Workshop to identify research needs and a future project to reduce bycatch and improve fuel efficiency via Low Impact Fuel Efficient (LIFE) prawn trawls

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In submitting this report, the researcher has agreed to FRDC publishing this material in its edited form.

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Executive Summary

This report describes the content, discussion and outcomes that arose from a workshop involving representatives of the prawn-trawl fisheries of Australia and fishing-gear experts to explore the work done so far in developing ways to reduce bycatch and discards and improve fuel efficiency in prawn trawls (both in Australia and overseas), and to identify industry's priorities for the way forward in this field.

The workshop learned of the many and varied options that are available to prawn trawler operators to reduce bycatch and/or improve fuel efficiency. These included the many physical and behavioural-type bycatch reduction devices (BRDs) and turtle exclusion devices (TEDs) used in or near codends, as well as new work describing a host of options available in the anterior (front) section of the trawl including modifications to the spreading mechanisms (including boards and numbers of nets), net tapers, hanging ratios, twine size, knot orientation, sweeps, ground gears, etc. The workshop also learned of current initiatives occurring in this field in Europe as a result of the implementation of the Landing Obligation (or Discard Ban).

The work presented showed that there now exists an impressive array of options (or 'tools') in a trawl gear "toolbox" that could be applied to prawn-trawl fisheries in the country. These tools have the potential to significantly reduce bycatch, habitat impacts and/or fuel usage, depending on the particular circumstances in each fishery. The workshop concluded that these tools now require full extension into individual fisheries so that they can be trialled, appropriately modified, tuned, modified again, etc. to achieve optimal performance in each situation. That is, the various adaptations presented at this workshop need to find their way into the myriad of prawn-trawl fishing operations occurring throughout the country—so that fishers can select appropriate options, use, modify and test them (in a scientifically defensible way and with appropriate approval by their management agency) so they can be adopted for routine use where appropriate.

The workshop ultimately recommended the organisation of a "Prawn Trawl Toolbox Travelling Roadshow", using the expertise of Australia's expert gear technologists to explain and discuss these concepts with fishers in each fishery. Then, local fishers should take the

various options and adopt them for trial/use in their own situation, leaning on the expertise of our gear technologists.

With regard to developing the existing modifications further via more research, it was felt that a better strategy would be to do the above-mentioned extension roadshow first (i.e. over the next year or so) and monitor other global innovations which are developed in Europe and elsewhere as a result of the increased focus on bycatch reduction and the implementation of the European Discard Ban. This will allow us to take full advantage of the innovations occurring in the Northern Hemisphere (and consider any additional tools that are developed) at a reduced cost.

Introduction

Despite decades developing more selective fishing gears, bycatch and discarding remain major fisheries issues throughout the world. Demersal prawn trawling (whose otter boards and ground gear contact the bottom) is still considered one of the least selective fishing methods. In addition to large quantities of bycatch, demersal trawling can also disturb benthic habitats, upon which prawns and associated ecosystems depend. Not only can such disturbances affect these systems, they also contribute to the high energy needs of trawlers, reducing their fuel efficiency. That is, the drag caused by various trawl components, especially otter boards and large twine areas, can lead to large expenses in fuel for owners and high energy footprints in some prawn-trawl fisheries.

Issues of bycatch and fuel efficiency are now becoming uppermost in the concerns of many stakeholders. These include: prawn trawl operators (who wish to reduce running costs and discard handling), environmental groups (who are concerned about ecosystem disturbance and energy use), eco-labelling agencies (whose requirements focus on bycatch and habitat impacts), and the general public (who dictate the social licence to operate for such fisheries). These issues have therefore attracted the attention of many governments and international agencies such as the Food and Agriculture Organisation (FAO)—who first coined the term Low Impact Fuel Efficient gears (LIFE) for methods that reduce bycatch whilst improving fuel efficiency.

However, there have been only a few studies that address these issues in tandem. One of the leading centres in the world where this work has occurred is the NSW Fisheries Conservation Technology Unit. This group obtained funding from the Fisheries Research and Development Corporation (FRDC) to conduct the project “Reducing the environmental impacts and improving the profitability of prawn trawling through a structured framework of anterior gear modifications” (Project No. 2011/010). In recent years, this group applied for further FRDC funds to further develop LIFE fishing gears. Their most recent application led to this current project to hold a workshop of representatives of prawn-trawling fisheries in Australia to develop the foci, objectives and ways forward for future work in this field.

Objectives

1. Organise and plan a workshop of key stakeholders in Australia's prawn-trawl fisheries whose goal is to ameliorate bycatch issues and improve fuel efficiency by developing Low Impact Fuel Efficient (LIFE) gears for those fisheries
2. Hold the above workshop over two days in Sydney; and
3. Prepare and finalise a report outlining the conduct and results of the workshop and the staged approach recommended for ongoing research.

Methods

Funding was obtained to hold a two-day workshop of trawl-gear experts and representatives from the key prawn trawl fisheries of Australia. The goals of the workshop were to discuss the work done so far in developing ways to reduce bycatch and discards and improve fuel efficiency in prawn trawls (both in Australia and overseas), and to identify industry's priorities for the way forward in this field. The workshop was held in Cronulla, NSW.

