ICES SGPOT Report 2007

ICES Fisheries Technology Committee
ICES CM 2007/FTC:02

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

21–22 April 2007

Dublin, Ireland

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:

ICES. 2007. Report of the Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT), 21–22 April 2007, Dublin, Ireland. ICES CM 2007/FTC:02. 18 pp.

Contents

Executive summary

The Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT) was a product of 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 on 21–22 April 2007 in Dublin, Ireland prior to the FTFB meeting. It was decided to work on the first two ToRs. The meeting was attended by 24 participants representing 12 countries, and the work was facilitated by the following presentations:

- Summary of GACAPOT meeting, Gloucester Nov. 2006 (Michael Pol).
- Canadian fish pot research (Philip Walsh and Alain Fréchet).
- Russian pot fisheries and research (Oleg Lapshin).
- Commercial pot fisheries around the world (Bjarti Thomsen).
- Pots as survey gear (David Stokes and Robert Bunn).
- Fishing consideration and survey design (Peter Munro).
- Pot entry patterns in relation to environmental variables (Peter Munro).
- Recent pot research by IFREMER (Jacques Sacchi).
- Pot studies in the Baltic (Sven Gunnnar Lunneryd).

The group determined that pots are widely used for crustaceans, but landings from fish pots are limited. However in a few areas pots are very important and account for more than 50% of total fish landings. The group developed a table describing existing commercial pot fisheries worldwide that will be finalised in the final report of the Study Group. With regard to stock assessment, pots are the primary gear for abundance indices of many crustaceans. Pots have the potential to be precise and accurate, through large sample sizes and low variances at fine spatial resolution, and can be used where other gears are unusable e.g. rough ground. The group identified factors that inhibit the use of pots as survey gear and recognized the need for additional research on the functioning of pots. One example is the question of the effective fishing area when used in abundance estimates. The group discussed research needs to improve efficiency. The conclusions of GACAPOT (Section 6.1) seem to be broadly applicable for all pots. The fish capture process in pots involves a complex process that includes interaction of attraction to the pot, encouraging ingress and restriction of egress. The group acknowledged the need to understand basic fish behaviour and biology in relation to fish pots. Attraction and consumption of bait by fish is known to involve multiple sensory modalities and multiple behavioural thresholds. Laboratory experiments on basic fish behaviour and biology can serve to isolate processes that are confounded in situ. The group identified a range of issues that need to be addressed. SGPOT will work by correspondence and meet at the WGFTFB meeting 2008.

1 Terms of Reference

The Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes [SGPOT] (Chair: Bjarti Thomsen, Faroe Islands) will be established and will meet in Dublin, Ireland from 20–22 April 2007 to:

a) review the current use of fish pots and provide a global overview of commercial fisheries and assessment surveys using these gears;

b) in order to improve catching efficiency and assessment use of pots, the group will identify fundamental research needs on fish behaviour, in particular:

  i) development of methodology for describing fish behaviour relevant for the capture and escape process.

  ii) reactions to different stimuli, including bait attraction, in the far and near field.

  iii) efficiency of pot and trap entrances, and

  iv) behavioural variation due to biological status and environmental conditions.

c) make recommendations for improving the mechanical design and construction of pots, with considerations given to ghost fishing, with the specific aim of improving catch efficiency and their utility as survey gear.

SGPOT will report by 15 May 2007 for the attention of the Fisheries Technology Committee and the findings of the SG will be reported in an *ICES Cooperative Research Report.*

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 held its first meeting at the Crowne Plaza Dublin Airport in Dublin, Ireland from 21–22 April 2007. Bjarti Thomsen (Faroe Islands) was Chair and Michael Pol (USA) was Rapporteur. Bjarti Thomsen opened the meeting and reviewed the agenda, which was then accepted by the group.

It was agreed that the focus of this meeting should be fulfilling the first two terms of reference, leaving the third for work by correspondence and in the next meeting. For the purposes of clarity, presentations, discussion and conclusions related to current pot use including assessment use of pots are reported in Section 3 below. Presentations, discussion and conclusions related to improvement of catching efficiency and behaviour are reported in Section 4 below.

3 Review of Current Fish Pot Use

The group worked collaboratively before and during the meeting to develop the review of current pot use. Four presentations were prepared for the meeting, one on commercial use and three on survey use (four following sections).

3.1 Commercial pot fisheries around the world

Bjarti Thomsen

Fish pots have a long history and evidence of early use of fish pots can be found in ancient literature and excavations worldwide. Pots are important fishing gears for crustaceans (crabs and lobster) but for fish they typically have low importance compared to other gears such as seine, trawl, gillnet, hook and line, and dredge. An example from Japan shows that from an annual pot catch of 85,000 tons in 1980 only 2% was fish, the rest being crabs, conch, shrimps, octopus and cuttlefish.

