

ICES SGPOT REPORT 2009

ICES FISHERIES TECHNOLOGY COMMITTEE

ICES CM 2009/FTC:10

REF. SCICOM

Report of the Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT)

16–17 May 2009

Ancona, Italy



ICES

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Recommended format for purposes of citation:

ICES. 2009. Report of the Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT), 16-17 May 2009, Ancona, Italy. ICES CM 2009/FTC:10. 13 pp.

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Executive summary

The Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT) held its third and final meeting in Ancona, Italy on 16–17 May 2009 prior to the WGFTFB meeting. The meeting was attended by 16 participants representing 11 countries. The terms of reference for this meeting involved mainly the final planning of a Cooperative Research Report (CRR) from the group's three-year work.

The CRR will be edited by Bjarti Thomsen and Michael Pol and will include chapters on terminology, commercial and survey use of fish pots, historic and current fish pot research and dark side of pots (unaccounted mortality including ghost fishing and gear conflict etc.). The 'meat' of the report will be a chapter on future research needs to develop fish pots as a viable alternative to other gears and for survey purposes. The group agreed on a first draft deadline of 19 October 2009 and the final draft deadline of 18 February 2010. The editors expect the final draft to be handed to ICES one month later for publications. An ICES resolution has been prepared on an internal publication of the CRR.

Several countries have ongoing research on fish pots and a session was allocated to allow participants to present on current and new fish pot research. These presentations were:

- Sonia Mehault, France: Test of different fish pot design in French water.
- Sara Königson, Sweden: Swedish development of fish pots, including making them 'seal safe'.
- James Mair and Mike Breen, Scotland: Fish pots used as survey tool
- Stephen Kaimmer, USA: Observations of halibut behaviour around fish pots.
- Francesco De Carlo, Italy: Comparing one and two entrance Norwegian fish pots.
- Antonello Sala, Italy: Further statistical analysis on the above item.
- Philip Walsh, Canada: Atlantic cod potting, handling and marketing.
- Mike Pol, USA: Seasonality and comparison of Canadian and Norwegian fish pots for Atlantic cod.
- Haraldur Einarsson, Iceland: Attraction of Atlantic cod to fish pots using trained fish.
- Bjarti Thomsen, Faroes: Use of vibrating devices to attract fish.

The group also suggested a theme session to be held at the ICES Annual Science Conference in 2010 and discussed how people interested in fish pot research can stay connected in the future.

1 Terms of Reference

The Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes [SGPOT] (Chair: B. Thomsen, Faroe Islands) will meet in Ancona, Italy on 16–17 May 2009 (concurrent with the WGFTFB meeting) to:

- a) finalize structure and text material for proposed ICES Cooperative Research Report;
- b) provide a timetable for ICES Cooperative Research Report publication.

SGPOT will report by 30 June 2009 to the attention of the Fisheries Technology Committee.

2 Introduction

The Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT) was established according to the recommendation from the topic group on “Alternative fishing gears” that met at the ICES-FAO Working Group on Fishing Technology and Fish Behaviour meeting in 2005 and 2006. SGPOT had its first meeting in Dublin, Ireland on 21–22 April 2007 and the second meeting in Tórshavn, Faroes on 19–20 April 2008. This third and final meeting was held at CNR, Istituto di Scienze Marine, Ancona, Italy on 16–17 May 2009. Bjarti Thomsen (Faroe Islands) was Chair and Michael Pol (USA) was Rapporteur. The meeting was attended by 16 participants representing 11 countries; see Annex 1 for full list of participants. Bjarti Thomsen opened the meeting with introduction and background of the Study Group and the ToRs and then reviewed the agenda, which was then accepted by the group, see Annex 2. The agenda included a session on updates of current pot research and developments.

3 Cooperative Research Report planning

After discussing the structure and content of the CRR the existing material from earlier meetings was reviewed to identify gaps of information and where more work was needed. The group then broke into smaller groups to work on individual chapters. Before ending the meeting the group met again to discuss pending matters.

