Pot Fishing and Research Western USA

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Three Main Subjects

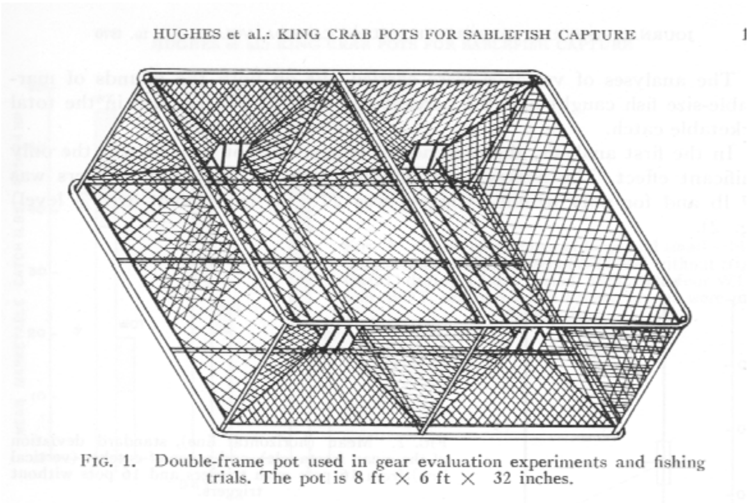
Pot fisheries and pot development

Basic behavioral information/model

Behavior studies

Sablefish pot development (late 60s early 70s)

Making Fish Pots from Alaska Crab Pots



HUGHES et al.: KING CRAB POTS FOR SABLEFISH CAPTURE 1

FIG. 1. Double-frame pot used in gear evaluation experiments and fishing trials. The pot is 8 ft × 6 ft × 32 inches.

Lead to: Smaller Pots (foldable, stackable, etc)

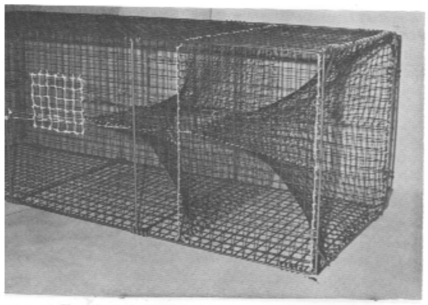


Figure 7.—A tandem tunnel trap showing a cotton destruct panel.

Fishery Facts 7

a trapping system for harvesting sablefish,

Anoplopoma fimbria

Small Pots are Longlined

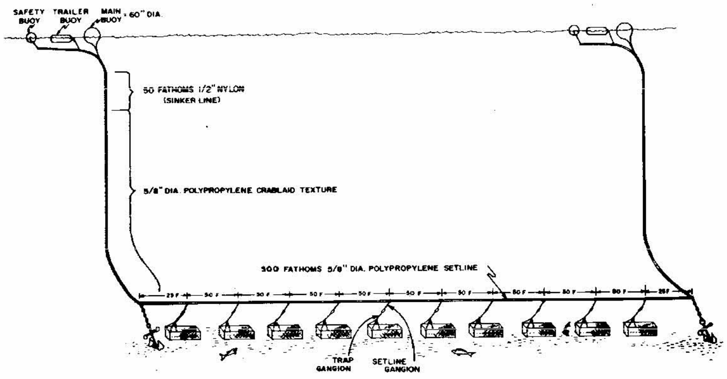
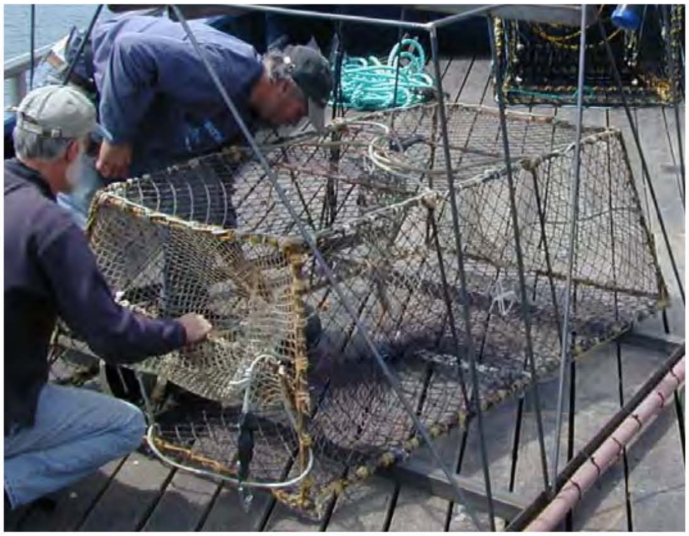
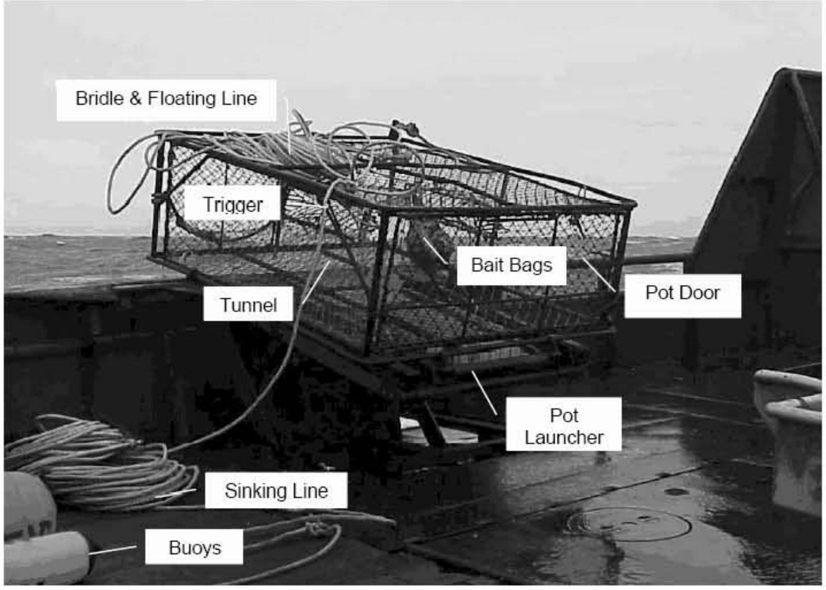

SAFETY BUOY
TRAILER BUOY
MAIN BUOY - 60" DIA.
50 FATHOMS 1/2" NYLON (SINKER LINE)
5/8" DIA. POLYPROPYLENE CRABLAID TEXTURE
500 FATHOMS 5/8" DIA. POLYPROPYLENE SETLINE
25 F
50 F
50 F
50 F
50 F
50 F
50 F
50 F
50 F
50 F
50 F
25 F
TRAP GANGION
SETLINE GANGION

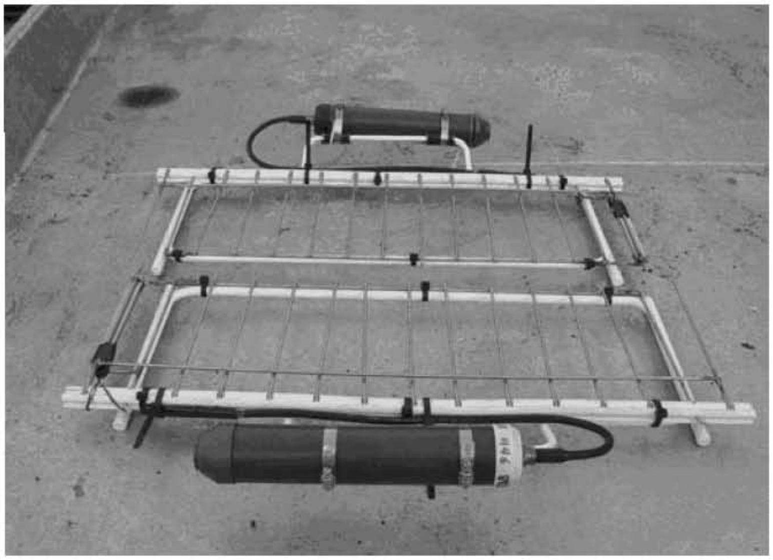
Figure 1.— A pictorial view of a string of sablefish trapping gear.



Alaska Cod Pot


Bridle & Floating Line
Trigger
Bait Bags
Pot Door
Tunnel
Pot Launcher
Sinking Line
Buoys

Recording triggers



Al Stoner's Bait Capture Papers

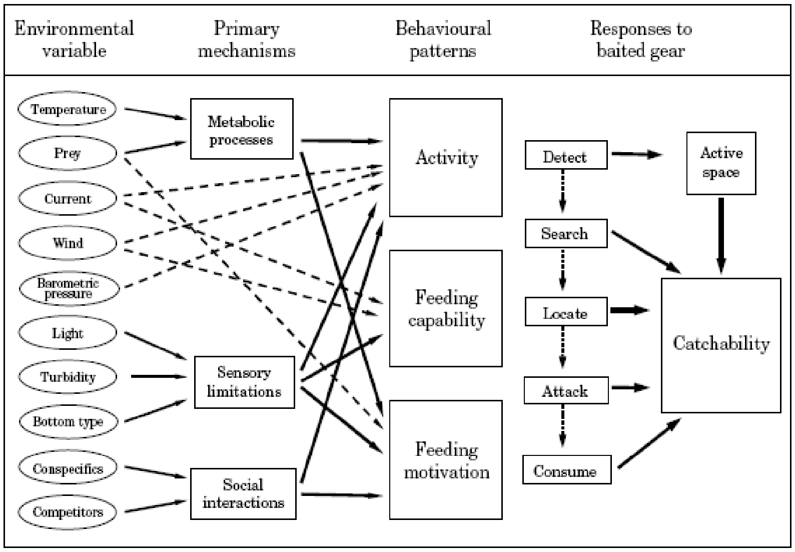
Stoner 2003 Hunger and light level alter response to bait by Pacific halibut: laboratory analysis of detection, location and attack.
Journal of Fish Biology (2003) 62, 1176–1193

Stoner 2004. Effects of environmental variables on fish feeding ecology: implications for the performance of baited fishing gear and stock assessment. Journal of Fish Biology (2004) 65, 1445–1471

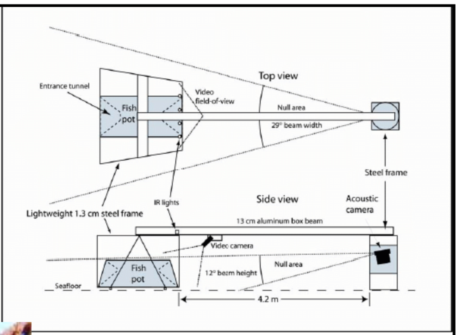
Stoner and Ottmar 2004. Fish density and size alter Pacific halibut feeding: implications for stock assessment.
Journal of Fish Biology (2004) 64, 1712–1724.

