the shortcomings of its coverage by urging Member states to come up with a scheme for monitoring smaller vessels. The Harbour porpoise's numbers were so depleted that the concept of "hot spots" was now meaningless and it was irrelevant which type of fisheries caused bycatch, since the result was porpoise mortality. Jarmo Vilhunen said that at the height of the season thousands of small vessels (including leisure boats) were engaged in fisheries in the Baltic and these vessels had no room for observers. Penina Blankett pointed out overlaps with the Habitats Directive and asked which provisions took precedence. The Habitats Directive did not specify the size of vessels to be observed.

The Jastarnia Group needed to send its views to the Commission. Although the Plan was relatively short, it might be too long a document for the Commission to digest easily, so it was suggested that key points be highlighted. The Plan had deliberately been written without an executive summary to ensure that the main document was kept concise.

As there was some opposition to using the Stralsund declaration as the basis for the Group's submission to the Commission, Stefan Bräger agreed to draft a position statement to be annexed to the report of the meeting (see Annex 3).

7. Re-evaluation of the Jastarnia Plan

The version of the plan to be discussed was the one dated February 2008; the Plan had been sent to members of the Group to give them an opportunity to comment and this version contained the questions raised and suggestions made.

It was suggested that the Plan should remain as one document rather than two. The background chapter listed all the meetings of the group and this would have to be updated each year, so Heidrun Frisch suggested deleting references to the meetings and replace them with a link to the ASCOBANS webpage where this information could be made available.

In view of the lack of data and the difficulty in extrapolating population figures for the whole Baltic from the small areas surveyed, many participants suggested that the bycatch target be amended in line with HELCOM to reduce by-catch towards zero. Mats Amundin questioned how the target of restoring populations to 80% of the carrying capacity had been devised, as no-one knew what the historic figures were and other factors, such as declining fish stocks were relevant. His suggestion to insert the term "viable populations" however was opposed by Stefan Bräger because this quantity was impossible to measure in the Baltic Proper.

As a result of the discussion concerning how to deal with certain data, it was agreed that a progress report should be prepared to save overloading the Plan itself with detailed information. The report would be fleshed out with national activities, details of which could be provided by the Parties.

The meeting reviewed the text of the Plan concentrating primarily on the comments received. The revised Plan with the amendments agreed at the meeting would be circulated separately by the Secretariat.

8. Selecting Natura 2000 Sites: Signe Sveegaard

Signe Sveegaard gave a presentation on satellite tracking, acoustic and aerial survey work undertaken in the northern North Sea, the southern North Sea, inner-Danish waters and the western Baltic, which would inform Denmark's site selection process under the Habitats Directive. Only one marine SAC had so far been designated by Denmark (the Wadden Sea).

Most of the Danish survey work had been conducted in the North Sea and the inner-Danish waters, while in the western Baltic German surveys were used to supplement satellite tracks. It appeared that there was little interchange between porpoises resident in the North Sea and inner Danish waters.

The summary of the Jonas Teilmann's report (High-density areas for harbour porpoises in Danish waters) appears as Annex 8 to this report. The full report can be found at:

http://www2.dmu.dk/Pub/FR657.pdf (the report)
http://www2.dmu.dk/Pub/FR657_appendix.pdf (appendixes to the report)

9. Swedish Genetic Project: Per Pallsböll and Nils Ryman

This presentation unfortunately had to be cancelled due to the illness of the speakers.

10. Election of New Chair

As Sara Königson could not guarantee that she would be available to chair the next meeting, she suggested that members of the Group considered possible candidates to replace her.

11. Date and Venue of Next Meeting

Penina Blankett (Finland) offered to host the next meeting. The provisionally agreed dates were Monday 23-Wednesday 25 February 2009. The Secretariat would contact the chairs of the ICES bycatch and marine mammal ecology groups to ensure these dates did not clash.

12. Any Other Business

It was agreed to extend an invitation to WWF to join the Jastarnia Group. Coalition Clean Baltic was also interested. Broadening the membership of the Group was considered to be desirable and more fishermen's associations should be encouraged to participate too.

Mats Amundin then gave a power point presentation on the SAMBAH project which used acoustic listening devices to locate porpoises in the Baltic Sea (slides attached as Annex 9). Two preparatory meetings for this project were already supported by ASCOBANS, and Stefan Bräger suggested that the Jastarnia Group officially recommended this research project for support to the Advisory Committee. There was unanimous support for such a recommendation.

13. Closure of the Meeting

After the customary vote of thanks to the hosts and organisers, with particular reference to the visit to the wolves' enclosure, the meeting was closed.

ANNEX 1

Fourth Meeting of the UNEP/ASCOBANS Jastarnia Group
25 - 27 February 2008, Kolmården, Sweden

List of Participants

Mats Amundin
Kolmårdens Djur & Naturpark
61892 Kolmården
Sweden
Tel. ++46 11 24 90 18
Fax ++46 11 24 90 65
mats.amundin@kolmarden.com

Penina Blankett
Ministry of the Environment
Land Use Department
P.O. Box 35
00023 GOVERNMENT
Finland
Tel. ++358 20 490 7103
Fax ++358 9 1603 9364
penina.blankett@ymparisto.fi

Stefan Bräger
German Oceanographic Museum
Katharinenberg 14-20
18439 Stralsund
Germany
Tel. ++49 3831 2650 303
Fax ++49 3831 2650 209
stefan.braeger@meeresmuseum.de

Heidrun Frisch
CMS/ASCOBANS Secretariat
Hermann-Ehlers-Str. 10
53113 Bonn
Germany
Tel. ++49 228 815 2418
Fax ++ 49 228 815 2440
h.frisch@ascobans.org

Jan-Erik Holmberg
Swedish Fishermen's Federation
Fiskerhamnsg. 33
414 58 Göteborg
Sweden
Tel. +46 31 12 45 90
Fax +46 31 24 86 35
jan.holmberg.eros@beta.telenordia.se

Karl-Hermann Kock
Institut für Seefischerei
Bundesforschungsanstalt für Fischerei
Palmaille 9
22767 Hamburg
Germany
Tel. ++49 40 38 905 104
Fax ++49 40 38 905 263
karl-hermann.kock@vti.bund.de

Sara Königson (Chair)
National Board of Fisheries
Institute of Coastal Research
P.O. Box 423
40126 Göteborg
Sweden
Tel. ++46 31 743 0422
Fax ++46 31 743 0444
sara.konigson@fiskeriverket.se

Iwona Kuklik
Stacja Morska
Instytutu Oceanografii Uniwersytet
Gdański
ul. Morska 2
84-150 Hel
Poland
Tel. ++48 58 675 0836
Fax ++48 58 675 0420
oceik@univ.gda.pl

Valdis Pilats
Gauja National Park Administration
Baznicas Iela 3
2150 Sigulda
Latvia
Tel. +371 67800 389
Fax +371 67971 344
Valdis.pilats@gnp.gov.lv

Bartlomiej Prezesmycki
Ministry of Agriculture and Rural Development
Department of Fisheries
Wspolna 30 Street
00 930 Warsaw
Poland
Tel. ++4822 385 9763
Fax ++4822 385 5774
bprzesmycki@mgm.gov.pl

Tine Lindberg-Roncari
CMS/ASCOBANS Secretariat
Hermann-Ehlers-Str. 10
53113 Bonn
Germany
Tel. ++49 228 815 2416
Fax ++ 49 228 815 2440
t.lindberg@ascobans.org

Signe Sveegaard
National Environmental Research Institution
Dept. Arctic Environment
Fredriksborgvej 399
4000 Roskilde
Denmark
Tel. ++45 4630 1961
sign@dmu.dk

Robert Vagg
CMS Secretariat
Hermann-Ehlers-Str. 10
53113 Bonn Germany
Tel : ++49 228 815 2476
Fax : ++49 228 815 2440
rvagg@cms.int

Jarmo Vilhunen
Ministry of Agriculture and Forestry
P.O. Box 30, Helsinki
00023 GOVERNMENT
Finland
Tel. ++358 9 160 52962
Fax ++358 9 160 52646
jarmo.vilhunen@mmm.fi

Invited Expert

Richard Caddell
Swansea University
School of Law
Singleton Park
Swansea
SA2 8PP
United Kingdom
Tel. ++44 1792 602726
j.r.caddell@swansea.ac.uk

ANNEX 2

Recommendations

- Bearing in mind the limited measures of EC Regulation 812/2004, Parties are reminded to urgently introduce pingers on fishing gear associated with harbour porpoise bycatch and then phase them out within three years. In the meantime, Parties must develop long-term measures to mitigate bycatch such as alternative fishing gear.
- Bearing in mind the Parties' commitments under the Habitats Directive and EC Regulation 812/2004, Parties are required to establish a system to monitor bycatch on all vessels regardless of size.
- The Advisory Committee should establish a small expert working group to evaluate the genetic, morphological and other biological research which has been undertaken so far. Based on this, the working group should assess what further research is required and possible for the conservation of the Baltic Sea sub-population(s). Parties are encouraged to provide funding for such future research.
- ASCOBANS should aim to attend the Baltic Sea RAC as an observer.
- The Secretariat should strive to strengthen links with HELCOM, particularly on outreach and with regard to the Baltic Sea Action Plan. Further, HELCOM should be invited to take part in the Jastarnia Group
- A working group should be established to evaluate how the selection guidelines for MPAs set out during the joint ECS/ACCOBAMS/ASCOBANS workshop (selection criteria for marine protected areas for cetaceans) in San Sebastian also can be adapted for use in the Baltic Sea.
- Parties should develop a collaborative approach to engaging fishers in reporting bycatch. Parties should involve stakeholders, including fishermen, in the work of reducing bycatch and in collaboration with them develop necessary mitigation measures.
- Recommendation on noise: parties should investigate possible detrimental effects of various types if sound and disturbance on harbour porpoises (including pinger signals, noise from vessels, wind parks or construction). Parties should initiate and support studies on the effect of anthropogenic noise on the harbour porpoise.
- Parties should promote studies on alternative fishing gear and interactive pingers.
- Funding should be provided for coordination and maintenance of the international Baltic Sea Harbour Porpoise Database after 2008.
- Funding should be provided for translation of information material for the general public and fishers into all Baltic languages.
- The Jastarnia Group notes the progress made by the Static Acoustic Monitoring of the Baltic Harbour Porpoise (SAMBAH) project and encourages Parties and relevant institutions to give their full support to it.
- Parties should urge their relevant authorities to investigate ways of limiting part-time and recreational set-net fisheries.

ANNEX 3

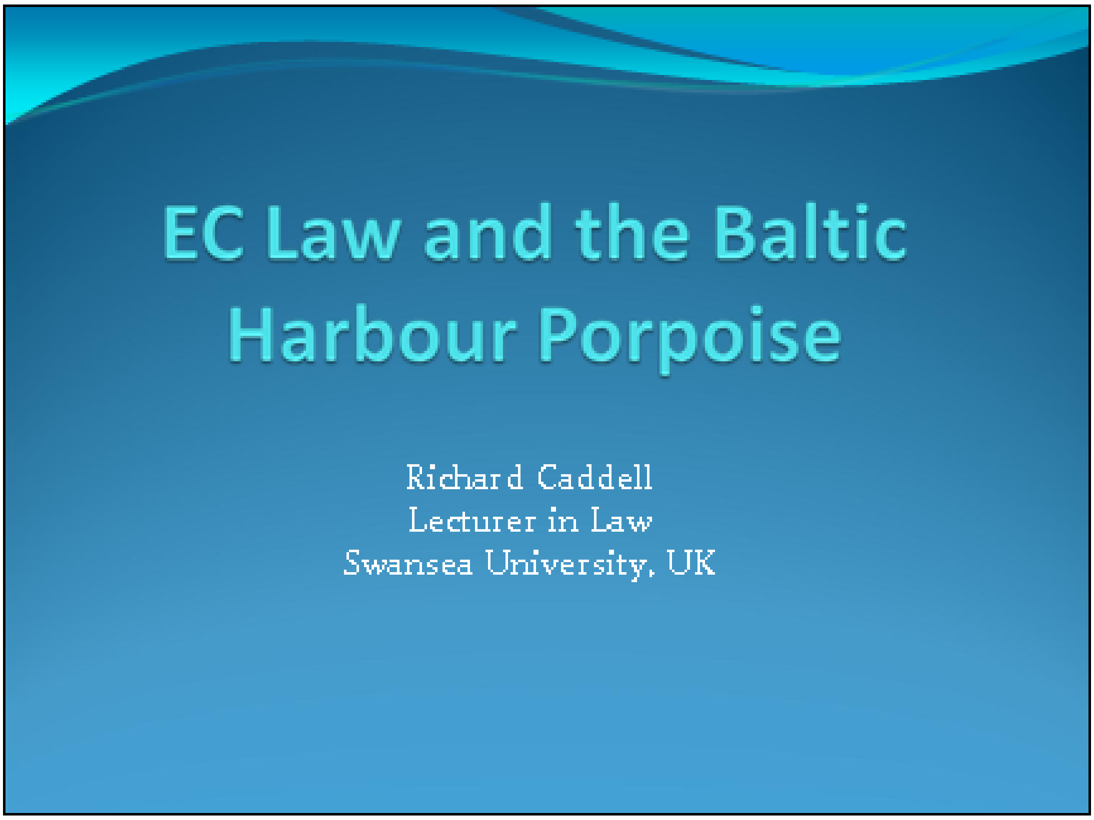
In reviewing Council Regulation 812/2004 for the Baltic Sea, the Jastarnia Group invites the Advisory Committee of ASCOBANS to suggest to the European Commission:

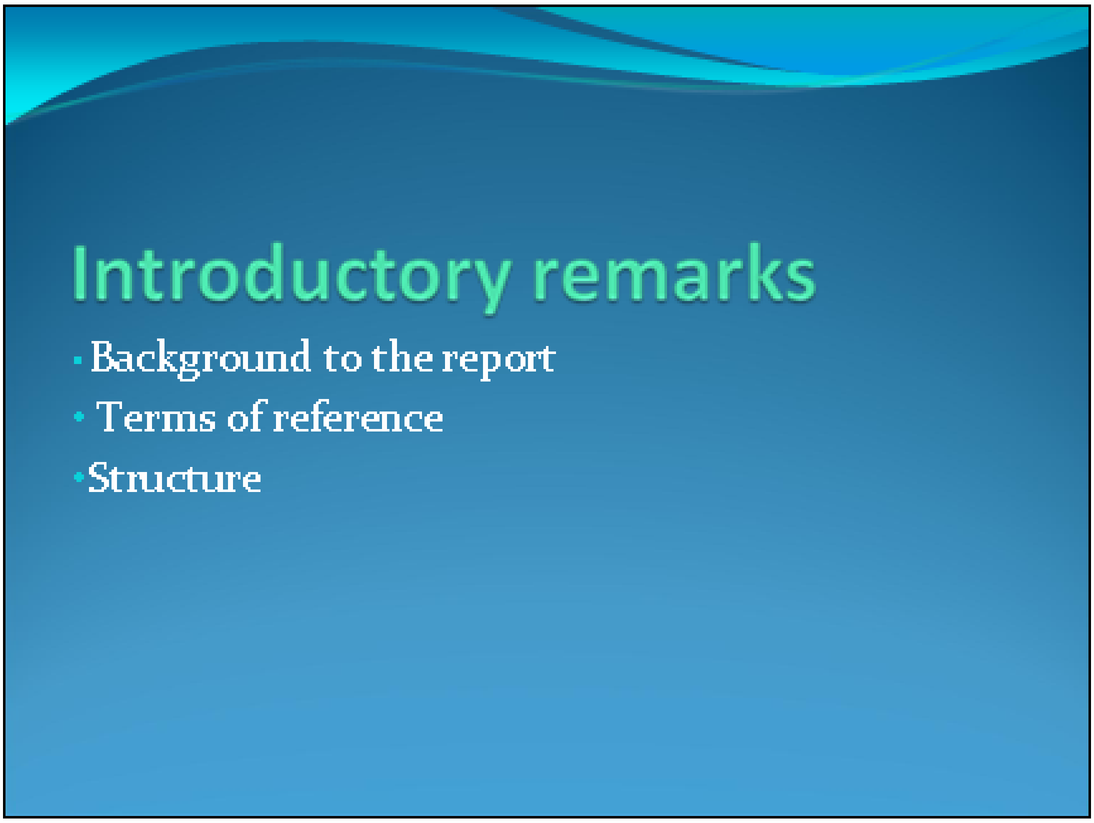
- To introduce the mandatory use of pingers as an interim measure in all gillnet or entangling net fisheries of high risk to cetaceans (i.e. harbour porpoise), regardless of vessel size, not only in ICES area IIId subdivision 24 but also in the remaining Baltic Sea including areas IIIb and IIIc. When introducing a comprehensive pinger scheme, take account of the objectives for by-catch mitigation laid down in the ASCOBANS Jastarnia Plan and ensure that a medium-term time line (not exceeding three years) is adopted for the achievement of these goals. Furthermore, the potentially negative side effects of pingers on cetaceans need to be studied, and their use and effectiveness need to be monitored simultaneously by on-board observers.

- To accelerate the testing and introduction of alternative fishing gear in order to make it possible to phase out gillnets in high-risk areas as soon as possible.

- To set in place an effective small cetaceans by-catch monitoring programme and to make it mandatory for all set-netting vessels (including vessels smaller than 15m), wherever feasible, reinforcing already existing provisions. Recreational and other part-time fisheries should be addressed in a similar fashion. This should also include areas where pingers are used, to evaluate the effectiveness of this mitigation method. Where human observers are not possible, appropriate electronic surveillance or another comprehensive monitoring providing data of equal quality should be conducted urgently. In addition to independent monitoring, comprehensive reporting of by-catch by fishermen should be encouraged.

ANNEX 4


EC Law and the Baltic Harbour Porpoise
Richard Caddell
Lecturer in Law
Swansea University, UK


Introductory remarks
Background to the report
Terms of reference
Structure

Guiding Policies

- Sixth Environmental Action Programme
- CBD 2010 targets
- EC Biodiversity Strategy and Action Plans
- Emerging policy areas in marine affairs: Marine Strategy & Maritime Policy

Sixth EAP

- Article 3 – effective and sustainable use of the sea
- Article 6 – priority actions in respect of CFP reform, marine strategy, development of ICZM and seawards application of the Habitats Directive.

EC Biodiversity Strategy

- Structure
- BAP on Natural Resources – improve record of the CFP; develop marine remit of the Habitats Directive.
- BAP on Fisheries – interactions with fisheries
- Message from Malahide – conserve and restore aquatic biodiversity
- Further developments – targets for addressing marine pollution, fisheries interactions and land-based pollution

Marine Strategy

- Greater regional cooperation envisaged
- Greater emphasis on regional problems
- Greater use of "existing regional institutional cooperation structures"
- Potential role of ASCOBANS, Jastarnia Group and HELCOM

Habitats Directive

- Pre-eminent nature conservation regime under EC Law
- Primary aim – "contribute towards ensuring bio-diversity through the conservation of natural habitats of wild flora and fauna in the European territory of the Member States"
- Natura 2000 network of SACs encompassing Annex I habitats and Annex II species (including the Baltic harbour porpoise)
- "Strict protection" measures required by all Member States for Annex IV(a) species (including "all species" of cetaceans)
- Broad maritime reach established for the Directive (Commission v. UK; Case C-6/04)

Natura 2000

- Process – nomination of Sites of Community Interest; development of Special Areas of Conservation
- Stewardship – Article 6; regulation and management, as opposed to strict prohibition of activity
- Article 6(4) exceptions – human heath/safety; beneficial consequences; Commission Opinion; "other imperative reasons of overriding public interest"
- Possible reasons of overriding public interest include many that may affect the Baltic harbour porpoise.
- EC Guidelines – need for a clear set of criteria for designation of porpoise SACs

“Strict Protection”

- Article 12(1) – prohibition of killing, disturbance and deterioration / destruction of breeding sites or resting places
- Article 12(4) – obligation to monitor incidental catches and killing and to undertake further research or conservation measures to ensure that there is no "significant negative affect" upon the species"
- Strict view of "strict protection" taken by the European Court of Justice (Commission v. Ireland; Case C-183/05)
- Possibility of derogations – Article 16

Role of the CFP

- By-catch mitigation requires practical fisheries measures, notwithstanding the role and relevance of the Habitats Directive
- Reform of CFP in 2002 introduced a clear environmental remit (Regulation 2371/2002), especially in the context of by-catches
- Some isolated by-catch provisions in 1990s, but the most important provisions have been forthcoming since 2002

Regulation 812/2004

- The first Regulation adopted under the new CFP to take the conservation needs and status of cetaceans into direct concern
- Seeks to adopt "an ecosystem approach" to by-catches
- Full elimination of driftnets in the Baltic Sea area following EU enlargement
- Monitoring activities
- Use of "pingers" compulsory

Driftnet fishing

- Considered an especially destructive practice
- First limited under the Wellington Convention 1989 to 2.5km limit
- Castries Declaration of the Organisation of Eastern Caribbean States 1989
- UN General Assembly Resolutions 44/225, 45/197 and 46/215
- Use of driftnets over 2.5km on the *high seas* prohibited
- Lack of application to the Baltic Sea – no areas of high seas present

EC driftnet ban

- Incremental phases
- Regulation 345/92 introduced the 2.5 km ban in EC waters
- Regulation 894/97 removed French albacore exception
- Regulation 1239/98 banned driftnets in all EC waters, aside from the Baltic Sea
- Regulation 812/2004 introduced an incremental phase-out of driftnets in the Baltic Sea
- Regulation 2187/2005 adjusted the time-scale in individual areas but not the 1 January 2008 deadline

Driftnet problems

- Open non-compliance, especially in the Mediterranean
- Legal challenges
- Protracted non-compliance process
- Modification problems – new definition drafted under Regulation 809/2007 to address this issue
- Development of new Community Fisheries Compliance Agency should assist in driftnet monitoring and compliance issues

Other policies

- A considerable body of policies could be advanced with application to the Baltic harbour porpoise – e.g. Climate change provisions; EIA considerations; provisions addressing land-based pollution
- Few direct provisions on marine pollution explicitly address wildlife as an holistic concern – more compensatory in nature.
- Seismic surveys likely to be addressed under Article 16 of the Habitats Directive
- Military sonar has been discussed by the European Parliament, but lack of military competence renders action unlikely in the near future.