The Cooperative Research Report (CRR) will be edited by Bjarti Thomsen and Michael Pol and will include following chapters (chapter authors in brackets):

1. Introduction (editors).
2. Terminology, including definitions and drawings of various types of fish pots, entrances etc. (Philip Walsh).
3. Commercial and scientific worldwide use of fish pots, including examples of (low) economic viability that stress the need for further development to increase efficiency, and pros and cons as a research tool (Bjarti Thomsen and David Stokes).
4. Historic and current research, using a model describing attraction, capture and retention (Mike Pol, Peter Munro, Svein Løkkeborg, Steve Kaimmer, Bjarti Thomsen).
5. Dark side of fish pots, describing unaccounted mortality including ghost fishing and gear conflict etc. (Mike Breen).
6. Future research needs and recommendations, using the same model as chapter 4 (Mike Pol, Peter Munro, Svein Løkkeborg, Steve Kaimmer and Bjarti Thomsen).

A bibliography will be included with an extensive list of papers on fish pots (Bjarti Thomsen).

Chapters 2–5 have been discussed in the two previous meetings and the bulk of text for these chapters already exist. Chapter 6 will be ‘the meat’ of the CRR and preparations for this chapter had a very good start at this year’s meeting.

The group agreed on a first draft deadline of 19 October 2009 and the final draft deadline of 18 February 2010. The editors expect the final draft to be handed to ICES one month later for publications.

SGPOT prepared an ICES resolution on internal publication of the CRR, see Annex 3.

4 New research on fish pots

In a session on new research on fish pots several participants reported national ongoing and planned research on the development and use of fish pots. Abstracts from presentation from this research are given below.

4.1 Testing and observing fish pots at sea, Ile de Houat, France, October 2008

Sonia Méhault, France.

A preliminary experiment on fish pots was conducted in 2008 by the fishing gear laboratory of Ifremer Lorient. The main problem faced was the predominant catch of conger. Further experiment with 5 newly designed models of fish pots targeting species of commercial interest (e.g. sea bass) will be conducted in June 2009 in Brittany (France). Each model will be tested at 3 distinct heights, attempting to avoid conger. Video systems will be deployed to observe fish and pots behaviour. The experiment will be conducted with the collaboration of fishermen who will share their knowledge to select a relevant study area at that time of the year. Their fishing operations and catch will be used as controls to confirm the presence of fish in the area. Following this experiment, the best performing fish pot models will be identified, and tested later under commercial conditions by fishermen. Further research will focus on bait composition and/or stimuli.

4.2 The Norwegian two-chamber trap used in commercial fisheries in the Baltic

Sara Königson, Sven-Gunnar Lunneryd and Mikael Ovegård, Sweden

The need to develop alternative fishing gear in the gillnet fisheries in the Baltic has increased in recent years due to the growing seal and fisheries conflict. A potential alternative fishing gear to the cod gillnet fisheries in the Baltic is the Norwegian two-chambered trap. In this study we have investigated the Norwegian cod trap’s fishing efficiency when used in a commercial fishery and if potential stimuli such as visual stimuli can increase the catch efficiency. We also wanted to investigate if we could reduce the catch of undersized cod by inserting a selection window in the traps.

A fishermen located in Blekinge in the central Baltic was contracted to carry out a trap fishery for cod with up to 96 cod traps through the fishing season. The Norwegian cod traps used were modified so that they were floating approximately half a meter above the bottom with only one entrance located downstream so that the fish could easily find its way into the trap. The traps were baited with fresh herring and linked on a bottom line with a distance of 60 meters between traps. On every line 8 traps were placed. To study if visual stimuli increased catch efficiency, 4 of the 8

traps on each 6 links were modified with a white strip placed in the middle of the trap on the bait bag. A selection window with a bar length mesh size of 60 mm was placed on 4 traps on each 4 links to study if the catch of undersized cod would decrease. Another selection window with a bar mesh size of 50 mm were placed on an additional 4 traps in each 2 links. An observer or the fishermen recorded the number of caught cod and the weight of the catch for every trap.