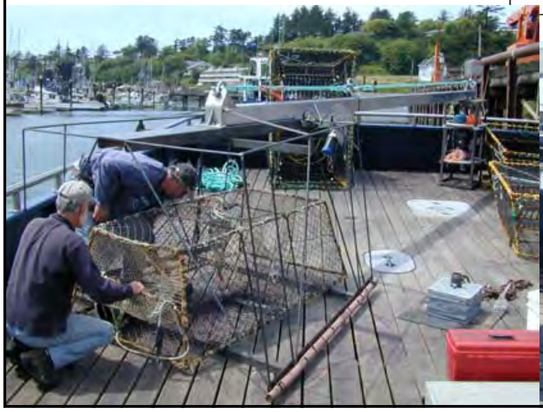
Stoner and Strum 2004. Temperature and hunger mediate sablefish (*Anoplopoma fimbria*) feeding motivation: implications for stock assessment.
Can. J. Fish. Aquat. Sci. **61**: 238–246.

Baited fishing gear behavior model


Environmental variable
Primary mechanisms
Behavioural patterns
Responses to baited gear
Temperature
Prey
Current
Wind
Barometric pressure
Light
Turbidity
Bottom type
Conspecifics
Competitors
Metabolic processes
Sensory limitations
Social interactions
Activity
Feeding capability
Feeding motivation
Detect
Search
Locate
Attack
Consume
Active space
Catchability

Observing Fish Near Pot with Sonar and Camera


Top view
Entrance tunnel
Fish pot
Video field-of-view
Null area
29° beam width
Steel frame
Side view
Acoustic camera
IR lights
Lightweight 1.3 cm steel frame
13 cm aluminum box beam
Video camera
Fish pot
12° beam height
Null area
Seafloor
4.2 m



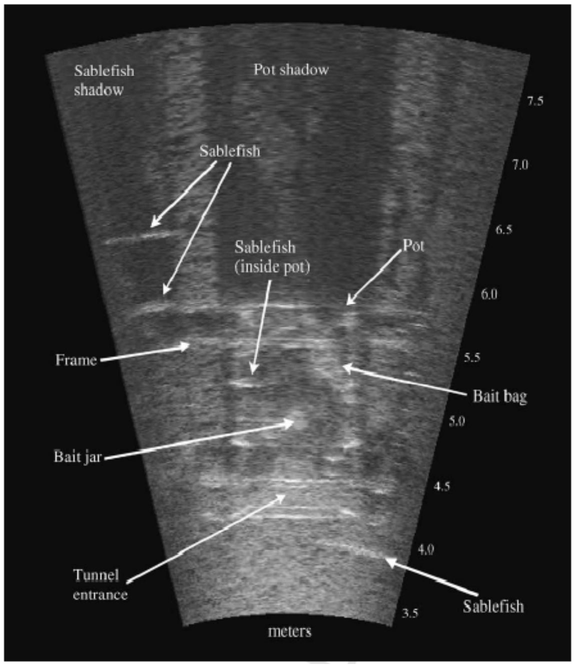
Tests and environmental conditions

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

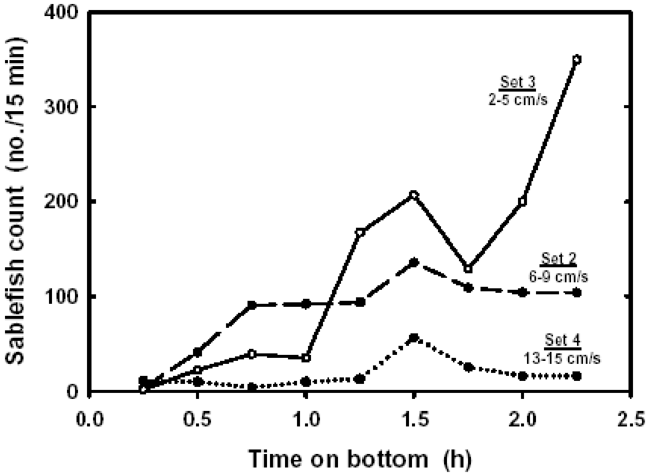
Tools
- ICCD camera with infrared illumination
- DIDSON sonar ‘camera’

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


Sablefish shadow
Pot shadow
Sablefish
Sablefish (inside pot)
Pot
Frame
Bait bag
Bait jar
Tunnel entrance
Sablefish
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
meters

Number of Fish by Time

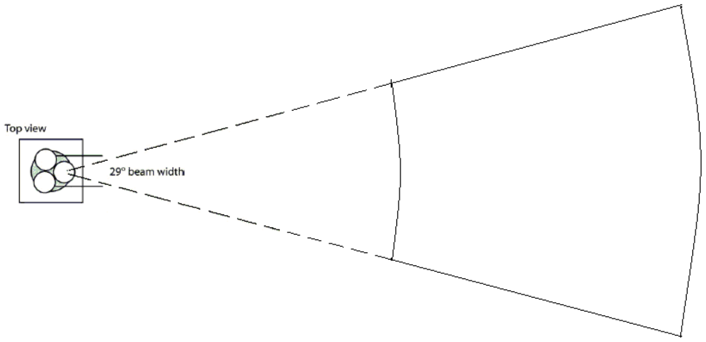


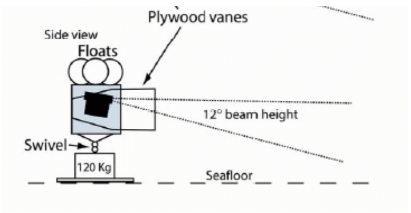
Highlights of results from pot/hook study

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


Top view
29° beam width

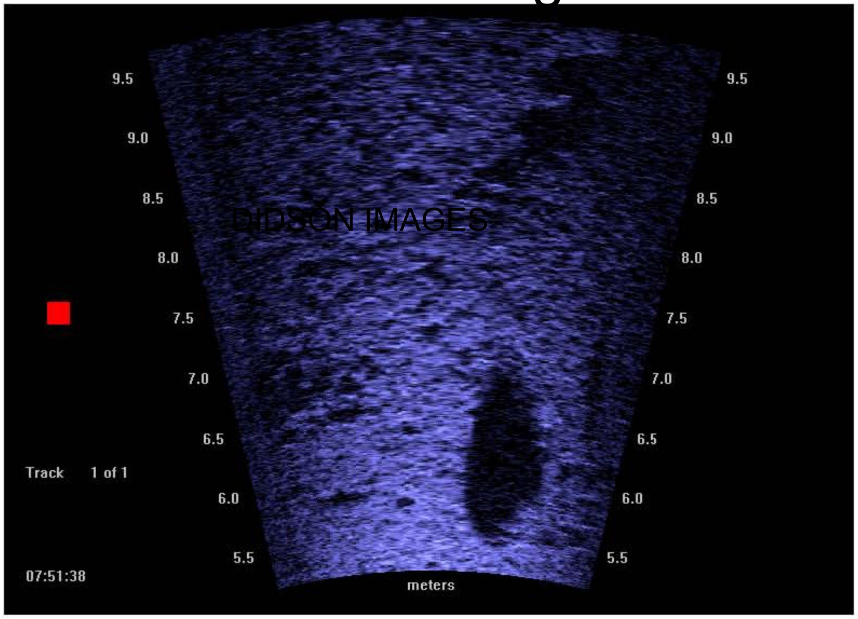

Side view
Floats
Plywood vanes
12° beam height
Swivel
120 Kg
Seafloor

‘Rotating’ Sonar Mount

Range 5-10 m

Launch of Rotating Sonar Mount

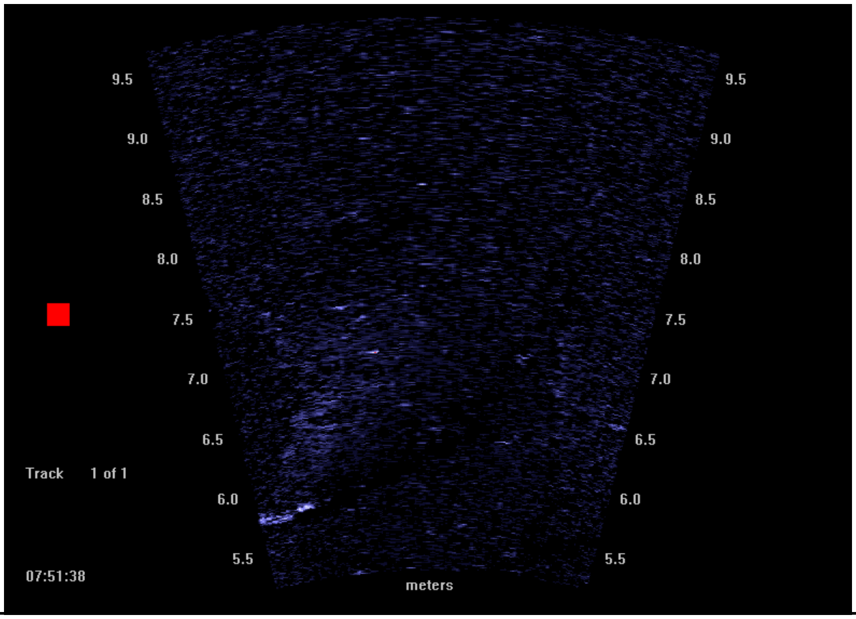
Sonar Image


9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
Track 1 of 1
07:51:38
meters