The agenda for the workshop is provided below:

Venue: Former Cronulla Fisheries Conference Room,
Facilitator: Steve Kennelly

DAY 1 (Tuesday 7th February, 2017)

10:00 – 10:15	Arrival and Morning Tea/Coffee
10:15 – 10:30	Welcome and Introductions (Steve Kennelly)
10:30 – 10:40	Background from FRDC (Crispian Ashby)

THEME 1:	**BYCATCH REDUCTION**
10:40 – 11:20	Bycatch Reduction: Best practices used throughout the world (Matt Broadhurst)
11:20 – 11:40	The EU Discard Ban and latest work in Europe (Steve Kennelly)
11:40 – 12.40	Presentations from each jurisdiction - past and present bycatch reduction initiatives (15 mins each including Q & A)
12.40– 1:30	Lunch and Informal Discussions
1:30 – 2:15	Presentations from each jurisdiction (continued)
2.15– 2:45	Facilitated discussion on presentations
2.45 – 3.00	Afternoon Tea/Coffee
3.00 – 4.30	Identification of Gaps/Needs – Bycatch Reduction (ALL)
6.30	Workshop Dinner and Informal Discussions (sponsored by the Australian Council of Prawn Fisheries)

DAY 2 (Wednesday 8th February, 2017)

THEME 2: FUEL EFFICIENT TRAWLS

9:00 – 9:10 Recap of Day 1 (Steve Kennelly)
9:10 – 9:40 Fuel Efficiency: Best practices being developed throughout the world (Matt Broadhurst)
9:40 – 9:50 UN, EU and MSC perspectives (Steve Kennelly)
9:50 – 10:30 Any other past or current initiatives in each jurisdiction (ALL)
10:30 – 10:45 Morning Tea/Coffee
10:45– 12:30 Identification of Gaps/Needs - Fuel Efficiency (ALL)
12:30 – 1:15 Lunch and Informal Discussions

BRINGING IT TOGETHER

1:15 – 2:15 Prioritisation of Gaps/Needs identified for both Themes (ALL)
2:15 – 3.15 Next steps – future research project(s)
3.15 – 3.30 Wrap Up - Workshop close

Results

Thanks to the work of ACPF and Rachel King, ACPF EO, the workshop attracted a very representative body of gear technology experts and prawn-trawl industry representatives from around Australia. It is worth noting, in fact, that rarely has there been such a well-attended meeting of trawl industry people from all over the country to discuss bycatch and efficiency issues. All of the major prawn fisheries were represented and most of Australia's current fishing gear scientists attended and provided presentations on their work. The following is the list of 21 attendees and their affiliations:

Crispian Ashby, FRDC	Annie Jarrett, NPF & ACPF	Andy Redfearn, QLD
Skye Barrett, FRDC	Kim Justice, SA	Kevin Reibel, QLD
Tricia Beatty, NSW	Steve Kennelly, ICIC	Phil Robson, NPF
Matt Broadhurst, NSW	Rachel King, ACPF	David Sterling, QLD
Johnathan Davey, VIC	Adrianne Laird, NPF	Tony Sterling, QLD
Chay Haldane, SA	Neil Macdonald, SA	John Wakeford, WA
Robert Hamilton, NSW	Ian Perry, NSW	Paul Watson, SA

As planned, the 1st day primarily focused on the theme of bycatch amelioration methods and the 2nd day on ways to improve the fuel efficiency of prawn trawlers.

Each day began with detailed presentations providing information about current best practices for each theme (from Australia and overseas) given by relevant gear technicians and scientists. Matt Broadhurst provided summaries of previous FRDC-funded, and other work in this area, Steve Kennelly provided updates on current initiatives occurring in Europe (as a result of the European Union's Common Fisheries Policy's Discard Ban, or Landing

Obligation), John Wakeford provided information on his work in Western Australia and Dave Sterling provided information on the latest developments with high order multi-net systems. In addition, representatives from each fishery described what is happening in their own fishery/jurisdiction and why. All of the presentations given at the workshop are in the Appendix to this report. The exception is the presentation by the Northern Prawn Fishery which is not yet available.

Throughout the course of the workshop, during the coffee and lunch breaks and at the workshop dinner, it became apparent that there are a significant number of options available for prawn-trawl fisheries in Australia to reduce bycatch and improve fuel efficiency. Some of the designs are familiar to many (e.g. bycatch reduction via grids, square-mesh panels, etc.) whilst others were relatively new developments which had not been previously seen by many in the industry, including much of the latest work by Matt Broadhurst and Dave Sterling.

The sorts of designs, gears and fishing practices that were discussed included:

- Modifications at or near the codend (the traditional location in the trawl where such work has occurred):
    - Physical and behavioural-type Bycatch Reduction Devices (BRDs) – grids, square mesh panels, full square mesh codends, funnels, super-shooters, T45, T90, etc.;
    - Turtle Excluder Devices (TEDs);,
    - Fisheyes (including a new design for the NPF termed Kon's Covered Fisheyes);
    - Modifications to TEDs designed to increase water turbulence and therefore assist in fish escape at the TED;
    - Adjusting tow speed (and water flow) through the net, TEDs and BRDs to allow the latter to work better;
    - Hanging ratios at the codend and the location of BRDs in the codend, and;
    - The role of visual cues in promoting fish escape.
- Modifications to the anterior trawl:
    - Overall gear design (single-, double-, dual-, triple-, quad-,and penta-rigs, beam trawls, W trawls, and tongue trawls);
    - Improved efficiencies associated with otter-board design including multi-foil doors, batwing boards, bisons, cambered doors, etc. The possible use of wheels and sleds on boards;
    - Effects of different ground gears including different sized chains, soft-brush gear, etc.;
    - Improved performance by using fewer boards, and more sleds, etc.;
    - The performance of simple lines at the mouth of the trawl (the simple anterior fish excluder—SAFE);

    - The role of twine size, net length, sweep length, low-drag netting, etc. in reducing drag and bycatch;
    - Wing mesh height and orientation (T45 and T90), and;
    - Trawl body taper, mesh size, seam number, and hanging ratios.