Some conclusions

- Currently, the Habitats Directive and aspects of fisheries law offer the most direct conservation possibilities for the Baltic harbour porpoise
- Nevertheless, these are a "work in progress" – the possibilities for SACs are just being realised
- Work remains in elaborating the distinct criteria for the establishment of SACs for species of cetaceans
- Continuing developments under the Marine Strategy and Biodiversity Strategy also offer potential benefits for species of cetaceans, including the Baltic harbour porpoise

ANNEX 5

The potential role of the ASCOBANS Jastarnia Group to the EC cetacean agenda

Following the Fourth Meeting of the ASCOBANS Jastarnia Group in February 2008 it was requested that an addendum to this report be made, in which a series of key proposals could be raised as to how the Jastarnia Group could potentially contribute to the work of the EC in the field of cetacean conservation, with particular reference to the Baltic harbour porpoise.

The proposals are as follows:

- Continue to communicate suggestions agreed at the end of each Jastarnia Group meeting to the European Commission as to the modification and improvement of key provisions of EC law that address the conservation status of the Baltic harbour porpoise, such as Regulation 812/2004.
- Provide advice and assistance in relation to areas of importance to the Baltic harbour porpoise, with a view towards ultimately contributing to the development of SACs for this species.
- Provide region- and species-specific advice on the conservation measures and status of the Baltic harbour porpoise to relevant Member States and groups of Member States acting to establish Marine Strategies under the MSFD, and increase the profile of the Jastarnia Group as a “regional institutional cooperation structure” envisaged by the Directive to this end.
- Establish, operate and maintain a database of personnel with professional expertise on issues affecting the Baltic harbour porpoise to generate closer cooperation and develop ideas on how best to advance the conservation needs of Baltic cetaceans under the relevant EC framework

Richard Caddell
March 2008

ANNEX 6

Evaluation of baited pots in the fishery for cod, (*Gadus morhua*) within the southeast Baltic

Peter Ljungberg
peter@ljungberg.nu

Masters Thesis in Marine Biology
Department of Biology, Lund University
Swedish Board of Fisheries

Supervisors:
Sara Königson
Swedish Board of Fisheries
Anders Persson
Department of Ecology, Limnology
Lund University

Abstract. One of the major problems in the modern fishery industry is the bycatch of non-target species and undersized fish. To reduce the damage on species, populations and ecosystems caused by bycatch, research and development of alternative gear during the last decade has focused on size and species selectiveness. Since the end of the 1990s, the increasing grey seal population within the Baltic Sea has lead to growing problems within the small scale fishery for cod. It is thereby of interest to develop seal proof gears with the ability to prevent seals from reaching the catch. A gear that could be of interest in the cod fishery in the future is baited pots. Pots have potential as seal proof gear and are known to have high size and species selectiveness. The purpose of this study is to evaluate pots within the Baltic cod fishery. A bait selection test will be conducted using herring, squid, shrimp and empty pots. Discard rate and soak-time is analysed and a comparison with gillnets is conducted. The results showed herring as the most efficient bait in comparison to squid and non-baited pots. When herring was compared to shrimp no difference was found between the two baits. Discard rate was 47.2 % within the study, which may be reduced by implementation of a selection panel in the pot. To get the best fishing results, three sets of links containing eight pots each should be used and each set should be collected from catch every third day. Even though pots in the study showed less catchability then gillnets, the gear still is in its very earliest stages and has a bright future ahead of it, based on several beneficial characteristics as high selectiveness towards the target species, keeping its catch alive inside the gear and ability to fish during hard weather conditions.

Introduction

One of the major problems in the modern fishery industry is the bycatch of non-target species and undersized fish. Bycatch affect seabirds, marine mammals, rare fish species, habitats and ecosystem processes (Jennings 2001). To reduce the damage on species, populations and ecosystems caused by bycatch, research and development of alternative gear during the last decade has focused on size and species selectiveness (Fiskeriverket 2007b). These gears allow a sustainable harvesting of fish resources. In general the gear design enables undersized fish and non-target species to escape through an exit window. Some of these gears are the BACOMA-trawl and trawls for catching Norway lobster (*Nephrops norvegicus*). In the fishery for Norway lobster, surveys have shown on a reduction of bycatch by 80 % when using the newly developed trawls (Fiskeriverket 2007b).

In contrast to letting species out, in some occasions it is desirable to prevent species from even reaching fishing gears. Since the end of the 1990s the population of grey seal (*Halichoerus grypus*) within the Baltic Sea has increased rapidly, from 9700 counted individuals in the year 2000 to 20700 in the year 2006 (RKTL 2007). The increasing population has lead to growing problem within the fishery industry (Sundqvist 2005, Konigson 2007). The grey seals collect the catch and destroys the nets, leading to economical losses for the fishermen. An affected fishery is the small scale fishery for cod (*Gadus morhua*). Passive gears such as gillnets and traps are used in this fishery. As much as 64 % of the caught cod is lost (Sundqvist 2005) to a total cost of 19 million per year (Fiskeriverket 2005). To solve the conflict, new alternative gears and methods to make it more complicated for seals to take advantage of the catch are continuously being developed and tested. The work is conducted by the Swedish Board of Fisheries along with the fisheries industry. All gear that has been developed and tested is stationary and supposes to be a complement to the traditional gillnet and trap fishery, but yet there is no gear that measures up to gillnets. The construction of all of the developed gears is based on a fixed fish compartment that prevents seals from entering the trap. One gear that have been developed and today is used by 86 % of the salmon trap fishermen, is the ‘push-up’ fish chamber (Lunneryd et al. 2003, Suuronen et al. 2006). Other gears that have been tried out are modified eel fyke nets and gillnets for catching eels (Konigson et al. 2007).

A gear that could be of interest in the future, as an alternative fishing gear to gillnets, is baited pots. Pots are used in a variety of different fisheries, i.e. for blue cod (*Parapercis colias*) in New Zealand (Cole et al. 2003), in fishery for conger eel (*Conger myriaster*) in Japan (Uchida et al. 1998) and in the rock lobster (*Jasus verreauxi*) fishery in southeast Australia (Montgomery 2005). Pot fishery for cod has been tested in Norway since the middle of 1990's and is now used as a complement to the gillnet fishery (Furevik & Lokkeborg 1994, Furevik 1997). The method is mainly used in the northern part of Norway where the invasion of the red king crab (*Paralithodes camtschaticus*) has caused problem through large amounts of bycatch in the net fishery (Furevik et al. 2004). The Norwegian pot is equipped with floating elements, allowing it to hover in the water. The floating pot has proven itself to be difficult to reach for de red king crab (Furevik et al. 2004). As the pot is a gear with an enclosed chamber it is possible to make seal proof and together with its moving ability it would be hard for seals to handle (Lunneryd and Königson, personal communication).

Before establishing pots potential as a seal proof gear, its catchability first has to be evaluated. The purpose of this study is thereby to test pots within the Baltic cod fishery. To avoid seal impact, the fishing ground chosen as a test area during this study has to be unaffected by grey seals and have a large quantity of cod. In a series of experiments, the catchability of pots was tested using different baits and soak-time. First, difference in catchability between baited and non-baited pots was tested. Second, difference in catchability between bait types was tested. Finally, the most efficient bait was used to compare catchability between pots and gillnets. Within the final part the amount of bycatch and the soak-time influence on catch was analysed.

Baited fishing gear effectiveness depends upon the behaviour of the target species, including actively rhythm, feeding motivation and sensory and locomotory abilities (Stoner 2004). To be able to attract the target species, the bait has to release feeding attractants in concentrations above the fish response threshold, during the period the fish is feeding. The release of attractants creates a plume known as an 'active space' within which fish may react to the bait. There is only a proportion of the fish within the active space that responds to the bait and a even smaller amount that attacks the bait (Stoner 2004). The amount of fish attacking the bait is determined by a variety of environmental factors, all affecting response within the active space and thereby the catchability of the fish (Stoner 2004). Cod uses both vision and chemical cues to localize their pray, making it most active during the daytime, preferably at dusk and dawn (Cohen et al. 1991, Lokkeborg 1998). The higher activity leads to an increased encounter rate to prey (Lokkeborg 1998, Lokkeborg & Ferno 1999). Apart from the diurnal variation, cod also have seasonal fluctuations in feeding (Cohen et al. 1991), based on prey abundance and prey hunger level (Stoner 2004). The fluctuations in prey abundance lead to lower catches with baited gears, longlines and pots, when natural prey is plentiful (He 2005).

Previous trials has evaluated how to increase the catch in baited pots (Furevik & Lokkeborg 1994, Furevik et al. 2004, Sullivan & Walsh 2006). In general three factors can be varied to determine catchability and effectiveness for pots; pot-shape, bait-type and soak-time. As the pot used in Norwegian trails has shown to catch cod in high quantities (Furevik et al. 2004), the same pot construction was used, leaving bait-type and soak time to be varied within the study.

Cod is an omnivorous species (Cohen et al. 1991) with opportunistic feeding habits (Scott & Scott 1988). Juveniles feed on crustaceans and other invertebrates, while adults mainly feed on fish. Cod is also known to have a cannibalistic behaviour toward younger conspecifics (Arntz 1977, Bogstad et al. 1994). An array of baits has been tested within pot trails and commercial fishing. Herring (*Clupea harengus*), squid (*Ilex sp.*) and mackerel (*Scomber scombrus*) are all known to catch cod (Furevik & Lokkeborg 1994, Godoy et al. 2003). Within this study, four bait arrangements will be tested - herring, squid (*Ilex argentinus*), shrimp (*Pandalus borealis*) and empty pots (non-baited). The different bait types were chosen by their potential to attract cod. Herring is the most natural bait in the study as it is one of the main food sources for cod in the Baltic Sea (Sparholt 1994). It is used in the hook fishery for cod in the same area as this study is conducted (Konigson & Hagberg 2007). Herring has also been used as bait in pot trails where cod has served as main target species (Furevik & Lokkeborg 1994, Sullivan & Walsh 2006). Squid is a species that do not exist in the Baltic Sea due to the low salinity, but is commonly used in the pot fishery for cod (Furevik & Lokkeborg 1994, Furevik et al. 2004). Squid bait has the ability to stay fresh for several days in the water. The shrimp species used in the study is a close relative to the crustaceans common prawn (*Leander adspersus*) and Isopod (*Saduria* *entomon*) which are preyed upon in by cod in the Baltic (Haahtela 1990). Shrimp is also commonly used within the gamefishery throughout the Baltic Sea. Fish has a behaviour that may be explained as ‘reef-effect’, meaning they seek protection in complex environments consisting of stone piles, bricks or seaweed (Gotceitas & Brown 1993, Gregory & Anderson 1997, Winger et al. 2002). A pot would act as a potential hideout, luring fish into it. Thereby would it be of interest to examine if non-baited pots have the ability to catch fish.

Soak-time of the baited pot is also affecting the catchability. Definition of soak-time is the time elapsed between last buoy deployment and first buoy retrieval of each gear link (Sigler 2000). The effects of soak-time on fishing efficiency have been examined in a series of studies, but the results are contrasting. Some studies show that a short soak-time give a higher catch (Whitelaw et al. 1991, Sheaves 1995). Other studies indicate that the catch constantly increase with soak-time (Sloan & Robinson 1985) in (Lokkeborg & Pain 1997), while yet other show that the catch may become asymptotic with increasing soak-time (Robertson 1989). Many of these studies are performed on crustaceans. In studies on fish, the results show that a relative short soak-time give the best catch rate (Lokkeborg & Pain 1997, Sigler 2000). It has been established that longer soak-time of bait, more than a few hours, reduce the odour concentration from the bait leading to a decreasing attack rate from fish (Sigler 2000). In this study, soak-time will be varied between one and four days to test for its effect on catchability.

Material and Methods

Study site

The fieldwork was conducted in the southeast part of Sweden, during the months of March and April 2007. As an observer/crew member I joined a professional fisherman in his fishery for cod in the southeast Baltic. The small scale cod fishery in the Baltic Sea is a gillnet based fishery mainly conducted by small vessels under 12 meters in length, which is often operated by one man who is returning to port every day. Usually the fisherman set out 3000 to 7000 meters of net, divided into links between 800 and 1000 meters. Gillnets are stationary and left in the water for 1 to 2 days before the catch is collected and the nets are reset into the water. Gillnets are known to be size and species selective (Huse et al. 2000) and take advantage of the fish swimming actively in their search for food.

Two major fishing areas were visited within the study, the waters outside Skillinge and Kåseberga (Appendix 1). Fishing sites are located within 6.5 nautical miles from port. Target areas were chosen by the fisherman as potential hot spots for catching cod at the time of year the study was conducted. Fishing sites is presented in Appendix 2. The position of all fishing sites was collected by a GPS. Fishing depth in the experiment varied between 7 and 43 meters and was measured by an echosounder (Furamo). Water temperature was measured by temperature loggers mounted on the pot link. Temperature ranged from 4.0 °C at the deepest spots in March to 9.7 °C at the more shallow locations in late April. Current data were held from the Swedish Meteorological and Hydrological Institute (SMHI). The direction of the current varied from N to SV depending of fishing locations.

The Pots

The pots used in the study are similar to the ones used by Norwegians (Godoy et al. 2003). A modified version of a standard bottom-set two-chamber collapsible pot (Figure 1) manufactured and sold by Norwegian Refa Frøystad group and

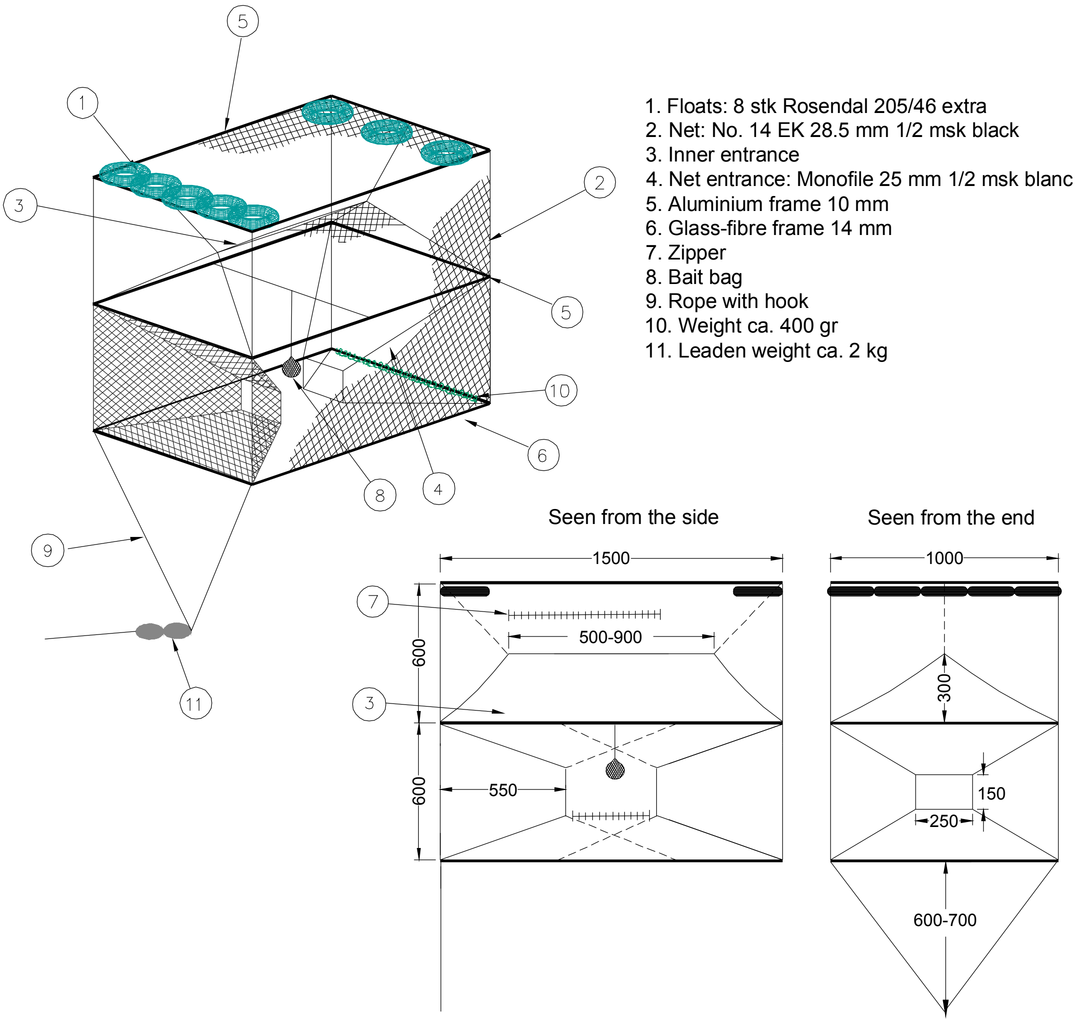


Figure 1. Sketch of pot construction.

Swedish Carapax group. The standard pot is 150 cm long, 100 cm wide and when unfolded it measures 120 cm in height. The pot has two entrances in the lower part chamber. To get into the upper chamber, the fish swim through a narrow opening in a net at the centre of the pot. Once in the upper chamber the fish has very little chance of escaping. The interior is accessed via a horizontal zipper placed in middle of each compartment. A nylon bait bag is put into the lower compartment through the zipper and held in place by two plastic clips. To be able to float the pot, it is equipped with additional floats in the upper frame. In one of the lower short sides a rope with a metal clip and a two kilo lead weight is mounted as a suspension arrangement. The floats allow the pot to hover approximately 50 cm above the seabed and orient itself in the direction of the current. The ability to orient itself makes the odour from the bait bag to always go through the downstream entrance of the pot and into the surrounding water.

The pot was hooked into a ground line by a metal clip in the suspension arrangement. Each ground line contained four or eight pots depending of fishing trial. The distance between pots was 60 meters in all experiments. To make the pot link stay in its position at the bottom a 10 kilo lead weight was tied in each end of the ground line. A nylon rope tied into a metal clip was hooked into the lead weight. In the other end of the rope a second metal clip was hooked into a flag, marking the two ends of the gear. Pot link setup is presented in Figure 2.