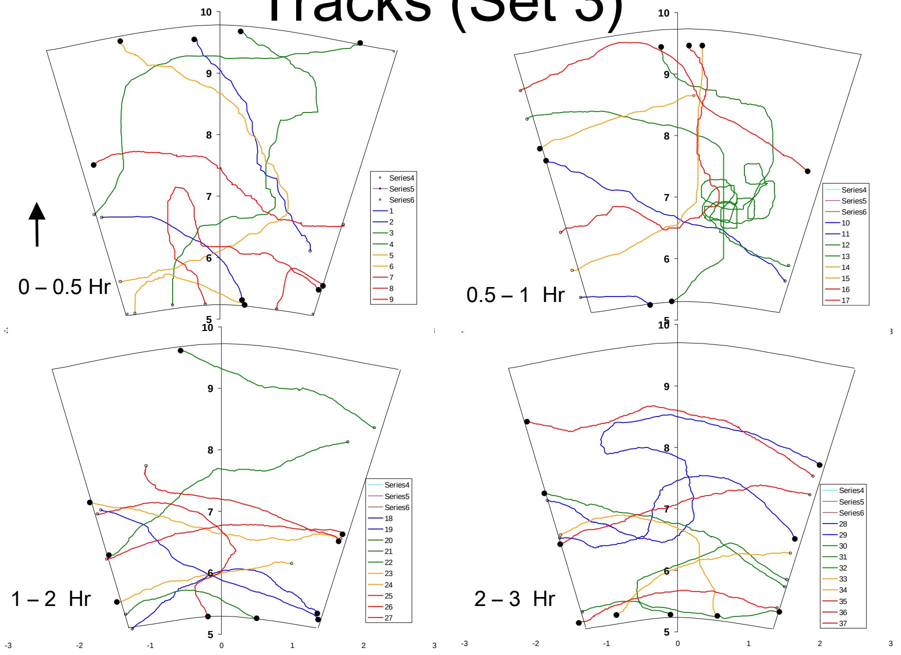
DIDSON IMAGES

Sonar Image

With background subtraction


9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
Track 1 of 1
07:51:38
meters

Tracks (Set 3)



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

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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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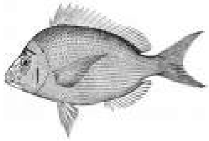
East Coast Pots

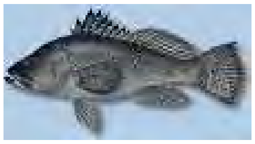
Lobster *Homarus americanus*, scup *Stenotomus chrysops*, Black Sea Bass *Centropristis striata*, Channeled whelk *Busycon canaliculatum*, Red Crabs

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





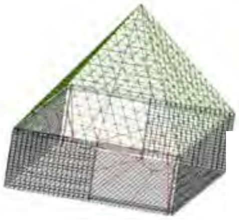
CSAR Pots

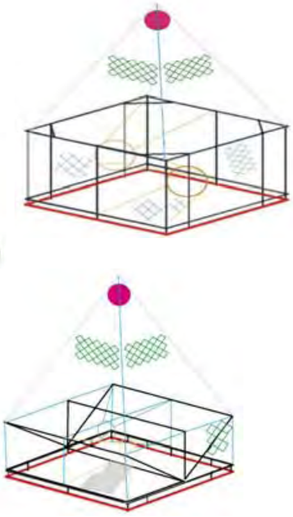
Frame: Either coated wire (183 cm by 183 cm by 106 cm), 16 mm rigid steel frame, or collapsible steel (183 cm by 183 cm by 102 cm).

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

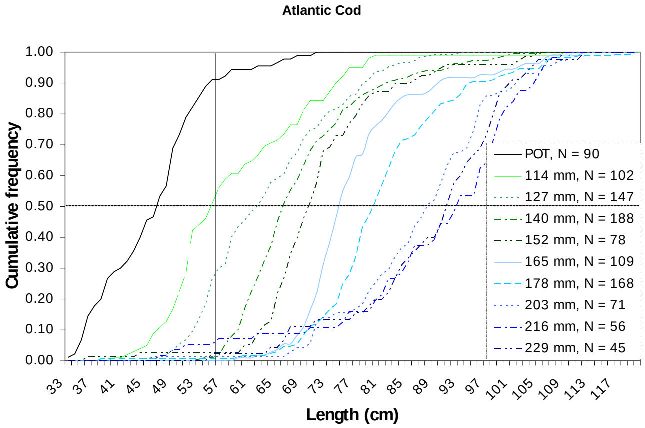
Location mattered

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

Pot alterations had no impact

Zero mortalities and many recaptures

Results



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.

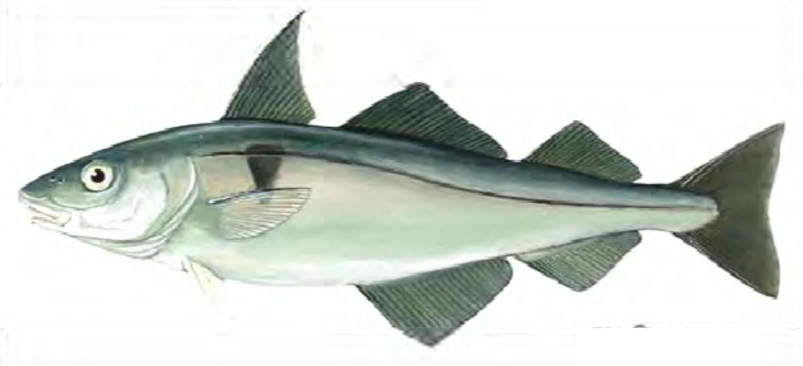
Focus on hunger and spawning relationships.

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



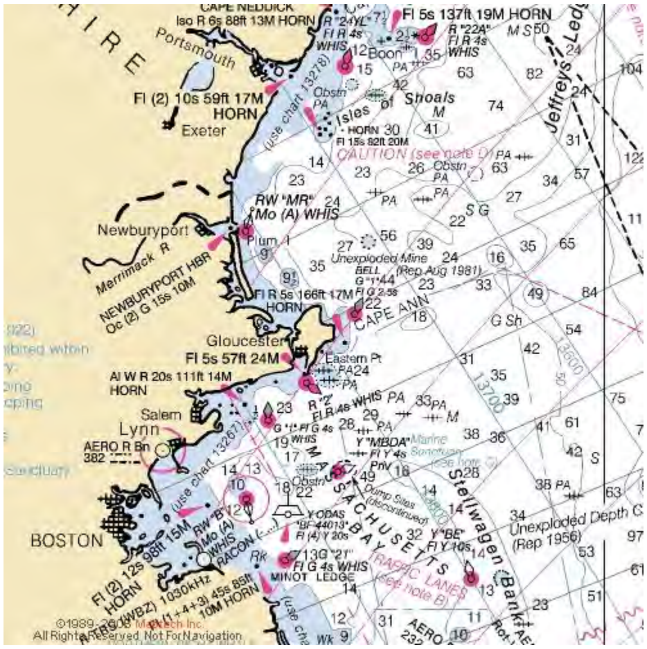
Ken La Valley,
University of New Hampshire and NH Sea Grant
Nesmith Hall, Durham, NH 03824
and
Kelo Pinkham, ME Fishermen
Bill Lee, MA Fishermen

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.


CAPE NEDDICK
Portsmouth
Isles of Shoals
Jeffreys Ledge
Exeter
Newburyport
Merrimack R
NEWBURYPORT HBR
Plum I
CAPE ANN
Gloucester
Eastern Pt
Salem
Lynn
BOSTON
MINOT LEDGE
MASSACHUSETTS BAY
Stellwagen Bank
CAUTION (see note D)
Unexploded Mine (Rep Aug 1981)
Unexploded Depth C (Rep 1956)
TRAFFIC LANES (see note B)
Dump Sites (discontinued)
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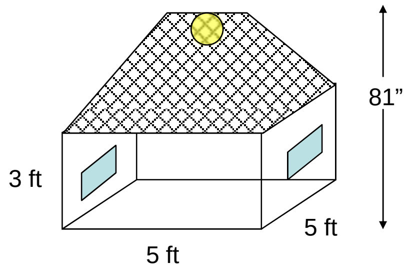
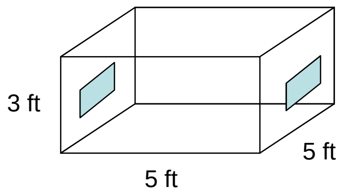
Trap Designs


3 ft
5 ft
5 ft
81”

Pacific Cod Pot

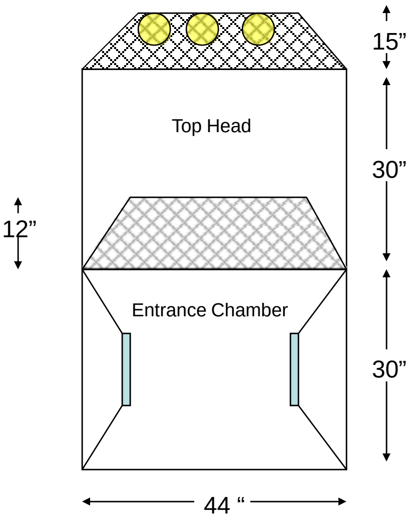
- Offset Entrance Head Trap
- 48” Mesh Balloon
- 9” x 18” Funnel Eye w/ Triggers
- Collapsible



Alaskan Crab Pot

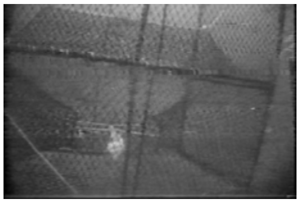
- In-line Entrance Head Trap
- 9” x 18” Funnel Eye
- Triggers
- Collapsible

Trap Designs Cont.


15”
Top Head
30”
12”
Entrance Chamber
30”
44 “

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 continous "sausage".

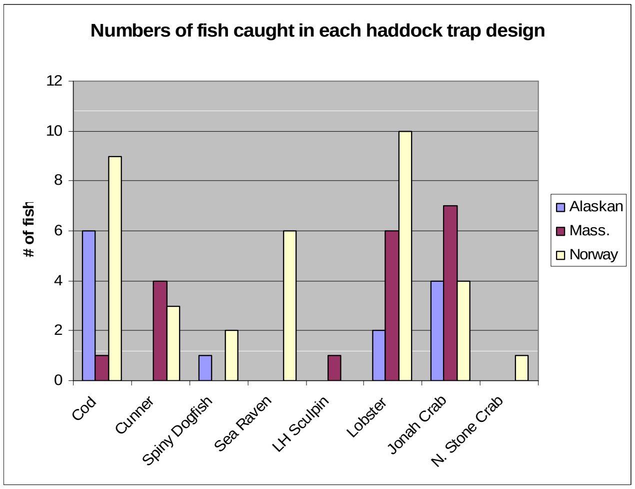
Road Blocks

- 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.