The best known fish pot is the Antillean pot used throughout the Caribbean where pots account for a high percentage of the total fish catch, e.g. 60–70% in US Virgin Islands and around 60% in four Lesser Antilles islands. In Jamaica, 54% of a total catch of 5,000–8,000 ton is taken by pots, and in Puerto Rico 22%. The species diversity caught by pots in Caribbean is high and may reach 144 different species in some areas. In the Caribbean, fish stocks have been over-fished mainly using pots and the preferred species the Nassau grouper *(Epinephelus striatus)* was overfished and is currently listed as threatened by the IUCN.

In Bermuda the number of pots was decreased from 3,200 to 1,600 in the late 1980's and banned altogether from 1990.

Pots are used on the US East coast for Black sea bass *(Centroprisits striata)* and account for 45% of the landings. On the US West coast pots became important fishing gear for Sablefish or black cod *(Anoplopoma fimbria)* in the 1970s but are less important today. In Alaska heavy pots (developed from crab pots) are used for Pacific cod *(Gadus macrocephalus)*. Pots account for around 17,000 tons, equal to 10 % of the total catch.

In the Arabian Gulf the local pot (gargoor) is important for fish catch. In Kuwait it accounts for 50% of fin fish landings and in Oman gargoor make up to 19% of all gears employed by the artisanal fishery.

In the Far East the local pot, the 'bubu', has a long tradition and is built entirely from bamboo. In the Philippines pot catches have increased from 2,899 tons in 1980 to 16,532 tons in 1995, which corresponds to around 2% of the total municipal catch. From around 1990 a live food-fish trade has developed throughout the Southeast Asia. In some places in Indonesia around 55% of live fish is taken by pots.

In Japan pots are popular in some places. One example is in Hokkaido where 306 tons of arabesque greenling *(Pleurogrammus azonus)* was taken in 2000.

In New South Wales in Australia pots are used in a 700 ton multi-species fishery with snappers *(Pagrus auratus)* as the most important. On Northwest shelf of Australia a circular pot is used for Nemipteridae, Lethrinidae, Lutjanidae and Serranidae. In New Zealand box shaped pots are used for blue cod *(Parapercis colias)*.

In Europe fish pots have low importance compared to other gears. In recent years a two chamber collapsible pot as been developed in Norway for cod *(Gadus morhua)* and a few boats have switched from gill nets and longline to pots.

3.2 Use of Pots for Fisheries Surveys

David Stokes and Robert Bunn

Large areas exist that cannot be surveyed using traditional trawl survey nets, due to rough bottom structure, mobile gear bans, and the presence of static gear. Also, species such as crustaceans may not be accurately surveyed using mobile gears. Pots and traps offer a fishery-independent survey possibility. While pots are mainly used in Northern Europe for scientific

research, pots are used in the Gulf of Mexico and Caribbean Sea, in Alaska south to California, and in Northern Australia as assessment tools. To use pots, the Effective Fishing Area (EFA) must be determined, and standardized. Factors such as bait type, quality, and size, soak duration, gear construction and setting procedure can be standardized. Environmental factors, such as current, visibility and temperature are greater challenges. Further, the species and size selectivity of pots need further understanding. A successful survey with pots may require a range of pot designs and baits, as well as additional instrumentation to account for environmental factors.

3.3 Pot Catch as an Index of Abundance: Practical Fishing Considerations and Survey and Experimental Design

Peter Munro

Modified commercial Pacific cod *Gadus macrocephalus* pots were assessed for use to measure the impact of a trawl fishery on localized abundance of sea lion *Eumetopias jubatus* prey. Pots, used in an existing fishery, satisfied the need for fine resolution and a large sample size with low variance by allowing multiple samples from one spot. Concerns were raised over competition among pots affecting their independence, saturation of pots with fish, and variations in feeding that could confound with abundance. A pilot study was designed with six identical clusters of pots, 13 pots per site. Pots were arranged with one central pot surrounded by six pots at 0.3 nm from the centre and each other. Another six pots were set at 6.5 nm, all at relatively the same depth. Results indicated pots were independent if greater than 0.6 nm apart.

Concerns over gear saturation were addressed by using a pot with a large internal volume, steep funnels with a smaller eye, short soaks, and using timing as index of saturation using trigger timers. Pulses in feeding patterns on each side of the pot were detected using timers that may be related to tidal cycles and adjustments to setting patterns were made to reduce zero catches. Overall, we determined that once sufficient distances and soak times were developed, longer cycles of variation could be taken into account and a successful experiment could be developed.