Two experiment setups where used within

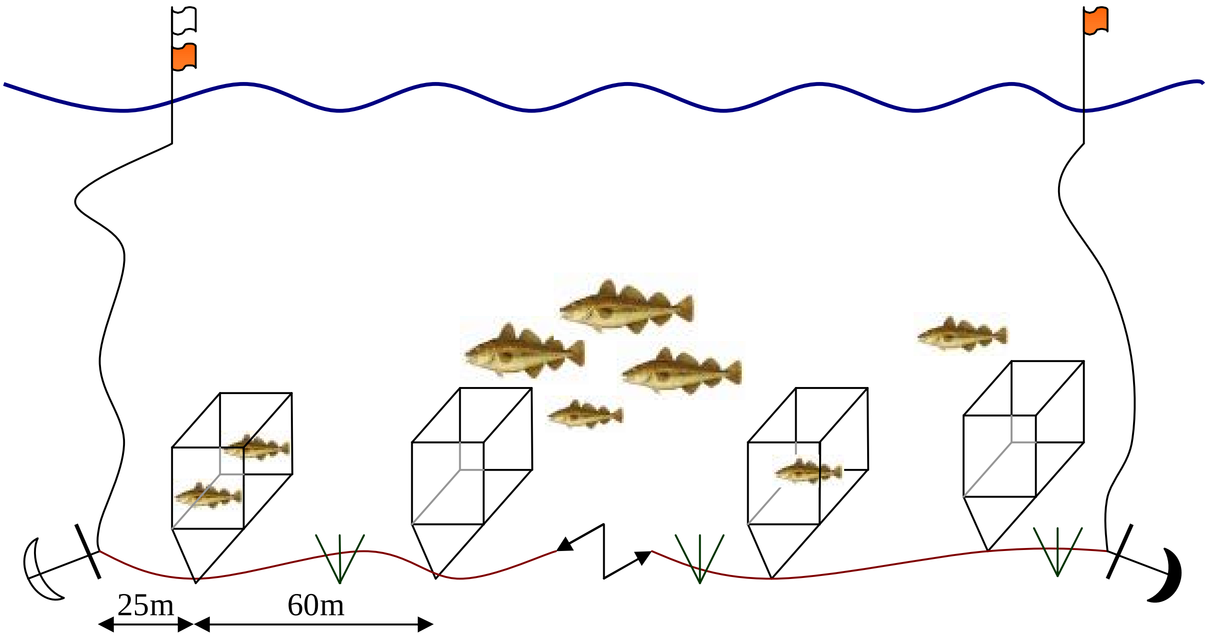


Figure 2. Sketch of a pot link setup.

the trials. Initial experimental setup was used to test for difference between baited (squid and herring) and non-baited pots, and between bait types, squid and herring. Five links containing four pots on each link were used in the initial setup. In the second setup the difference between shrimp and herring was tested, along with establishing the difference in catchability between pots and gillnets, using the most efficient bait type. Three links containing eight pots each was used within the second setup. Soak-time and discard analysis were conducted on the cod caught in the second setup.

Bait type

Baits were provided from different suppliers, but treated in the same way. Frozen squid and shrimp were delivered from Gothenburg and where kept frozen until being used in the trials. Herring was bought fresh from a local wholesaler in Simrishamn. After the delivery, each herring was cut into 6-8 smaller pieces, depending on original size. An amount of 200-250 gram of cut herring was placed in a small plastic bag. Each bag was tied together and put into the freezer until the bait was about to be used. Squid and shrimp were also cut into smaller pieces before use. The reason for cutting down the bait was to enhance odour release. Before resetting of a pot link, the old bait was removed and new frozen bait where put into the bag. By using frozen bait the bait would stay fresh for a longer time. In links containing non-baited pots the bait bag was left inside the pot to avoid any visual differences between pots that may affect the trails.

All the pots within a link were baited with the same bait type, herring, squid or non-baited. Bait type was randomized between links in every new setting. Main fishing ground for each setting was determined by the fisherman and each link was randomized into its final position. Soak-time differed from two to four days depending on the weather. Links were hauled and re-baited before each setting. The total number of cod in each link was counted and used as one sample selection in the data analyses.

In the second setup a test for difference between herring and shrimp was conducted. One of the three links was baited with shrimp and was fished alongside a link containing herring. As in the first setup, bait was randomized into the two links and the links were then randomized into their final position. The soak-time varied from one to three days and the total number of cod in each link was used as sample selection.

Discard

Length data was collected to analyse the discard rate of the cod caught in the pots. 38 cm was used as discard limit as it is the size limit of cod in the Baltic.

Soak-time

The weight data of kept and rinsed cod from every pot link was collected along with the soak-time of each pot link. The aim was to test for effects of soak-time on total catch and if soak-time influences the Catch per unit effort (CPUE).

Net vs. Pots

Last experiment in the study was to test for difference in catchability between pots and gillnet. Weight data from the soak-time experiment was used, together with the total handling time of the pot links. CPUE for pot links was calculated using weight and soak-time. The unit for CPUE was total catch per 100 meter link^{-1} day^{-1}. Total handling time contain hauling, rebaiting and resetting the link.

The fisherman's ordinary gillnet fishery was maintained throughout the entire study. Data including total catch together with handling time and soak-time for the nets was collected. Weight data was received from the fisherman's logbook. Handling time contained hauling, collecting the catch and resetting each net. Weight and soak-time was used to calculate the CPUE for the net fishery. As CPUE the total catch per 100 meter net^{-1} day^{-1} was used. All other species along cod were counted and registered as bycatch.

Weight of the rinsed cod from the pots and gillnets, together with the handling time was used to compare the two gear types. Mean handling time of gillnets was divided with handling time of pot links, establishing the amount of pot links, which can be handled within the same amount of time. Mean catch in pots multiplied with the number of pot links which can be managed, generates the theoretical amount of cod which can be caught in a day, based on soak-time ranging from one to three days.

Finally the mean weight of the cod caught in the pots was recalculated to determine the theoretical amount of pot links needed for the same catch as in the gillnets, based on the soak-time of one, two and three days.

Statistics

In order to test for differences in catch between baited and non-baited pots and between bait types, the data was tested using U-test (Mann-Whitney). To test for effects of soak-time for pots, linear regression was used.

Results

Bait type

In all bait selection analyses, the total numbers of cod caught in a pot link was used. Pots baited with herring gave a significantly better catch (Figure 3) then non baited pots (Mann-Whitney U-test, $p<0.05$). When squid was tested to non-baited pots no significant differences where found between catches (Mann-Whitney U-test, $p>>0.05$), Figure 3.

In the test for differences between pots baited with herring and pots baited with squid, herring showed significant better catch (Mann-Whitney U-test, $p<0.05$), Figure 3. In the test for differences in catch between pots baited with herring and pots baited with shrimp, analysis of the data showed no significance (Mann-Whitney U-test, $p>0.05$), Figure 4.

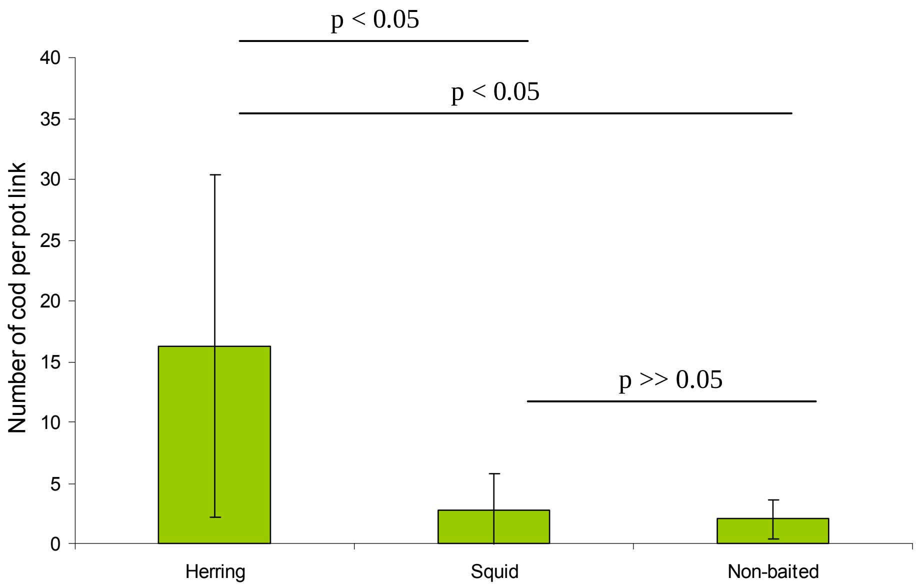


Figure 3. Mean number of cod caught in pot links. Each link containing four pots and was baited with herring, squid or non-baited. Lines between bars show significance of Mann-Whitney, U-tests made between baits. Error bars show standard deviation.

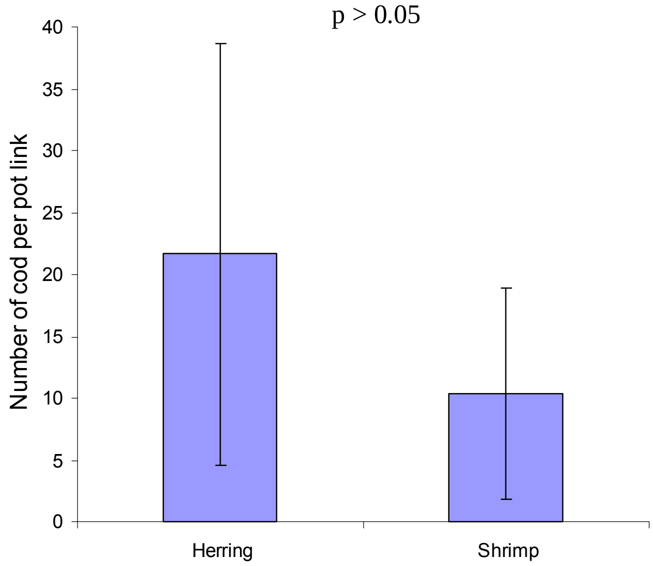


Figure 4. Mean number of cod caught in pot links. Each link containing eight pots and was baited with herring or shrimp. Lines between bars show significance of Mann-Whitney, U-tests made between baits. Error bars show standard deviation.

Discard

As 38 cm is the size limit, it is also the discard limit of cod within the Baltic. The mesh size of 28.5 mm, used in pots, is smaller than the minimum mesh size of 55 mm, which is allowed for gillnets in the Baltic Sea. As pots has a tendency to catch undersized fish, several individuals less then the size limit of 38 cm, where caught

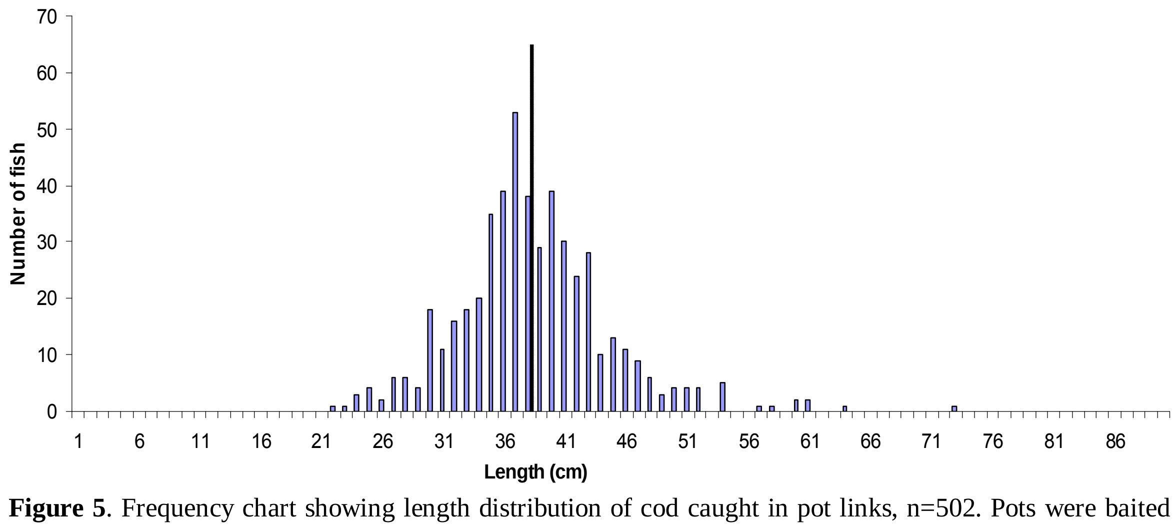


Figure 5. Frequency chart showing length distribution of cod caught in pot links, n=502. Pots were baited with herring. Black solid line indicates 38 cm, the size limit of cod in the Baltic.

within the experiment and had to be discarded. Analysis showed a discard rate of 47.2 % (n=502) in the pod caught cod. A frequency chart of the length analysis is presented in Figure 5.

Soak-time

To establish the effects of soak-time on catchability, weight data from pot links with soak-time ranging from one to three days was analysed within the study. Data was collected from links containing eight pots and who was baited with the most efficient bait, herring. Weights of the rinsed cod are presented in Table 1. A linear regression (Figure 6) on the weight data showed that an increased soak-time gave a significant higher catch ($F_{1.17}$=11.96, $p<0.05$). However soak-time did not seem to affect catch when divided down to mean catch per day (p=0.20), Figure 7. Based on the results from the linear regressions, the best catch could be expected if several sets of pot links was used and the sets was collected from catch every third day.

Table 1. Mean catch and mean handling time per pot link, based on links soak-lime. Each link containing eight pots and was baited with herring.

Soak-time	1 day	2 days	3 days
Catch /potlink (kg)	6	10	15
	12	7	60
	3	5	13
	0.6	2	30
	1.8	12	
	0.9	10.5	
		9	
Mean catch (kg)	4.1	7.9	29.5
Mean handling time (min)	21	22	26

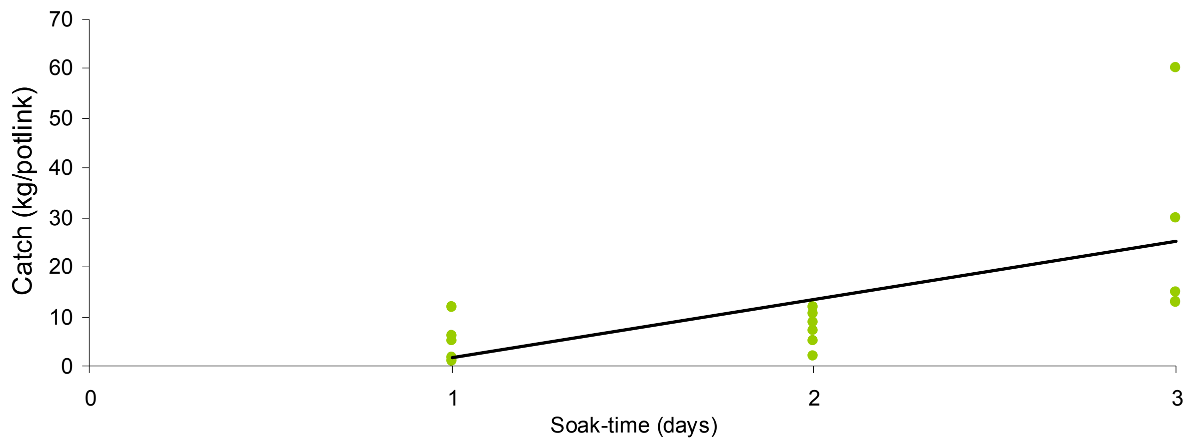


Figure 6. Linear regression of the total catch in pot links, based on soak-time ($F_{1.17}$=11.96, $p<0.05$). Each link contains eight pots and is baited with herring.

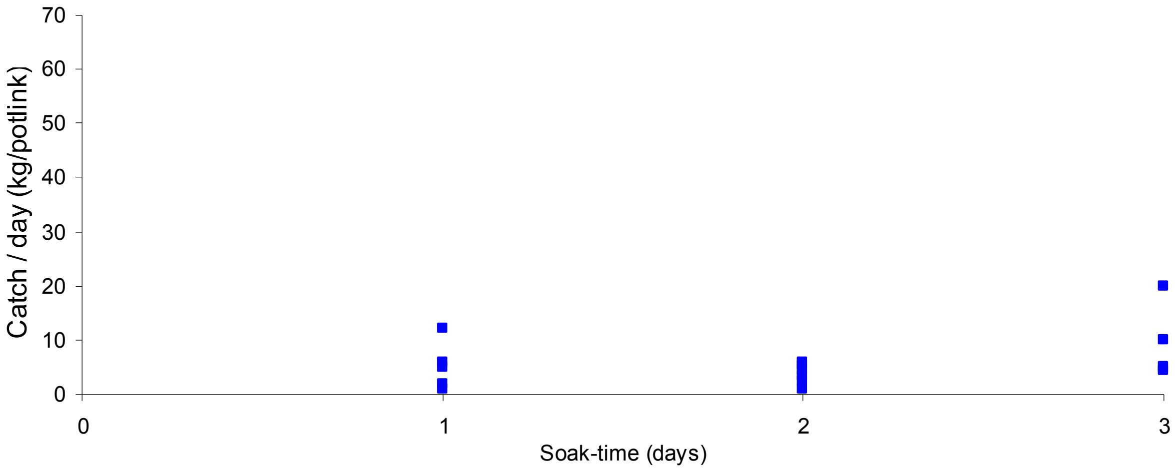


Figure 7. Linear regression of the total catch in pot links divided per day, based on soak-time (p=0.20). Each link containing eight pots and was baited with herring.

Net Fishery

CPUE of the pot fishery was 1,27 kg cod 100 meter link^{-1} day^{-1}, based on kept and rinsed fish above 38 cm. Pots did not catch any other species than cod. Handling time of pot was between 21 and 26 minutes depending on soak-time (Table 1). Hence a prolonged soak-time did lead to higher catches and an increased handling time for the pot links.

During the trial period the average catch in the nets was 197 kg cod per day and the handling time was on average 2 hours and 6 minutes per day. Along with the cod, gillnets caught various amounts of bycatch, mostly plaice (*Pleuronectes platessa*) and flounder (*Platichthys flesus*). The amount of kept bycatch was in general rather small, below 10 kg per day. As the aim was to look at the differences between pot and net fishery for cod, only cod was used to establish the CPUE of gillnets. Calculations showed a CPUE rate of 5.27 kg 100 meter net^{-1} day^{-1} in March and 4.33 kg per 100 meter net^{-1} day^{-1} in April.

Calculations from the experiment showed that it was not possible to catch the same amount of cod in the same or less handling time as gillnets (2 hours and 6 minutes) when using pots. The total number of links (5.9, 5.8 and 4.9) handled within the same handling time as gillnets and theoretical amount of catch (23.9, 45.6 and 143.7 kg) of this links, is presented as crosses in Figure 8. Finally the theoretical amount of pot links needed to catch the same amount of cod as when gillnets are used was calculated. Best result to catch cod in the same extent as with nets is by using three sets of seven pot links, containing eight pots each. Each set would have to be collected from catch and rebaited every

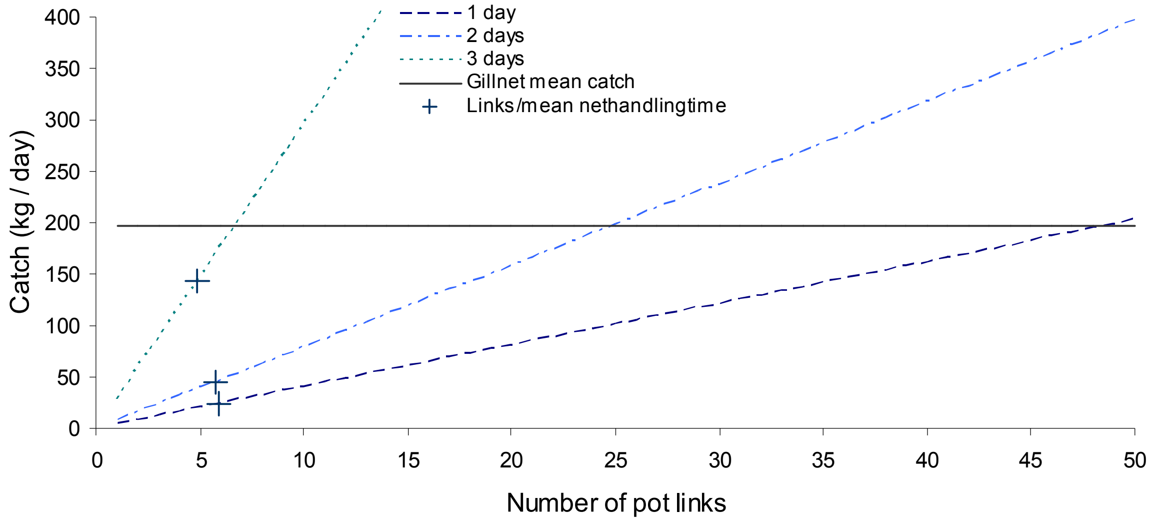


Figure 8. Chart is showing soak-time dependent catches of cod in pot links, each containing eight pots, in relation to catches in gillnets. Solid line shows mean catch of cod per day in gillnets during the survey period. Crosses show the number of pot links which can be managed within the mean handling time of gillnets (2h and 6min). Crosses also indicate the theoretical amount of cod that will be caught, within these pot links. Intersection between dotted lines and solid line show how many pot links would be needed to reach the same catch in pots as in gillnets. Note that numbers are based on daily collection of catch i.e. for pot links with a soak-time of two days, two sets of links are needed and each set has to be collected every second day. For links with a soak time of three days, three sets are needed and every set is collected every third day.

third day. Number of pot links needed, based on soak-time, is shown as lines in Figure 8.