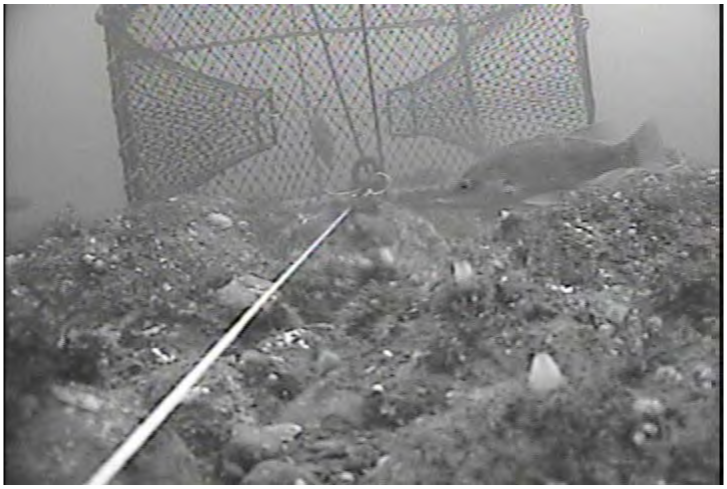
Initial Results

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

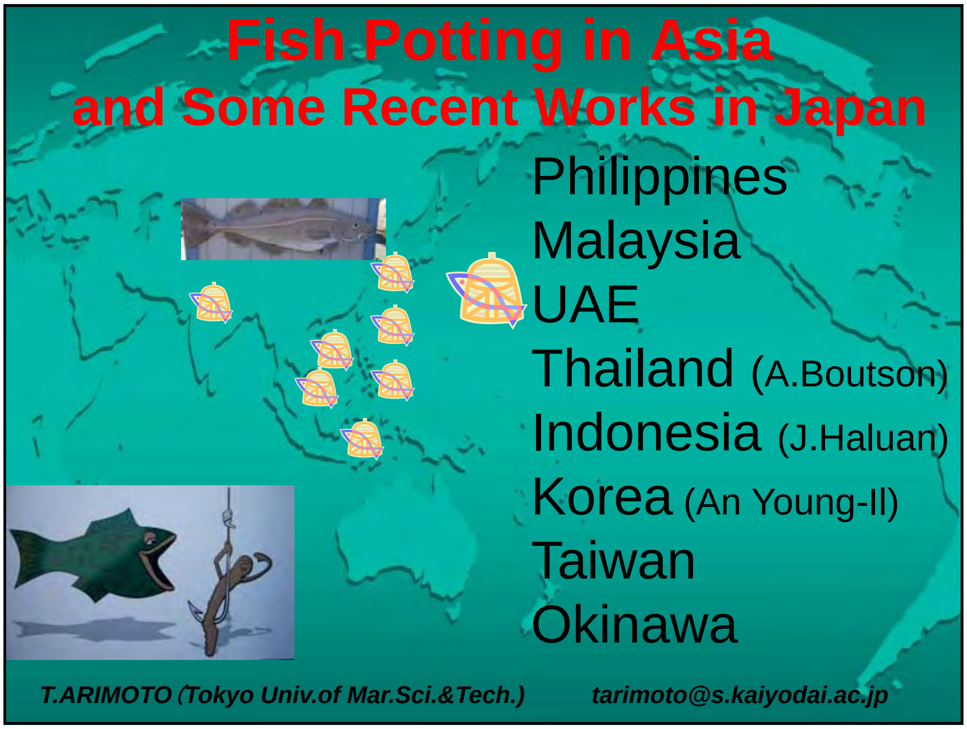
What Can We Say?

- 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?



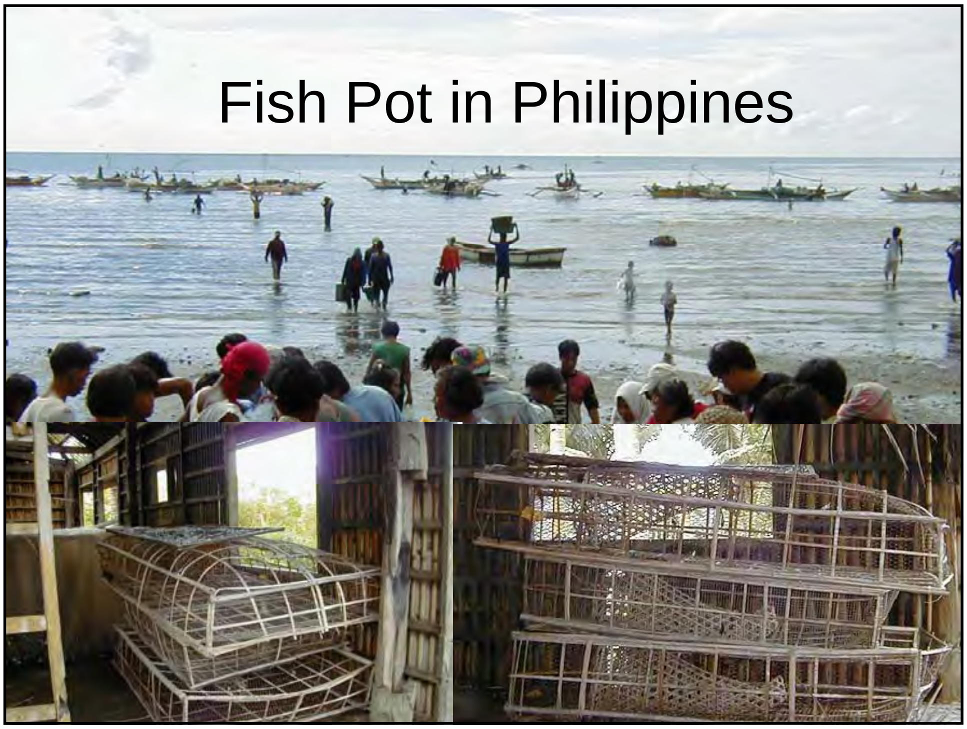
Fish Potting in Asia and Some Recent Works in Japan

- Philippines
- Malaysia
- UAE
- Thailand (A.Boutson)
- Indonesia (J.Haluan)
- Korea (An Young-Il)
- Taiwan
- Okinawa

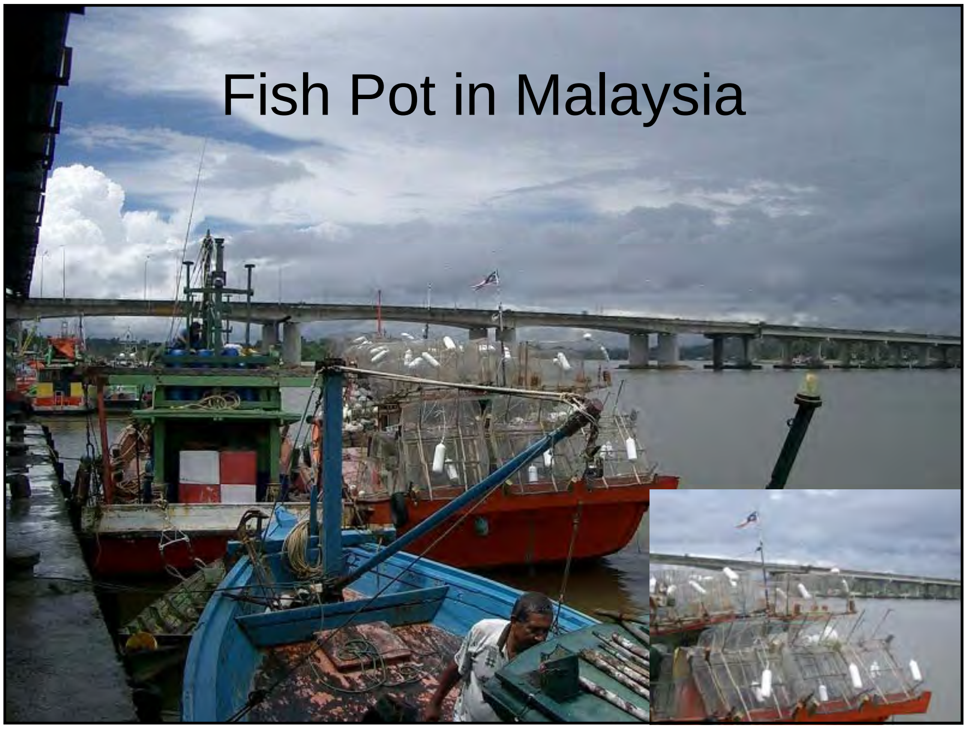
T.ARIMOTO (Tokyo Univ.of Mar.Sci.&Tech.) *tarimoto@s.kaiyodai.ac.jp*