On the second afternoon of the workshop, we attempted to 'bring together' all the information presented by assembling a list of needs, gaps and consequent recommendations for a way forward in this field. These are summarised and grouped below as quite specific and more overarching (general) issues.

Specific issues:

- South Australia
    - Spencer Gulf: Very progressive fishery but old gear is used, double rig, old otter boards. Problems are blue swimmer crab bycatch and (sometimes) cuttlefish issues. Basic rigs and (especially) otter boards need attention.
    - Asked about IP issues regarding the work presented at the workshop but the modifications, gears and concepts discussed are not proprietary and are freely available to all fishers.
    - Would need to have any ongoing work organised through the association. The priorities are to get the information presented here into the industry, identify needs for further testing and get in the right experts to do it.
    - Need developments that address both fuel efficiency and bycatch reduction to encourage uptake.
- New South Wales
    - Would like a travelling roadshow across industry presenting the work discussed here.
    - Would like a streamlining of permit (so-called 'section 37') approvals to allow trials, adoption (and modification) of the various devices. A meeting with fisheries management to pursue this was requested during the workshop by the NSW PFA.
    - Bycatch issues are the main problem especially small fish and mulloway. There are also weed problems in estuaries but it was noted that there were currently no 'silver bullets' to reduce weed in trawls, other than spatial closures.
- Western Australia
    - There is a need for prawn-trawl fishers (in WA but also more broadly throughout the country) to ensure that their existing gears and boats are tuned correctly, built correctly and aspects like hanging ratios, mesh sizes, sweeps, boards, and even overall gear configuration (dual-, double-, triple-, quad-rig), etc. are all set correctly—otherwise this can affect BRD performance, fuel efficiency, etc.

    - Continue work on otter boards as well as modifications at the TED to improve fish exclusion.
- Victoria
    - Extension of everything discussed to industry so they understand and have access to the information.
- Queensland
    - Happy with existing net configurations, but would like to focus on other aspects like boards, soft-brush ground gear (the latter perhaps applicable in sensitive habitats).
    - Would like to see quantification of the catching efficiency of trawl gear in catching targeted prawns. That is, 'how do we catch prawns more efficiently with less passes?'
- Northern Prawn Fishery
    - A significant issue is the use of different trawl designs depending on the target prawns (tiger or bananas).
    - Committed to 30% reduction in bycatch (an MSC consideration). Kon's Covered Fisheyes are a good start and is due for imminent release. But getting access to grounds out of season (as is done in SA) to test options is a priority. It can occur but is costly.

General issues:

- Get information such as that presented extended out to all prawn-trawl fisheries and fishers throughout Australia, so all can see, understand, appreciate, trial, and improve the (now) quite large toolbox of solutions available.
- In doing so, such extension, and the individual fisheries need to take full advantage of the very valuable expertise of Australia's small cadre of fishing gear technologists (Broadhurst, Wakeford, Balash, Robson and the Sterlings).
- We also require management-specific extension of this information—perhaps, in the first instance, via a briefing to the Australian Fisheries Management Forum (AFMF).
- We also need to consider the effects of such changes to other scientists (stock assessment scientists, etc.) because changes in gear technology will affect their data time series, etc.
- Need to monitor, report and demonstrate uptake of new concepts.
- ACPF to consider working with FRDC to develop an extension project (the Toolbox Roadshow) that is based around industry briefings and port meetings, augmented (but not replaced) with other materials (web, videos, etc.).
- Such a program will showcase the existing options/concepts currently available for fishers to try which may lead (later) to more specific (or generic) R&D.

- Initial examples of such options could be the use of low-drag netting in trawls, new generation otter boards, Kon's covered fisheyes BRD, penta-rig trawls, SAFE technology, etc.
- Future industry-based trials that arise out of this roadshow require proper scientific input with respect to design, data collection and reporting.
- This strategy will also provide a year or so of time to see what/if additional items for the toolbox come from other global innovations, including the EU's new investment in this field as part of their Discard Ban (Landing Obligation) implementation.

Discussion and Conclusions

The modifications and concepts presented and discussed at the workshop left everyone with no doubt that there now exists an impressive array of options (or "tools") in a Trawl Gear "Toolbox" that could be tested in Australia's prawn-trawl fisheries. These tools can have the potential to significantly reduce bycatch, habitat impacts and/or drag, depending on the particular circumstances in any fishery in terms of its bycatch issues, habitats, location, season, existing fishing vessels, infrastructure, fleet dynamics, administrative arrangements, existing management plans and regulations, etc.