Discussion

The study showed that herring was the most efficient bait compared to squid and empty pots. When herring was compared to shrimp there where no significance in catchability between the two bait types. Taking in consideration where to asset the different baits, herring is a better choice than shrimp. The number of fish discarded from pots was 47.2 % within the study. The discard rate of undersized cod may easily be lowered to nearly zero by a selection panel with a larger mesh size in one of the sides of the pot. To get the best catch using pots, three sets of links containing eight pots each should be used and each set should be collected every third day. Within the same handling time, it is not possible to catch the same amount of cod with pots as with gillnets.

To make the fishing efficiency increase for the pots, either the handling time per pot link has to be reduced or the catch in each pot link have to be increased. No boats in the Baltic are today optimized for pot fishery and the handling time is thereby likely to be decreased with an extended use of the gear. Forcing a higher catch into the pots is more complicated, but by using fresh bait more odours would be spread from it and the thereby more fish might be attracted of the bait.

Even though herring baited pots was superior, the non-baited pots indeed did catch small amounts of cod. All individuals except one caught in non-baited pots were less than 38 cm in length, indicating that non-baited pots may attract mostly small individuals which have to be discarded. A reason why only small individuals entered the pots might be behaviour to avoid predators. Juvenile cod is known to stay close to boulders, rocks and macroalgae to seek shelter from predators (Gregory & Anderson 1997, Cote et al. 2002). If one individual have found a secure place it may attract conspecifics, a behaviour that has been found amongst eels (Svedang & Westerberg 2000). As cod is known to have cannibalistic behaviour, the undersized cod caught in non-baited pots may serve as attractants, luring larger cod into the pots. When rinsing the catch, two newly eaten conspecifics were found within one larger cod (personal observation).

Cod preferred herring over squid. Because squid do not exist in the Baltic, cod may lack search behaviour towards squid. However the capability to stay fresh could favour the use of squid as bait in areas where it serves as a main food source. As squid do occur in Swedish waters, from the Sound and northwards, it has potential as bait in cod fishery in those regions. Even though there was no difference between herring and shrimp, there are other factors affecting the choice of bait. To be able to use a species as bait, it has to be available on the market or the fisherman has to be able to collect it. Either way, the effort is time and money consuming. In the southeast Baltic there is a large scale herring fishery with Simrishamn as one of the main ports for the industry (Königson, personal communication). Simrishamn vicinity to Skillinge makes the port ideal in order to recover herring to bargain price. Shrimp on the other hand has to be shipped from either Denmark or the Gothenburg area. Together with a higher price, the longer shipping distance increases the price. Put together, this makes herring the most useful bait when fishing with pots in the southeast Baltic.

Discard is a large problem within the fisheries. Undersized target species and non-target species without economical value are removed from the catch and thrown back to sea (Jennings 2001), with little chance of survival. Quotas are often set on economical valuable species as a management strategy. As the price is related to size, larger fish are often more valuable. A discard rate of 47.2 %, in pots, is high in comparison to gillnets and trawl. In the trawl fishery for cod, between 10 and 35 % catch is discarded, which is between 8 and 20 % of the total weight. In the gillnet fishery, between 4 and 12 % of the catch is discarded, based on weights (Fiskeriverket 2007a). Data from gillnets and trawl includes non-target species. A main difference between pots and other gear types is the pots capacity to keep the catch alive, allowing the discard to be thrown back alive after hauling, presuming the fishing depth is not to large. To deal with the problem of the high discard rate improvements can be done to the pot design. In the lower chamber, the undersized fish is able to swim back out through the entrances. Once in the upper chamber the fish has no chance of escaping. To make it possible for the undersized fish to escape from the upper chamber, one of the short sides could be replaced with a larger mesh-size depending on target species, letting out smaller individuals. Not having to deal with undersized fish, will also lower the pots handling time.

Links with a soak-time of three days gave significant better catch results (Figure 6), although there were no significant differences when divided down to catch per day (Figure 7). In earlier studies a short soak-time, less the 24 hours, has given the best catch rate of cod (Lokkeborg & Pain 1997). A prolonged soak-time has only shown to be effective when trapping crustaceans, making the result from this study rather unique. Former studies have shown that fish’s motivation to attack bait decreases while the odour washes out of the bait (Sigler 2000). Why results from this study show a different pattern in comparison with others is not known, and has to be examined further. One possibility could be as explained earlier, conspecifics may serve as attractants to other fish, either in search for shelter or to eat smaller individuals.

Gillnets generate a proportion of bycatch, mainly plaice and flounder. As the amount of bycatch is rather small, the economical value in this case can be neglected. To reach the same amount of mean catch with pots as with gillnets, a total of three sets of seven pot links with eight pots on each link would give the best catch. Each set would have to be collected from catch and reset every third day. The handling time of this effort is higher in comparison to the mean handling time needed within the net fishery, making it impossible to reach the nets efficiency using pots. Using the same handling time in pot fishery as with nets, about five links, containing eight pots each, is the maximum amount of pot links that could be managed per day (Figure 8). The catch from these pots would yield about 75% of the cod catch when gillnets are being used. To be able to make pots comparable to gillnets, either the pot handling time has to be decreased or the catch has to be increased. As cod pots is a rather new fishing gear in the Swedish fishery industry, the handling time is likely to decrease if there is to be an extended use of the gear. Boats today are often a one man operated workplace optimized for net fishery, making both boat and fisherman unfamiliar to the pots. During the field period the fisherman got more used to the pots, making small adjustments in the pot setup to be able to handle it in a more effective way (personal observation). It is likely that such adjustments, both on the boat and in management, over time will decrease the handling time of pots.

To increase the catch, a larger amount of fish has to enter the pots. It may be done by developing more long-lasting bait, which has the ability to attract fish for an extended period of time. Development of more long-lasting bait is studied on by researchers in the Faeroe Islands (Thomsen 2006). As cod is known to be attracted by both chemical and visual cues (Brawn 1969, Ferno & Olsen 1994), an increased amount of visual stimuli might increase cods attack rate to bait, leading to an increased catch. Seasonal variation in catchability is another feature that may affect catch. Logbook analyses show that long-lining efficiency in the southeast Baltic is fluctuating during the year (Konigson & Hagberg 2007). Best catch is registered in May and August. Since pots are fishing under the same conditions as long-lining, relying on fish availability and vulnerability to the gear (Ferno & Olsen 1994), it is reasonable to assume that the catchability of the pots will increase during these periods.

Conclusions and Future studies

The underlying purpose of this study was to seek alternative seal proof gears. Even though this study showed that pots didn’t catch cod in the same extent as gillnets, it might be a possible solution to the rising seal stock in the Baltic. There are features with pots which still have to be evaluated. Should pots be fished in links or would it be more effective to set them individual spots known to accommodate large quantities of cod? The survival of live discarded fish from pots would also have to be examined further. If fresh bait were to be used how would that affect the catch? Pots also have to be tested in areas exposed to seal and evaluate seals reaction in the vicinity of the gear. Besides its potential as seal proof gear, pots offer several additional benefits. As pots keep its catch alive, the fish will stay in good condition until it is collected. The freshness of the fish makes it a high quality product, which may lead to a higher value in a certain niched marked (Furevik & Lokkeborg 1994, He 2005). A higher price will in some extent also compensate for less catchability. During hard weather other gear has to be picked up while pots have the ability to ride it out, still catching fish, making them more resistant to more severe weather conditions. No bycatch, except undersized cod, was caught within pots, making its selectivity superior in contrast with other gears. A size selective fishery may be maintained towards any specific target species using pots. The mesh-size can be varied to allow all individuals beneath a certain length to escape the pot. Changing the entrance construction can regulate the maximum size of entering fish, sparing the largest individuals in the spawning stock. As larger individuals have the ability to produce roe and thereby larva's in larger mass specific quantities (Cohen et al. 1991) they contribute in a greater extent to the recruitment of the stock. Along with keeping the seals out, the pots narrow entrance funnel may also protect other marine mammals from getting trapped. Harbour porpoise (*Phocoena phocoena*) is declining in the Baltic (Helcom 2007). By using pots the bycatch of the species within the fishery might decrease. Like every other fishing gear, pot fishery has to be learned and continuously developed to stay effective. Low bycatch, potential low discards and protection both towards and against marine animals, makes it a versatile gear. Even though pots still is in its early stages, this study show on pots potential to evolve into a useful gear within the fishery.

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All the cod that had to put up with being sacrificed within the study, and those who were discarded.

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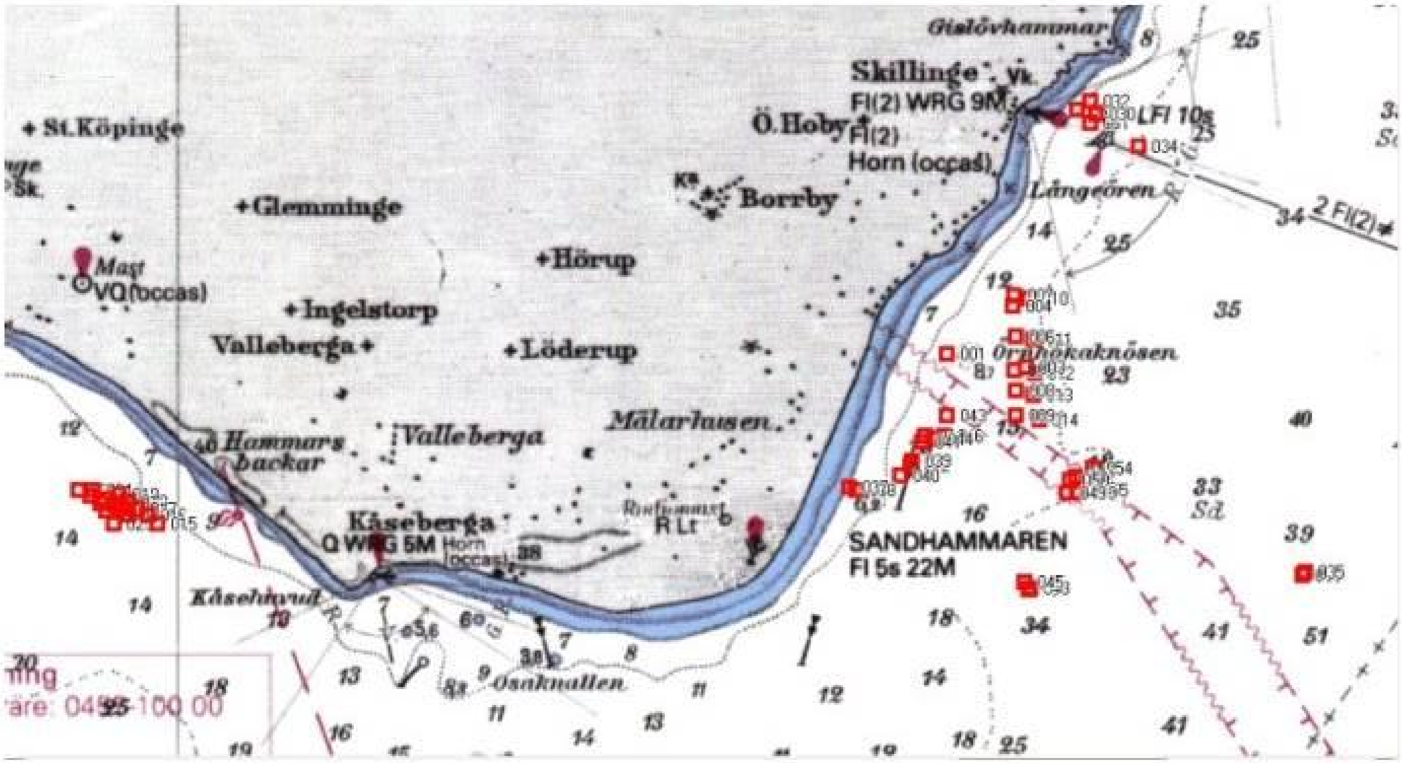
Appendix 1. Survey area and positions fished with pot links.



ANNEX 7

CAN GREY SEAL (*HALICHOERUS GRUPUS)* LEARN TO USE ACOUSTIC DETERRENTS TO LOCATE FISHING GEAR?

Master Degree project

Department of System ecology, Stockholms University & Swedish Board of Fisheries

Supervisor: Magnus Appelberg;

Department of System ecology, Stockholms University & Swedish Board of Fisheries

Secondary supervisor: Sara Königson;

Swedish Board of Fisheries

Abstract

Harbour porpoise (*Phocoena phocoena*) is the only commonly seen cetacean in Swedish waters. The harbour porpoise is protected due to a reduction in population size. One of the main reasons for the reduction is presumed to be a high amount of by-catch in the net-fisheries. European Council Regulation No. 812/2004 lays down measures concerning incidental catches of cetaceans. Vessels that measure 40 feet or more are prohibited to use net links without using active acoustic deterrents in certain areas and fishing with driftnets in the Baltic will be forbidden from the year 2008. In the Baltic Sea the grey seal (*Halichoerus grupus*) population has increased, and this has lead to a growing conflict between seals and fisheries. Seals damage the fishermen's catch and fishing gear. Another part of the conflict is the increase of by-caught seals. It has been suspected that sound, such as a seal deterrents or the sound from the fishermen's boat, can work as a dinner bell for seal and help the seals locate the nets. If that is the case, active acoustic deterrents placed on net links, could lead to an even increased conflict between fisheries and seals. To evaluate effects of acoustic deterrents an observer joined a professional fisherman fishing for cod (*Gadus morhua*) in the central Baltic Sea for 14 weeks in 2006. Systematic visual seal observations were carried out for 2 minutes at the boats four cardinal points at every fishing occasion. Only grey seals and no other seal species were seen at the seal observations. Net links with active and inactive acoustic deterrents were set out randomly and all cods caught in both net links were counted and then calculated into CPUE (number of cod/ (100meter net and hour)). Damaged cods were also counted and thereafter calculated into DPUE (number of damaged cod/ (100meter net and hour)). The CPUE and DPUE for net links with active and inactive acoustic deterrents were compared over the whole study period. The study was also divided into four periods dependent on the number of fishing occasions. The CPUE and DPUE for the net links with active acoustic deterrents were compared to the net links with the inactive acoustic deterrents in all four periods to analyze change over time. There was a significant reduced CPUE in net links with active acoustic deterrents for the whole period. There was also a significantly higher DPUE in the net links with active acoustic deterrents compared to the net link with inactive acoustic deterrents during the last period. In addition, a study of hidden losses, i.e. fish lost from the net links by seals without them leaving any trace, such as fish rests, was carried out on net links with active and inactive acoustic deterrents. By leaving marked entangled cods in both links with acoustic deterrents, and then resetting the net links again, it was possible to estimate the hidden losses. When emptying the two net links the numbers of fully retrieved, damaged and disappeared cods were counted. Studies on spontaneous cod losses were made by setting out a net link with a known number entangled and marked cods, and then the links were retrieved immediately. The amount of cods that fell of during the handling was counted to estimate the natural losses. Data from an earlier study on spontaneously fall off was used as a complement in the calculations. If more cods fell of than the calculated natural losses it was assumed that there had been a seal visit. The hidden damage study showed significant higher amount of damage and hidden losses in the net links with active acoustic deterrents compared to the net links with inactive acoustic deterrents. These results indicate that grey seals can use acoustic deterrents to localize fishing gear, thereby causing negative effects on fisheries.

Key words: Harbour porpoises, (Phocoena phocoena),. Grey seal, (Halichoerus grupus),. Atlantic cod, (Gadus morhua),. Acoustic deterrents, Aquamark 100.

1. Introduction

In Sweden the harbour porpoise (*Phocoena phocoena*) is the only common cetacean, and it has been protected since 1973 due to a reduction in population size (Berggren, 1994). Many populations of harbour porpoises are substantially reduced from historical levels and the Black and Baltic Sea populations are among the most threatened (Reeves *et al.,* 2002). However the harbour porpoise stock identity in the Baltic Sea has not been fully understood, but because of high mortality in the Baltic Sea and small migration between the Baltic Sea and the Danish waters, the Baltic harbour porpoise is considered an endangered subpopulation and should be administrated as a separate population (Lindahl *et al*., 2003). One of the main reasons for the decline is presumed to be high amount of by-catches in fisheries, especially bottom-set gillnets (Berggren *et al*., 2002; Reeves *et al.,* 2002). To decrease the by-catch, considerable effort has been devoted to develop acoustic deterrents for use together with gillnets and driftnets. Results from studies indicate that acoustic deterrents significantly reduce the probability of harbour porpoise entanglement in bottom-set gillnets used in the fishery (Gearin *et al.,* 2000; Kastelein *et al.,* 2007). The European Council Regulation No. 812/2004, no. 88/98 sets preventive measures to reduce the by-catches of cetaceans. All vessels that are 40 feet (12 meter) or more in certain areas are prohibited to use any bottom-set gill net, entangling net or driftnet for fishing without the simultaneous use of active acoustic deterrents. In an experiment in Argentina acoustic alarms were used to avoid by-catches of the Fransciscana dolphin (*Pontoporia blainvillei*). The by-catches of the dolphin decreased, but during the experiment they found that pinnipeds, sea lions (*Otaria flavescens*), damaged the fish caught in net links with active acoustic deterrents significantly more than in net links with inactive acoustic deterrents (Bordino *et al*., 2002). Therefore it is suspected that acoustic deterrents emitting a sound, which pinnipeds can hear, might work as a dinner bell. Also earlier studies have shown that grey seals (*Halichoerus grypus*) can learn to localize fishing gear by acoustic deterrents as were meant to harass seals (Königson, 2007).

In Sweden the grey seal has increased dramatically (Karlsson and Helander, 2005) and in 2006 the number of counted grey seals in the Baltic were 20.700 (Ministry of agriculture and forestry, 2007). Photo ID studies indicate that the count covers 60-70 % of the total population (Swedish Environment Protection agency, 2001) which means that the population is now well over 25,000 animals. The gaining population has lead to a growing conflict between grey seals and fisheries (Lunneryd *et al.*, 2004). Seals damage both the catch and fishing gears. An increasing number of by-caught seals are also a part of the conflict. The by-catch of seals does not affect the seal population but are unethical [0]and a problem for fishermen (Lunneryd *et al.,* 2004; Königson *et al.,* 2007). Today more then 400 grey seals are caught in the Swedish fisheries (Lunneryd *et al*., 2004). Beside the apparent losses such as damaged fish and fishing gear, there may also be significant hidden losses. Such losses would include fish that are removed completely from the fishing gear, leaving no traces. Königson *et al.* (2007) described these losses in the gillnet fisheries for herring. Fjälling (2005) estimated the hidden losses in salmon set-traps to be at least 20% of the total catch, and more than 50% of the potential catch for an average day with a seal visit. In addition to these losses, seals can scare fish away from the fishing gear, creating additional hidden losses (Königson *et al.,* 2007).

Grey seals forage both individually and cooperatively in groups. Their foraging strategies exhibit considerably plasticity depending on type and distribution of the food resource (Berta *et al.,* 2006). Grey seals hear and call both under water and in air, and are potentially subject to noise effects in both media (Richardson *et al.,* 1995). The grey seals can hear underwater sounds at frequencies from 1 kHz up to 60 kHz, however, above 60 kHz the sensitivity is poor, and different frequencies cannot be discriminated (Richardson *et al., 1995*). The aim of this study was to evaluate if grey seals can use acoustic deterrents to localize fishing gear and thereby increase the seal-fishery conflict. If seals do use the acoustic deterrents as dinnerbells this could lead to a reduction in catch, an increase in damaged catch and an increase of hidden losses. Therefore we wanted to examine if the catch per unit effort (number of cod/(100m net and hour)) did decrease in net links with acoustic deterrents compared to net links with inactive acoustic deterrents. We also wanted to examine if the damaged fish per unit effort (number of damaged cod/(100m net and hour)) did increase when acoustic deterrents were used on the net links. At last, the amount of hidden losses, i.e. fish lost from the net links without leaving any trace, were compared between net links with active and inactive acoustic deterrents to evaluate if the hidden losses were higher in net links with acoustic deterrents.