Fish pot in Asia

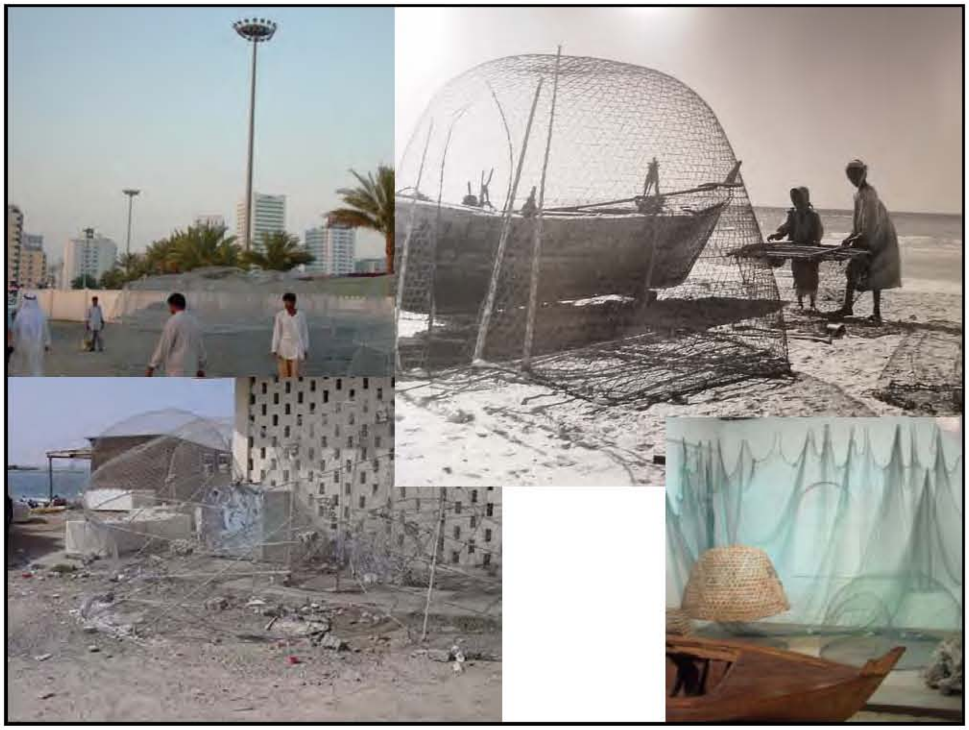
Fish Pot in Philippines

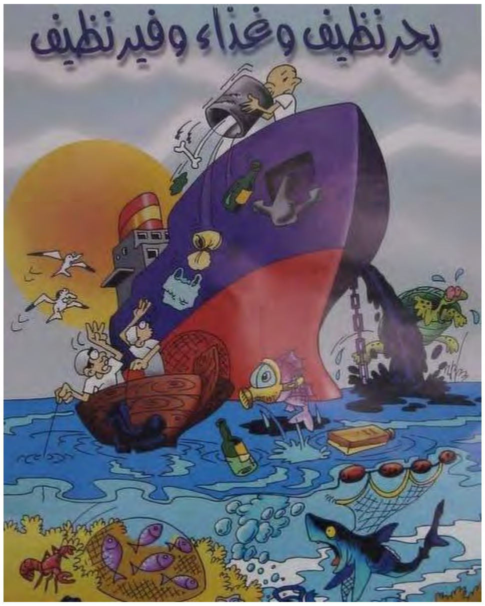


Fish Pot in Malaysia

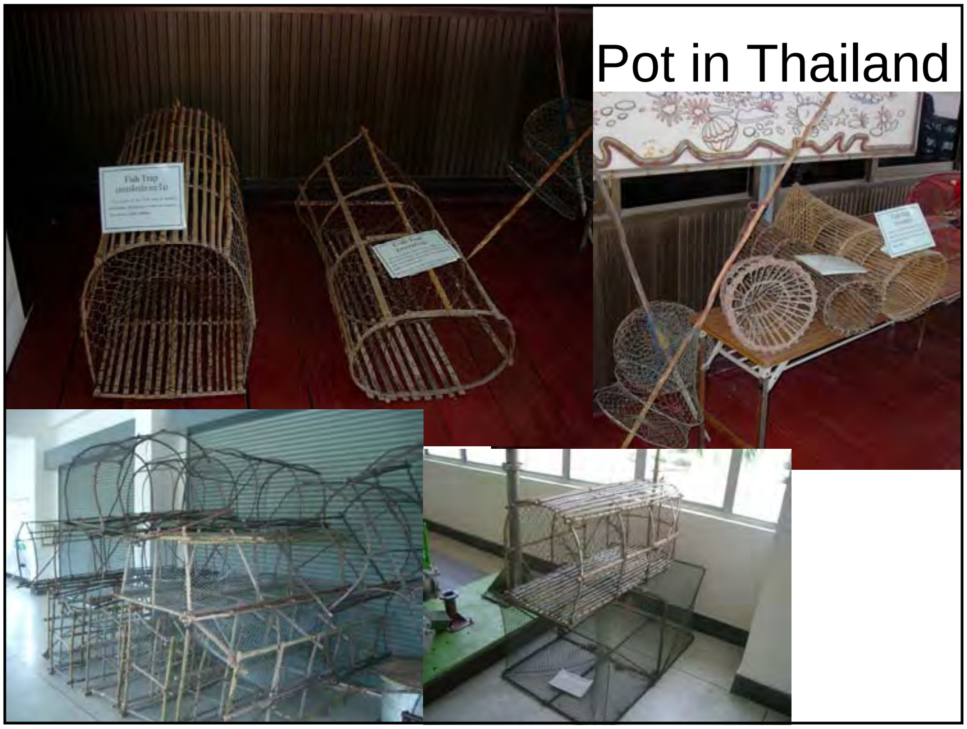


Fish Pot in U.A.E




بحر نظيف وغذاء وفير نظيف

Pot in Thailand



Bycatch and Its Reduction from Blue Swimming Crab Pot Fishery in Thailand

By

BOUTSON Anukorn, MAHASAWASDE Chaichan, MAHASAWAS Songsri and ARIMOTO Takafumi

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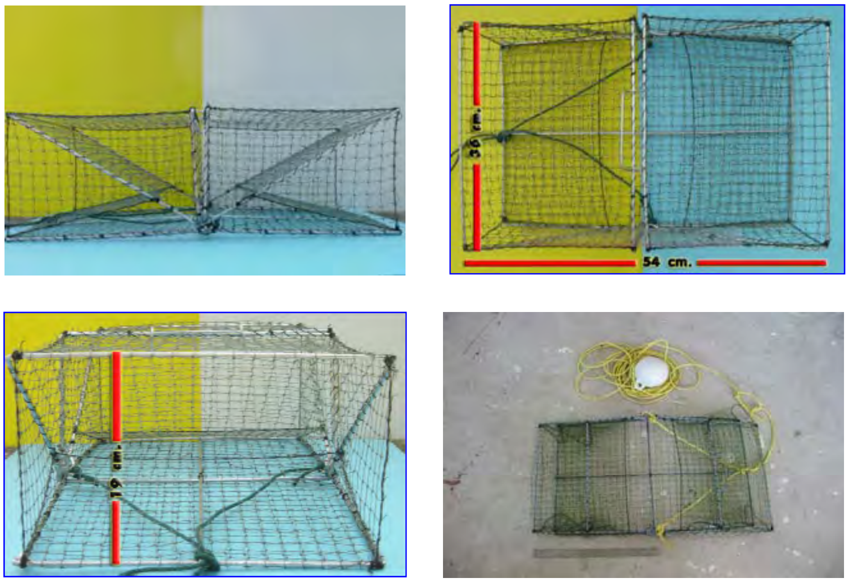
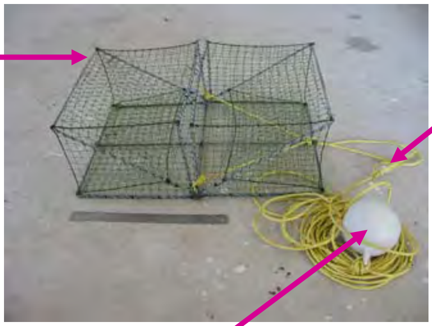
Collapsible blue swimming crab pot



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

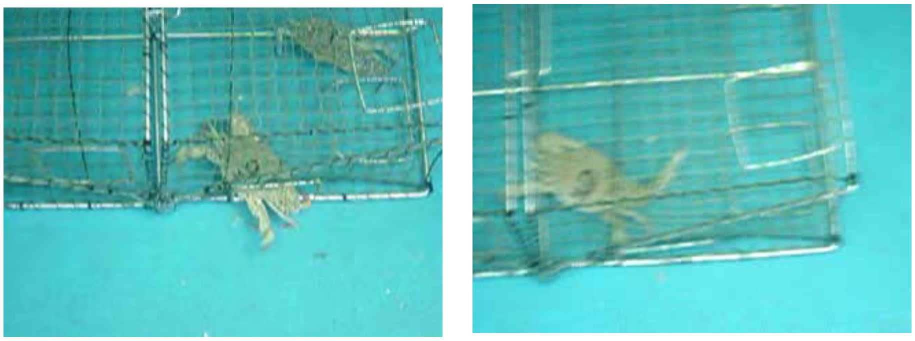
- ➢ 200-300 pots
- ➢ 6-8 m boat length

- ➢ One man operation
- ➢ 12-24 hr Soaking time

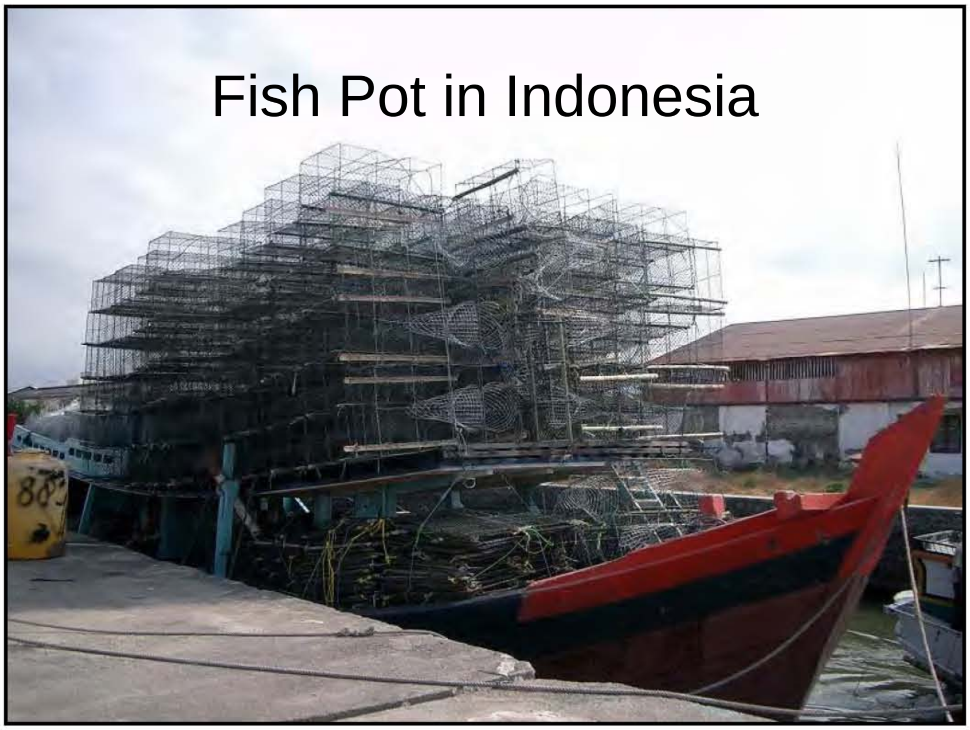
Commercial crab pot boat

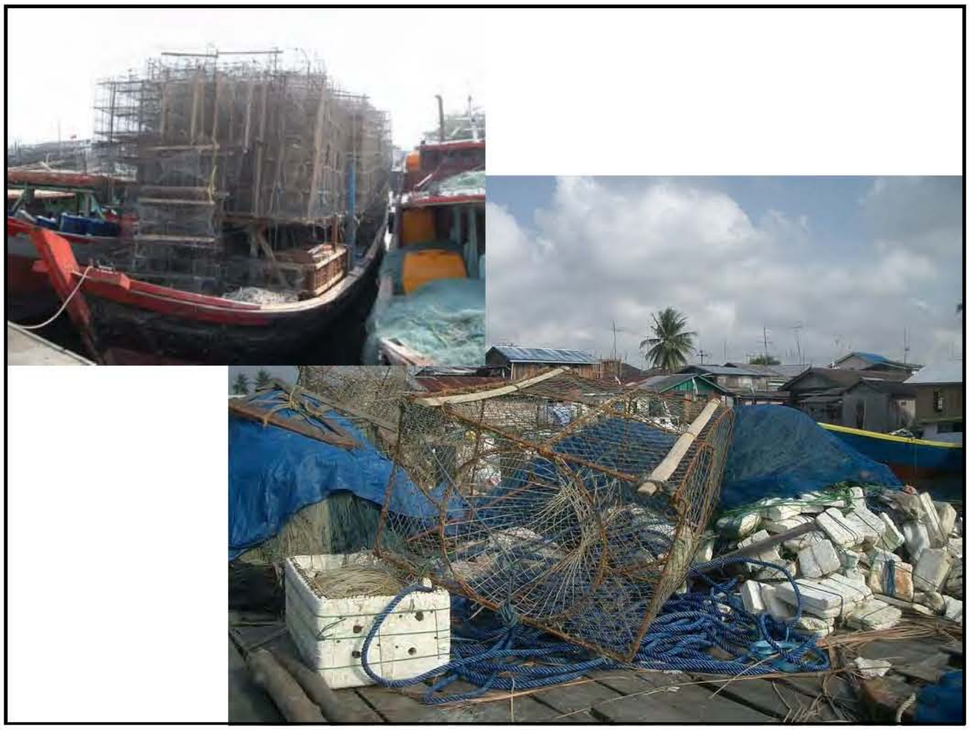
- 2,000－5,000 Pots/boat
- Hauling machine

