Proceedings of the International Technical Workshop on Gadoid Capture by Pots (GACAPOT)

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Commonwealth of Massachusetts
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Department of Fish and Game
Massachusetts Division of Marine Fisheries

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**TR-5** Chase, B.C., and A.R. Childs. 2002. *Rainbow smelt (Osmerus mordax) spawning habitat in the Weymouth-Fore River.*


**TR-12** Howe, A. B., S. J. Correia, T. P. Currier, J. King, and R. Johnston. 2002. *Spatial distribution of ages 0 and 1 Atlantic cod (Gadus morhua) off the Eastern Massachusetts coast, relative to ‘Habitat Area of Special Concern’.*


**TR-22** Lyman, E.G. and D.J. McKiernan. 2005. *Scale modeling of fixed-fishing gear to compare and quantify differently configured buoyline and groundline profiles: an investigation of entanglement threat.*


**TR-29** Glenn, R., T. Pugh, J. Barber, and D. Chosid. 2007. *2005 Massachusetts lobster monitoring and stock status report.*

**TR-30** Chase, B. C. 2006. *Rainbow smelt (Osmerus mordax) spawning habitat on the Gulf of Maine coast of Massachusetts.*


**TR-33** Chase, B. C., Plouff, J., H., and M. Gabriel. 2007. *An evaluation of the use of egg transfers and habitat restoration to establish an anadromous rainbow smelt spawning population.*

Continued on inside back cover
Proceedings of the International Technical Workshop on Gadoid Capture by Pots (GACAPOT)

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Abstract: An international technical workshop to discuss the capture of gadoids (cods, haddock, and saithe/pollock) in baited traps, or pots, was held in Gloucester, Massachusetts, USA on 4 November 2006. Attendance at the workshop included 50 scientists and fishermen actively studying pot capture of gadoids, technical staff and others interested in pots in general from 16 nations and five continents. The workshop determined 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. Conclusions suggested that research into pots was still at an early stage, and that much vital work needed to be done; however, pot volume and orientation of the bait plume and entrances were identified as important factors. Future studies using a combination of laboratory and field techniques to identify critical design details and behavioral factors such as reaction and behavioral thresholds for a variety of stimuli were described.

Introduction

An international technical workshop to discuss the capture of gadoids (cods, haddock *Melanogrammus aeglefinus*, and saithe/pollock *Pollachius virens*) in baited traps, or pots, was held in Gloucester, Massachusetts, USA on 4 November 2006. The workshop, known as GACAPOT, was convened by Dr. Paul Winger of the Centre for Sustainable Aquatic Resources of the Marine Institute, Memorial University of Newfoundland and Labrador, Dr. Pingguo He of the Institute for the Study of Earth, Oceans, and Space at the University of New Hampshire, and Mr. Michael Pol of the Massachusetts Division of Marine Fisheries.

Fish pots, baited structures for capturing fish, are an alternative gear with ideal or near-ideal qualities, including low impact on habitat, narrow species selection and low capture and discard mortalities. Pots have also demonstrated a remarkable degree of species selectivity. Furthermore, although post-pot-capture mortality of gadoids is unquantified, qualitative assessment of discarded fish indicates high survival rates. A commercial pot fishery for Pacific cod *Gadus macrocephalus* has been established; however, for other gadoids, improved catch rates are needed to reach commercial viability.

This workshop attempted to focus 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. The workshop was primarily intended for researchers actively studying the pot capture of gadoids, including technical staff and fishermen, and secondarily for those interested in pots in general.

Attendance at the workshop included 50 scientists and fishermen, technical staff and others from 16 nations and five continents (Table 1). The morning session of the workshop consisted of 9 invited talks. The afternoon session included a focused, lively discussion on defining essential pot characteristics and directing future research and ended with a listing of conclusions.

At the time of the workshop, research on pots targeting Atlantic cod *Gadus morhua* had recently been conducted in Canada, Faeroe Islands, Norway, and the United States. Research on pots targeting haddock *Melanogrammus aeglefinus* and saithe/pollock *Pollachius virens* had also been conducted in Norway and the United States. In addition, an ICES Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT) had been proposed. Since the GACAPOT workshop, work on gadoid capture has continued and expanded to other Northern Hemisphere nations, including Iceland, Sweden, France, Germany, Scotland, Ireland and other nations. SGPOT has now met and corresponded for three years and is currently developing a formal report on their work.

This document includes summaries of each presentation and of the questions that each generated. The Discussion section describes the content of the workshop’s afternoon session. A list of conclusions was made at the end of the meeting by M. Pol. Slide images from each presentation are included in the Appendix.
### Table 1. Workshop attendees and their contact information.

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Presentations

Pingguo He, “Fishing with Baited Pots: An Introduction”. Pingguo He gave an overview of fish potting. He discussed pot definitions and qualities, comparing and contrasting pots to traps, and proposed a new definition. He showed examples of pots and traps through photographs (Appendix, pp A4-A15), and highlighted the limitation of the FAO definition where a pot is classified as a type of trap. The difference between pots and traps was summarized by pointing out that traps guide and then trap fish, while pots attract and then retain fish. He then reviewed capture principles, showing commonalities with other stationary gears, and the distinctive aspect of pots, a non-return device that allows entry, but discourages exit. He described possible environmental factors affecting pot fishing, differences in fishing effects, and mammal interactions, emphasizing previous work on attraction to baited gears. Specifically, the impact of temperature on swimming speed and the effective area of a pot was illustrated. A list of references on pot topics such as: searching, attraction and reaction; soak duration; baited pot fishing trials; pot size selectivity; conservation issues (ghostfishing and mammal entanglement); pots as research tools; study methods for pots; and literature reviews was provided. He asked attendees to consider several points as we worked through the day: fishing season, feeding and spawning; availability of prey items; bait type and presentation; pot size and entrance; and how to balance entry and exit.

Pingguo He, “Some Fish Pot Experiments in Newfoundland and in Gulf of Maine”. He presented his own experiences in Newfoundland with flounder pots, spherical pots, collapsible pots and trapots (traps along a leader line) (Appendix, pp A16-A19.)