3.4 Timing of capture of Pacific cod in research pots: Implications for the cod pot as a survey sampling instrument

Peter Munro

Gear saturation can invalidate catch as an index of abundance. We hypothesized that some aspect of the timing of the catch process could serve as an alternate index of abundance. To measure rate of accumulation, a possible function of abundance, we developed hook timers that recorded movement of triggers on entrance to pots and hoped they indicated fish entry. Analysis of trigger movement indicated that entrances often came in pulses, isolated to one pot entrance, and alternated between pot entrances. The observed pattern may be related to the tidal cycle, resulting from slack tides or plume shifts. Sensors deployed with pots (current meter, CTD, light meter, turbidity meter, and dissolved oxygen meter) may provide additional explanation for periodicity in pot entry but remain unanalyzed. The conclusions are that gear saturation does not appear to be a problem in this case, and triggers indicate periodicity in pot entrance that may be linked to measurable oceanographic conditions. Further understanding of entry factors will contribute to the effectiveness of pots as a survey tool.

3.5 Group Discussion on Current Fish Pot Use and Assessment Use

It was generally recognized that landings from fish pots are limited, probably because of low efficiency, although in some regions participation is high and the number of pots fished is large. Changes in efficiency and increases in costs (e.g. fuel, habitat damage) of more

commonly used gear may increase industry acceptance of pots. The group developed a table (Table 3.3.1) from available literature and participants' knowledge describing existing commercial pot fisheries worldwide that will be finalised in the final report of the Study Group and include catch quantities and catch rates.

Table 3.3.1

World pot catches

Area	Species	Latin name	Pot type	References
Caribbea	Nassau grouper	Epinephelus striatus	Antillean	Munro
Caribbea	Coral reef fish			
US east coast	Black Sea Bass	Centroprisits striata	Box	Collins, 1990; Eklund and Targett, 1991; Shepherd et al., 2002
US east coast	Scup	Stenotomus chrysops		
US west coast	Sablefish	Anoplopoma fimbria		Schirripa and Colbert, 2005; Coonradt and Holum, 2003; Hanselman et al 2006
Alaska	Pacific cod	Gadus macrocephalus		Thompson et al 2006
Newfoundland	Atlantic cod	Gadus morhua		Walsh; Pol
Norway	Wrasse	Labridae		Treasurer, 2000; Bjordal,
Norway	Atlantic cod	Gadus morhua	Double	Furevik; Løkkeborg;
Baltic Sea	Perch	Perca fluviatiles		
Argentina	Sea bream	Pagrus pagrus		
Caribbean/Venezuela	Lutjanidae, Serranidae			
Gulf of Lions	Conger	Conger conger		
Arabian Gulf	Fin fish		Gargoor	Lee and Al-Baz, 1989; Al-Masroori et al, 2004
Indonesia	Serranids			Pet-Soede and Erdmann (1998)
Japan, Hokkaido	Arabesque greenling	Pleurogrammus azonus		Li et al. 2006
Australia	Snappers	Pagrus auratus		Stewart and Ferrell, 2003
Australia	Nemipteridae, Lethrinidae, Lutjanidae and Serranidae			Whitlaw et al., 1991
New Zealand	Blue cod	Parapercis colias		Cole et al., 2003;
CCMLAR	Patagonian tootfish (	Dissostichus eleginoides		Purves et al., 2003; Pilling et al., 2001
North Sea/Baltic	Eels	Anguilla		
NW Atlantic	Hagfish	Myxotomidae		Scott Grant,
China/Japan	Conger eel			
Oregon/California	Hagfish			

Pots are the primary gear used to determine indices of abundance for many crustacean species. For fish, pots have the potential to be more precise and more accurate, through greater sample size and lower variances at finer spatial resolution, compared to trawl survey gear. Additionally, sampling for abundance with pots can also occur over shorter time spans compared to trawl surveys, perhaps providing more accurate estimates. Use of pots can avoid common sources of bias found in trawl surveys, including reduction or elimination of vessel effects. Potentially, these factors could contribute to greater longevity of survey time series if pots are used.

The group identified factors that inhibit the use of pots as survey gear. Absolute indices of abundance, desired for stock assessment, require knowledge of the absolute fishing area of the pot. This area (or volume) can be estimated for trawl gear, but because fish are attracted by bait to pots, the fishing area is difficult to quantify. This volume may also be different for each species. While it is theoretically possible to model the fishing area based on concentration of bait molecules and circulation patterns, the bait characteristics would need to be standardized. Natural baits can be available in multiple conditions (e.g. fresh, frozen, salted) and can be highly inconsistent in oil content, volume, density, and other measures of quality.

The potential for relative abundances was also discussed. As in attempting to quantify absolute abundance, a constant catchability must be maintained. While standardization of bait, pot, and procedure may be possible, some environmental variables cannot be, such as current, visibility, and temperature, all of which are known to impact fish behaviour and the size, durability, and shape of bait plumes. SCUBA transects could be used as a comparative measure, although this technique has limitations. NOAA (USA) was identified as a RFMO that has managed to standardized gear and procedures and uses pots for relative abundance.