A regularly-occurring theme throughout the workshop, therefore, was the recognition that, whilst all these concepts and designs have been shown (through an impressive amount and quality of scientific endeavour) to work, they require proper extension into individual fisheries, locations and vessels so that they can be trialled, appropriately modified, tuned, modified again, etc. to achieve optimal performance in specific situations. That is, the "Toolbox" we all saw at this workshop needs to find its way into the myriad of prawn-trawling operations occurring throughout the country—so that each fishery can select appropriate options, and use, modify and test them (in a scientifically defensible way and with appropriate approval by their management agency) so that they can be adopted for routine use where appropriate.

The best way to do this is, basically, to take the workshop just held "on the road" using the expertise of Australia's very small number of expert gear technologists to explain and discuss these concepts with fishers in each fishery. Local fishers should then take the various options and trial them for use in their own situation, leaning on the expertise of our small but impressive cadre of gear technologists.

In considering whether we should continue along the current route of developing the existing concepts and modifications further via more research, it was felt that a better strategy would be to get the existing toolbox out into the industry now (i.e. over the next year or so) so that individual fisheries can begin to trial and adopt these tools sooner rather than later. While this is occurring, Australia can monitor other global innovations which are developed in Europe and elsewhere as a result of the increased focus on bycatch reduction and the implementation of the European Discard Ban.

For example, the workshop learnt from Steve Kennelly about the imminent publication of a Selectivity Manual by the EU's DiscardLess initiative which will contain an easy-to-read summary of all current bycatch reduction devices. There is also new research occurring into the efficacy of LED lights in trawl gear to reduce discards. Delaying ongoing research in this field for a year or so in Australia (while a dedicated extension program is undertaken) will allow us to take full advantage of the new work occurring in the Northern Hemisphere and elsewhere at reduced cost.

Recommendations

- ACPF, ICIC and FRDC should work together to organise a "travelling roadshow" (the "Prawn Trawl Toolbox Roadshow") to reach as many prawn trawl fisheries and fishers as possible throughout Australia.
- The purpose of the roadshow will be to detail and explain the various options available to reduce bycatch and improve fuel efficiency in trawl gear.
- This roadshow need to include the expertise of one or more of Australia's small cadre of fish gear technologists (i.e. Broadhurst, Kennelly, Wakeford, Balash, Robson and the Sterlings).
- Subsequent to the roadshow, and as separate, small projects, individual fisheries should be encouraged to select, trial and modify options in the toolbox for their own situations.
- Industry trials should involve proper scientific oversight, design, analysis and reporting, with funding provided by the fisheries themselves, particular jurisdictions, FRDC TRFs, RACs and/or other entities.
- To assist the trialling of gear, jurisdictions should streamline approval processes to facilitate such work.
- Fisheries management agencies and scientists from other fields (stock assessment, etc.) should be briefed about this roadshow and its tools—initially via a briefing note to AFMF.
- Overseas developments in this field should be monitored—particularly the work occurring in Europe—to identify additional tool that could be added to the Toolbox.

Appendix – Workshop presentations

Powerpoint presentations provided at the workshop detailing the various Bycatch Reduction and Fuel Efficient tools discussed. The presentation by the Northern Prawn Fishery is not yet available:

1. Broadhurst, M.K. Low Impact Fuel Efficient Trawling: past, present and future.
2. Kennelly, S.J. The European Discard Ban and other international initiatives.

3. Wakeford, J. Prawn trawl bycatch reduction activity in the Exmouth gulf prawn managed fishery (EGPMF).
4. Raptis, J. St. Vincent's Gulf Bycatch work (given by Neil Macdonald)
5. Sterling, D. Trawl rigging developments.
6. Beatty, T. NSW Professional Fishermen's Association. Bycatch work in NSW.

Low Impact Fuel Efficient Trawling: past, present and future

Matt Broadhurst

The problem

The total mortality of aquatic stocks (Z) is the sum of the fishing (F) and natural (N) mortalities.

$$Z = F + N$$

F is quite complex…….

$$F = F_C + F_B + F_D + F_E + F_O + F_G + F_A + F_H$$

"Accounted'"

F_C Catch mortality

"Unaccounted"