Bjarti Thomsen, “Pot research and pot fishery in the Faeroe Islands and other European countries”. Thomsen continued the discussion of pot definitions including the FAO definitions and offered to share his list of references on pot work (Appendix, pp. A20-A32). Thomsen highlighted the low observed efficiencies of pots and gave an overview of pot use in Europe. He gave his impression of pot functionality and behavioral effects and mentioned some new work that has been completed by others. In Thomsen’s own experiments, he looked at long lasting baits, alternative stimuli, and varying pot designs and showed video demonstrating cod attraction. His methodology of video observation was detailed. However, no strongly positive results were obtained. He presented various design evolutions that dealt with bait container locations, frozen bait, and visual lure tests using movement and light. Cod were observed to defend bait for lengthy periods, preventing other fish from accessing the pot entrance. Pot entrances on top were tried. Fish did not react to a leading light. Thomsen felt that the observational methodology was successful, and that an effective long-lasting bait had been developed, that pot entrances should face downstream or be accessible on all sides, and suggested future research on pot designs and visual stimuli and their impact on fish’s optimotor responses, including moving objects, light, sound, and electricity. He also presented a diagram of an idealized pot system.

Attendees requested more details on his underwater observation system, types of fingers used, and the success of light emitting diodes. The territoriality of individual cod was observed, but no solution for deterring these fish was suggested.

Svein Løkkeborg (presenter) and Odd-Børre Humborstad, “The Norwegian Pot Story”. The history and development of the original Norwegian pot 30 years ago were described, including difficulty with low catch efficiency and large pot size. Løkkeborg showed how development of torsk Brosme brosme pots and collapsible pots continued (Appendix, p. A33-A42). He discussed cod behaviors with respect to entrances and retention in the pot and Humborstad’s and his work with double and wider entrances. Cod were found to dislike narrow entrances, but to readily escape from large entrances. He mentioned potential problems like size and bait location. He showed design modifications for reducing king crab bycatch and increasing cod catch with two-chambered, floating
pots. Løkkeborg demonstrated the importance of the odor plume orientation with the pot opening. Finally, Løkkeborg showed torsk reaction to bait with a streamer and deployment of a trapot or “underwear” (the meaning of “trapot” in Norwegian). He described continued development of long-lasting bait and added stimuli to increase the rate of entry into pots. A summary of an ideal cod pot’s characteristics based on their research was presented: floating, with the odor plume oriented out of the funnel, a wide or double funnel, with two chambers separated by a narrow entrance. Long-lasting bait with visual and other stimuli was also included.

Discussions and questions focused on long-lasting bait possibilities, further modifications in the pot designs, methodologies that they had used, the importance of funnel sizes on fish size-dependent captures, and possible usage of visual stimuli.

Philip Walsh, “Development of baited pots for harvesting cod in Newfoundland and Labrador”. Walsh showed the advantages of cod pots from both environmental and industry perspectives: environmental friendliness; high discard survival; high quality; good size and species selectivity; minimal ghost fishing; and research uses (live fish for tagging, etc.) (Appendix, pp. A44-A53). These aspects were summarized by saying that “pots catch fish, they do not kill fish.” He discussed the history and methodologies of research at the Marine Institute, testing various cod pot designs beginning in 2000. During that time they have compared the effectiveness of funnels, floating roofs, funnel shape, and entrance characteristics among other factors. Pot size and shape, opening shapes, triggers, depths and soak times were all examined. Comparisons to gillnets showed that pots could double gillnet catches. Walsh identified the importance of the fish’s seasonal condition and hunger status to the capture process. He then showed video of a pot retrieval and cod behavior around a pot.

Questions for Walsh concerned his pot designs with respect to bait types and locations and funnel shapes, the importance of color, escape vents for bycatch, and sampling design with respect to soak times.

Craig Rose, “Pot Fishing and research in western USA”. Rose presented research for sablefish pot development based on Alaskan crab pots (Appendix, pp. A54-A65). Rose reviewed a baited fishing gear behavioral model and illustrated the effectiveness of DIDSON sonar and an ICCD camera to determine fish movement tracks around pots. While thousands of entries into the sonar field were recorded, only 19 pot entries were recorded. His observations showed that the abundance estimates were dependent on the relation of the observed side to the current direction: more fish were observed on the downcurrent side. Rose continued by proposing possible improvements of pot designs by optimizing pot volume, improving tunnels and other aspects, and future work with bait. He also suggested setting entangling gear (gillnets or trammel nets) near the pot to improve catches.

Questions pertained to catch rates, bait types, and the results of his study, including bait placement.

Michael Pol, “It isn’t the pot - it’s the cod”. Pol described US East Coast pot fisheries with various species (American lobster Homarus americanus, scup Stenotomus chrysops, black sea bass Centropristis striata, channeled whelk Busycon canaliculatum, and red crabs Chaceon quinquedens) and attempts to modify those gears for cod potting (Appendix, pp. A66-A70). He presented his own work with Walsh’s pot designs using various baits showing successful but low cod catches in Massachusetts Bay. Comparisons to fish in nearby gillnets showed emptier stomachs in pot-caught fish. Pot frame type seemed unimportant, and modifications to entrance details did not improve catches. Tag recaptures and no observed mortalities suggested good survival. Video of cod behavior showed cod biting a loose string (likely displacement behavior) and a strong rush to the bait once it was vigorously attacked. Pol concluded that future work should look at hunger and spawning conditions, other comparative designs, contrast effects such as flashing, and density dependency.
Questions raised included topics of cod learning behaviors and sampling design.

Ken La Valley, “Feasibility of a directed Atlantic haddock trap fishery in the Gulf of Maine”. La Valley identified high abundances of haddock and low abundances of cod as his motivation for a haddock pot fishery. He then reviewed his experiment in Maine with trap designs based on Pacific cod pots, Alaskan crab pots, and a two-chamber pot (Appendix, pp. A71-A76). He also hoped to compare three baits (Norbait, surf clam, herring). No haddock were caught, but for other species the two-chamber pot and clam bait caught the most fish, all species combined. Each design caught fish, but haddock abundance in the area was low. LaValley concluded that seasonal components and the pot design were important and that future modifications will use floated pots with modified one-way devices or entrances (triggers).

Questions focused on haddock availability.