A total of 885 traps were emptied during a period of 3.5 months. The mean catch of large cod per trap was 2.5 kg with 95 % C.I 0.17, not taking into account soak time. However the catch did not increase with longer soak times. Traps modified with a white strip to increase the visual stimuli did indeed get a significant higher CPUE than traps without white strips (2.61 with 95 % C.I 0.27 in modified traps compared to 2.21 with 95 % C.I 0.23 number of cod per trap and day in standard traps, T-test $p < 0.05$). Therefore we conclude that visual stimuli do affect the traps fishing efficiency. The number of small cod as well as the number of large cod per trap did decrease significantly when placing a selection window with a bar length of 60 mm compared to the traps with no selection windows (Mann Whitney U-test $p < 0.05$). The CPUE for small and large cod in modified traps were 0.02 with 95 % C.I 0.03 and 0.12 with 95 % C.I 0.04 number of cod per trap and day compared to 2.03 with 95 % C.I 0.32 and 0.72 with 95 % C.I 0.13 number of cod per trap and day in standard traps. When modifying the traps with a selection window with a bar length mesh size of 50 mm the CPUE of small cod did significantly decrease but the CPUE for large cod did not decrease (Mann-Whitney U-test). The CPUE for small and large cod in modified traps was 0.02 with 95 % C.I 0.03 and 0.57 with 95 % C.I 0.26 number of cod per trap and day compared to 1.39 with 95 % C.I 0.74 and 0.49 with 95 % C.I 0.26 number of cod per trap and day in standard traps. We therefore concluded that a selection window placed in the trap does increase the fishing gear's selectivity by decreasing the catch of small cod without decreasing the catch of large cod. These results are important for the further development of the Norwegian trap. The traps catch efficiency also show that it is possible to consider the trap as a potential alternative fishing gear.

4.3 Fish Pot Development in Scotland

Jim Mair and Mike Breen, Scotland

Three small scale exercises were undertaken in 2008/9 by Fisheries Research Services (FRS) to develop fish pots as a survey tool. The first two trials were conducted in coastal waters (depths $< 70\text{m}$) near Buckie, Scotland, in September 2008 and January 2009. Both of these trials focused on specific pot design concepts, including entrance design and the number of retaining compartments in the pot. The third exercise, in April 2009, was in support of a research cruise on F/V Alba na Mara dedicated to developing survey techniques for inshore waters (in & near Loch Ewe). The fish pots were compared against other sampling techniques (namely, trawl and baited cameras) and proved more successful in providing quantifiable numbers of fish, as well as demonstrating differences in species assemblage at relative high resolution (i.e. sampling stations were approximately 1 nm apart).

4.4 Examining the behaviour of rockfish and halibut around pots

Steve Kaimmer, USA

The International Pacific Halibut Commission (IPHC) used a high-frequency acoustic camera to observe fish behaviour around a fish pot during the summer of 2006. This study was designed to investigate Pacific halibut (*Hippoglossus stenolepis*) and rockfish

(*Sebastes* spp.) behaviours, which might be exploited to catch halibut without catching rockfish. The purpose of this study was to investigate pot modifications that might allow captures of Pacific halibut while either impeding capture or allowing escape of unwanted rockfish species. Although we encountered some halibut and many rockfish, very low catch rates for both species precluded using entrance and escape behaviours to evaluate pot modifications. Pots were deployed within a metal frame which allowed real time observation of fish interactions using a DIDSON (Dual frequency IDentification SONar) acoustic camera. Various pot modifications were anticipated, including tunnel modifications, size and locations of escape rings. We encountered very few halibut during the 10-day trip, and our major accomplishment was in demonstrating the success of this gear for observing fish behaviour in areas of extremely low light.

4.5 Comparative fishing trial with one- and two-entry floated fish pots

Terje Jørgensen and Svein Løkkeborg, Norway; Francesco De Carlo, Italy

Pots are not really common in the Norwegian commercial cod and haddock fisheries, mainly due to their low catch efficiency. However, pots are well known as environmentally-friendly fishing gear as they have low potential impact on the marine ecosystem and generally good size- and species-selective properties. Previous work demonstrates the possibility to reduce the by-catch of red king crab (*Paralithodes camtschaticus*) by floating the traditional fish pots off the bottom.