Indirect measures of abundance such as time to hook in longline gear or time to first arrival could be adapted to pots. However, work with timers on pot gates was not encouraging. Pot entry was episodic and limited to one side of a pot at a time; it was theorized the entry of fish was related to bait plumes and tidal cycles.

Another identified hurdle to the use of pots as a survey tool may be the high species and size selectivity of pots. A case was cited where fish in pots were larger than those in survey trawls. Also, trawls can sample a wide range of species while pots in temperate waters tend to be species selective. A survey pot may require a mix of baits to attract more than one species.

It was demonstrated that some concerns such as saturation of pots by large numbers of fish, and competition among pots could be overcome through pilot studies. Further discussion was held on a direction for further work. A range of pot sizes and baits may be a possibility for further research. What are the instruments that would be required to measure the uncontrollable environmental factors?

It was finally concluded that with additional research on the functioning of pots, pots could provide an effective index of relative abundance of individual species, especially where trawls are unusable.

4 Improvement of Catching Efficiency

Several talks were presented describing the current state of knowledge regarding the improvement of catching efficiency of pots. Most of these presentations directly or indirectly focused on understanding fish behaviour.

4.1 Summary of GACAPOT meeting, Gloucester November 2006

Michael Pol

An International Technical Workshop on Gadoid Capture by Pots (GACAPOT) was held on 4 November 2006 in Gloucester, Massachusetts hosted by Massachusetts Division of Marine Fisheries, University of New Hampshire and Marine Institute, Newfoundland. The workshop focused on determining basic principles for potting gadoid species by examining the current state of research on gadoid capture in pots and assessing the direction of future research for improving catch rates. There were fifty attendees from 16 countries on five continents (Asia, Australia, Europe, North and South America) and included a mixture of researchers, harvesters, gear manufacturers and students.

The main conclusions presented were based on Pol's observations alone, and have not been formally concluded by the conveners. His main conclusions from the workshop were as follows:

a) Research of pots is still in the early stages and a lot of basic testing of pot characteristics needs to be done e.g. on entrance size, shape, orientation; currents; others – colour, contrast, and seasonality.

b) Catches might be simply related to abundance, and it is difficult to establish what the local species density is.

c) Increasing pot volume appears to increase catch. The behavioural reason for this is unclear, although the effect could be density-related.

d) An optimization exercise could help define the catch rates necessary for practical use.

e) Plume orientation with entrance is vital, and can be achieved through floating, setting practice, or multiple entrances.

f) Pot design (volume and floating, adding a leader) would benefit from tank/engineering exercises.

g) Alternate, additional stimuli appear to have some promise although it is not clear exactly what stimuli are most effective.

h) There is a need to understand the feeding behaviour of the target species, including detection threshold and reaction thresholds.

i) Observation of cod is extremely valuable and inexpensive; laboratory experiments are also useful. Observations could also help to establish rather easily whether familiarity or novelty is a factor in capture in pots.

Proceedings from this report will be published shortly.

4.2 Development of baited pots for harvesting cod *(Gadus morhua)* in Canada

Philip Walsh and Alain Fréchet

The development of baited pots in Canada has been spurred by numerous advantages associated with pots over other fishing gears. Overall, pots are viewed as less harmful to fish, resulting in low discard mortality, higher quality product, and opportunities for tag-and-release and other fisheries research. Pots are also highly species- and size-selective. Research on pots for cod began in earnest in 2000, and continues to the present deployment to fisherman for commercial use. The resulting pot design was developed by testing the importance of volume, pot shape and construction, and entrance shape and length. Bait location and type were determined to be linked to catch rates.

Catch rates were seasonally influenced, and appeared to decrease in the presence of bait fish. Direct comparisons to gillnets and longlines were favourable.

4.3 Russian pot fisheries and research

Oleg Lapshin

The presentation considers 'compact' or 'small' relocatable pots with either rigid or flexible frames. Fyke nets and fixed seine nets are excluded. Pots as passive fishing gear rely on the probability of the entering of fish to be higher than the probability of escape. The activity of fish is usually increased by psychological impact in the form of bait. A few huge researches can be found in USSR literature including test of light, physical chemical irritants and use of electricity and sound.

In the 1980s researchers from PINRO (Murmansk) carried out trials with rectangular and cylindrical pots (2–3 m^3) for cod and halibut in the Barents and Norwegian seas. One major difficulty was bycatch of crabs. The bait used was capelin and mean catch was 10 kg per pot during a 12–24 hour soak time.

Researchers at TINRO (Vladivostok) also carried out experiments with cylindrical and rectangular pots on depths up to 980 m in the 1980s. Folding pots with two serial input were also tested. Rectangular pots of 2.5 m^3 constituted 32–94% of cylindrical pots of 4.9m^3. Cylindrical pots with four openings constituted 42–46 kg for 40 hour exposition. When decreasing the number of openings from four to one the catch decreased considerably. Round cylindrical pots (Ø3m x 0.8 m high) were found to be more convenient when working on big depths.