Escaping from the lower side panel position (VDO)

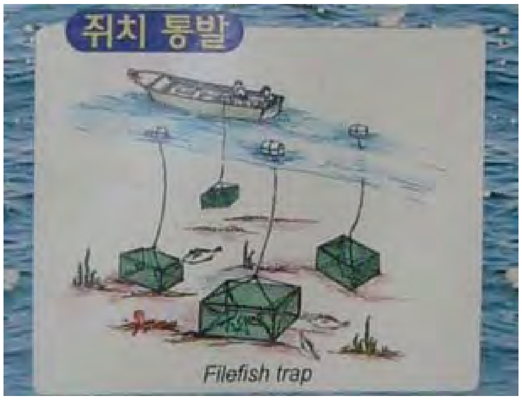


Fish Pot in Indonesia

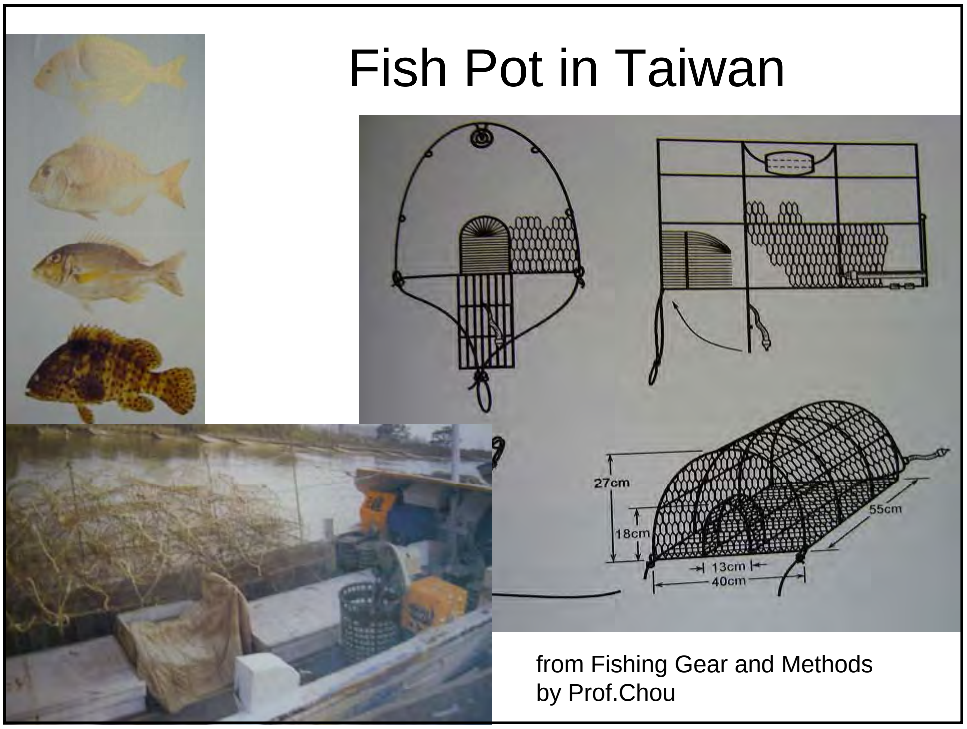




Pot in Korea

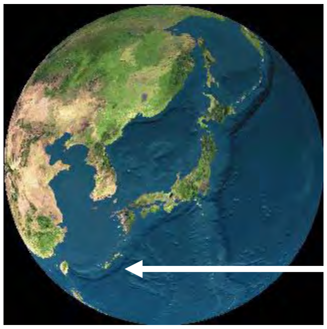

쥐치 통발
Filefish trap

Fish Pot in Taiwan


27cm
18cm
13cm
40cm
55cm

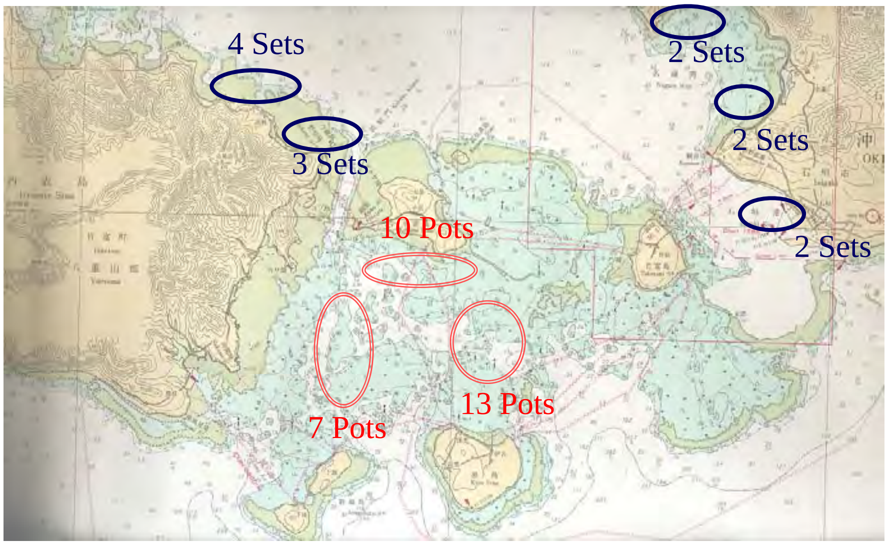
from Fishing Gear and Methods
by Prof.Chou

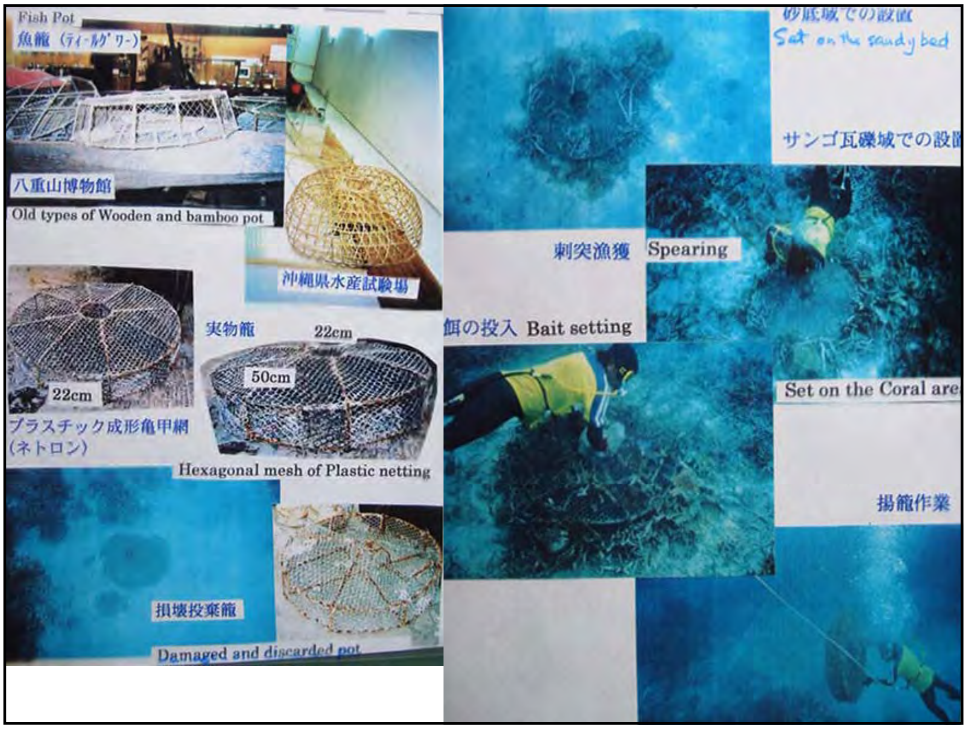
Fishing Activities in Okinawa Coral Reef

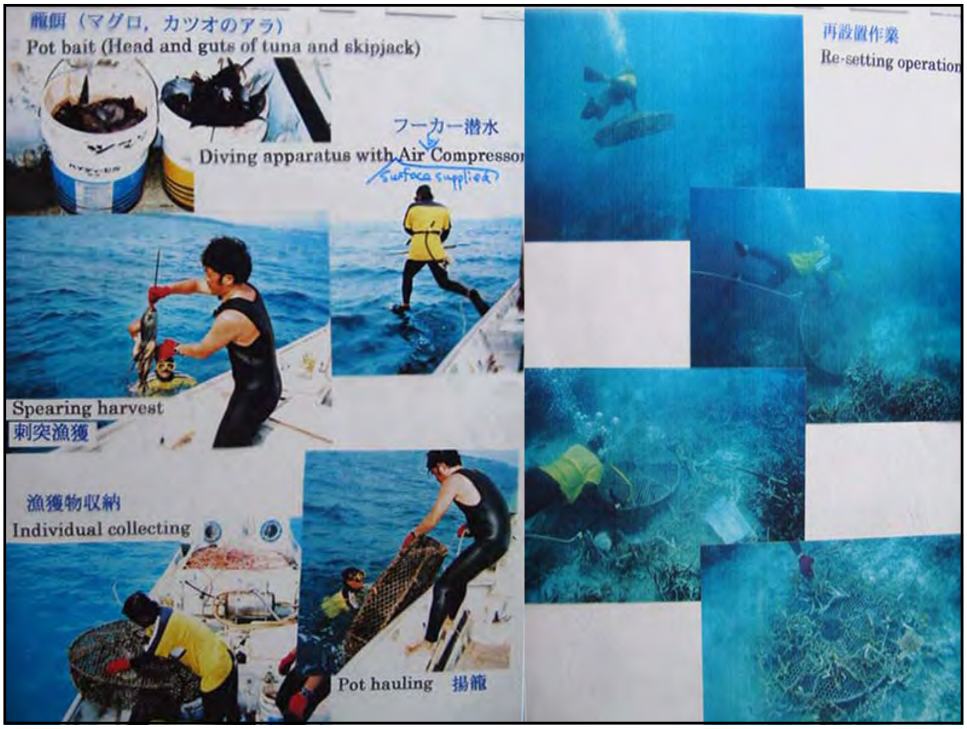


- **Angling**
    - **Hook and line**
    - **Longline**
    - **Trolling**
- **Net Fishing**
    - **Set-net**
    - **Drive-in net**
    - **Gill net**
- **Others**
    - **Fish Pot**
    - **Spearing for lobster and turtle**
    - **Diving collection for octopus, cuttlefish, shells and urchins, and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