F_B Misreported catch mortality

F_D Discard mortality

F_E Escape mortality

F_O Drop-out mortality

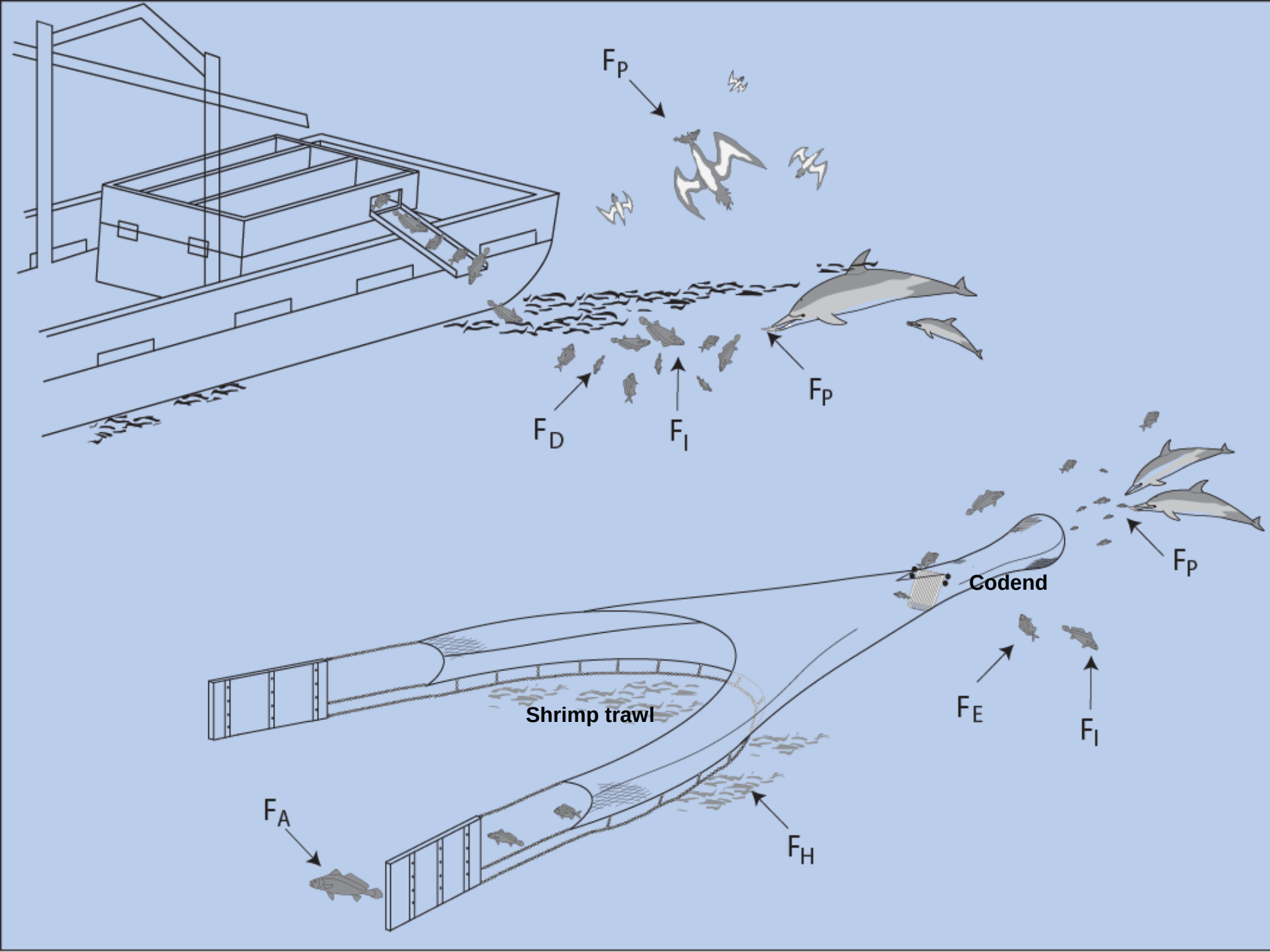
F_G Ghost fishing mortality

F_A Avoidance mortality

F_H Habitat degradation mortality

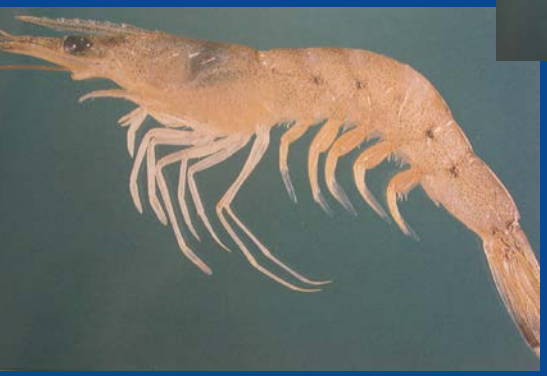
F_I Infection mortality

F_P Predation mortality


F_P
F_P
F_D
F_I
F_P
Codend
Shrimp trawl
F_E
F_I
F_A
F_H

Shrimp- or prawn-trawl fisheries

> 110 species are targeted, contributing towards 1.5% of the world's total wild marine harvest.




gina's recipes


Shrimp-trawl fisheries account for 27% of the world's discarded 'bycatch'.
HADRIAN
Australia


Southern Brazil


Northern Brazil


Iran

Solutions for addressing bycatch (discard mortality)

1). Spatial or temporal closures to fishing (e.g. marine parks);

2). Modify conventional trawls to reduce the quantity of bycatch; or

3). Modify operational and/or handling procedures to minimise discard mortality.

Modify conventional trawls to reduce bycatch

1). Promote escape (mostly from the codend using bycatch reduction devices - BRDs); or less commonly