Takafumi Arimoto, Anukorn Boutson, and John Haluan, “Fish pots in Asia and some recent works in Japan”. Under the framework of this title, a review of potting in eastern Asia was presented (Appendix, pp. A76-A95). Arimoto began by referring to a pot meeting that occurred 20 years prior. He described the use of pots from the Philippines, Malaysia, United Arab Emirates, Taiwan, and Okinawa, Japan. Boutson presented, “Bycatch and its reduction from blue swimming crab pot fishery in Thailand” where he reviewed Thailand’s pot fishery and his own experiment modifying the pot design. Haluan continued this presentation with “Fish pots in Indonesia” where he discussed Indonesia’s pot designs and methods. Arimoto finished the presentation with an overview of fish potting in other areas of Asia. He also identified published research on reactions of puffer fish to pots in the laboratory, the hydrodynamics of various pot designs and behavioral responses of greenling to small changes in entrance architecture. Arimoto concluded that further research should address pot entry and escape, inter- and intra-specific behaviors inside the pot, soak times, and density relationships. Work should continue on improving the efficiency of the pot designs, particularly increasing the pot volume, setting pots in longlines, entrance characteristics, and optimal bait.

Questions addressed the environmental benefits of pots on corals over other harvest methods.

Discussion

Paul Winger introduced and moderated the final discussion session of the workshop starting with two questions: What are the essential successful characteristics of pots? What are their weaknesses? Referring to a behavioral model of reactions to baited fishing gear, he described how a fish's condition is filtered through mediating mechanisms and output responses based on behavioral patterns. Drawing on understanding those mechanisms can offer a pathway to maximize catchability.

Discussion continued around the importance of familiarity of the gear to fish, and on a fish's ability to learn. Examples were cited of rapid learning by wild fish held captive in underwater cages. The model of lobster gear, where sublegal lobsters may experience captures and escapes from pots before retention, was considered for relevance to new gadoid pot fisheries. Do gadoids need to have prior entry and escape experience with pots prior to entry and capture? The role of social facilitation of cod was discussed, and the possibility of leaving a cod in a pot as an attractant was considered - this practice is not used in the Alaskan fishery.

Strategies and ideas for luring fish to pots were discussed, including the development of long-lasting baits as a means of reducing costs to the fisherman by allowing gear to remain attractive longer. The importance of a model which includes consideration of both the environmental conditions and a fish's individual condition (hunger state, etc) was described as a way of understanding capture likelihood. Additional possible attractants were discussed, including lights and metal.
Seasonality of capture was discussed, including the possible effect of the spawning status of the target fish. The effect of spawning on hunger status was considered.

Winger listed the consensus for “things that haven’t worked so far” which included setting pots in the absence of fish, setting at the wrong time of year, narrow entrances, poor bait placement, unbaited trapots, summer fishing in Newfoundland, unstable (moving) pots, and light emitting diodes (as currently placed).

The possibility of using leaders (as in a trapot) was considered and discussed. The role of prey availability and hunger status was theorized to affect both capture and seasonality of capture.

Multiple participants mentioned the role of pot volume and shape, especially whether round or square pots were better. The possibility that pot movement might be an attractant was considered. Volume impacts not only attraction, but also retention by changing the saturation level of the pot. Smaller pots allow the use of a smaller boat, which decreases fixed costs. The benefit of multiple chambers, and the choice they offer to fish, was considered. Winger continued with two ideas to improve trap designs: multiple entrances on all sides or correctly orienting the entrance. Details of pot entrance configuration were discussed. For floating pots, especially in a current, the importance of balancing the flotation was mentioned. Also, the complexities of bait led to consideration that strongly stimulating baits might confuse fish; the viability and value of different baits were discussed. Bait intensity limits were briefly mentioned.

The potential for interspecies interactions, including bycatch and conflicts with marine mammals, were the final items discussed.

1. We are still in the early stages of understanding pots, and a lot of basic testing of pot characteristics needs to be done.
2. Catches might be simply related to abundance; we rarely know the local densities.
3. Increasing pot volume appears to increase catch.
4. Behavioral reasons for the effect of larger volume are unclear, although the effect could be density-dependent.
5. An optimization exercise could help define the catch rates necessary for practical use.
6. Bait plume orientation with entrance is vital, and can be achieved through floating pots, orientation while setting, or multiple entrances.
7. Pot design (volume and floating, adding a leader) could be a tank/engineering exercise.
8. Cod learning is possible and laboratory experiments could illuminate whether familiarity or novelty is a factor.
9. Use of non-olfactory or multiple stimuli appears to have some promise for increasing catches. We need to understand the feeding behavior of the target species, including detection and reaction thresholds.
10. Observation of cod is extremely valuable; inexpensive and expensive technologies are available to help us observe and record fish behavior; laboratory experiments are also useful.

The meeting concluded with positive remarks and a desire to continue the networking and dialogue initiated by the meeting.

**Summary and Conclusions**

Michael Pol abstracted the main points of the GACAPOT workshop, based on the presentations and the discussions.
List of Massachusetts Division of Marine Fisheries Technical Reports (continued from inside front cover)

TR-39 Dean, M. J. 2010. **Massachusetts lobster fishery statistics for 2006.**
Thinking Inside and Outside of the Box

• Fish pots, baited structures for capturing fish, are an alternative gear with ideal or near-ideal qualities, including low impact on habitat, narrow species selection and low capture and discard mortalities. Research on pots targeting Atlantic cod Gadus morhua has recently been conducted in Canada, Faeroe Islands, Norway, and the US.

• Research on pots targeting haddock Melanogrammus aeglefinus and saithe/pollock Pollachius virens has also been conducted in Norway and the US.

• ICES Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes [SGPOT] has been proposed.

• A commercial fishery for Pacific cod Gadus macrocephalus has been established. However, for other gadoids improved catch rates are needed to reach commercial viability.
• This workshop will focus 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.

• The morning session will consist of invited talks from speakers, focusing on their understanding of the principles of gadoid capture.

• The afternoon session will consist of a focused discussion for defining essential pot characteristics and directing future research.

• The workshop is primarily intended for researchers actively studying pot capture of gadoids, including technical staff and fishermen, and secondarily for those interested in pots in general.