Pots with cylindrical shape, rectangular, truncated cone, Z-shape and S-shape have been used for Sablefish, bass, cod and halibut with different success and numbers for pot volume and catch per exposition is given. For Sablefish cylindrical pots (ø 0.9m x 2.2–2.4 m) or truncated cone 1.1–1.9 m^3 are recommended, for Bass S-shape or rectangular pots are recommended, for Cod rectangular pots with two serial cone-shaped inlets are recommended and for Cod and Halibut cylindrical (ø3m x 0.8 m high) with three cone-shape inlets are recommended.

Figures on catch depends on pot size and shape, inlet number, size and shape and duration of catching process are given and discussed.

Although scientific results exist, pots are not in practical use. In Russia some discussions have been held to change to pots, but pots are not ready yet.

4.4 Recent pot research by IFREMER

Jacques Sacchi

Pot fishing has a long tradition in France, but has been reduced progressively since the 60's with the introduction of nylon gillnets. Pot fishing is mainly used for cuttlefish, snail and crustaceans off Brittany and Normandy and seasonally targeting conger, sea breams, wrasses etc. Due to the advantages of capture quality and environment preservation pots are often proposed in regional projects. Recently pot experiments were carried out on deep crustacean resources of the Mediterranean continental slope: the deep pink shrimp (*Plesionika edwarsii*) and the Norwegian lobster (*Nephrops norvegicus*)

Since 2005, Norwegian collapsible pots have been used for fish at 100–600 m depth. Technical modifications have been tested to adapt these pots for small size Provençal coastal vessels (less than 15 m LOA) and the environmental fishing conditions (depth, hard bottom, current). Different material (PVC, PE, PU) and assembling were tested with the aim to improve the resistance of the frame of pots and reduce their fabrication costs. Their behaviour in different current configurations was measured in a flume tank and compared with other shapes of pot (trapezoidal). Experiments at sea have been carried out using 2 fleets of 20 pots spaced out 50 m and baited with sardines. Comparison was made with Argentine collapsible pots (one funnel, green, without chamber). Main results of these trials gave a catch average of ~2,47 kg/pot composed of 11 main species with 91 % of conger *(Conger conger)*. The main part of the catch is in the upper chamber.

Forthcoming research programs for French waters will include experimentation of fish pots for sea bream and sea bass in the Laguna de Thau (Mediterranean coast) and Gulf of Biscay with cooperation with fishing cooperation and Regional Council (Nasmed, ITIS), experimentation on folding trap for catch of deep sea crustacean fishery, Crawfish (*Palinurus spp*.), Nephrops (*Nephrops norvegicus*) shrimp (*Plesionika spp*) and biological and economical study for the implementation of these techniques within the small scale Mediterranean fisheries.

4.5 Pot studies in the Baltic

Sven Gunnnar Lunneryd

In the Baltic the growing seal population has resulted in increasing difficulties for the fishermen. In the cod fishery in the Baltic one third of all hauls in the central Baltic are now reported with seal damage in the logbook. There might also be large hidden damages, as 6 of 7 cod taken by seal leave no remains in the net. The loss of catch and gear damage from each grey seal costs at least 400 Euro. Another problem is the bycatch of harbour porpoise, which also may pose restrictions of the fishery. Questions that arise are the extent of genetic subpopulation, how many animals there are and how large are the by-catches.

One solution to bycatch problems seems to be the use of static gears such as pots.

In the salmon fishery large salmon pushup traps have been developed. These are large structures with double Dyneema netting and with a grate in the entrance. They can be raised from the bottom by pumping air in lifting buoys.

In the southern Sweden the Norwegian two-chamber pot has been tried for bottom species. Experiments with links with 4 to 8 pots showed catches in one pot equal 50 m gillnet. Pots baited with herring gave better catch compared to squid bait, which was only slightly better than unbaited pots.

In the future the intention is to develop pot fishing and introduce the gear in the fishery. Emphasis will be to resolve seal interactions and prevent bycatches

4.6 Group Discussion of Improving Catch Efficiency

Improvement of catch efficiency was linked to deeper understanding of fish behaviour during discussions. First, the discussion on fish behaviour was initiated by a discussion of behavioural methodology. The classical behavioural studies by Tinbergen were cited as a starting point for researchers; other approaches (probabilistic, physiological, and ecological) were identified. Further, the need to get beyond the "what" of behaviour to the "why" was cited.