In the present work, we have hypothesized that removing the second upstream entry of the floated pot, catch efficiency will be not affected. Alternatively, the catch may differ, e.g. increase because the removal of the entry, reduces the escape probability and also allows more free space inside the pot. Fishing experiments and behavioural observation were performed in the Varangerfjord, to test this hypothesis, comparing the catch per unit effort of target species in the two- and one-entry floated pots.

4.6 Cod potting on Fogo Island, Newfoundland, Canada

Philip Walsh, Canada

In September 2008 cod pots and handlines were used to harvest Atlantic cod in the community of Fogo, on Fogo Island. Eight pots were used along with two handlines and both were baited with squid. A harvester from Deep Bay, Fogo Island was involved and captured his quota (approx. 3200 lb) in 3 days of fishing. Pots were fished within a couple of miles of Fogo on traditional fishing grounds.

The goal of the project was to harvest Atlantic cod with conservation-minded technologies that produce a top quality product. This was accomplished by incorporating primary processing techniques such as bleeding the fish as soon as it arrived onboard the vessel; fish were then gutted, cleaned and iced. The fish was then placed in storage until the vessel arrived at unloading facility. The Fogo Island Co-op (processor) processed the fish after it arrived in port and kept it separate from all other fish captured by other harvesting methods. Much of the Atlantic cod went into fillets while the rest was specially processed into specific items for niche markets (Nicole's Restaurant). All fish processed from the pots and handlines were Grade A quality, while as much as 50% of the fish harvested using gillnets during the same time went into block which is the lowest grade going to traditional markets. Two bad weather days during the week meant harvesters could not retrieve their gear. Fish in the pots remained alive while a lot of fish in the gillnets were in poor shape. A report released by the Fishermen's Union (FFAW) and Department of Fisheries, Newfoundland gov-

ernment on work completed on the west coast of Newfoundland stated that cod pots produced a consistently better product than gillnets and longlines. The result showed the difference was significant when it came to gillnets and marginally better than longlines.

Nicole's Restaurant and the Shore Fast Foundation situated in Joe Bats Arm (Fogo Island, Newfoundland) agreed to purchase the Atlantic cod from the processor at top dollar prices if all steps were adhered to and the harvester produced top quality product during this project. Approximately 1200 lbs of gutted cod was harvested in the pots while the remaining cod were harvested using handlines. The handlines worked very well as the cod harvested were captured while the harvester was attached to the mooring line to one of the pots. As a strategy pots were set close together and these pots gathered fish and while the pots were fishing the handlines were used to harvest fish that were around the pots.

The project was a success and it is hoped that further development can be achieved in 2009.

4.7 Catch comparison analysis with one- and two-entrance floated fish pots.

Antonello Sala, Italy

We compared the catches of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*), from experimental pots with one entrance to those from the standard commercial two entrance pots. The *logit* of the expected proportions at length may adequately be approximated by a low order polynomial in length. For haul data we used Generalised Linear Mixed Models (GLMM) to obtain a pragmatic and reliable curve for the expected proportions at length and obtain realistic variance estimates by modelling the sampling structure. In this work we principally used R statistical software and applied the *glmmPQL* function in the MASS package.

The optimal GLMM generated for cod was the *logit*-linear curve and demonstrated that fish length was a significant factor in the curve fit ($p < 0.001$). Larger cod preferred to a greater extent than smaller cod the one entrance pot. This trend was statistically significant above 38 cm ($p < 0.001$). As supported by the GLMM, the trend for haddock was opposite to cod. Below 40 cm, the one entrance pot caught statistically more animals than the pot with two entrances ($p < 0.001$).