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


4 Sets
2 Sets
2 Sets
3 Sets
10 Pots
2 Sets
13 Pots
7 Pots

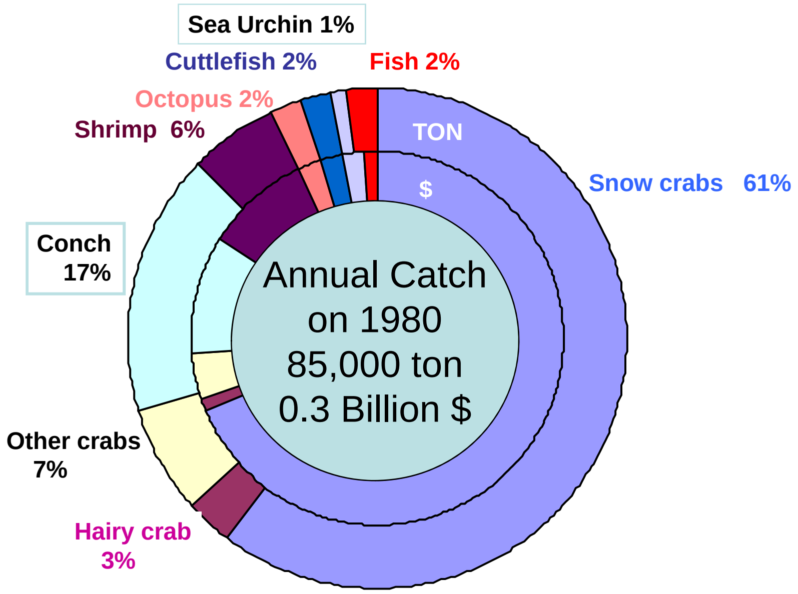

Fish Pot
魚籠（ﾃｨｰﾙｸﾞﾜｰ）
八重山博物館
Old types of Wooden and bamboo pot
沖縄県水産試験場
実物籠
22cm
50cm
22cm
プラスチック成形亀甲網
（ネトロン）
Hexagonal mesh of Plastic netting
損壊投棄籠
Damaged and discarded pot
砂底域での設置
Set on the sandy bed
サンゴ瓦礫域での設
刺突漁獲
Spearing
餌の投入 Bait setting
Set on the Coral are
揚籠作業


籠餌（マグロ，カツオのアラ）
Pot bait (Head and guts of tuna and skipjack)
フーカー潜水
Diving apparatus with Air Compressor
Surface supplied
Spearing harvest
刺突漁獲
漁獲物収納
Individual collecting
Pot hauling 揚籠
再設置作業
Re-setting operation

Pot, Trap, Basket, Tube, ……

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

Pot Fishing in Japan

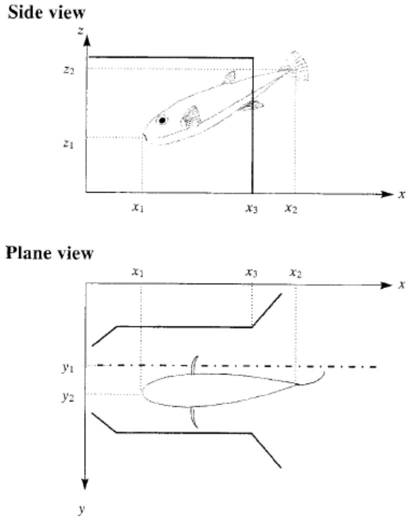


Annual Catch
on 1980
85,000 ton
0.3 Billion $

Behavior of Puffer *Lagosephalus* and the Fishing Mechanism of the Pot Trap

Mamoru Hirayama,*2 Shigeru Fuwa,*2
Munechika Ishizaki,*2 and Takehiko Imai*3

Nippon Suisan Gakkaishi **65**(3), 419–426 (1999)


Side view
z
z_2
z_1
x_1
x_3
x_2
x
Plane view
x_1
x_3
x_2
x
y_1
y_2
y

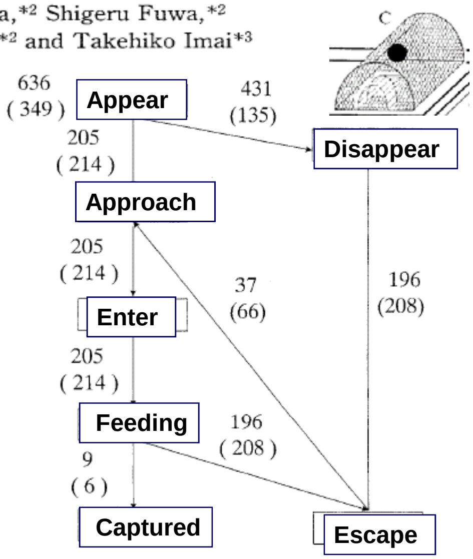
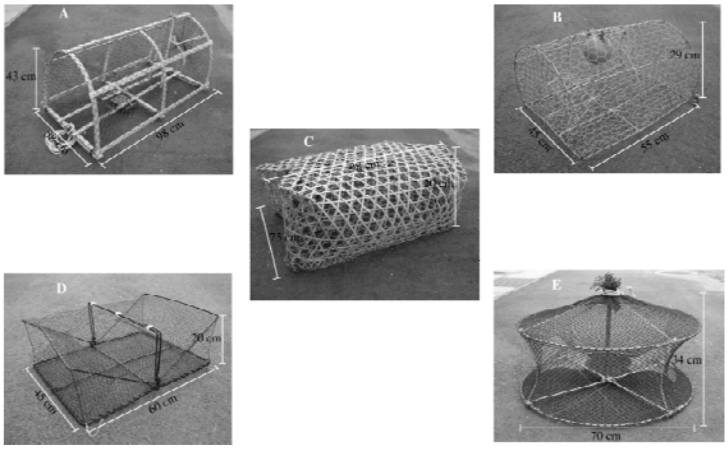

C
636
(349)
Appear
431
(135)
Disappear
205
(214)
Approach
205
(214)
37
(66)
196
(208)
Enter
205
(214)
Feeding
196
(208)
9
(6)
Captured
Escape

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.

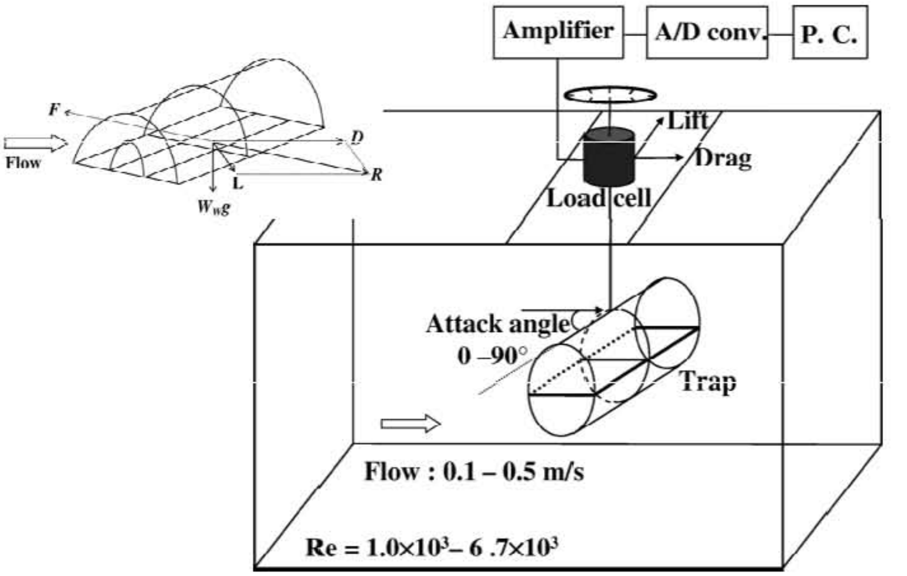
Fisheries Science 70 (6), 952-959. 2004

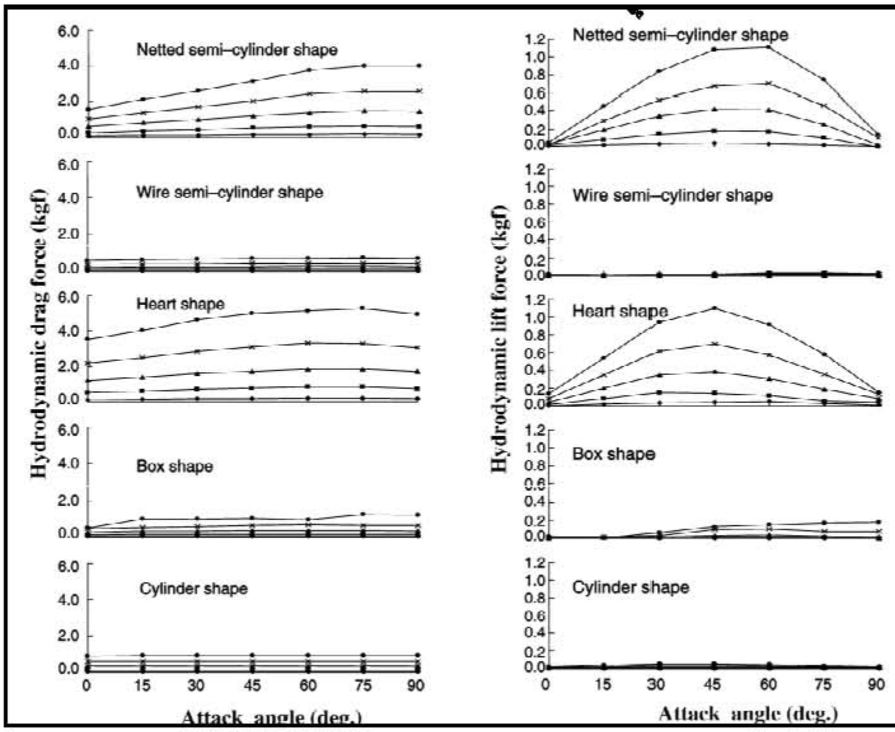
BUDIMAN J, FUWA S. & EBATA K.