Thinking Inside and Outside of the Box

• Name Tags and Contact Information
• Bathrooms and Kitchen
• No Smoking in the Building
• Remember to speak clearly
• Relax; be informal; participate
• Anything else, just ask.
Agenda

9:00 AM  Mike Pol  Welcome and introduction to the workshop, agenda, and logistics
9:10 AM  Pingguo He  Introduction to fish capture by pots
9:50 AM  Bjarti Thomsen  Pot research and pot fishery in Faeroe Islands and other European countries
10:10 AM  Svein Løkkeberg and Odd-Børre Humbostad  Pot research and pot fishery in Norway
10:30 AM  Break
11:00 AM  Phil Walsh  Pot research in eastern Canada
11:20 AM  Craig Rose  Pot research and pot fishery in the American west coast
11:40 AM  Mike Pol  Pot research in the American east coast
12:00 AM  Ken La Valley  Haddock pot experiment in Gulf of Maine
12:15 AM  Takafuli Arimoto  Pot research in Asian countries
12:30 PM  Lunch (provided to all participants)
1:00 PM  Paul Winger  Introduction to afternoon discussions
4:00 PM  Mike Pol  Summary and wrap up
Fishing with Baited Pots: An Introduction

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Institute for the Study of Earth, Oceans and Space
New Hampshire Sea Grant
University of New Hampshire
Durham, NH, USA
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Fishing with Baited Pots

- Fish pot: definition and terms
- Factors affect pot fishing
- Some recent literature on pot research
What is a Pot

- Pot is a stationary gear
- Pot has a relatively small enclosure
- Pot is usually baited

Pot is a baited small enclosure with entrances which lead animals to get in and prevent them to get out

Pot vs. Trap

<table>
<thead>
<tr>
<th></th>
<th>Pot</th>
<th>Trap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Small</td>
<td>Large</td>
</tr>
<tr>
<td>Bait</td>
<td>Used</td>
<td>Not used</td>
</tr>
<tr>
<td>Leader</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Mobility</td>
<td>Can be moved</td>
<td>Stationary for a season</td>
</tr>
<tr>
<td>Capture mechanism</td>
<td>Attract/retain</td>
<td>Guide/trap</td>
</tr>
</tbody>
</table>
Examples of Traps

Main principal of trap capture is GUIDE and TRAP

Examples of Pot

Main principal of pot capture is ATTRACT and RETAIN
# International Standard Statistical Classification of Fishing Gear (ISSCFG)

<table>
<thead>
<tr>
<th>GEAR</th>
<th>STANDARD ISSCFG</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURROUNDING NETS</td>
<td>01.0.0</td>
</tr>
<tr>
<td>SEINE NETS</td>
<td>02.0.0</td>
</tr>
<tr>
<td>TRAWLS</td>
<td>03.0.0</td>
</tr>
<tr>
<td>DREDGES</td>
<td>04.0.0</td>
</tr>
<tr>
<td>LIFT NETS</td>
<td>05.0.0</td>
</tr>
<tr>
<td>FALLING GEAR</td>
<td>06.0.0</td>
</tr>
<tr>
<td>GILLNETS AND ENTANGLING NETS</td>
<td>07.0.0</td>
</tr>
<tr>
<td>TRAPS</td>
<td>08.0.0</td>
</tr>
<tr>
<td>Stationary uncovered pound nets</td>
<td>FPN 08.1.0</td>
</tr>
<tr>
<td>Pots</td>
<td>FPO 08.2.0</td>
</tr>
<tr>
<td>Fyke nets</td>
<td>FYK 08.3.0</td>
</tr>
<tr>
<td>Stow nets</td>
<td>FSN 08.4.0</td>
</tr>
<tr>
<td>Barriers, fences, weirs, etc.</td>
<td>FWR 08.5.0</td>
</tr>
<tr>
<td>Aerial traps</td>
<td>FAR 08.6.0</td>
</tr>
<tr>
<td>Traps (not specified)</td>
<td>FIX 08.9.0</td>
</tr>
<tr>
<td>HOOKS AND LINES</td>
<td>09.0.0</td>
</tr>
<tr>
<td>GRAPPLING AND WOUNDING</td>
<td>10.0.0</td>
</tr>
<tr>
<td>HARVESTING MACHINES</td>
<td>11.0.0</td>
</tr>
<tr>
<td>MISCELLANEOUS GEAR</td>
<td>MIS 20.0.0</td>
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<tr>
<td>RECREATIONAL GEAR</td>
<td>RG 25.0.0</td>
</tr>
<tr>
<td>GEAR NOT KNOWN</td>
<td>NK 99.0.0</td>
</tr>
</tbody>
</table>

Therefore, in strict sense and according to FAO, pot is a gear within the trap category.

# Essentials for Fish Capture by Pots

**Common to all Stationary Gears**
- Fish is available
- Fish moves

For baited gear (pots and baited hooks)
- Fish feeds

**Non-return devices**
- Entrance large enough for entry but small enough to prevent escape
Pot Design and Fishing Operations?

Ed Wyman, Neptune Marine, Inc. Seattle:

- Large internal volume
- Multiple entrances
- Use bait bags
- Hull often
- Proper web netting to release undersize fish
- Use “triggers”

Fish Catch Process

Able to locate an entrance? Entrainces large enough? Bait odor getting stronger? Able to locate the bait visually? Within bait plume? Hungry?

- Enough space inside? Able to locate an exit? Mesh size small enough?
- How long the bait will last? Soaking duration suitable?

As far as 800 m (Kally et al. 2003)
Factors Affecting Pot Fishing

- Light level
- Temperature
- Presence of bait/prey species
- Scavengers and parasites

Effects of environmental variables on fish feeding ecology: implications for the performance of baited fishing gear and stock assessment


- The effectiveness of baited fishing gear ultimately depends upon behaviour of the target species – activity rhythms, feeding motivation, and sensory and locomotory abilities.
- Environment related variation in feeding behaviour can act through four different mechanisms: metabolic processes, sensory limitations, social interactions and direct impacts.
- Water temperature, light level, current velocity and ambient prey density are likely to have largest effects on fish catchability, potentially affecting variation in CPUE by a factor of ten.
- Feeding behaviour is also density dependent, with both positive and negative effects.
- There is a critical need for greater understanding of how environmental variables affect feeding related performance of baited fishing gear.
Swimming Activity Reductions
at lower temperatures

![Graph showing swimming activity relative to water temperature](image_url)
Swimming Speed, Fishing Area of a Baited Pot and Water Temperature

Potential fishing range Soaking time: 12 h

- 4.4 °C
- 2 °C
- 0 °C
- 1.2 °C
- 0.45 nm²
- 1.09 nm²
- 2.77 nm²
- 5.81 nm²

Winter flounder
Pleuronectes americanus

L=0.4 m

Searching, Attraction and Reaction


Jawhar Kallayil et al. 2003. Fish Res. 61: 125-133. Baiting Gillnets-how is fish behavior affected?