Numerous sensory modalities were identified that had perhaps been neglected by researchers, including sensitivity to electrical fields, sound, greater details of fish vision (such as focal points), and swimming patterns. For example, it was pointed out that pots may create a great deal of noise, may create or disturb weak electrical fields, and may create disturbing or attractive swimming patterns in target species. Complex interactions of behaviours were discussed, including variation due to seasonality and other environmental factors, as well as individual variation within species and differences in behaviour between isolated fish and fish in schools. The role of learning and transferral of knowledge among fish was also discussed. The possibility of sequential or triggering behaviours that trigger still further behaviours was identified as an additional form of complexity.

Overall, the need to conduct experiments or measurements of behaviour was repeatedly emphasized. The expense of measurement tools and laboratory facilities was identified as a barrier. For example, the orientation of a pot on the sea floor, considered vital for identifying attraction patterns, requires the use of expensive sensors. However, an ingenious inexpensive method involving warm gelatine and a compass was described by one participant. The need to measure on different scales (school, entrance, exit) was also discussed as vital but difficult. Acoustics (pingers, telemetry arrays, split-beam sounders mounted horizontally, scanning sonars) could be a direction of study. One researcher offered the exciting possibility of conducting behavioural experiments by experienced researchers in his institute that are designed by group members.

Discussion was also held centering around the physical details of pot construction. (One researcher indicated that the terminology for describing pots is not standardized and could be an additional task for the group). Some pot researchers have conducted multiple experiments to determine geometry of fish pots while others have adopted or adapted designs. The need to understand the importance of each detail of a pot (angle and shape of entrances, colour of webbing, and so on) was discussed. The internal shape of the pot's effect on swimming patterns and escape was mentioned as a vital driver. The importance of orienting the pot entrance in the direction of the bait plume was mentioned often; it was noted that fish swim up the bait plume, and cannot be expected to exit this primary stimulus to swim around a pot to find an entrance.

In summary, a great deal more experimentation with details of pot construction and fish behaviour appears vital to increasing pot efficiency. Several participants indicated their intention to work in this direction.

5 FTFB Plenary discussion

A summary of the SGPOT meeting was presented and discussed in the FTFB Working Group on 23 April 2007.

The importance of collaboration with the fish behaviour group was noted, as being vital to maximize the catching effort of the pots and further research on behaviour was required to improve the catching efficiency for fish species. The point was also raised as to whether SGPOT had considered gear conflicts. The example was given of the Georges Bank fishery, where there was well-documented evidence of conflict between fixed and mobile gears. The

Chair of SGPOT agreed this was an important issue and stated the group would consider this at their next meeting, along with other ecosystem effects related to pot fisheries.

Following the first meeting text has been prepared for the final report dealing with 'Unaccounted fishing mortalities in the use of pots' as attached in Annex 3.

Annex 1: List of participants

NAME	ADDRESS	PHONE/FAX	EMAIL
Robert Bunn	Marine Institute, Ireland		robert.bunn@marine.ie
Francois Gerlotto	IRD – Lima		francois.gerlotto@ird.fr
Martial Laurans	IFREMER – Brest		martial.laurans@ifremer.fr
Sven Gunnar Lunneryd	Swedish Board of Fisheries	Tel: +46 526 686 25	sven-gunnar.lunneryd@fiskeriverket.se
Fabien Morandeau	IFREMER – Lorient		Fabien.morandeau@ifremer.fr
Clare Murray	Galway-Mayo Institute of Technology, Ireland		claremurray21@gmail.com
David Stokes	Marine Institute, Ireland		david.stokes@marine.ie
Kris Van Craeynest	ILVO-Fisheries, Ankerstraat 1, Oostende, B-8400, Belgium.		Kris.vancraeynest@ilvo.vlaanderen.be
Hakan Westerberg	Swedish Board of Fisheries		hakan.westerberg@fiskeriverket.se
Alain Fréchet	Maurice Lamontagne Institute, 850 Route de la mer, Mont-Joli, G5H 3Z4, Canada	Tel: +418 7750628 Fax: +418 7750679	frecheta@dfo-mpo.gc.ca
Bjarti Thomsen *Chair*	Faroese Fisheries Laboratory, Noatun 1, P O Box 3051, Torshavn, Faroe Islands	Tel: +298 353900 Fax: +298 353901	bjartit@frs.fo
Daniel Valentinsson	Institute of Marine Research, P.O. Box 4, Lysekil, S-453 21, Sweden	Tel: +4652318747 Fax: +4652313977	Daniel.Valentinsson@fiskeriverket.se
Haraldur Einarsson	Marine Research Institute of Iceland, Skúlagata 4, 101, Reykjavík, Iceland	Tel: +354 5752000 Fax: +354 5752001	haraldur@hafro.is
Jacques Sacchi	IFREMER, Jean Monnet, Sete, 34200, France	Tel: +33 4 99 57 32 08	jacques.sacchi@ifremer.fr
Jochen Depestele	ILVO-Fisheries, Ankerstraat 1, Oostende, B-8400, Belgium.	Tel: +32 59 56 98 38 Fax: +32 59 33 06 29	jochen.depestele@ilvo.vlaanderen.be
Michael Pol	Mass. Division of Marine Fisheries, 1213 Purchase St, New Bedford, MA, 02740, USA	Tel: +11 508 9902860 Fax:+11 508 9900449	mike.pol@state.ma.us
Mike Breen	Fisheries Research Services, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland	Tel: +44 1224 295474 Fax: +44 1224 295511	breenm@marlab.ac.uk
Olafur Ingolfsson	Marine Research Institute, Arnagata 2-4, Isafjordur, 400, Iceland	Tel: +354 5752303	olafur@hafro.is
Oleg Lapshin	VNIRO 17, Verkhne Krasnoselskaya, Moscow, 107140, Russia	Tel: +7 495 264 9310 Fax: +7 495 264 9187	lapshin@vniro.ru
Paul Winger	Marine Institute, 155 Ridge Rd., St. Johns, A1C5R3, Canada	Tel: +1 709 7780430 Fax: +1 709 7780661	Paul.Winger@mi.mun.ca