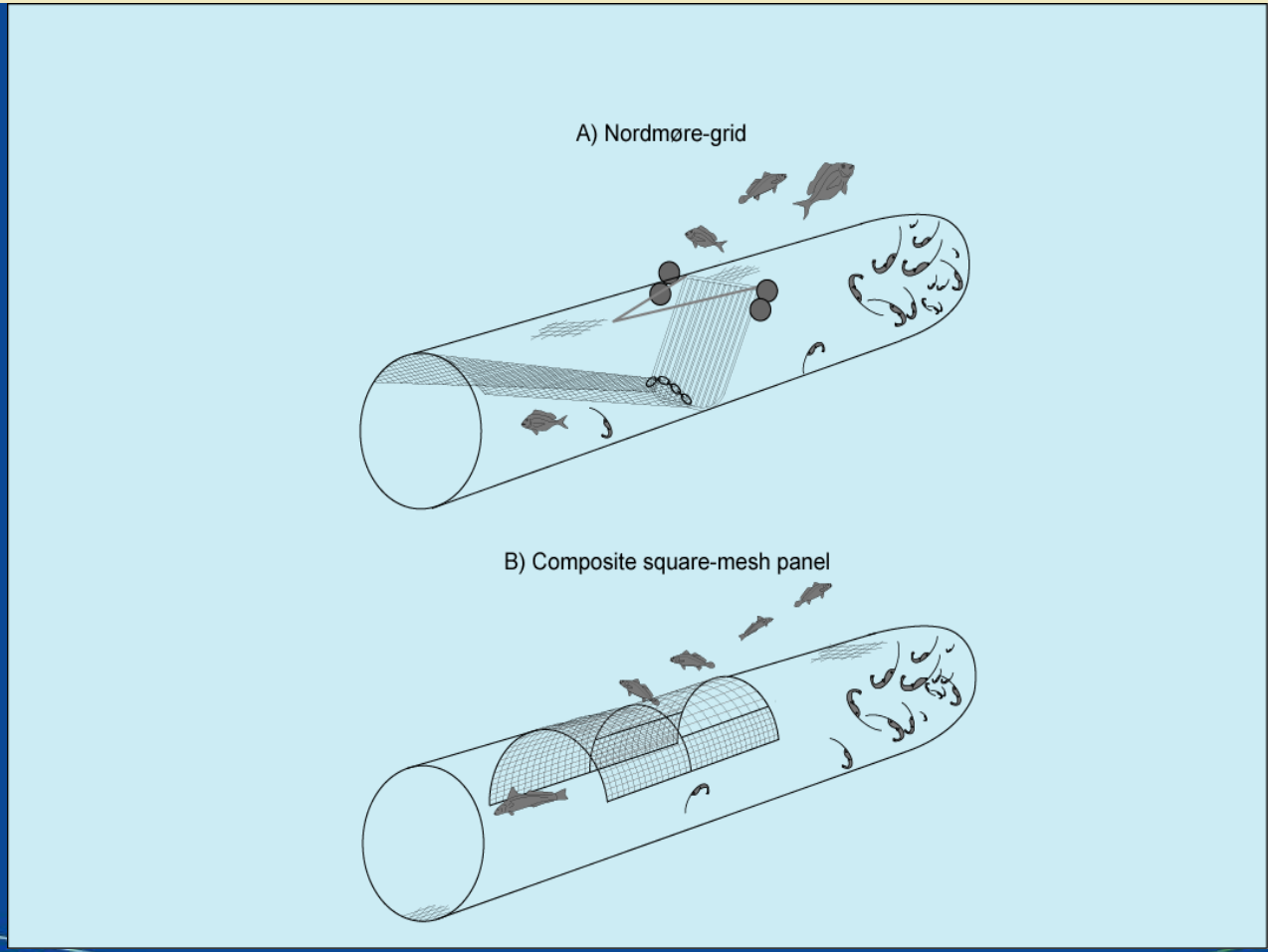
2). Promote avoidance (from the anterior section of the trawl).

Bycatch reduction devices

- Some of the earliest experiments to develop BRDs for shrimp-trawl fisheries occurred in Europe in the mid 1960s.
- >150 relevant papers published in the international literature; most in the past 10 years.
- BRDs have been assessed in many fisheries, although most of the early work was done in the USA and Australia.

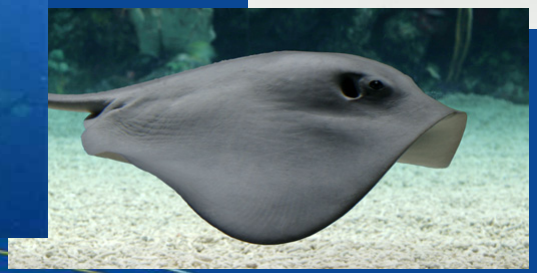
Bycatch reduction devices

There are many different designs, although most can be classified as either mechanical or behavioural separators.