[Cod responses to bait up to 800 m away]
Soaking Duration

  Russell G. Cole, Niki K. Alcock, Anna Tovey and Sean J. Handley

- Ed Wyman: “Alaska fishermen often haul 2-3 times a day”

Baited Pot Fishing Trials

Bjordal, A. & Furevik, D. 1988. ICES CM, 1988/B:33. Full scale fishing trials for tusk (Brosme Brosme) and cod (Gadus Morhua) with a collapsible fish trap.


Studies on Pot Selectivity


Conservation Issues

Ghostfishing and Mammal entanglement


Use Baited Pot for Research

• Catching cod for experiment

• As a survey tool

  Conners, M., Munro, P., and Neidetcher (2004)

Methods to Study Baited Fish Pot

Underwater video camera
Sonar camera
Comparative fishing in the field
Laboratory studies

• Use of high-frequency imaging sonar to observe fish behavior near baited fishing gears. Fisheries Research, Volume 76, Issue 2, November 2005, Pages 291-304
  Craig S. Rose, Allan W. Stoner and Keith Matteson

• The role of trap cameras in catch per unit effort calculations for species of the South Atlantic Bight snapper-grouper complex Fisheries Research, Volume 22, Issues 1-2, February 1995, Pages 1-9
  Patrick J. Harris
Reviews on Baited Pots


Bugging Your Mind …

Keep these in mind when you interact with the following presentations and afternoon discussions:

• Fishing season and how it relates to feeding and spawning conditions
• Availability or lack of prey species
• Type of bait, how bait is presented, bait bags
• Pot size and entrance/non-return devices
• Balancing entry and exit

Thank you
Some Fish Pot Experiments in Newfoundland and in Gulf of Maine

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Early Newfoundland Experiments

Flounder Pot
Early Newfoundland Experiments

Spherical Cod Pot

(Z. Kwidzinski, MUN)

Early Newfoundland Experiments

Cod Pot
Trapot – A Hybrid of Trap and Pot

Trapot – A Hybrid of Trap and Pot
Gulf of Maine Cod Pot Experiment

With roof

Without roof

Thank you
Pot research and pot fishery in the Faroe Islands and other European countries

Bjarti Thomsen
Research Manager - Fisheries Technology
Faroese Fisheries Laboratory

GACAPOT, Gloucester 4. Nov. 2006

Introduction
Potting in Europe
Faroese experiments (video)
Future work
People in different parts of the world are not always referring to exactly the same things when they use the words "trap" and "pot". In general, traps are large structures fixed to the shore. Pots are smaller, movable traps, enclosed baskets or boxes that are set from a boat or by hand.

Literature on fish pots is not overwhelming

Collected old and new refs in pdf files

Efficiency of pots:
1.5% on Gadoids (Valdemarsen et al., 1977)
2 % on Puffer fish (Hirayama et al., 1999)
<1% on Sablefish (Rose et al., 2005)
Potting in Europe
Turkey

Evaluation of the relative catching power of pots for north European wrasse
By J. W. Treasurer, J. Appl. Ichthyol., 1999
Fish pot experiments in the Faroe Islands to develop a commercial pot for traditional species

- Long lasting bait
- Alternative stimulation
- Pot design (shape, size, entrance etc.)

Examples of video recordings
Equipment
Equipment

Depths: 20-50 m

Long lasting bait
Cod keep distance downstream from the pot

A ‘pyramid’ pot with entrance on top
Territorial cod

Fish did not react to chasing light
Conclusions
Equipment and observation technique has been succesful
Long lasting bait: a useful system has been developed
Pot entrance should face downstream or be accessible from all sides
Need more work on effective entrance
Need more work on design (shape, size) of pot and how this affect fish behaviour. A pyramid shape may be an alternative
Alternative stimulation: only initial experiments – no success yet

Future work:
Pot shape
Bait (bait soup pump)
Transparent pot
Optomotor (LEDs, moving object)
Light
Sound
(Electricity)
If you are enthusiastic about this subject and have ideas that you want to share with me, you are invited to visit me and work with me on the gear of the future!

**Invitation**
ICES-FAO FTFB SGPOT

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 XXXXX for the attention of the Fisheries Technology Committee and the findings of the SG will be reported in an ICES Cooperative Research Report.

Thank you!

Welcome to the Faroe Islands
- 18 green islands in the world’s cleanest ocean
- a wild and beautiful environment which offers many exciting experiences

A32
The Norwegian Pot Story

Svein Løkkeborg
and
Odd-Børre Humborstad

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Email: svein.lokkeborg@imr.no

The Start:
The Sablefish Pot used in Alaska

Problems:
- Low catches of cod
- Too big for our coastal vessels
• Use by a few vessels targeting tusk
• Too low catches of cod

Collapsible Pot

Cod Do Not Like Narrow Funnels
However, They are Good at Escaping

Double Funnel: one wide and one narrow

Problem:
The position of the bait bag

Gave a three-fold increase in catches of cod, but still too low
The Position of the Bait Bag is Crucial

The Two-Chamber Pot
Vertical Search Pattern

The Two-Chamber Pot
"Oh shit, these bloody crabs"

Floated Pot
Catch Rates Cod
Floated pots caught 45% more cod

Approach Direction
Approach Direction Bottom-Set Pots

4 %

96 %

Approach Direction Floated Pots

95 %

5 %
The Ideal Pot for Cod

- Floated
- Odour plume out of the funnel
- A wide funnel
- Double funnel?
- Two chambers separated by a narrow funnel
- Long-lasting bait
- Visual stimulus
- Other stimuli