Peter Munro	Alaska Fisheries Science Center (NOAA), 7600 Sand Point Way NE, Seattle, 98115, USA	Tel: +1 206 526 4292 Fax: +1 206 526 6723	peter.munro@noaa.gov
Philip Walsh	Marine Institute, 155 Ridge Rd., St. Johns, A1C5R3, Canada	Tel: +1 709 7780430 Fax: +1 709 7780661	philip.walsh@mi.mun.ca
Pingguo He	University of New Hampshire, 137 Morse Hall, Durham, NH, 03824, USA	Tel: +1 603 8623154 Fax: +1 603 8620243	Pingguo.He@unh.edu
Svein Lokkeborg	Institute of Marine Research, Nordnesgaten 50, Bergen, 5817, Norway	Tel : +47 655236826 Fax : +47 55236830	svein.lokkeborg@imr.no

Annex 2: Agenda

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

Meeting Place: Crowne Plaza Hotel, Dublin Airport, Dublin, Eire (Ireland)

Saturday, 21 April 2007

09:00 Welcome, practical issues, Study Group background

Bjarti Thomsen

09:30 Summary of GACAPOT meeting, Gloucester Nov. 2006

Michael Pol

10:00 Canadian fish pot research

Alain Fréchet and Philip Walsh

10:30 Coffee break

10:45 Russian pot fisheries and research

Oleg Lapshin

11:15 Examples of commercial pot fisheries around the world

Bjarti Thomsen

11:35 Discussion and input from participants on commercial pot fisheries

12:30 Lunch break

13:30 Pots as survey gear

David Stokes and Robert Bunn

14:00 Discussion and input from participants on pots as survey gear

15:15 Coffee break

15:30 Discussion and report preparation on commercial pots and survey gear

16:45 Preparations for next day meeting

17:00 Closing

Sunday, 22 April 2007

09:00 Pot entry patterns in relation to environmental variables

Peter Munro

09:30 Discussion and participant input on methodology for describing fish behaviour

10:30 Coffee break

10:45 Examples of fish reaction to visual and other stimulation (TBA)

11:15 Discussion and participant input on fish reaction to stimuli

12:30 Lunch break

13:30 Discussion and participant input on behavioural variation

14:30 Discussion and participant input on pot entrance design and pot efficiency

15:15 Coffee break

15:30 Discussion and report preparation on research need on fish behaviour

16:30 Discussion and planning of future SGPOT work and meetings

17:00 Closing

Annex 3: Section for the SGPOT report

Contribution of Alain Fréchet and Mike Breen

Unaccounted fishing mortalities in the use of pots.

Recent research has revealed that many modern fishing practices can often be associated with an unintentional and unutilised mortality amongst target and bycatch species, for example through discarding, escape mortality and ghost fishing (ICES 2005). Minimizing this "unaccounted fishing mortality" through the use of appropriate fishing gears and practices is an important conservation objective. Although there are no known studies specifically investigating the occurrence of unaccounted fishing mortality in fish pots, the nature of the capture process in this gear infers that the survival of fish escaping or being discarded from pots is likely to be high.