2. Material and Methods

2.1 Experimental design.

The field study was carried out in cooperation with a local fisherman in Byxelkrok which is a small town situated at northern Öland on the Swedish east coast (fig.1). The study started March 31 and ended July 14, 2006. The observer joined the fisherman on his daily fishing trips and noted the caught fish (whole and damaged cod and additional by-catch of other species) and the net links soak time. Positions for the net links were taken with a GPS. At every setting and retrieving of the net links, systematic visual seal observations were carried out for 2 minutes at the boats four cardinal points. Bottom-set gillnets (net links) with a mesh-size of 55 to 65 cm and 12 to 20 feet in height were used through out the study. The net links consisted most often of 8 to 10 nets linked together forming a net link with a maximum length of 1100 meter. The soak time was at minimum 12 hours and at maximum 49 hours depending on weather and catch. Five to six net links were set out on every fishing trip in two separate areas. In each area, a net link was placed with either active or inactive acoustic deterrents attached to the head rope of the net link (defined as active or inactive net links). The minimum distance between the area with active and inactive net links were at least 0.5 nautical miles. The acoustic deterrents were mounted at every 200m on the net links. Other net links in the studied areas had no acoustic deterrents attached and were placed randomly in both areas, but only the net links with acoustic deterrents were used and compared to each other to ensure that the distance between the active and inactive net links used in the analysis did exceed 0.5 nautical miles.

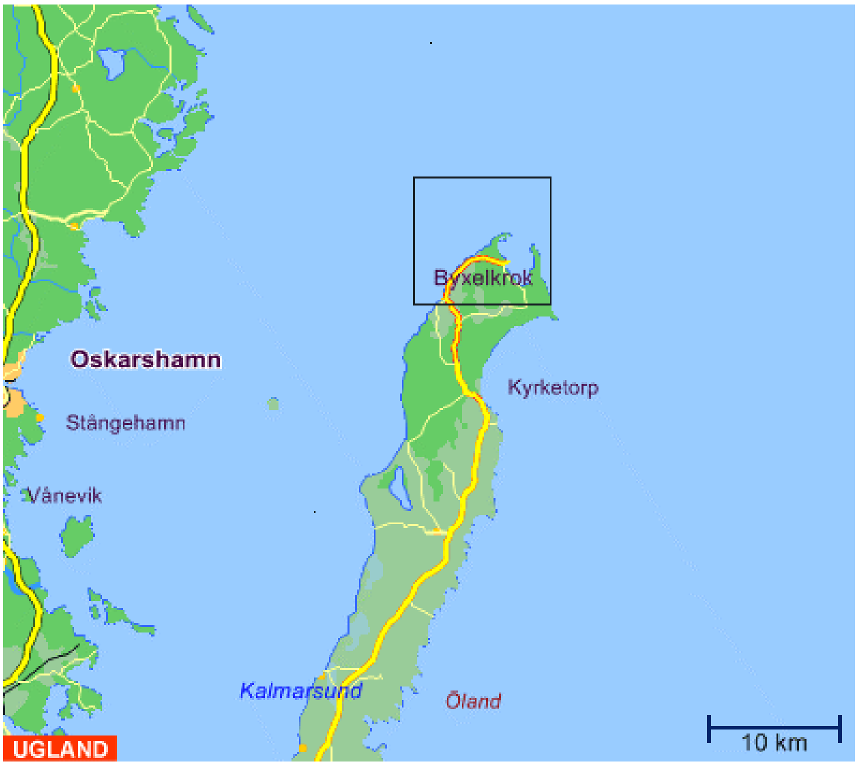


Figure 1. Map of northern Öland, an island of the central east coast of Sweden. The square indicate the area where the fishing took place.

The used acoustic deterrents were the digital model AQUAmark 100 (fig. 2). It has a frequency of 20-160 kHz with a source level of 140 dB re 1µPa @ 1m. Its weight is 410g and the pulse durable 200-300ms with pulse interval 4-30s (BIM, 2005). The acoustic deterrents were coupled with floats on both sides to keep the deterrent floating and to workout as shock absorbers.

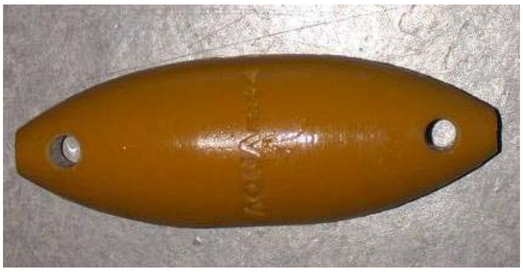


Figure 2. The acoustic deterrent, AQUAmark 100.

2.2 Caught cod (CPUE)

When retrieving the net links the observer counted the amount of whole cods in both active and inactive net links. The amount of cod was calculated in CPUE (number of cod/ (100meter net and hour)) for each net link. The whole study period was analyzed to assess if there was a total difference over the whole fishing period between active and inactive net links. The study was also divided into four periods determined by the number of fishing occasions, with equal fishing occasions of both active and inactive links per period. To be able to see if there had been any difference over time, i.e if the CPUE had increased over time, CPUE in the active net links were compared to the inactive net links in all periods. The four periods were: 5th of April to 26th of May, 27th of May to 16th of June, 17th of June to 30th of June and 3rd July to 13th of July.

2.3 Visible damage (DPUE)

When retrieving both the active and inactive net links the number of damaged cods was counted by the observer. DPUE (number of damaged cod/ (100 meter net and hour)) was calculated for each net link. Data were analyzed as described in earlier paragraph and included a comparison of the whole study period and a comparison of the four above mentioned periods. All damaged cods were documented and divided into three categories; partly damaged, heads and unidentified remains (fig. 3).

Figure 3) Example of fish rests left in the net after a seal has visited the nets.

2.4 Hidden damage

The hidden damage was estimated by marking and leaving self entangled caught cods in the active and inactive net links (fig. 4). A minimum of five entangled cods were reset in active and inactive net link per fishing occasion. When there were no caught cods to be entangled, the observer manually entangled fresh or frozen cods. When the net links were retrieved the amount of remaining, damaged and lost fish was counted and the percentage of damaged or lost cod was calculated (number of marked damaged or lost cods/ (total amount of marked entangled cods)). This provided an estimate of the unknown loss, the so-called hidden damage.

Figure 4). Example of an entangled and marked cod left in the net and reset again.

The results from the active and inactive net links were compared over the whole study. Corrections of data were made to account for fish that spontaneously fell of, by setting out net links with a known number frozen entangled cods and then retrieving them directly. In an earlier study of spontaneously handling losses from manually and self entangled cods the maximum fall off was 8.9% (tab. 1) (Sundqvist, 2005). Based on these results, it was estimated that a seal disturbance occurred when more than 10% of the marked cods where missing. The amount of lost cods was calculated with a 10% fall of. The amount of the hidden damage was estimated in percentage and compared between the active and inactive net links.

Table 1.

Results from control trials where the amount of the spontaneously fall offs were calculated. The average percent fall offs with a bootstrapped 95% confidence interval (CI) are shown for different ways of entanglement.

Way of; Entanglement	No. of; Control trials	No. of; Marked fishes	No. of; Lost fishes	Average fall off % (95% CI max/min)
Self entangled	9	72	3	4.0 (8.9/1.1)
Manually entangled	9	51	2	2.6 (5.9/0.0)
Defrozen & Manually entangled	6	36	1	2.8 (8.3/0.0)

2.5 Statistical analysis

The normal distribution of all data was examined with the Kolmogorov-Smirnov test. When the data was normal distributed the independent t-Test was used. The ranking test, Mann-Whitney U-Test, was used when data was not normally distributed. When the sample could not be adequately represented by a normal distribution to illustrate the sample variation, mean and confidence intervals were estimated by a bootstrap procedure (Haddon, 2001). A Visual Basic macro was used in Excel to simulate the data collection procedure with repeated re-sampling with replacement using 2000 iterations.

3. Results

3.1 Caught cod (CPUE)

A total of 4 394 cods were caught in the 77 active and inactive net links set out. In the active net links there were 1 559 cods caught at 38 occasions, and 2 835 cods were caught in the inactive net links at 39 occasions. The total CPUE was 0.06 whole cod/effort in active net links, and 0.13 cods/effort in inactive net links (tab.2).

Table 2. CPUE from active or inactive net links over the whole study period and the four periods. Confidence intervals are bootstrapped and statistical difference between active and inactive net links is indicated by a star.

	Active	95% CI max/min	Inactive	95% CI max/min	P<0.05
Total mean value (CPUE)	64.9 E-3	154.0 E-3 ± 22.9 E-3	126.5 E-3	293.8 E-3 ± 38.3 E-3	*
Mean value (CPUE) period 1	15.4 E-3	43.6 E-3 ± 9.2E-03	35.8 E-3	100.6 E-3 ± 22 E-3	-
Mean value (CPUE) period 2	95.1 E-3	236.3 E-3 ± 38.5 E-3	225.6 E-3	535.2 E-3 ± 94.4 E-3	*
Mean value (CPUE) period 3	118.7 E-3	335 E-3 ± 60.9 E-3	196 E-3	473.7 E-3 ± 89.6 E-3	*
Mean value (CPUE) period 4	30.6 E-3	80.8 E-3 ± 14.8 E-3	49.6 E-3	115.1 E-3 ± 16 E-3	-

There was a large variation in CPUE over the whole fishing season in both active and inactive net links. However, the CPUE in the active net links was significantly lower than in the inactive net links (t-test, F=2.9, df=75, p<0.05), fig. 5). There was no significant difference when comparing CPUE in the active and inactive net links in the last period (4). However, in periods 2 and 3 CPUE were significantly higher[0] in active links than[0] in the inactive links (p<0.05 Mann-Whitney U-test)[0][0].

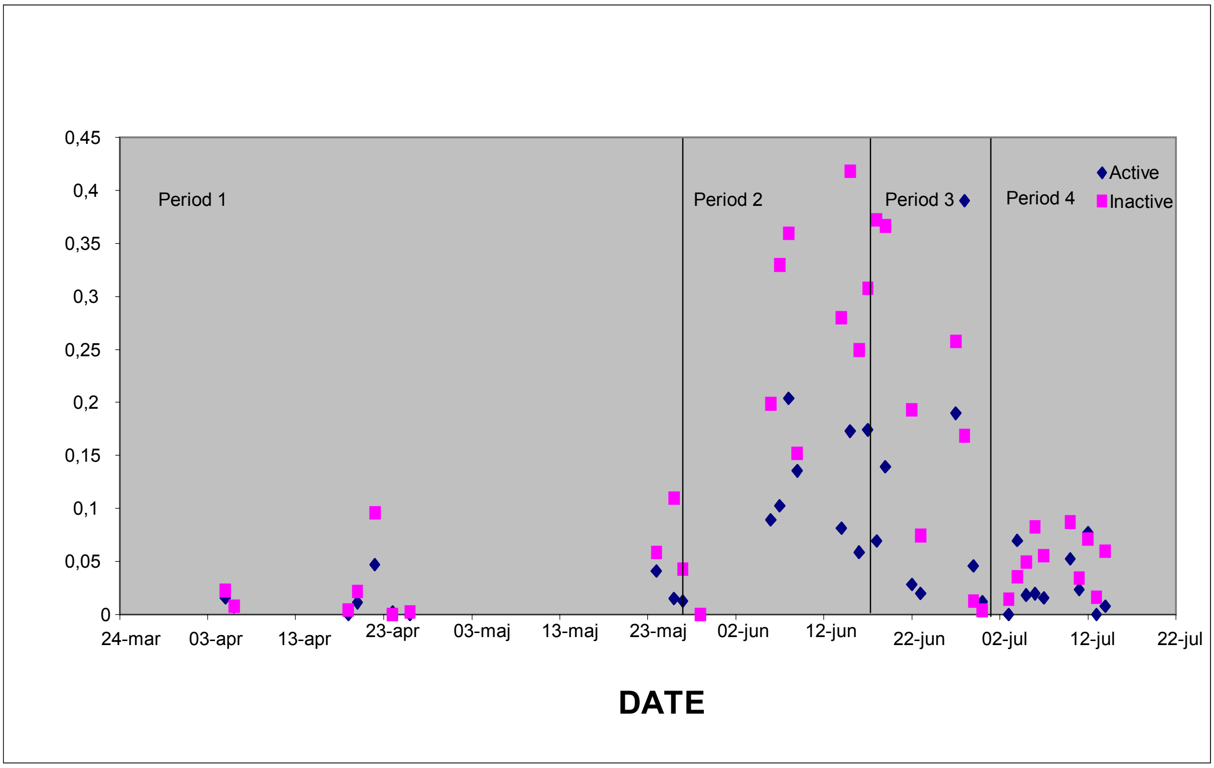


Figure 5.) The CPUE in active and inactive net links at every fishing occasion during the whole study.

3.2 Visible damage (DPUE)

There was 166 damaged cods found in the 77 active and inactive set out net links, 80 damaged cods were caught in active net links, and 86 damaged cods were caught in inactive net links. The percentage of net links set out and retrieved with visible rests of damaged cods was 61% of all active set out net links. 51% of the set out inactive net links where retrieved with visible rests of damaged cod. There was no significant difference in DPUE between the active and inactive net links over the whole study. However, there was a significant difference in DPUE during the last period with more damaged fish in the active net links (P<0. 05 Mann-Whitney U-test, tab.3).

Table. 3. DPUE from active and inactive net links. over the whole study period and the four periods. Confidensintervals are bootstrapped and statistical difference between active and inactive net links is indicated by a star.

	Active	95% CI max/min	Inactive	95% CI max/min	P<0.05
Total mean value (DPUE)	7. 6 E-03	20.5 E-03 ± 3.4E-03	7. 4E-03	21.5 E-03 ± 3.6E-03	-
Mean value (DPUE) period 1	3. 2 E-03	5.4 E-03 ± 1. 3 E-03	4. 0 E-03	7.3 E-03 ± 1. 1 E-03	-
Mean value (DPUE) period 2	3. 0 E-03	7.4 E-03 ± 0. 5 E-03	6. 6 E-03	12. 7 E-03 ± 1. 7 E-03	-
Mean value (DPUE) period 3	9. 9 E-03	23. 1 E-03 ± 4. 0 E-03	15. 6 E-03	47. 1 E-03 ± 6. 6 E-03	-
Mean value (DPUE) period 4	14 5 E-03	40. 6 E-03 ± 6. 5 E-03	3. 3 E-03	4. 0 E-03 ± 0. 0 E-03	*

3.3 Hidden damage

Out of 266 entangled and marked cods left in the net link when set out, there were 169 cods damaged or lost (tab.4). At the 41 occasions of a total of 44 occasions when entangled cods were left in active and inactive net links, net links were subjected to seal damage.

Table. 4. Summary of data from net links where cods were marked and reset to estimate the hidden damage.

	Active	Inactive	Total
Number of marked and entangled cod	115	151	266
Numbers of damaged cods;	11	8	19
Numbers of lost[1] cods;	83	67	150
Numbers of damaged and lost cods;	94	75	169

Lost[1]= Amount of lost cods after calculating with 10% natural fall of.

There was a significant higher percentage of lost marked cods in the active net links (72%) compared to the inactive net links (44%) during the whole study (t-test, $F=1.0$, $df=42$, $p<0.05$). The results also show a significant higher amount of lost and damaged cods in the active net links (82%) compared to the inactive net links (50%) (t-test, $F=1.4$, $df=42$, $p<0.05$, fig. 6). However, there was no significant difference in damaged marked fish between active and inactive net links.

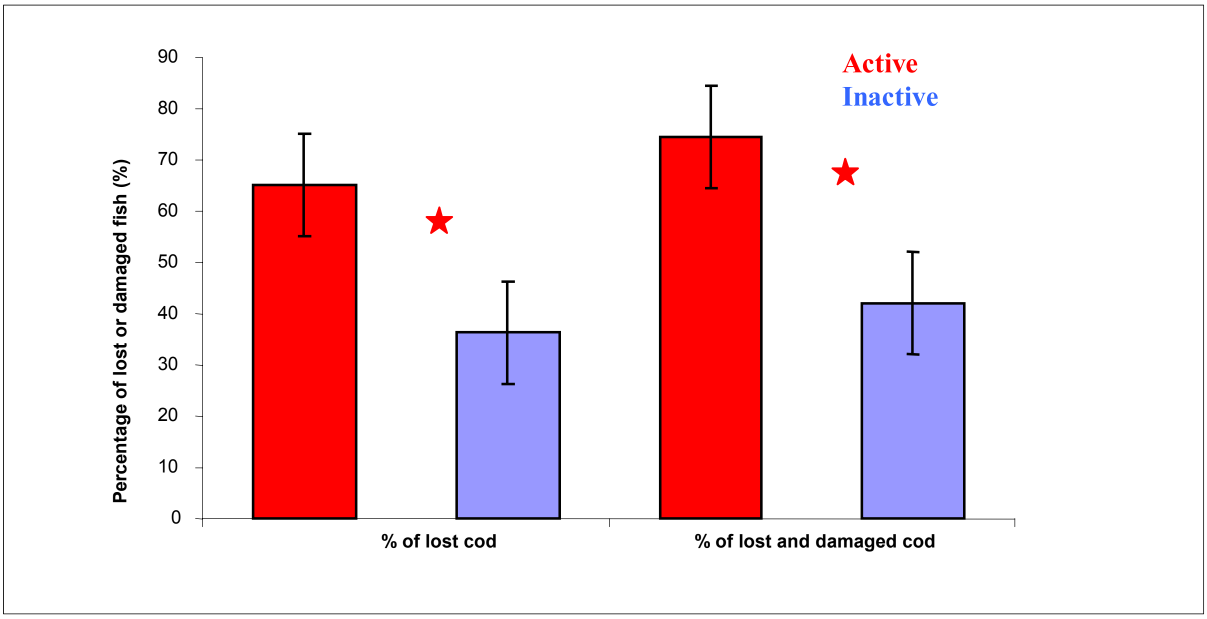


Figure 6.). The percentage of lost and damaged marked cods in the active and inactive net links, with significant higher hidden losses in the active net links. Error bars showing C.I. and stars indicate significant difference.

3.4 Seal observations

Only grey seals and no other species of seals were observed during the systematic seal observations made when net links were set or retrieved, and there were no differences in number of observed seals nearby the active or inactive net links. Out of 67 seal observations made when the active net links were set or retrieved, 3 seals were seen at the retrieving of the net link. And out of 69 seal observations made when the inactive net links were set or retrieved, 4 seals were seen also at the retrieving of the net link. When net links were set nearby the active and inactive net links, a total of 100 set out net links, 165 seal observations were carried out during setting and retrieving the nets. Only 3 grey seals were seen when retrieving the nets and no cormorants were observed.

4. Discussion

Except for the grey seal there are other conceivable predators on cod in the Baltic Sea. For example cannibalism by cod occurs. Cannibalism is more common by large cods (>35 cm) and rare by the smaller size range (<35 cm). However the size of cods being eaten is often around 5-15 cm (Uzars and Pliksh, 2000). The cods used in the hidden damage study exceeded that size (the smallest cod was 37 cm) and cods caught on net links were in the same range of length. Cormorants *(Phalacrocorax carbo*) can dive to great depths and damage the catch, however damages on the fish caused by cormorants do not often result in remains where head and backbone is left behind, they swallow the fish whole (Lunneryd, 2001). A large part of the remains left in the nets in the study included the head and had the backbone cut off (57%). Neither were cormorants seen in the vicinity of the fishing locations or by-caught in the nets. The Isopod (*Saduria entomon*) also scavenge on dead fish caught in nets, although they leave characteristic remains with intact fishbones and skeletons and no remains like that were found in the nets. Other seal species found in the Baltic Sea is the ringed seal *(Phoca hispida botnica)* and harbour seal (*Phoca vitulina)* (Ministry of agriculture and forestry, 2007; Königson, 2007). There is a small population of harbour seals south of the study area in the Kalmar Sound (Härkönen, 2006). However, there have been no reports from fishermen that harbour seals are interacting with fisheries in this area. The ringed seal lives in the northern parts of the Baltic Sea and individuals are only sporadic found further south (Ministry of agriculture and forestry, 2007). During the conducted seal observations no other seal species than grey seal were observed. Grey seals are the dominant species in the Baltic and they are abundant in the study area and they are the most likely predators attacking the nets in this study. Other studies have also concluded that it is the grey seal that causes damage and losses in the commercial fisheries (Fjälling, 2006; Ministry of agriculture and forestry, 2007; Königson, 2007).