Trap/pot experiments
Conclusion

• Increase rate of attraction
  • Long-lasting bait
• Increase rate of entry
  • Improve entrance design
  • Additional stimuli
  • Long-lasting bait
Development of Baited pots for harvesting cod (*Gadus morhua*) in Newfoundland and Labrador, Canada

Philip Walsh, Wade Hiscock & Rennie Sullivan
Centre for Sustainable Aquatic Resources
P.O. Box 4920
St. John’s, NL, Canada
A1C 5R3

Ph: 709-778-0521
http://www.mi.mun.ca
http://www.mun.ca

WHY POTTING TECHNOLOGY

- Environmentally friendliness
- High discard survivability
- High quality of the catch
- Good species and size selectivity
- Good source of live fish
- Management perspective: The ability to tag more fish for less fish harvested (Fish are much better shape).
- No unaccounted mortality due to poor weather.
- Minimal ghost fishing due to netting escape vents, and opening in triggers

www.mi.mun.ca
WHY POTTING TECHNOLOGY

Many governments, environmental awareness groups, Individuals, etc. are prepared to ban trawling. If this happens potting technology may be an unavoidable alternative.

Cod pots catch fish they do not kill fish

Project Goals

- Design an appropriate style of cod pot for Newfoundland inshore vessels
- Build prototypes and conduct tests
- Conduct sea trials to evaluate commercial feasibility and to recommend further improvements as required
- Conduct underwater observations to monitor fishing performance and fish behavior and recommend improvement in design and operation of the pots.
- The main focus was to see if we could develop a cod pot that could catch commercial amounts of Atlantic cod
Experimental Testing

Experimental Testing Of Cod Pots
South West Coast, NL (Nov. 2000)
– Funnels vs. no funnels
– Floating Roof Sections

Cod Pot Sea Trials, May 9-20, 2001
Placentia Bay Newfoundland
– Circular Funnels
– Floating Roof Sections

Experimental Testing
2000/01

• Funnel System to guide fish to an entrance and pot interior volume was essential to improving catchability

• Weather was a major problem and resulted in many lost sea days. One positive from the lost sea days was the number of days fish were in the pots (up to 10 days) and when retrieved all fish were active with no mortalities.
Experimental Testing
2003/04 Study Area

Bar Haven Bank area in Placentia Bay on the south coast of the island in NAFO division 3Ps.

Depths ranged from 10 ftm to 65 ftm.

Bottom water temperatures ranged from 2.2 to 7 °C.

Soak Times varied from Day to Day due to bad weather.

Fishing Trials
2003

Commercial gillnets with monofilament twine and 5 ½-inch mesh size was used as the control gear to ensure there were Atlantic cod in the area being fished by the pots and for catch comparison purposes.

As well, handlines were used to verify fish availability to the gears types before and after setting.

Two types of bait were used during the experiment, squid (*Illex illecebrosus*) and mackerel (*Scomber scombrus*).
### Results

**Cod catch and Comparisons Pots (December 2003)**

The circle 5 was compared to trapezoid P, Trapezoid S, Ramp 5 to see if entrance styles played a role in catchability. Also, there were two pots (Ramp 6 and Circle 6) used to see if pot size (Volume) played a role in catchability.
Results

Cod catch and Comparisons Pots (December 2003)

Two 50 ftm (5.5 inch mesh size) gillnets were fished alongside the two Circle 5 and Circle 6a pots for a total of 7 sets. Over the seven sets, the Circle 5 pots harvested 37 fish with a CPUE of 0.094, the gillnets harvested 52 fish with a CPUE of 0.082 and the Circle 6a pot captured 104 fish with a CPUE of 0.24.

<table>
<thead>
<tr>
<th>Pot Type</th>
<th># of sets</th>
<th>Catch # = n</th>
<th>CPUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle 5</td>
<td>7</td>
<td>37</td>
<td>0.094</td>
</tr>
<tr>
<td>Circle 6a</td>
<td>7</td>
<td>104</td>
<td>0.24</td>
</tr>
<tr>
<td>Gillnet</td>
<td>7</td>
<td>52</td>
<td>0.082</td>
</tr>
</tbody>
</table>

Size Selectivity Pots and Gillnets 2003

Circle 6 (n=562),
Circle 5 (n=87) gillnet catches (n=104).

Circle 6 pots
Range of 42 cm to 93 cm. 576g- 3493g, mean 54.3cm/1296g.

Circle 5 pots
Range of 47 cm to 83 cm 872g to 4640g mean 56.5cm/1640g.

Gillnets
Range of 47 cm to 81 cm 840g to 2969g, mean 64.3cm/2142g.

Results 2003
Results

2003

During the experiment in 2003, funnel length in the Circle 6 (a, b & c) pots were compared to see if length of funnel made a difference in catch and size of fish captured. Five sets were completed on the pots There was no significant difference based on length of funnels. Funnel lengths were 16, 20 and 24 meshes deep of 2” white knotless nylon.

Results

2004

There was a significant difference in CPUE of Circle 6 pots vs. Circle 5 pots.

When further tests were completed on funnel depth and Funnel inside opening there was no significant difference. Funnel inside opening was 14 & 16 inches.

The majority of cod entering the pot entered within the first 12 hours.
Four prototype pots were constructed for testing in December 2004; these pots were similar to the successful (Circle funnel) pots fished in 2003.

Fishing Trials 2005

Harvesters in the Sentinel Fishery fished two to four pots at different times during the 2005 season. The commercial harvester from Labrador fished up to 10 pots in late July and September during the commercial cod fishery. The pots in the Sentinel Fishery were set alongside traditional gears (gillnets and longlines) and in Labrador, pots were fished on traditional grounds where commercial harvesters were fishing.
Results 2005

At-sea experimental testing program that was conducted during the Newfoundland and Labrador Sentinel Fishery and in the commercial cod fishery from coastal Labrador in 2005. Experiments were carried out between July and Dec by harvesters in NAFO Divisions 3Ps, 3L, 4R and 3K.

These tests were completed to look at catchability based on time of the year.

Collapsible Pot

www.mi.mun.ca
Results 2005

Pots are a seasonal type fishery.