A
43 cm
98 cm
B
29 cm
45 cm
55 cm
C
75 cm
D
70 cm
45 cm
60 cm
E
34 cm
70 cm

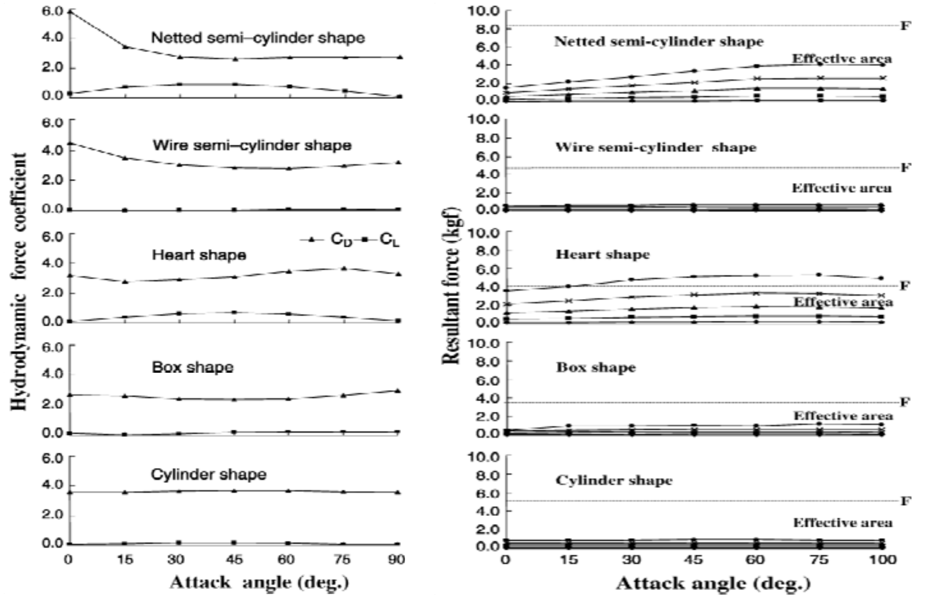
(a) Netted semi-cylinder; (b) Wire semi-cylinder; (c) Heart; (d) Box; and (e) Cylinder shape.

Schematic of the experimental apparatus used to measure hydrodynamic resistance.


Amplifier
A/D conv.
P. C.
F
D
Flow
L
R
$W_B g$
Lift
Drag
Load cell
Attack angle
0 –90°
Trap
Flow : 0.1 – 0.5 m/s
Re = 1.0×10³– 6 .7×10³

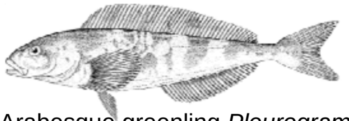


Comparison between the frictional force (*F*)
among the different attack angles and resultant force.
0.1 m/s; ■, 0.2 m/s; ▲, 0.3 m/s; ×, 0.4 m/s; •, 0.5 m/s.



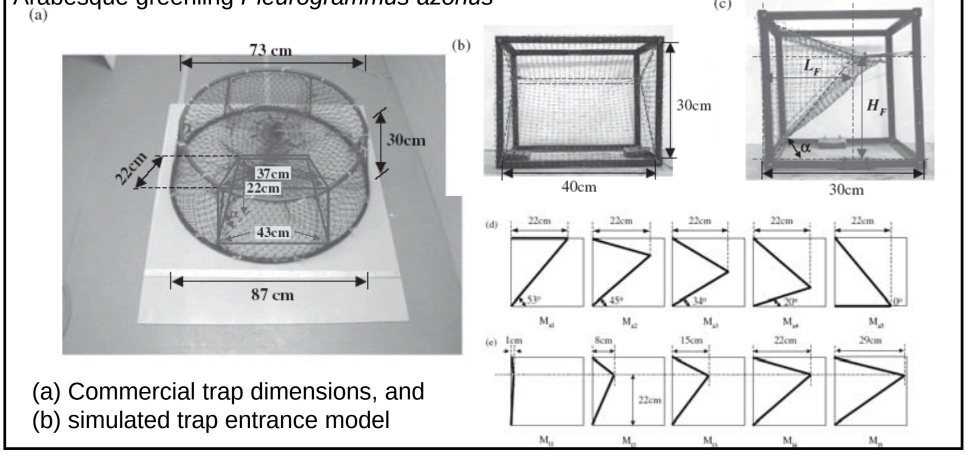
Behavioral responses of arabesque greenling to trap entrance design.

Fisheries Science **72** (4), 821-828. 2006



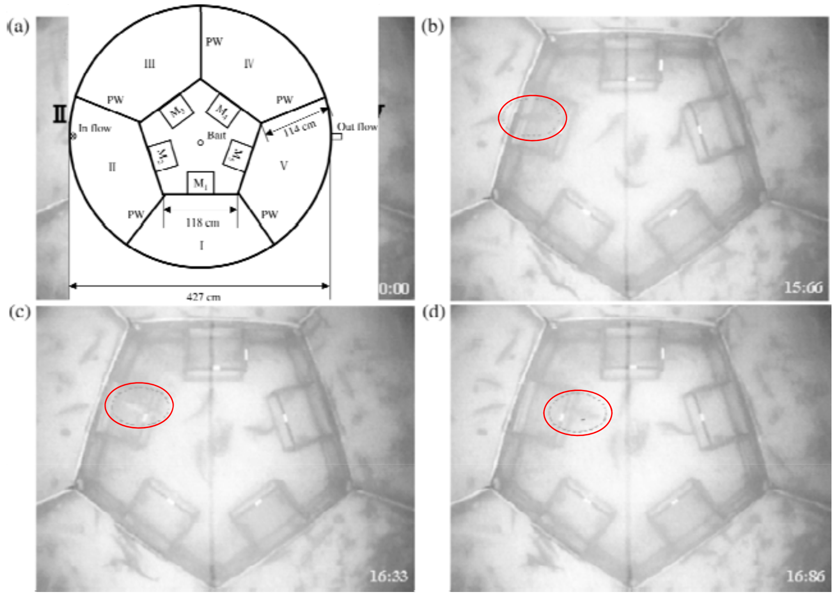
LI Yong, YAMAMOTO K., HIRAISHI T.,
NASHIMOTO K. & YOSHINO H.

Arabesque greenling *Pleurogrammus azonus*

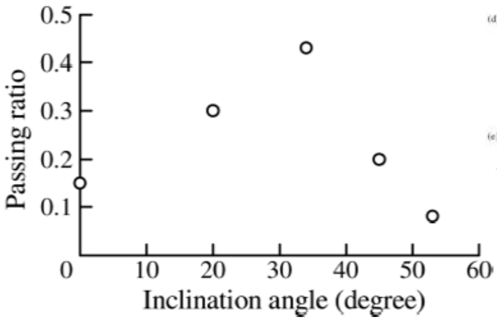


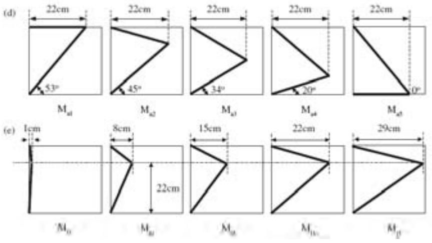
(a)
73 cm
30cm
22cm
37cm
22cm
43cm
87 cm
(b)
30cm
40cm
(c)
L_F
H_F
α
30cm
(d)
22cm
22cm
22cm
22cm
22cm
53°
45°
34°
20°
0°
M_{a1}
M_{a2}
M_{a3}
M_{a4}
M_{a5}
(e)
1cm
8cm
15cm
22cm
29cm
22cm

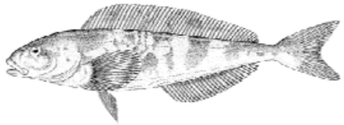
(a) Commercial trap dimensions, and
(b) simulated trap entrance model

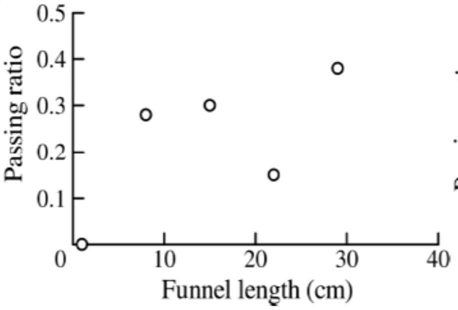

(a)
(b)
(c)
(d)
PW
III
IV
PW
PW
II
In flow
Out flow
M2
M3
M5
M4
Bait
114 cm
II
V
M1
PW
PW
118 cm
I
427 cm
0:00
15:66
16:33
16:86

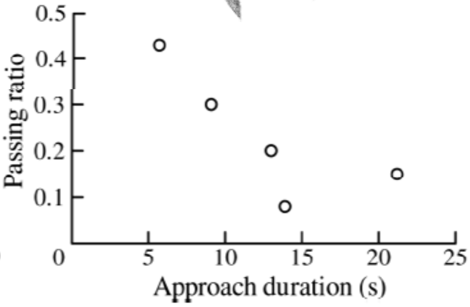
(a) Fish swims towards the model, (b) fish approaches the model, (c) fish is passing, (d) fish has passed through the trap entrance.




(d)
22cm
53°
45°
34°
20°
0°
(e)
1cm
8cm
15cm
22cm
29cm
22cm





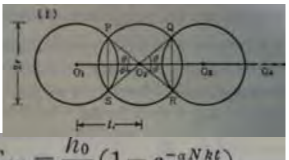


What can we learn from …?

- 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



$$C_{(t)} = \frac{n_0}{k}(1-e^{-\alpha Nkt}) = C_\infty(1-e^{-\alpha Nkt})$$

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

Red crab trap instrumented for recording video and audio
MIT FER
CATCH OF THE DAY
HARPOON
BREWERY