CPUE was found to be significant lower in the active net links than in the inactive net links over the whole study period. There were significantly more damaged fish (DPUE) in the active net links during the last period. However, this was not the case for the whole study period or in any of the other periods. The hidden losses study showed that when net links were subjected to damage by seals, most of the cods were lost without a trace, more than 70 % of the cods placed in the active net links were lost without a trace compared to only a loss of 44% of the cods placed in the inactive net links. The clearest evidence of increased seal disturbance in the active net links compared to the inactive net links were in the hidden damage study. With its significant higher amount of lost, and lost including damaged cods in the active net links it showed increased disturbance around the active net links. Because a larger amount of caught cod is lost without a trace in the active net links this could explain the decreased CPUE in the active net links. Losses due to damages by seals have earlier been estimated by counting the remains of fish left in the nets (Fjälling, 2006). However looking at the loss of cod due to seals with regard to the hidden damage study, the loss of fish to seals are at a far greater extent then if only counting the remains left in net links.

There have been different theories about how acoustic deterrents affect the fisheries. In an earlier study including fisheries and acoustic deterrents it was suggested that fish could avoid net links with acoustic deterrents because of their ability of sound detection (Kraus *et al.*, 1997), but Atlantic cod is presumed only to detect high sound levels at 38 kHz and strength 194.4 dB re 1µPa (Astrup and Møhl 1993) and could therefore not hear the acoustic deterrents used in this study. In addition, a study of the effect of acoustic deterrents on cod showed no behavioural responses to the sound (Kastelein *et al.,* 2007). Fishermen have claimed that they can see on sonar how herring *(Clupea harengus*) avoid areas around net links when seals appear in the area (KönIgson, 2007). If cod also avoid net links because of seal presence this could be an additional hidden loss and an explanation for the reduced CPUE in the active net link.

During the fishing season many fishermen were active and numerous net links were spread out in close vicinity of each other in the study area. Seals could easily feed by the net links and were not forced to forage actively, i.e. they didn't need to search for sounds from the active net links to get hold of their food. Because of a special permit we continued fishing after the fishing season ended, our net links were the only net links in the area. With a decreased number of net links in the area and therefore a decreased cod supply by the net links, the seals became forced to forage actively and the motivation to seek the active net links increased. This could be the reason why the damaged catch in the active net links increased the last period, because it was easier for the seals to locate net links which announce its present compared to silent net links in an open sea without any other net links in the vicinity. This could be evidence that suggests that the dinner bell effect occurred and that the seals learned to find fishing gear by the active acoustic deterrents.

Another problem with acoustic deterrents is that habituation will probably limit long-term effectiveness of acoustic deterrents scaring device (Richardson *et al.*, 1995). It is less likely to result in habituation if acoustic deterrents are used only for shorter periods than continuously (Kastelin *et al.*, 2006) and with random frequencies (Kastelin *et al.*, 2007; Richardson *et al.*, 1995). To avoid habituation both by grey seals and harbour porpoises another scaring device than acoustic deterrents AQUAmark 100 is needed. Habituation may be reduced by using scaring measures cautiously, in combinations, and by occasional reinforcement with more threatening stimuli (Richardson *et al.,* 1995). According to a study it was suggested that AQUAmark 100 with its high frequency would be the most difficult acoustic deterrents for the seals to hear comparing the acoustic deterrents available on the market (Hagberg, 2006). However these acoustic deterrents are not a solution to the harbour porpoise by-catch problem when used in areas nearby seal populations. Another possibility to decrease the by-catch of harbour porpoises without increasing the seal fisheries conflict could be to use interactive acoustic deterrents which are triggered by the harbour porpoise echolocation signals. Because the interactive acoustic deterrents only emit sounds when a harbour porpoise is nearby and thereby it can't cause any dinner bell effect.

In summary, with reduced catch, increased damaged catch and increased hidden losses in active net links this study shows that in absence of other negative stimuli the grey seal associate the sound from the acoustic deterrents with fish and the dinner bell effect occurs. The grey seal do localize fishing gear by acoustic deterrents and continuous use of acoustic deterrents could add further problems to the already infected conflict between seals and fisheries in the future.

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ANNEX 8

No. 657: High-density areas for harbour porpoises in Danish waters

Teilmann, J., Sveegaard, S., Dietz, R., Petersen, I.K., Berggren, P. & Desportes, G. 2008: High density areas for harbour porpoises in Danish waters. National Environmental Research Institute, University of Aarhus. 84 pp. – NERI Technical Report No. 657.

Summary

Designating protected areas for harbour porpoises implies identifying areas of high porpoise density with particular focus on the distribution during the breeding season. This report collates all relevant data on movements and density of the harbour porpoises in Danish and adjacent waters in order to identify key habitats, i.e. areas with high density, for harbour porpoises in Denmark that may be useful when designating protected areas under the Habitats Directive.

Comprehensive data from satellite tracking, aerial and ship surveys as well as acoustic surveys from ship have been collected from 1991 to 2007 in Danish waters. In this study the primary source of data for identifying key habitats is satellite tracking of 63 harbour porpoises in the period 1997-2007. The only major areas that were not covered by the tagged animals were the Southern North Sea and the waters around Bornholm. In the Southern North Sea, data from aerial surveys was used to identify high-density areas. Data from the area around Bornholm were too limited to determine harbour porpoise distribution and density. In northern North Sea and Inner Danish Waters acoustic ship surveys and aerial surveys were used as an independent method to confirm the presence of the high-density areas found by analysis of the satellite tracking data.

The high density areas are described separately based on the management units proposed based on previous population structure studies. Four management areas are proposed but only in three areas there are data enough to identify high-density areas. The three areas are: 1. The Inner Danish Waters (south of Læsø in Kattegat) through the belts and Øresund to the Western Baltic (west of Bornholm). 2. The Skagerrak/northern North Sea/northern Kattegat (north of Læsø and north of Ringkøbing), 3. The southern North Sea (south of Ringkøbing). Each high-density area is ranked based on our current knowledge of population structure, density, seasonal variation in distribution and other relevant information. The rankings are defined as 1 = high importance, 2 = medium importance and 3 = lower importance.

Sixteen areas were found to have high density and were ranked as follows for the three areas:

Inner Danish Waters:

Northern Little Belt (2), Southern Little Belt (1), Southern Samsø Belt (2), Northern Samsø Belt (3), Northern Øresund (1), Store Middelgrund (2), Kalundborg Fjord (1), Great Belt (1), Smålandsfarvandet (3), Flensborg Fjord (1), Fehmarn Belt (1), Kadet Trench (2).

Northern North Sea:

Tip of Jylland (1), Skagerrak (along Norwegian Trench, 2).

Southern North Sea:

Horns Rev (1), German Bight (1).

http://www.dmu.dk/Udgivelser/Faglige+rapporter/Nr-650-699/Abstracts/FR657_GB.htm

ANNEX 9

SAMBAH
A Baltic Sea international joint venture to monitor porpoises with static acoustic monitoring devices

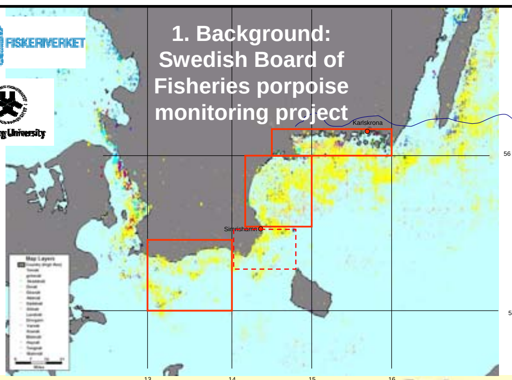
Mats Amundin, Daniel Wennerberg, Joanna Stenback, Ida Carlén, Jonas Teilmann, Jacob Tougaard, Geneviève Desportes, Penina Blankett, Sanna Kuningas, Markku Lahtinen, Kai Mattsson, Ivar Jüssi, Iwona Kuklik, Ursula Verfuss, Harald Benke, Michael Dähne, Anja Meding

1. Background: BoF monitoring project
   - SAM project hooked on to pinger implementation: Are there any porpoises to deter?
   - Required a new type of SAM unit – the PCL
2. Results from these studies
   - Parallel collection of crucial basic SAM info: calibrations, g(0), max detection range, detection probability function
3. New project: Expand monitoring to entire Baltic
   - Aim: population density => total abundance…??
   - Point transect sampling approach
   - International cooperation
   - Different logistics solutions: deployment
   - Joint analysis: Across countries, T-POD vs PCL data

1. Background: Swedish Board of Fisheries porpoise monitoring project

FISKERIVERKET

Linköping University



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Integrated with fishing operations, i.e. fishermen responsible for deployment, data retrieval and battery charging = cost efficient!

Required a new type of SAM unit – the Porpoise Click Logger or PCL

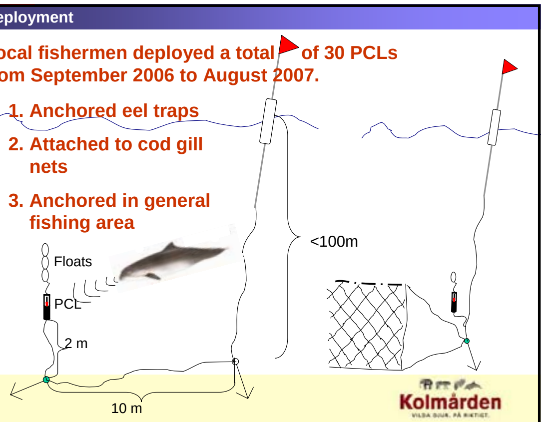
The PCL needed to be:

- **Very robust**
- **Easy to operate**
- **Short battery life acceptable**

Deployment

Local fishermen deployed a total of 30 PCLs from September 2006 to August 2007.

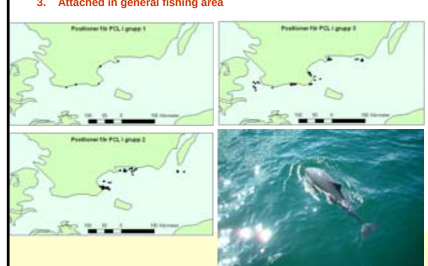
1. **Anchored eel traps**
2. **Attached to cod gill nets**
3. **Anchored in general fishing area**



2. Results – Observation effort

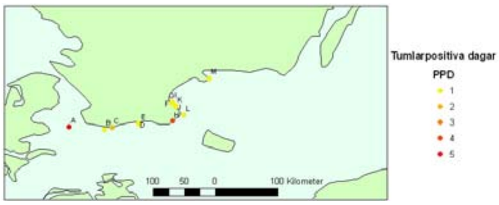
- **2 409 days of PCL data was collected in 184 positions between July 2006 and September 2007**

1. Anchored in eel traps
2. Attached to cod gill nets
3. Attached in general fishing area



2. Results – Porpoise detections

- In total 21 porpoise positive days (PPD)
- Most PPD:s in the fall-winter 2006
- Most PPD:s in the West half of the studied area



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Parallel with *in situ* monitoring:

Collection of crucial basic info:

- hydrophone calibrations
- unit calibration

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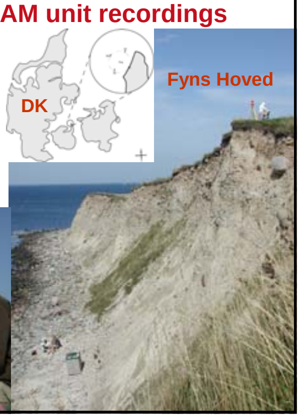
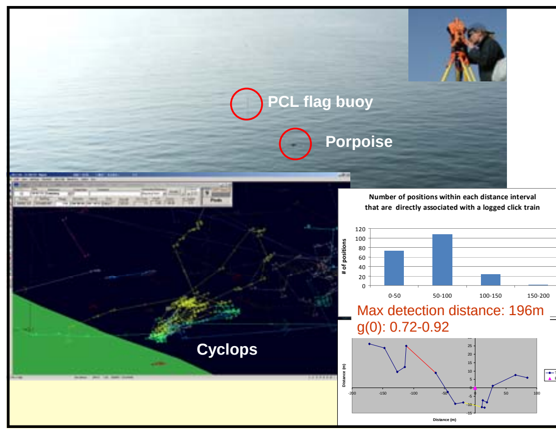
Visual tracking vs SAM unit recordings

Collection of crucial basic info:

- calibrations
- g(0)
- max detection range
- detection probability function





Visual and SAM unit data vs hydrophone array recordings

Collection of crucial basic info:

- calibrations
- ~~g(0)~~

Next step:

- Baltic fishermen have a point? Why bycatch mitigation if there are no porpoises?
- Mitigation goal <1% of population size. Which is?

In areas with low density populations like the Baltic, traditional survey methods unusable. SAM is the currently most interesting alternative

SAM advantages/limitations:

- Less weather dependent
- Not daylight dependent
- Long or continuous data series
- Diurnal and annual variations
- Trends
- Only relative abundance?

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Point transect sampling based on SAM

Aim: population density => total abundance (?)

$$D = \frac{E(n) * E(s)}{a * P_a}$$

Number of detected objects; Estimated group size; Density; Sampled area; Detection probability

Number of animals in a detection impossible to determine. Apply average group size??

More problems with SAM:

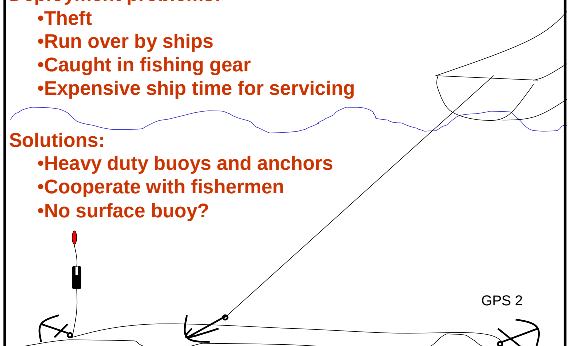
- How many units needed?? Power analysis
- Cover the whole Baltic??
- Comparability T-POD vs PCL

Deployment problems:

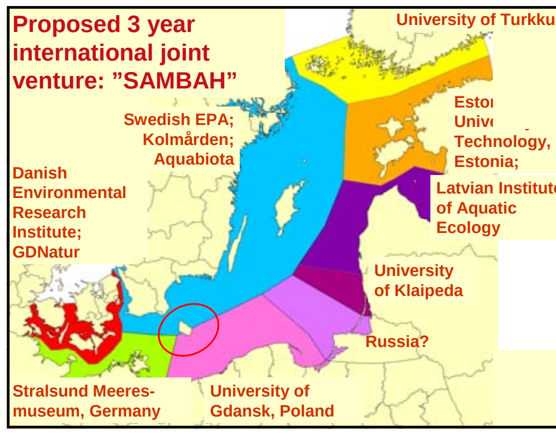
- •Theft
- •Run over by ships
- •Caught in fishing gear
- •Expensive ship time for servicing

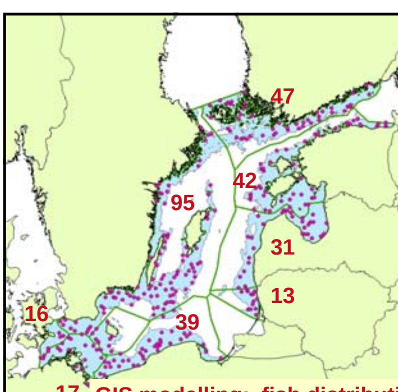
Solutions:

- •Heavy duty buoys and anchors
- •Cooperate with fishermen
- •No surface buoy?



Proposed 3 year international joint venture: "SAMBAH"

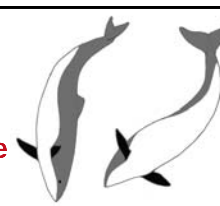




Suggested, randomised distribution of 300 units. NB! only 5-50m water depth

GIS modelling: fish distribution, sediment, slope, currents, oxygen, temperature…

Rough time structure



Year 2008: g(0), detection prob. in different density areas, logistics, input to GIS models…
Year 2009-2010: SAM data collection
Year 2010-2011: Analysis and reporting

Funding

Swedish EPA: SAM unit characterisation
Nordic Council of Ministers, MiFi: ?
ASCOBANS: Prep meeting expenses
BONUS+ : LoI submitted; 1st decision
March 15: Final deadline April 15

LIFE+ : ?
Kolmarden Fund Raising Foundation: ?
Participating institutions – working time
Swedish Sea Rescue Association: Ship time
Coast Guard: Ship time

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Funding agencies for SAM study: Swedish Board of Fisheries & Swedish Fishermen's Association,
For DK study: Swedish EPA.

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Thanks for your attention!

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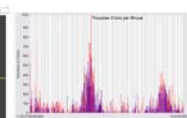
PCL Analysis



Diurnal click sound activity

Automatic and manual interpretation

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ABUNDANCE OF HARBOUR PORPOISES IN THE BALTIC SEA FROM AERIAL SURVEYS CONDUCTED IN SUMMER 2002

Berggren[1], P., Hiby[2], L. and Lovell[3], P. and Scheidat[4], M.,

[1]Department of Zoology, Stockholm University, S-106 91 Stockholm, Sweden
[2]Conservation Research Ltd., Cambridge, England, UK
[3]Sea Mammal Research Unit, Gatty Marine Lab., Univ. of St. Andrews, Fife, KY16 8L, UK
[4]FTZ Westküste Büsum, Hafentörn, 25761 Büsum, Germany

For information contact: berggren@zoologi.su.se

Abstract

An aerial survey was conducted to estimate the abundance of harbour porpoises the Baltic Sea in July 2002. The survey covered about 2.25% of the approximately 20,000 nm^2 (68,000 km^2) survey area based on an estimated effective strip width of 268 metres. The survey area represents the currently documented distribution range of the species in the Baltic Sea. The survey was conducted along seven replicate zig-zag tracks, which were designed by using a random start point, to give a non-zero probability of covering any point in the survey area. One porpoise pod was seen on each of two of the tracks. A point estimate of the number of porpoise pods in the survey area is 93 pods. Based on an assumed negative binomial distribution for the number of pod sightings per track and incorporating the uncertainty in the estimate of effective strip width, the 95% confidence limits for the pod abundance estimate are from 10 to 460 pods.

Introduction

The harbour porpoise (*Phocoena phocoena*) is the only cetacean species regularly encountered in the Baltic Sea (Schulze 1996). Population-level differences have been found among harbour porpoises from the Baltic Sea, the Kiel and Mecklenburger Bights, and the North Sea (Kinze 1985, Andersen 1993, Tiedemann et al. 1996, Huggenberger 1997, Andersen et al. 2001, Huggenberger et al. 2002). In addition, differences have been found among the Baltic Sea, the Skagerrak/Kattegat Seas and the west coast of Norway (Börjesson and Berggren 1997, Wang and Berggren 1997, Berggren et al. 1999).

All evidence suggests that the species' distribution range in the Baltic has been reduced dramatically since the middle of the twentieth century (see Koschinski 2002). Once common in the entire area as far north as the Bothnian Bay, now few documented sightings or bycatches have been reported since the 1960s (Otterlind 1976, Määtänen 1990, Berggren and Arrhenius 1995a, b, Berggren et al. 2002, Kuklik and Skora 2003). Although a few sightings have been reported in Finnish and Swedish waters in recent years the current eastern limit of regular occurrence of the Baltic harbour porpoise lies somewhere between Gdansk Bay in the south and the northern limit close to the Swedish island Gotland (IWC 1996). Very little information is available on the historic and current status of the species in this area. However, qualitative information on trends in relative abundance suggests that the abundance of porpoises in these waters has declined dramatically over the past few decades.. In Swedish waters of the Baltic Sea harbour porpoise relative abundance is believed to have declined drastically between the 1960s and 1980s (Berggren and Arrhenius 1995a) with no subsequent recovery (Berggren and Arrhenius 1995b). Porpoises have also become less common during the last decades in other areas of the Baltic region, including Danish (Andersen 1982; Clausen and Andersen 1988), Polish (Skora et al. 1988), and Finnish (Määttänen 1990) waters. An estimate of abundance of harbour porpoises in the Baltic Sea exists from an aerial survey conducted in 1995 covering the same area apart from a 22 km corridor along the Polish coast. This survey gave an estimate of 599 porpoises (CV 0.57, CI 200-3300), (Hiby and Lovell, 1996). The magnitude of harbour porpoise (*Phocoena phocoena*) by-catch in commercial fisheries has lead to increased concern over the status of this species in recent years (Berggren 1994; Perrin et al. 1994; HELCOM 1996; IWC 1996; ASCOBANS 1997; 2000; ICES 1997). Bycatch of harbour porpoises occur year round in the Baltic Sea (Berggren 1994; Kuklik and Skora 2003), although no reliable estimates of the magnitude of this catch is available. However, using the number of bycaught porpoises submitted to local museums and other collection agencies, bycatch numbers have been shown to exceed calculated mortality limits for the Baltic Sea (Berggren et al. 2002).