In NL they work best from September to December

They will most likely work well in early spring when fish are very hungry.

Catches in summer months are substantially less than gillnets but gillnets have a major problem with quality at this time.

In the fall Pots harvested as much as the gillnets Two pots had a mean CPUE of 51.5 fish while one 50 ftm gillnet 5.5 inch mesh had a CPUE of 30.8 fish for 24 hour set.

Gillnets with 24 hour set did have fish that was of lower quality. Pot no dead fish.

All fish from pots given to plant in the area was grade A quality.

What do we know about Cod Pots in NL

Pots can catch commercial amounts of cod at certain times of the year (Fall). Catches have been as high as 59 fish in one set for a total of Approx 357lbs.

Mass. Division of Marine Fisheries has used the pots for tagging cod during potting experiments 2005.

If in areas where lobsters are present pots will have to be outfitted with lobster escape vents to deduce by-catch.

Other by-catch can be released alive.
What do we know about Cod Pots in NL

Is it the pot or the fish that determine catchability/efficiency.

It is both.

Fish condition
- Spawning
- Are bait fish present
- Are fish Hungry

Bait

Current Direction

Bait Smell

Thank-you
Pot Fishing and Research Western USA

Craig S. Rose

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Three Main Subjects

Pot fisheries and pot development
Basic behavioral information/model
Behavior studies
Sablefish pot development
(late 60s early 70s)

Making Fish Pots from Alaska Crab Pots

Lead to: Smaller Pots
(foldable, stackable, etc)
Small Pots are Longlined

Figure 1.—A pictorial view of a string of rockfish trapping gear.
Alaska Cod Pot

Recording triggers
Al Stoner’s Bait Capture Papers


Baited fishing gear behavior model
Observing Fish Near Pot with Sonar and Camera

Tests and environmental conditions

Observations
Within 1 m of a 1 x 2 m fish pot (and baited hooks)
5 – 10 m away from (downstream) bait

Tools
ICCD camera with infrared illumination
DIDSON sonar ‘camera’

Environment
366 m deep
current 2 – 15 cm/sec
Temperature 5.5 – 6.5 degrees C
Light < 10⁻⁷ micromoles-photons m⁻¹ s⁻¹
Observing Fish Near Pot with Sonar and Camera

Number of Fish by Time

![Graph showing number of fish by time.](image)
Highlights of results from pot/hook study

Of 2000 + 5000 entries of sablefish into the observed field (sonar) 19 sablefish were caught.

Restricted view of video camera can give a biased impression of fish abundance and behavior

- particularly dependant on relation of observed side to current direction

‘Rotating’ Sonar Mount
Range 5-10 m
Launch of Rotating Sonar Mount

Sonar Image
Sonar Image
With background subtraction

Tracks (Set 3)

0 - 0.5 Hr
0.5 - 1 Hr
1 - 2 Hr
2 - 3 Hr
Initial highlights from ‘approach’ study

Fish commonly 5 – 10 m from bait

Much fish motion is circulation around the bait, not just to and from the bait

Ways Forward

Improved pots

Improve proportion entering
Active tunnels
Behavioral tuning
Volume / Number optimization
Bait optimization
Ways Forward –
Alternative combinations/gear

Baited tangle gear (short gill nets)
   Angles of crossing

Bait combined with active gear
   Time to highest concentration
   Local bottom disturbance as bait
It isn’t the Pot – It’s the Cod

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East Coast Pots

Lobster *Homarus americanus*,
scup *Stenotomus chrysops*, Black Sea Bass *Centropristis striata*,
Channeled whelk *Busycon canaliculatum*, Red Crabs

Flounders: David Beutel; Pingguo He and Kelo Pinkham: Not much luck; low densities

Gadoids: P. He and Proctor Wells: Not much luck; low densities. Pot modified from CSAR design

Cliff Goudey and Mathew Thompson: Round pot; no luck
CSAR Pots

Frame: Either coated wire (183 cm by 183 cm by 106 cm), 16 mm rigid steel frame, or collapsible steel (183 cm by 183 cm by 102 cm).

Top: 30 M of 10 cm diamond PE with float.

Entrances (2): Rectangular opening, 41-cm ring with SS one-way triggers spaced ~5 cm apart. 20 M of 2.5 in nylon

Bait: Squid, salted herring, clam, scallop, other using buckets, cages, and skivers.

Results

348 cod in 137 soaks; 2.5 cod/soak; first ever! Maximum of 13

Length range = 32-75 cm; average = 47 cm

Construction type did not matter

Location mattered

Cod in pots had empty stomachs, and were not spawning.

Pot alterations had no impact

Zero mortalities and many recaptures
Results

Atlantic Cod

Inside the Box
Nip at String

Loose Bait Frenzy plus Penetration
Entrance Attempt?

Conclusions and Directions

Pots can catch cod in two seasons; changing entrances did not improve catches.

Focus on hunger and spawning relationships.

Compare pots to longlines – although same season.

Alter bait contrast or induce flashing - feeding “frenzy” necessary?

Or is it just density dependent?
Feasibility of a Directed Atlantic Haddock Pot Fishery in the Gulf of Maine

Ken La Valley,
University of New Hampshire and NH Sea Grant
Nesmith Hall, Durham, NH 03824
and
Kelo Pinkham, ME Fishermen
Bill Lee, MA Fishermen

Why a Haddock Pot Fishery?

• recent increase in abundance of the Gulf of Maine haddock,

• recent unexpectedly low projection of cod abundance, and

• inability of the current means of harvest to access these fish without the taking of excessive amounts of bycatch (species of greatest concern being Cod).
Project Objectives

- Evaluate three trap designs for their ability to catch fish in general, and target Haddock.

- Evaluate fish behavior in and around fish traps using underwater video.

- Evaluate three several baits for their ability to catch fish in general, and target Haddock.
Trap Designs

Pacific Cod Pot
- Offset Entrance Head Trap
- 48” Mesh Balloon
- 9” x 18” Funnel Eye w/ Triggers
- Collapsible

Alaskan Crab Pot
- In-line Entrance Head Trap
- 9” x 18” Funnel Eye
- Triggers
- Collapsible

Trap Designs Cont.