The capture process in fish pots is dependent upon the voluntary behaviour of the target fish, which are attracted by a bait odour plume into the pot, which then passively retains them. In comparison to many other gears, there is no intentional contact with individuals. For example: in trawls fish are herded into the towed net by first fatiguing them, where they are then exposed to further potential stresses and injury by being compressed in the codend catch or affecting an escape by passing through the meshes of the net. Even other passive gears have the potential to induce stress and injury. Gill and trammel nets function by restricting the passage of a fish through a netting mesh, which then restrains fish by means of its maximum girth in the forward direct and its gill covers acting as a barb in the reverse. Long-lines induce unavoidable injury, as the fish is restrained on a baited hook. In the case of pots, the fish are simply attracted into an enclosure where their retention is not dependent upon physical and potentially injurious contact; they are simply enclosed in a cage. This however does not mean the potential for stress (due to confinement or the presence of predators) and injury (through incidental contact with the pot structure) is avoided; but the capture process in pots is not dependent upon such stressful and injurious interactions. It is thus generally presumed that the fish will not suffer high levels of stress or injury, and their potential survival following discarding or escape is likely to be high, excepting that handling practices and hyperbaric injury may affect this. In short, "fish pots are designed to catch fish, not kill them" (Walsh, pers. comm.).

With this in mind, it is easy to understand why some fisheries, which specifically target the capture of live fish (e.g for use in aquaria and as cleaner fish in aquaculture), have developed using pots as the principle capture method. Furthermore, there are also examples were pots have been the preferred capture methods by researchers were the quality and viability of the captive fish is critical. An investigation assessing the escape mortality of gadoid fish escaping from towed gears (Project Survival; Breen et al, 2007), successfully used fish pots to obtain cod, haddock and whiting for use as captivity controls in the experiments. These fish were transferred by divers into seabed cages adjacent to cages holding trawl escapees, to assess captivity-induced mortality. None of these pot-caught fish died during the eight day monitoring period. However, they were not brought to the surface and so cannot be used to infer the survival potential of discards from pots, because they were not exposed to the same stressors, eg. air exposure, temperature change and decompression. Recent work in Newfoundland used pots to capture cod for tagging (Walsh and Frechet, pers. comm.). Although no post-tagging mortality estimates were obtained (by monitoring tagged cod for a few days in captivity), the results were very encouraging, as the pots provided a good capture method, which provided uninjured and seemingly unstressed cod prior to the tagging.

Although these studies infer that the survival potential of escaping and discarded fish from pots may be high, it is recommended that specific studies be conducted with pots to confirm this assumption. Moreover, it is important to remember that pots have the potential to cause an

unaccounted mortality in both target and none target species, through ghost fishing and entanglement. This important issue will be address by the SG next year.

Annex 4: SGPOT Terms of Reference for 2008 meeting

The Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes [SGPOT] (Chair: B. Thomsen, Faroe Islands) will meet in Torshavn, Faroe Islands, in April 2008 (concurrent with the WGFTFB meeting) to:

a) complete a review of the current use of fish pots and provide a global overview of commercial fisheries and assessment surveys using these gears;

b) more specifically identify fundamental research needs on fish behaviour in order to improve catching efficiency and assessment use of pots, in particular:

  i) development of methodology for describing fish behaviour relevant for the capture and escape process.

  ii) reactions to different stimuli, including bait attraction, in the far and near field.

  iii) efficiency of pot and trap entrances, and

  iv) behavioural variation due to biological status and environmental conditions.

c) suggest specific behavioural experiments to be conducted jointly between institutes;

d) make recommendations for improving the mechanical design and construction of pots, with considerations given to ecosystem effects sush as ghost fishing and other unaccounted fishing mortality, with the specific aim of improving catch efficiency and their utility as survey gear, including drafting recommended consensus terminology for parts of a fish pot;

e) consider conflicts between pots and other fixed and mobile gears;

f) develop an outline for writing a Cooperative Research Report.

SGPOT will report by 31 May 2008 to the attention of the Fisheries Technology Committee.

Supporting Information

PRIORITY:	The current activities of this Group will monitor and encourage current ongoing work in several countries, faciliate communication of results and lead ICES into improved techniques for surveying marine living resources. The work of this group is the development of a fishing gear that has many environmental benefits and will contribute to sustainable fishing. Consequently, these activities are considered to have a high priority.
SCIENTIFIC JUSTIFICATION AND RELATION TO ACTION PLAN:	The group's work is of relevance to the ICES Action Plan 1.13, 3.16, 3.17 and 3.18. Several research milieus are conducting significant studies in the development of fish pots development both for commercial use and for survey purposes. The study group is working towards an ICES CRR providing comprehensive review of state-of-the-art and further research needs.
RESOURCE REQUIREMENTS:	The research programmes which provide the main input to this group are ongoing, and resources are already committed.
PARTICIPANTS:	The Group is normally attended by some 20–25 members.
SECRETARIAT FACILITIES:	None.
FINANCIAL:	No financial implications.
LINKAGES TO ADVISORY COMMITTEES:	There are no obvious direct linkages with the advisory committees.
LINKAGES TO OTHER COMMITTEES OR GROUPS:	There is a close working relationship with WGFTFB

LINKAGES TO OTHER ORGANIZATIONS:	
SECRETARIAT MARGINAL COST SHARE:	