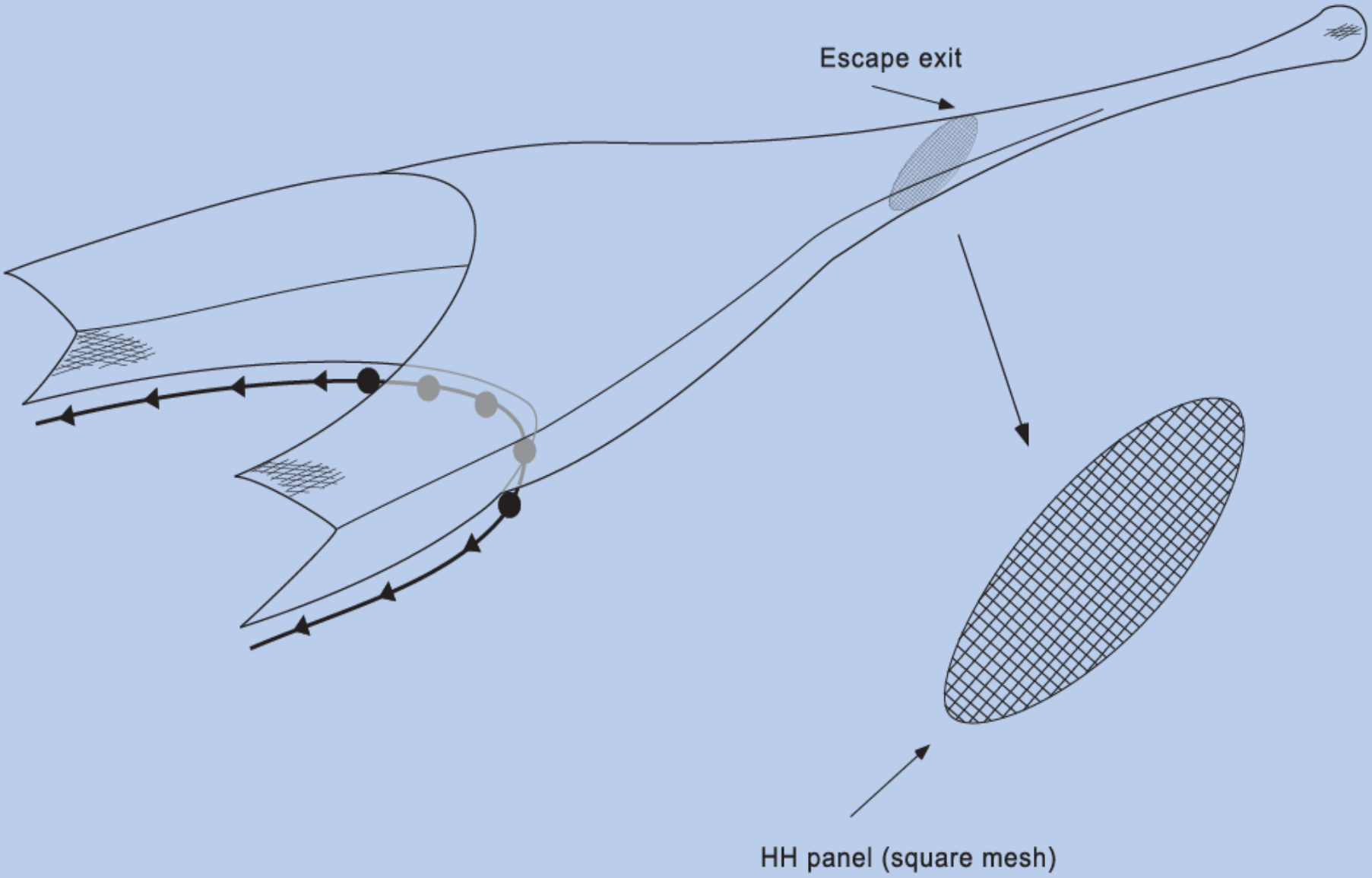


Mechanical separation

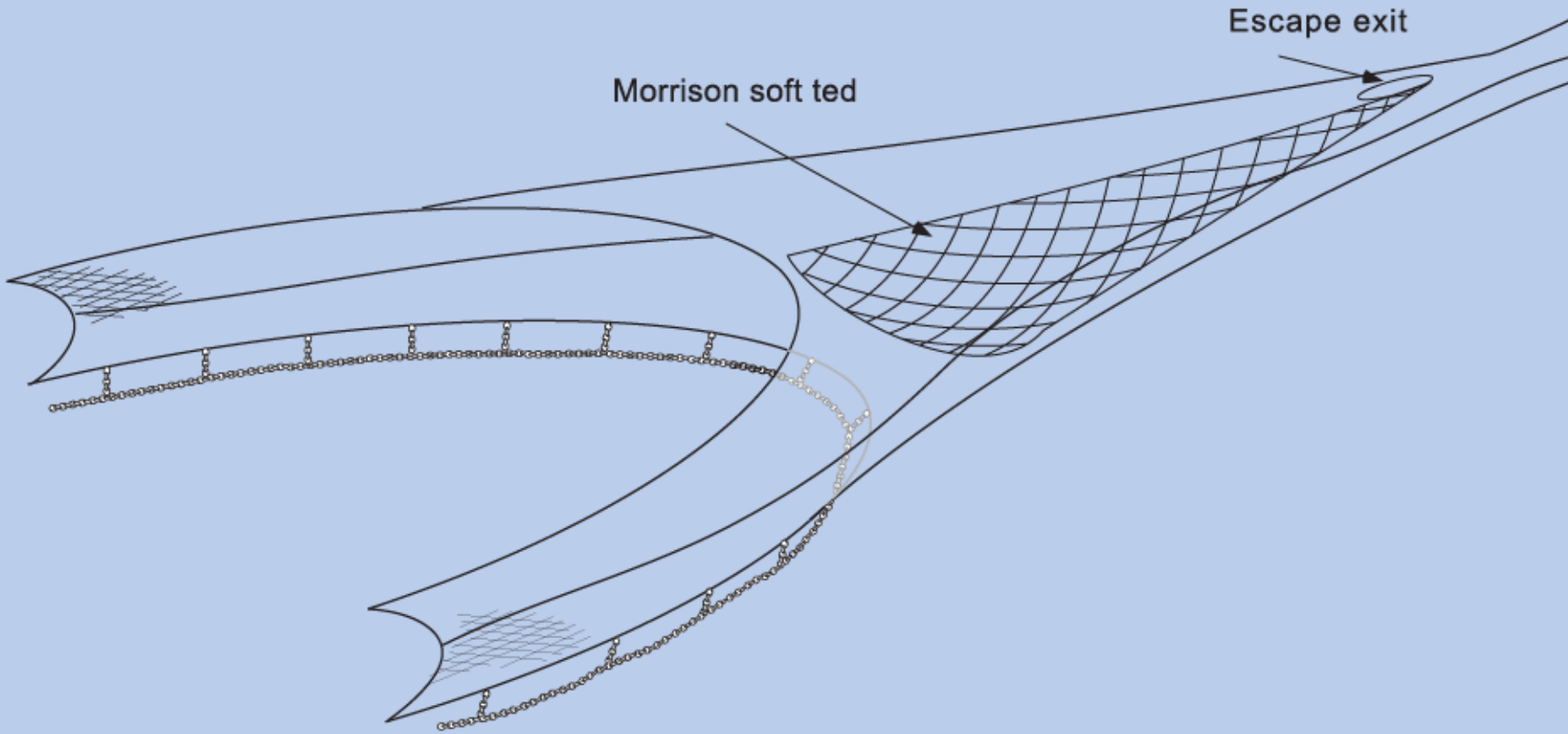
Includes panels or grids, located in the codend that are designed to partition the catch mechanically, according to size, and to exclude those individuals that are larger than the targeted shrimp.