The objective of the present study was to estimate the abundance of harbour porpoises from aerial surveys conducted in the Baltic Sea in 2002 covering the area currently representing the distribution range of the species in the area.

Methods

Flights were carried out during the summer of 2002 in German coastal waters and the area of the Baltic Sea shown in figure 1, on tracks designed before commencement of the survey. The objective was to estimate abundance of porpoise pods in the Baltic area, and confidence limits on those estimates based on results from replicate tracks. We anticipated that sighting rates in the Baltic area would be too low to allow effective strip width to be estimated there so we planned to base that estimate on results from the German coastal surveys. The observers who carried out the Baltic survey also took part in the German coastal surveys so that the effective strip width measured there would be applicable to the Baltic survey results also.

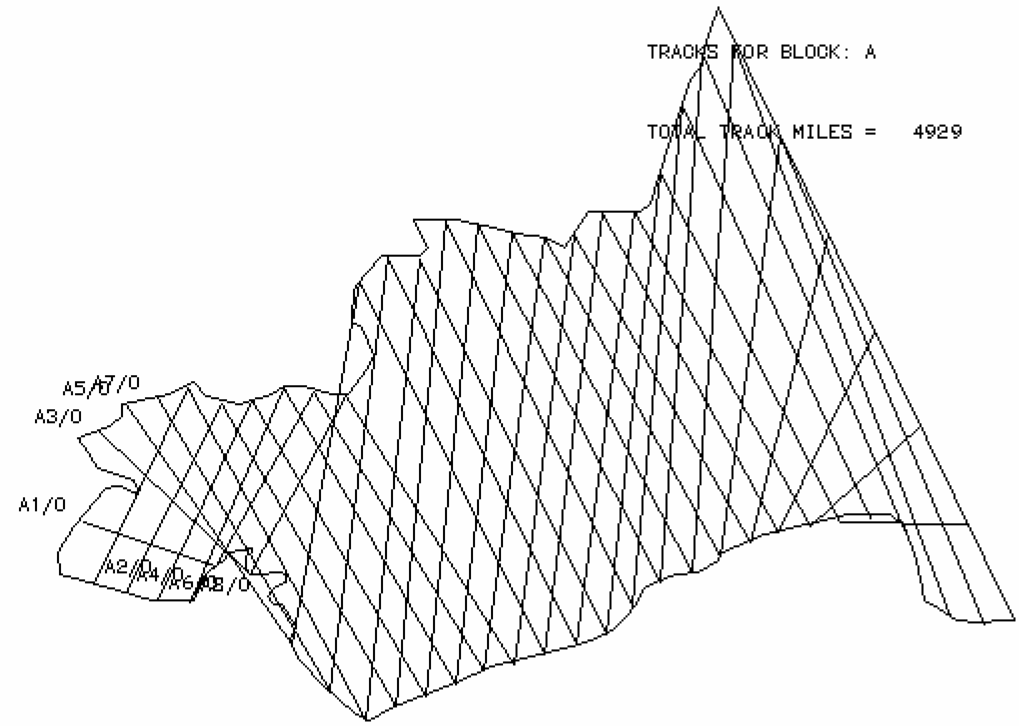

Figure 1. The area of the Baltic Sea surveyed in 2002 and the location of the eight survey tracks designed prior to the survey. The eastern boundary of the survey area was from 57º 07′ N, 17º 00′ E to 54º 22′ N, 19º 16′ E.

Cruise Track Design

Cruise tracks, consisting of sets of successive waypoints, were constructed using pseudorandom starting positions so that selection of a single track would provide nonzero coverage probability for any point in the block. By surveying replicate tracks a mean abundance estimate with confidence limits would therefore be available. Several replicate zig-zag tracks were constructed by first defining a set of parallel lines perpendicular to a common axis, and then using the intersections of those lines with the block boundaries as successive waypoints for the track (see Figure 1). Each set of parallel lines provides two replicate tracks, one starting at the southern end of the western-most line and the other at the northern end. Further tracks were constructed by shifting the set of parallel lines along the axis.

The coverage of an area provided by a set of tracks increases as the spacing between the parallel lines used in their construction decreases. The tracks were designed to be completed in the number of survey hours specified for the Baltic area based on the available funding. Inevitably, the coverage varies in response to the shape of the boundary, but the variation was minimised by adjusting the orientation of the common axis and the remaining variation was allowed for by the method used to estimate abundance. That method required calculation of coverage probability at each sighting location, so the track design technique was computerised to speed up those calculations as well as the construction of the cruise tracks.

Data Collection

The airplane surveyed at an altitude of 600 feet (183m) and a speed of around 100 knots (185km/h). Bubble windows allowed each of the two observers on the aircraft to search the sea area on their side of the aircraft, from the abeam line forward to the trackline. The chief scientist in the co-pilot seat recorded all changes in sighting conditions during on-effort periods and the observers notified the chief scientist about porpoise pod sightings and the moment at which each sighting came abeam of the aircraft. Estimated pod size was recorded for each sighting and also the declination angle to the pod as it came abeam. This was estimated using a hand-held declinometer and, in conjunction with aircraft altitude, provided an estimate of the perpendicular distance to the sighting.

The conditions recorded by the chief scientist included Beaufort, cloud cover, angle obscured by glare, turbidity and a subjective assessment of overall sighting conditions as “good”, “moderate” or “poor”. The sightings and conditions data were entered into a laptop computer during the flight via an interface program that also accepted output from a GPS receiver. The times at which porpoise pod sightings came abeam of the aircraft were recorded by pressing, at that exact moment, one of two laptop keys assigned for sightings by the left and right hand observer. Prior to each flight the waypoint coordinates for each "zig" or "zag" of the track selected for survey on that day were entered into the aircraft GPS receiver and the code for that track entered into the interface program. Thus at completion of the flight the recorded positions for all sightings and changes in conditions could be related to both the planned trackline and the actual flight path.

On some of the tracks in the Baltic the chief scientist acted as one of the observers and was then positioned either in the starboard or port observer seat. During these flights each observer used a tape recorder and digital watch to record changes in sighting conditions during on-effort periods and porpoise pod sightings and the moment at which each sighting came abeam of the aircraft. These data were entered into the computer at the end of each survey day. The watches were calibrated to the aircraft’s onboard GPS at the beginning of each survey day. All other data was recorded as noted above.

The recording system allowed us to generate data for estimation of effective strip width from a number of circling manoeuvres conducted during the survey. These were initiated by the occurrence of a porpoise pod sighting and were designed to cause the aircraft to overfly the same sighting a second time. The aircraft conducted survey flights along transects lying between successive waypoints, as usual. A short "dead-time" was imposed following departure from each waypoint but following that period any pod sighting initiated a break-off from the trackline after an interval of about 30 seconds (equivalent to a distance of about 1.5 km) to allow the aircraft to fly back and rejoin the trackline at a point 1.5 km before the point from which the sighting occurred. The aircraft then resumed the survey along the original trackline, passing the location of the original sighting, and continued to the next waypoint. This resulted in a “racetrack” flight pattern, familiar to most pilots as a holding pattern for aircraft waiting to land at a busy airport (Figure 2).

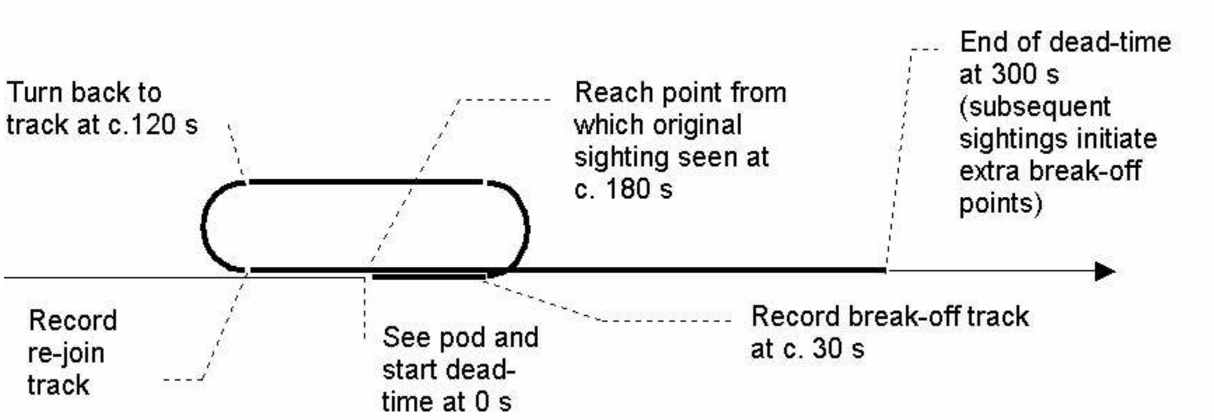

Figure 2. Flight path used to provide duplicate sighting effort over selected trackline sections. The section from the recorded re-join point to the recorded break-off point is assigned to duplicate effort by the database management system.

If further pod sightings occurred before the next waypoint was reached the repeat-flight protocol was followed again, except that a dead-time was imposed after each of the sightings which initiated a break-off to avoid excessive circling in areas of high pod density. The aircraft takes about 30 seconds to complete each turn, so this procedure provided the potential for duplicate sighting of a sample of pods following a time interval of about three minutes. As this is well in excess of the average duration of a dive cycle (Westgate et al., 1995) we assumed that the probability a pod would be near the surface at the time of the second overflight would not be effected by the fact it had been seen on the first overflight (and was therefore near the surface at that time).

Estimation of G(0) and Effective Strip Width

Estimation from these data of the shape of the sighting function, g(y), its value on the trackline, g(0) and hence the effective strip width, is described in Hiby (1998) and Hiby & Lovell (1998). Briefly, the synchronous recording of GPS data, abeam times and declination angles allows the positions of pods sighted on the first and second overflights to be calculated relative to the aircraft locations at those times. Given a decision as to which of the pods seen on the first and second overflights were duplicates, the likelihood of those positions can be maximised with respect to g(0), the parameters of the g(y) function and a number of other “nuisance” parameters: the mean density of porpoise pods in those regions of the survey area inhabited by porpoises, the proportion of the area covered by those regions and the parameters of the function describing the shift in location of pods between the first and second overflights. Synchronous recording of GPS data and sighting conditions allows the sighting locations to be assigned to sections of effort completed under specific conditions and estimates of g(0), the scale parameter of the sighting function and hence the effective strip width, to depend on those conditions.

To apply this method it was necessary to identify the duplicate and non-duplicate pairs of sightings from the first and second overflights. Some of the sighting times from the two overflights are too far apart to be duplicates. The remaining sightings form groups within which pairs of sightings from the first and second overflights may or may not be of the same pod - there are no distinguishing features that can be used to identify individuals. Our approach was to use a recursive code to generate all possible pairings of sightings within each group (including the special case of no duplicates at all). Those arrangements form an exhaustive set of mutually exclusive events so that the probability for the observed sighting positions equals the sum of the probabilities for each possible arrangement. In this way we calculated the likelihood for the data on each section of the survey conducted under consistent conditions; the log likelihood for the entire survey was obtained as the sum of the log likelihood for each section.

Estimation of Porpoise Pod Abundance

To estimate abundance using the pod sightings from a given track we used the inverse selection probability method (Hansen and Hurwitz, 1943). If a given survey area contains N pods and pod i has probability p_i of being detected by survey along a randomly selected track, then $\Sigma x_i/p_i$ has expectation N, where the dummy variable x_i equals 1 if the i^{th} pod is detected and 0 otherwise. That sum is equivalent to the sum of $1/p_i$ for the detected pods only, which is therefore an unbiased estimator for N. The derivation implies that the p_i are non-zero for all N pods, i.e. that design of cruise tracks gives every point of the survey block a non-zero chance of being surveyed. The cruise track program was used to illustrate the coverage probability over the survey area and verify that it was non-zero everywhere.

For each selected survey track coverage probabilities were obtained from the cruise-track design program for the locations where pods were detected along that track, based on a nominal strip width of 1 km. They were then multiplied by the average esw for that track to give the p_i required in the abundance estimator. The average allowed for sections of good and moderate conditions, and for zero esw where conditions were poor or unacceptable.

The 95% confidence intervals on pod abundance were not derived directly from the sample variance of replicate tracks because of the small number of pods sighted. Although the sample variance of abundance estimated from replicate tracks is unbiased for the variance of the abundance estimator, a given value may not be useful for deriving confidence limits when based on very few data. For example when, by chance, the (small) number of sightings on replicate transects is identical the sample variance is zero whereas the abundance estimate is clearly still subject to error. Confidence limits may still be valuable, however, particularly as considerable survey effort may have been expended in the survey area. We derived confidence limits by assuming the number of sightings on a track has a negative binomial distribution with expectation and variance proportional to the coverage provided by that track. Different tracks thus have different expectations and variances but the same expected variance to mean ratio, namely the reciprocal of the negative binomial *p* parameter. The expected count for each track was expressed in terms of its coverage and the pod abundance, N, so that the joint probability for all track counts in the block could be expressed as a function of coverage, N and *p*. Coverage was set by the estimate of effective strip width and the asymptotic distribution of the esw estimate about its ML value included as a separate term in the likelihood. Confidence limits on N were then available as values of N for which the likelihood maximised with respect to *p* and esw was 1.92 less than the likelihood maximised with respect to *p,* esw and N.

Figure 3 shows the frequency distribution of perpendicular distances to porpoise pod sightings under good and moderate conditions. The usual dip near the trackline is evident, resulting from the reduced time for which pods near the aircraft are visible. The fitted hazard rate curves show little or no reduction in width under moderate as compared to good conditions (data collected under "poor" conditions were excluded from the analysis).

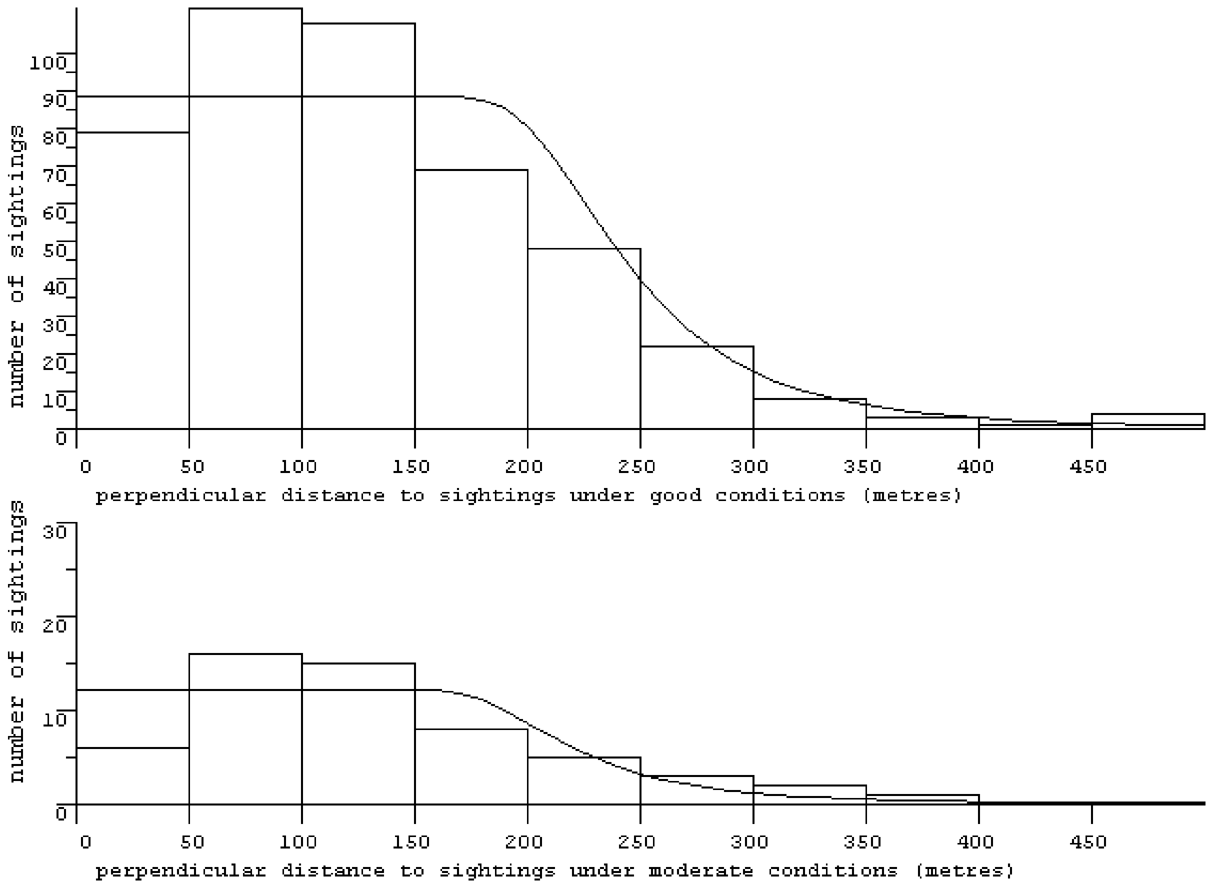

Figure 3. Frequency distribution of perpendicular distances to porpoise pod sightings under good (upper graph) and moderate conditions (lower graph).

Figure 4 shows the frequency distribution of perpendicular distance to porpoise pods to left and right of the trackline from the first and second overflight sections of the circling manoeuvres. Because there were only 20 sightings from the second overflight sections it is difficult to infer much from their frequency distribution. However, there is some indication of reduced distance to those sightings. This result is expected (in the absence of avoidance behaviour) because pods on a path converging with the trackline on the first overflight are more likely to be resighted on the second.

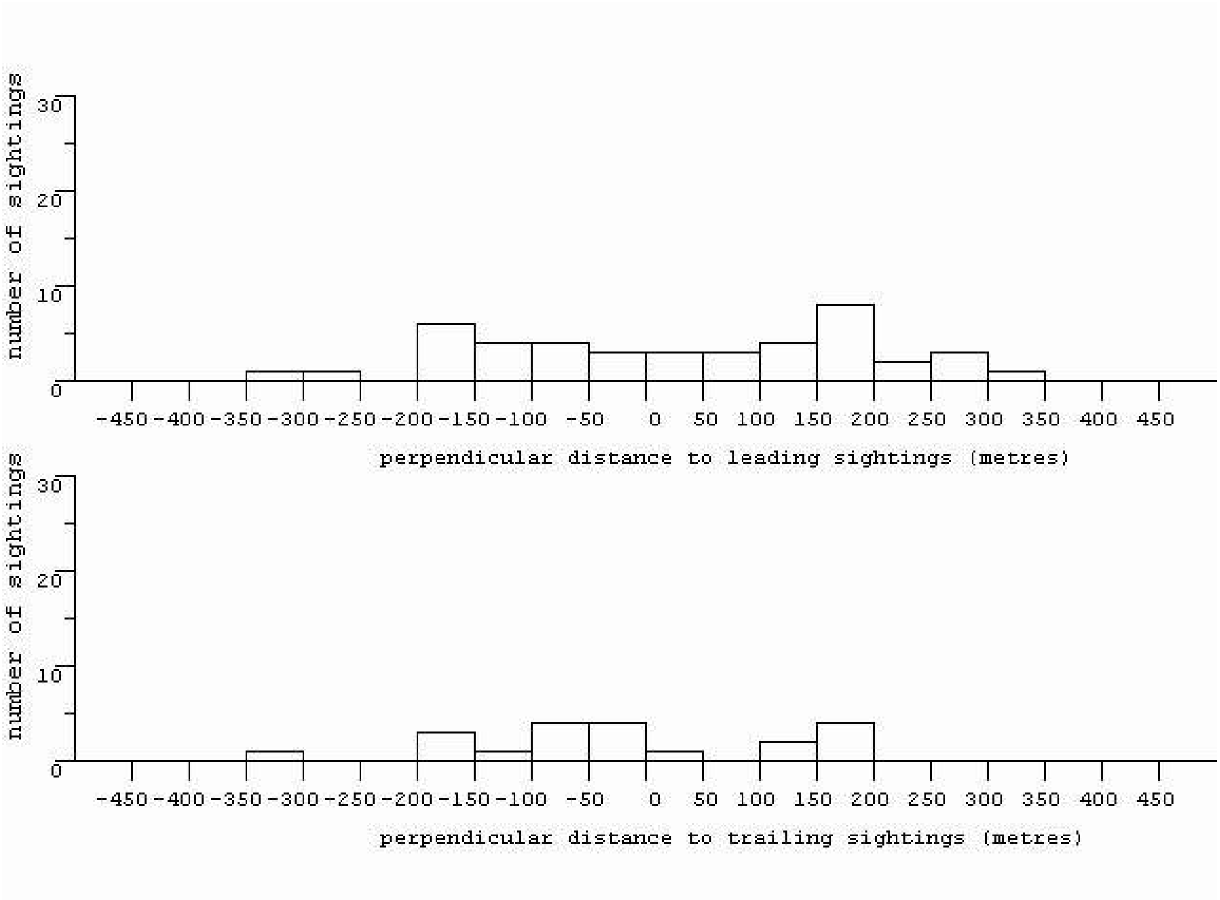

Figure 4. "Leading" and "trailing" sightings refer to those from the first and second overflight sections of a circling manoeuvre.