4.8 Icelandic programs focusing to attract cod to or into pots

Haraldur Arnar Einarsson, Iceland

Using pots as commercial fishing gear has never been common in Iceland. But lately more interest has risen, mostly combined with cod farming. Two main programs are ongoing in Iceland, both focusing to attract cod to or into pots. The first program conducted by Dr. Björn Björnsson aims to control the behaviour of cod. From 2005 to 2006 wild cod were conditioned to accept frozen capelin at four stations inside a large fjord (Arnarfjörður). The feeding was carried out 3 times a week for 21 months. Cod were tagged at the four stations in July 2006. Recaptures 3–4 months later showed that 82% of the fish had been tagged at the same station, 12% in the nearest station and 6% in the two distant stations (across the fjord). Last year a trial with cod's learning ability was done by Björnsson as well. Twenty cod were put in a cage with two feeding platforms equipped with transducers. Prior to and during feeding low frequency (250 Hz) sound signals were emitted. A video camera and sonar were used to record behaviour. It took the cod six days to learn to react to the sound and come di-

rectly to the correct platform. The experiment was repeated with 10 experienced cod from the first experiment (teachers) and 10 naive cod (students). The students followed the teachers right away to the platforms. In the third experiment there were 19 students and one teacher. After only 10 minutes the students were following the teacher to the platform. Two days later the teacher was removed to see if the students had really learned to react to the sound signals. They reacted immediately to the sound signal demonstrating that naive cod can learn from experienced cod. The plan is to repeat these experiments next year with conditioned cod released in a coastal area and attempt to train them to swim between two feeding stations 100–1000 m apart. The question is whether these trained cod are going to attract wild cod with them to the feeding stations. For further information please contact Björn Björnsson (bjornb@hafro.is).

The other program is called “attraction and trapping of cod”. The objective of this project is to investigate a cost-efficient method to trap cod. That search is based on direct observation of how cod is caught in traditional traps/pots and is divided in three phases: 1) Finding useable odour-solution to use for attraction. 2) Building of odour releaser and control unit. 3) Testing of equipment and effects of odour release. The first phase was finished in 2008; no mixtures of amino acids were found efficient unless in extreme quantities. A solution with mixed herring, and even boiled herring mix was found to be effective in attracting cod. Building of an odour releaser, control unit and camera rigging with the ability to remotely control and observe the devices through wireless communication interface is under construction and planned to be tested in May/June 2009. Some other researches to pot fishing are in planning phase but need capital to start.

4.9 Determining the Seasonality of Cod Pots

Michael Pol, Robert Marcella, and Mark Szymanski, USA

A project is partially completed to determine the seasonal vulnerability of Atlantic cod *Gadus morhua* to two pot designs (Newfoundland and Norwegian) in coastal Massachusetts, USA by comparing monthly catches of cod for four days each month from November to June for one year, and by comparing catches in each pot type. Initial results indicate that both pots caught Atlantic cod, with the Norwegian floating design catching more fish, especially of smaller size. January and February had very low catches, with higher catches in April and December.

4.10 Development of fish pots in the Faroe Islands

Bjarti Thomsen, Faroe Islands

A project to develop fish pots with increased catch efficiency for traditional fish species has been carried out in the Faroe Islands since late 2005. The project has generated a substantial amount of underwater video observation of fish behaviour around fish pots, especially of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). On several occasions fish (cod) have been observed to be attracted to (sudden) movement of other fishes. It is not clear whether this is a result of purely visual stimuli or whether also sounds and mechanoreceptor stimuli are involved. To investigate this in deeper detail a system to control an ‘electronic’ vibrating fish has been developed and the first trials have started in May 2009. The work to develop fish pots will continue the next two years. Further behavioural studies of fish around fish pots will be conducted to clarify whether additional stimulation to bait can be found to attract and agitate fish to readily enter fish pots and thereby increase catching effi-

ciency. Also underwater video observation systems have been further developed to include smaller and better instruments.

5 ICES ASC Theme Session suggestion and future work

From the discussions in the group it is apparent that fish pots and other static gear need development to become a viable alternative to other fishing gears. As a result of increases in energy costs and greater awareness of environmental impacts from fishing activities several nations have prioritized the investigation and improvement of static gears such as fish pots both for commercial and survey purposes. With background in the study group work on fish pots, it was felt appropriate to suggest a theme session for the ICES ASC in 2010 on fish behaviour and static gear research, see Annex 4.