Norwegian 2-Chamber Pot
- two 30” chambers
- 15” Mesh Balloon
- 20” Entrance w/o Triggers
- Collapsible

* Photograph courtesy of Bill Lee
Evaluated Bait Types

- Artificial haddock bait (NORBAIT)
- Surf Clam - shucked, bait quality
- Herring - bait quality

Norbait™ is manufactured by restructuring waste fish and fish offal from processing industry and mixed with gelling agents, binders and other attractants. The mixture is then extruded into a fiber mesh tube for a continuous "sausage".

Road Blocks

- Field trials were scheduled for spring and summer 2006 during high abundance of inshore haddock.
- NMFS EFP permitting process delayed experiments until October.
- Charter vessels and gill net fishermen reported low haddock catch rates. October is the tail end of haddock movement out of the inshore area.
- We decided to begin trials to evaluate design construction and camera systems.
Initial Results

Conducted (5) Experimental hauls with 24 hour soak times.

Initial results appear to indicate the Norway design to be most effective and the whole clam bait to perform the best.

Off-Set Entrance Pacific Cod Pot Design

* Photograph courtesy of Bill Lee
What Can We Say?

• Each pot design successfully caught fish.
• Seasonal correlation between fish abundance and trap CPUE probably accounted for low catch.
• The Norway trap w/ surf clam bait appeared to be the most successful combination.
• Field trials are scheduled to begin in April/May 2007 when high haddock abundance is observed.

Potential Modifications

• Evaluate a “Floated” two-chamber design to eliminate lobster/crab bycatch, and allow free rotation with current which will maintain optimum bait plume directionality.

• Add triggers to the two-chamber design?
Fish Potting in Asia
and Some Recent Works in Japan
Philippines
Malaysia
UAE
Thailand (A.Boutson)
Indonesia (J.Haluan)
Korea (An Young-II)
Taiwan
Okinawa

T.ARIMOTO (Tokyo Univ.of Mar.Sci.&Tech.)  tarimoto@s.kaiyodai.ac.jp

Fish pot in Asia
Fish Pot in U.A.E
Bycatch and Its Reduction from Blue Swimming Crab Pot Fishery in Thailand

By

BOUTSON Anukorn, MAHASAWASDE Chaichan, MAHASAWAS Songsri and ARIMOTO Takafumi

Collapsible blue swimming crab pot
A set of single crab pot

**Body**
- Iron structured
- Box shape
- PE 38 mm
- Hook

**Float line**
- PP rope
- Length 2-3 times of water depth
- small lead (sinker)

**Float**
- Plastic/Foam

Collapsible crab pot (single pot) operation

- 200-300 pots
- 6-8 m boat length

- One man operation
- 12-24 hr Soaking time
Commercial crab pot boat

- 2,000—5,000 Pots/boat
- Hauling machine

Escaping from the lower side panel position (VDO)
Fish Pot in Indonesia
Pot in Korea

Fish Pot in Taiwan

from Fishing Gear and Methods
by Prof. Chou
Fishing Activities in Okinawa Coral Reef

• Angling
• Hook and line
• Longline
• Trolling
• Net Fishing
• Set-net
• Drive-in net
• Gill net
• Others
• Fish Pot
• Spearing for lobster and turtle
• Diving collection for octopus, cuttlefish, shells and urchins, and sea algae

Fishing Grounds for **Fish Pot** and **Set-net** in Coral Lagoon
Fish Pot in Coral Reef Area

Operation Process with Underwater Diving Works

Set on the sandy bed

Bait setting

Set on the Coral area

Spearing

Pot bait (Head and guts of tuna and skipjack)

Diving apparatus with Air Compressor

Spearing harvest

Individual collecting

Pot hauling
Pot, Trap, Basket, Tube, ……

- Bamboo / wooden frame
- Chicken cage
- Longline setting
- How many……?

Pot Fishing in Japan

- Snow crabs: 61%
- Shrimp: 6%
- Conch: 17%
- Other crabs: 7%
- Hairy crab: 3%
- Sea Urchin: 1%
- Cuttlefish: 2%
- Octopus: 2%

Annual Catch on 1980

85,000 ton
0.3 Billion $
Behavior of Puffer *Lagocephalus* and the Fishing Mechanism of the Pot Trap

Mamoru Hirayama, Shigeru Fuwa, Munechika Ishizaki, and Takehiko Imai

Nippon Suisan Gakkaishi 65(3), 419-426 (1999) 636 (349) 431 (135)

**Side view**

**Plane view**

**Approach**

**Enter**

**Feeding**

**Captured**

**Appear**

**Disappear**

**Escape**

Fig. 5. Behavior sequence chart of puffer to the trap. Bracketed numbers shows the result of tank experiments and make it possible to show to the trap.

Fundamental studies on the hydrodynamic resistance of small pot traps.

Fisheries Science 70 (6), 952-959. 2004

BUDIMAN J, FUWA S. & EBATA K.

(a) Netted semi-cylinder; (b) Wire semi-cylinder; (c) Heart; (d) Box; and (e) Cylinder shape.
Schematic of the experimental apparatus used to measure hydrodynamic resistance.

Flow: 0.1 - 0.5 m/s

Re = 10^3 - 6.7 x 10^4
Behavioral responses of arabesque greenling to trap entrance design.
LI Yong, YAMAMOTO K., HIRAISHI T., NASHIMOTO K. & YOSHINO H.

Arabesque greenling *Pleurogrammus azonus*

(a) Commercial trap dimensions, and
(b) simulated trap entrance model
(a) Fish swims towards the model, (b) fish approaches the model, (c) fish is passing, (d) fish has passed through the trap entrance.
What can we learn from …?

• Comparison from others
  – Gill net, longline, hand line, … trawl,…?
• Comparison from other traps
  – crustaceans
• Possibility for trawl ban alternatives…?
  – Eco-friendly aspects
  – Size / species selectivity
• Possibility for increasing efficiency

Research Topics

• Enter / Escape
• Inter/Intra-specific Behaviour inside pot
• Accumulation and Soaking Time
• Density related aspects

• Improving efficiency
  – Larger space
  – Long-line system with collapsible/piling-up
  – Entrance / Funnel design
  – Bait