The upper curve in Figure 5 shows the log likelihood for all sighting positions as a function of g(0), the value at zero of the estimated sighting function under good conditions. The likelihood is maximised at a value of 0.7 for g(0) under good conditions with an estimated 65% reduction (i.e. to 0.245) under moderate conditions (there is estimated to be no reduction in the width of the sighting function). The corresponding effective strip widths are 321 and 113 metres. The likelihood curve does not have a sharp maximum so that 95% confidence limits on g(0) are very wide, from 0.15 to 1 under good conditions. The limits are estimated as the values of g(0) at which the log likelihood is 1.92 less than the maximum likelihood, as indicated by the dotted line.

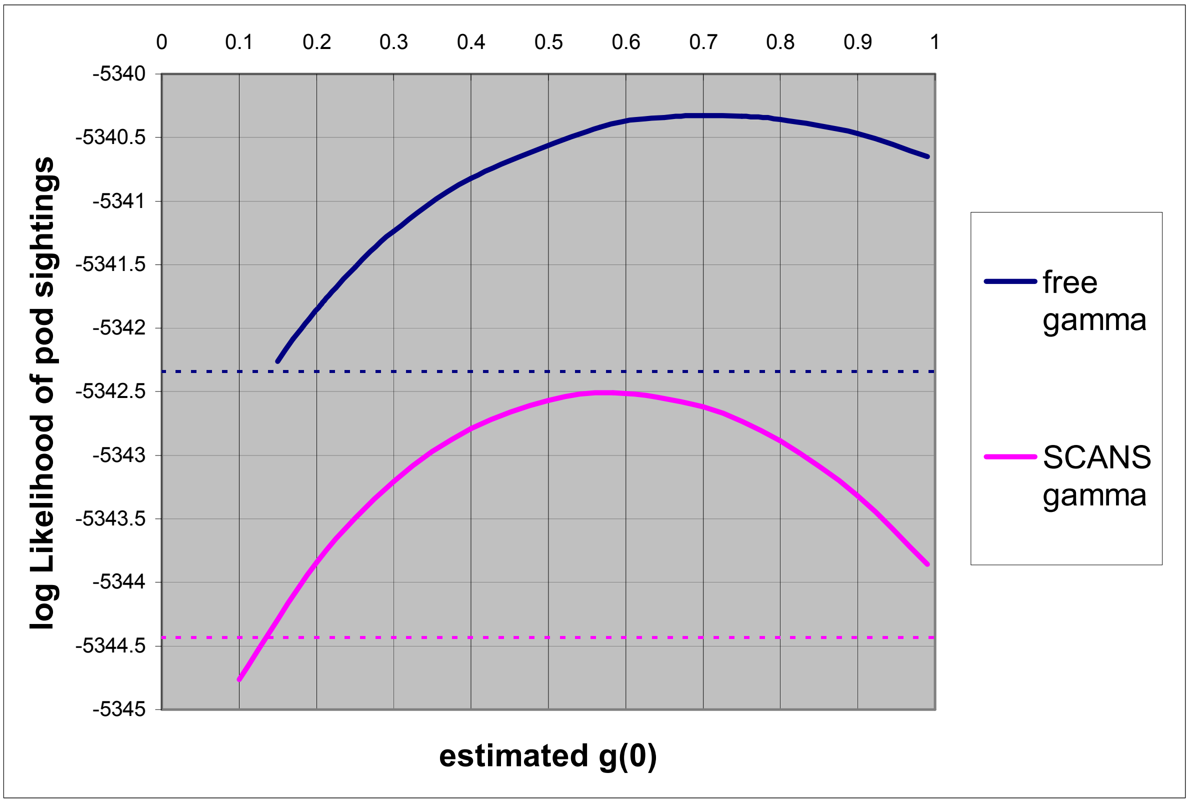

Figure 5. The log likelihood for all sighting positions as a function of g(0), for the present survey (upper curve) and the SCANS survey (lower curve), the value at zero of the estimated sighting function under good conditions.

The width of the confidence interval on the maximum likelihood (ML) estimate for g(0) indicates that it was not possible to obtain a reliable estimate of g(0) from the current data. The reason for the very wide confidence limits is evident from inspection of Figure 6. It shows the frequency distribution of differences between expected and observed sighting times for the 20 sightings from the second overflights if each was a resighting of the pod seen on the first overflight.

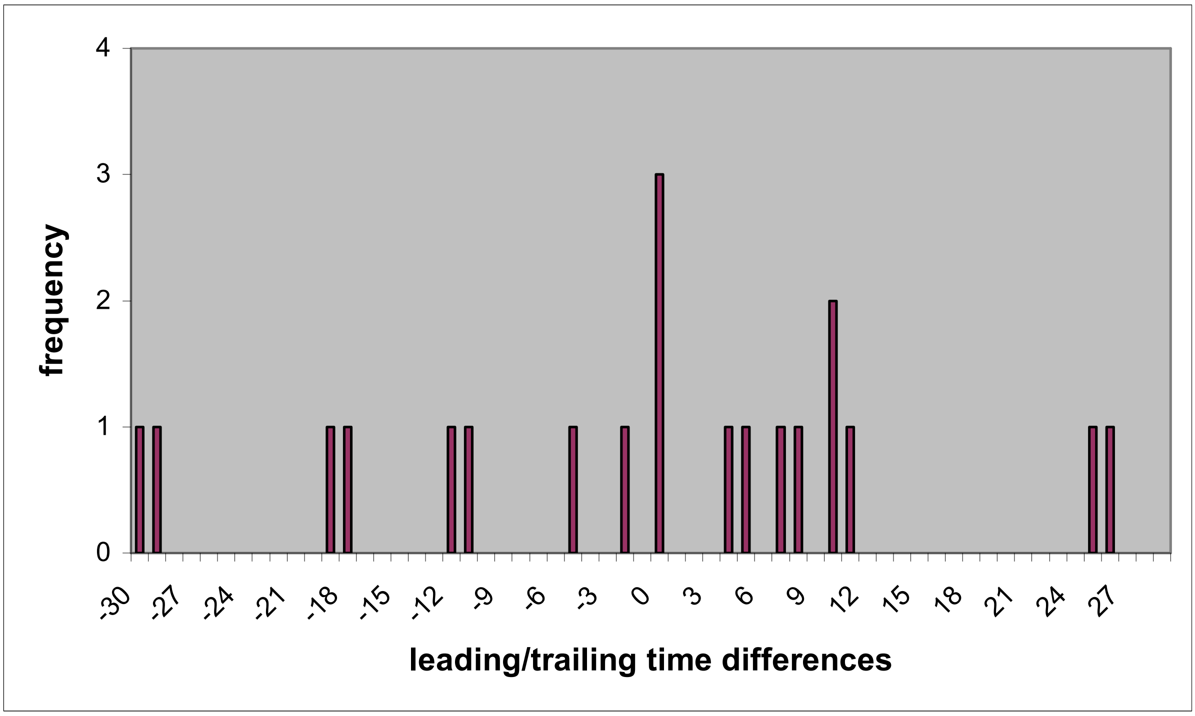

Figure 6. The frequency distribution of differences between expected and observed sighting times for the 20 sightings from the second overflights if each was a resighting of the pod seen on the first overflight.

Figure 7 shows the estimated mean pod movement speed corresponding to the range of g(0) estimates in Figure 5 – the estimated mean speed corresponding to a value of 0.7 for g(0) under good conditions is 1.68 m/s. If we accept that the mean rate of displacement of a pod is probably no more than 2 m/s and it takes about 200 seconds for the aircraft to circle round to the place from which the pod was seen on the first overflight then a pod should not have moved more than about 400 metres. That would result in a deviation of observed from expected sighting time of, at most, 8 seconds if movement was along the trackline. Thus we would expect a cluster of time differences to occur between, say, -5 and 5 seconds in Figure 6 with a scatter of times beyond those limits due to "new" pods seen on the second overflight. In fact the differences are spread almost evenly over the –30 to 30 seconds range so that a set of parameters corresponding to high pod movement, many resightings and a high g(0) generates almost the same likelihood as a set corresponding to low pod movement, few resightings and a low g(0). Thus a more reliable estimate of g(0) depends on obtaining more data from circling manoeuvres conducted under lower pod densities.

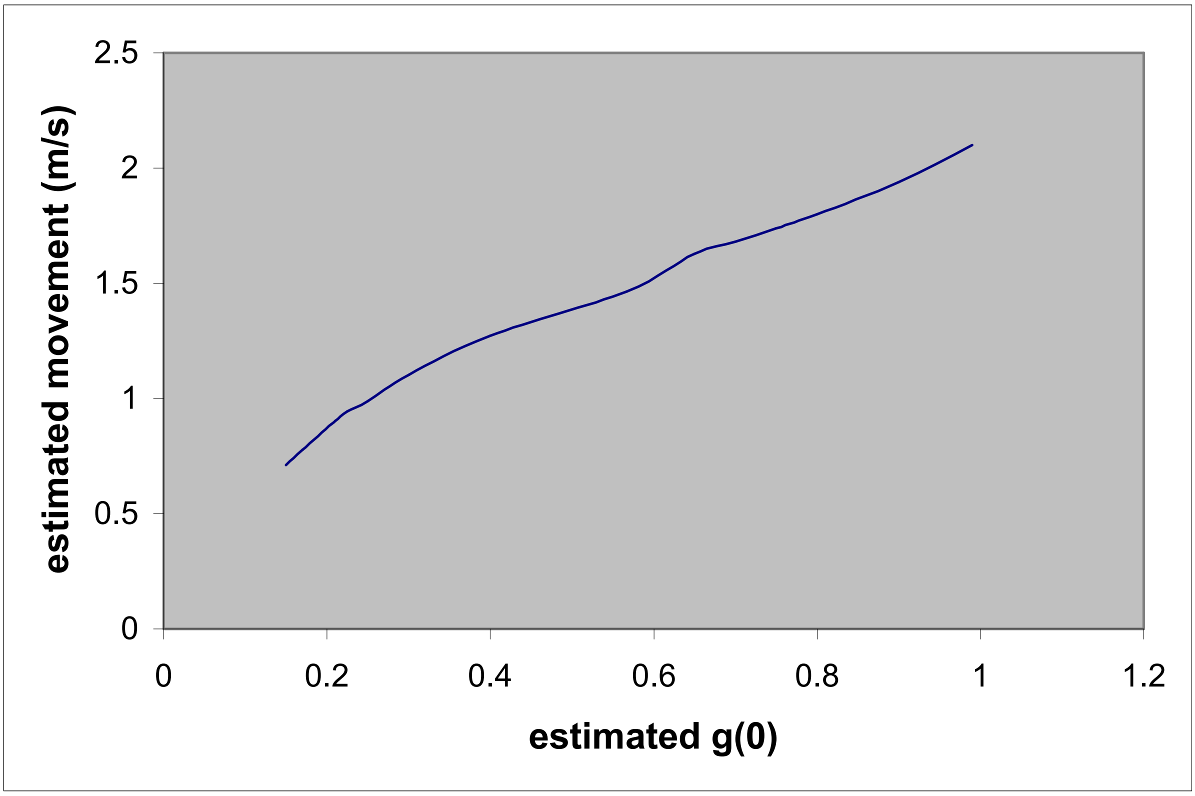

Figure 7. Estimated mean pod movement speed corresponding to the range of g(0) estimates in Fig. 5.

The g(0) and effective strip width estimates are far larger than those obtained from SCANS (Hammond et al. 1995, 2002) under good conditions (0.7 and 321 metres as compared to 0.25 and 130 metres from SCANS) though the difference under moderate conditions is less marked (113 metres as compared to the SCANS estimate of 80 metres) so part of the difference may be due to a less stringent definition of "good" conditions by the SCANS observers. The ML estimates for mean speed of pod movement are not very different at 1.68 m/s as compared to 1.5 m/s from SCANS. Constraining the current parameters for the gamma distribution of pod movement speed to the values estimated from SCANS reduces the current estimate of g(0) under good conditions to 0.58 (the reduction for moderate conditions is as given above) with a far-from-significant reduction in maximum likelihood, as shown by the lower curve in Figure 5. Thus one option for a point estimate of g(0) is to accept this more believable value until more data is available. The corresponding estimate of effective strip width is 268 metres. We used this revised estimate of g(0) to calculate the coverage probabilities for the porpoise pod sightings from the 2002 survey.

Results

The survey was conducted over seven of the eight designed tracks, as shown in figure 8.

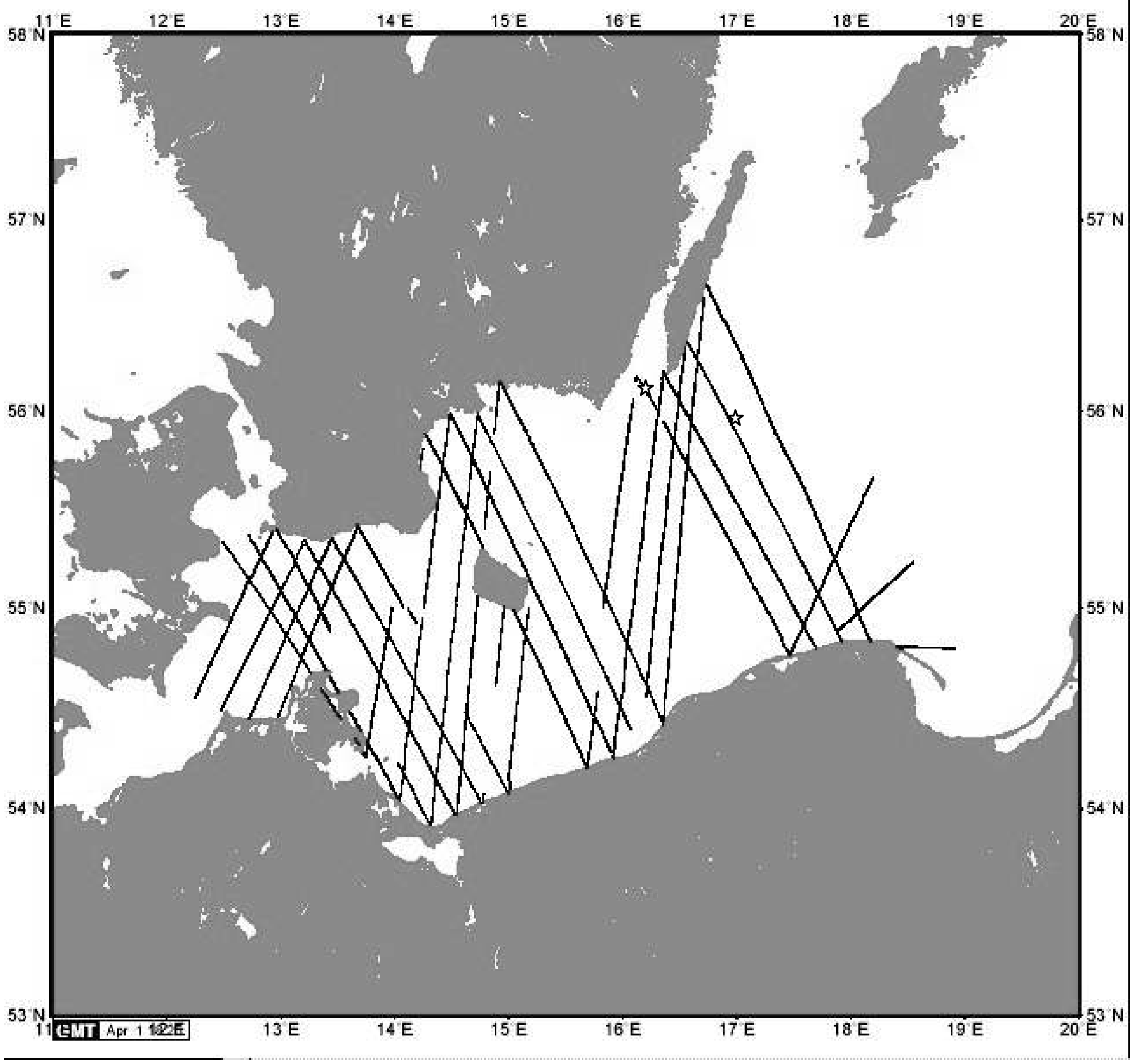

Figure 8. Tracks flown on sighting effort. ☆ Shows the approximate pod sighting positions.

There were only two porpoise pod sightings, so that five out of the seven selected tracks generated zero abundance estimates (Table 1).

The total percentage coverage of the Baltic survey area was 2.25% of the approximately 20,000 nm^2 (68,000 km^2) survey area based on an estimated effective strip width of 268 metres and the mean porpoise pod abundance over the seven tracks, weighted by track coverage, was 93 pods. Assuming a negative binomial distribution for number of pod sightings per track and using the observed numbers of sightings and the coverage given in Table 1 gave 95% confidence limits on the number of porpoise pods in the surveyed area of the Baltic from 10 to 460 pods.

Table 1. Track number, number of harbour porpoise pod sightings, percentage (%) area covered of respective track and estimated porpoise pod abundance on the track.

Track number	Pod sightings	% survey area covered	Estimated porpoise pod abundance
2	1	0.52	241
3	0	0.04	0
4	0	0.49	0
5	1	0.43	191
6	0	0.17	0
7	0	0.44	0
8	0	0.16	0

Discussion

In order to generate an abundance estimate from the survey conducted in 2002 we had to use data on porpoise movement parameters collected during the 1994 SCANS aerial surveys. This was necessary because the circling data (n=20) collected in German waters was not sufficient to produce a reliable estimate of the effective search width (esw) from these surveys. This is of course a weakness and possible bias in the abundance estimate generated from the present study. However, the few sightings recorded and the relatively large coverage of the survey area indicates that the abundance estimate is not unrealistic.

Only sightings of single porpoises were made during the survey. This was also the case in the Baltic survey conducted in the same area in 1995 (Hiby and Lovell 1996). In order to avoid introducing additional bias we decided against using group size estimates from other surveys conducted in adjacent areas. However, at the same time we acknowledge that a mean group size of 1.0 for the Baltic porpoise population is probably unrealistic given that there should be at least some mother calf pairs present in the area if the population is still breeding. We therefore chose to calculate the abundance for pods rather than number of animals (the same was done in 1995). We used a negative binomial assumption for sightings per transect to calculate the confidence intervals for the pod abundance which is really the only option when so few sightings (in this case two) are available.

The abundance estimate and confidence interval (93 CI 10, 460) are smaller than that from the 1995 survey (599 CI 200, 3300). However, the higher interval (460) from the 2002 survey and the lower (200) from the 1995 survey overlap indicating that the difference may not be significant. Given the fact that the 2002 abundance had to use porpoise movement parameters collected in 1994 to derive a more realistic esw we suggest that not too much emphasis should be put on comparing the two abundance estimates. Instead we believe it is pertinent to point out that the result of the new survey rather indicate that there is no apparent improvement in the number of porpoises in the Baltic which further stress conservation actions to improve the situation for this already endangered population

If additional circlings can be conducted using the same airplane and observers in low and medium density areas it would be possible to produce an unbiased estimate of esw from the survey which could used to produce an updated and perhaps more accurate abundance estimate from the 2002 survey in the Baltic sea.

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