The study group also discussed several options to allow researchers working on fish pot development to stay connected in the future for exchange of information. The usefulness of Internet solutions, such as web pages, facebook etc. will be considered and tried by group members.

Annex 1: List of participants

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Annex 2: Agenda

Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT)

Meeting Place: CNR, Istituto di Scienze Marine, Ancona, Italy

Saturday, 16 May 2009

- 09:00 Welcome and adoption of agenda
- 09:15 Goals of this meeting
- 09:30 Discussion of CRR format, structure, timeline
- 10:30 Coffee, espresso etc.
- 11:00 Discuss available text, tables and figures
- 12:30 Lunch
- 13:30 Presentations on progress/current/new pot work
(from several countries)
- 15:15 Coffee, espresso etc.
- 15:45 Discussion on research needs
- 16:45 Break into groups and work on chapters

Sunday, 17 May 2009

- 09:00 Work in groups on chapters
- 10:30 Coffee, espresso etc.
- 11:00 Work in groups on chapters
- 12:30 Lunch
- 13:30 Work in groups on chapters
- 15:15 Coffee, espresso etc.
- 15:45 SGPOT meeting report and CRR resolution
- 16:15 Future media/contact point for fish pot info
- 16:30 Closing remarks

Annex 3: Resolution for an ICES Internal Publication

The report on **Fish Pots**, edited by Bjarti Thomsen (Faroe Islands) and Michael Pol (USA), as reviewed and approved by the Chair of the SSGESST Committee, will be published in the *ICES Cooperative Research Report* series. The estimated number of pages is 80.

The Study Group on Fish Pots (SGPOT) agrees to submit the final draft of the proposed publication by 18 March 2010.

SUPPORTING INFORMATION

Priority:	<p>This has a high priority for various reasons.</p> <p>The work of this group has assisted the development of a fishing gear that has many environmental benefits and will contribute to sustainable fishing.</p> <p>Currently multiple ICES member nations (and others) have prioritised the development of fish pots for commercial and survey use.</p> <p>This report is intended to enhance pot development by reviewing earlier work, describing current work and defining future research needs, therefore sharing valuable knowledge across institutions.</p>
Scientific justification:	<p>Improving the use of this potential benign fishing gear will require substantial future research.</p> <p>The forthcoming ICES Cooperative Research Report provides a valuable tool to assist and to guide future development. It provides a synthesis of what is known and what needs to be known about fish pots.</p>
Resource requirements:	<p>Publication of this material as a CRR will cost ca. 10 000 DKK. The material in the report is fairly straightforward, and therefore no specific additional costs are necessary.</p>
Participants:	<p>Approximately one month's work is required by the authors and editors to prepare and finalise this report.</p>
Secretariat facilities:	<p>About one month of the services of Secretariat Professional and General Staff will be required.</p>
Financial:	<p>Publication costs.</p>
Linkages to advisory committees:	<p>The preparing work has been reported to FTFB. This product has been endorsed by FTFB.</p>
Linkages to other committees or groups:	
Linkages to other organizations:	

Annex 4: ICES ASC theme session suggestion 2010

Title: Fish behaviour and static gears

Drawing on a model of attraction, capture and retention, this theme session has the objective to assist in the development of low impact fuel efficient (LIFE) fishing gears by gathering together new research on fish behaviour in relation to static gears.

Papers will be invited on farfield attraction (e.g. chemosensory reception), nearfield stimuli (e.g. vision and mechanosensory reception), and gear modifications that improve catch and retention of fish in static gears.

Justification:

Increases in energy costs and greater awareness of environmental impacts has led to a greater interest in innovative low impact and low energy fishing gears. Recent investigations of fish pots has highlighted the need to increase the efficiency of these gears to become a viable alternative. It has been proposed that a behavioural model of fish attraction, capture, and retention can be used to help understand the static gear capture process.

Several ICES and non-ICES nations have prioritized the investigation and improvement of static gears both for commercial and survey purposes