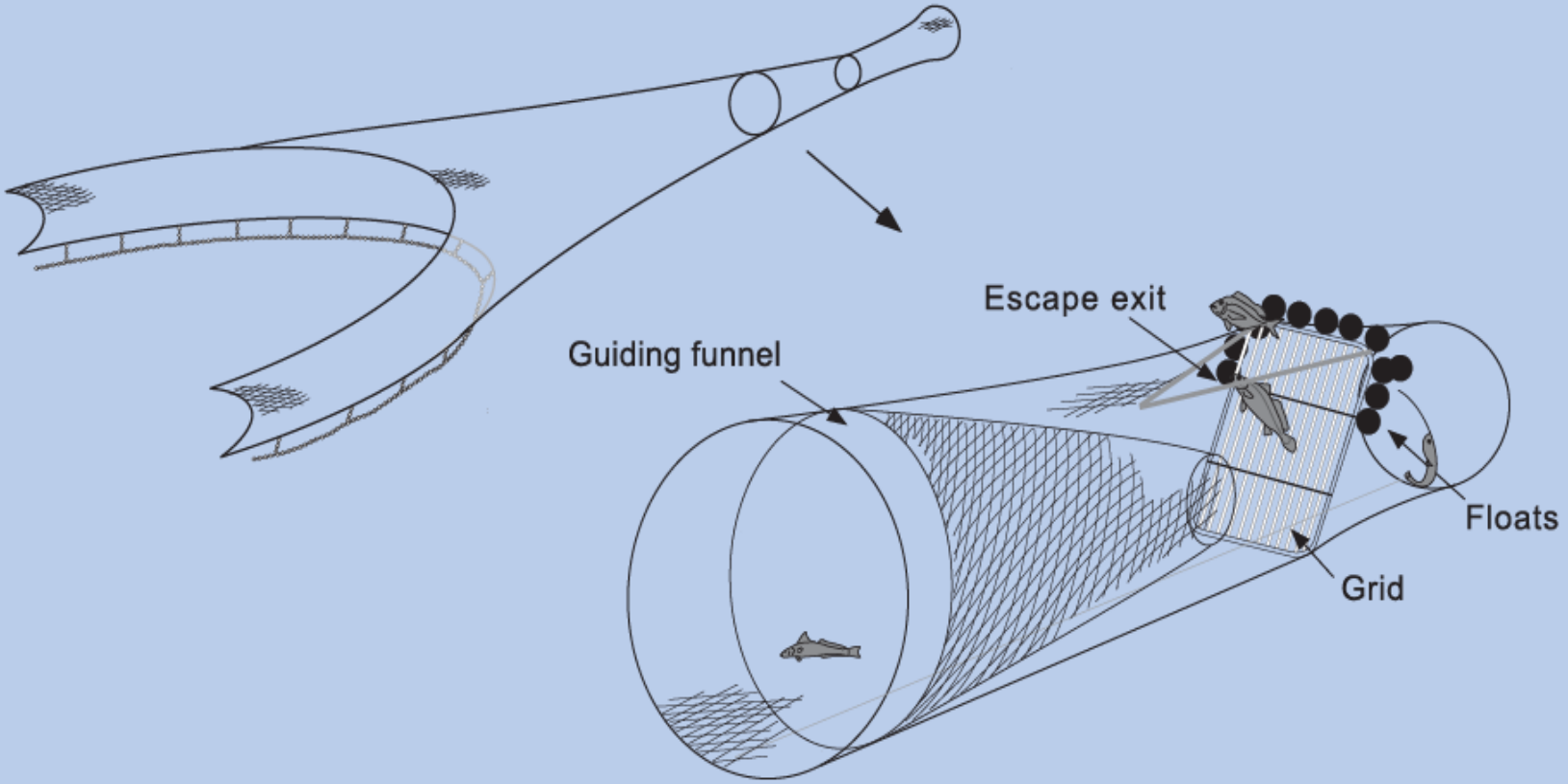
Typically reduce total bycatch by ~ 70%



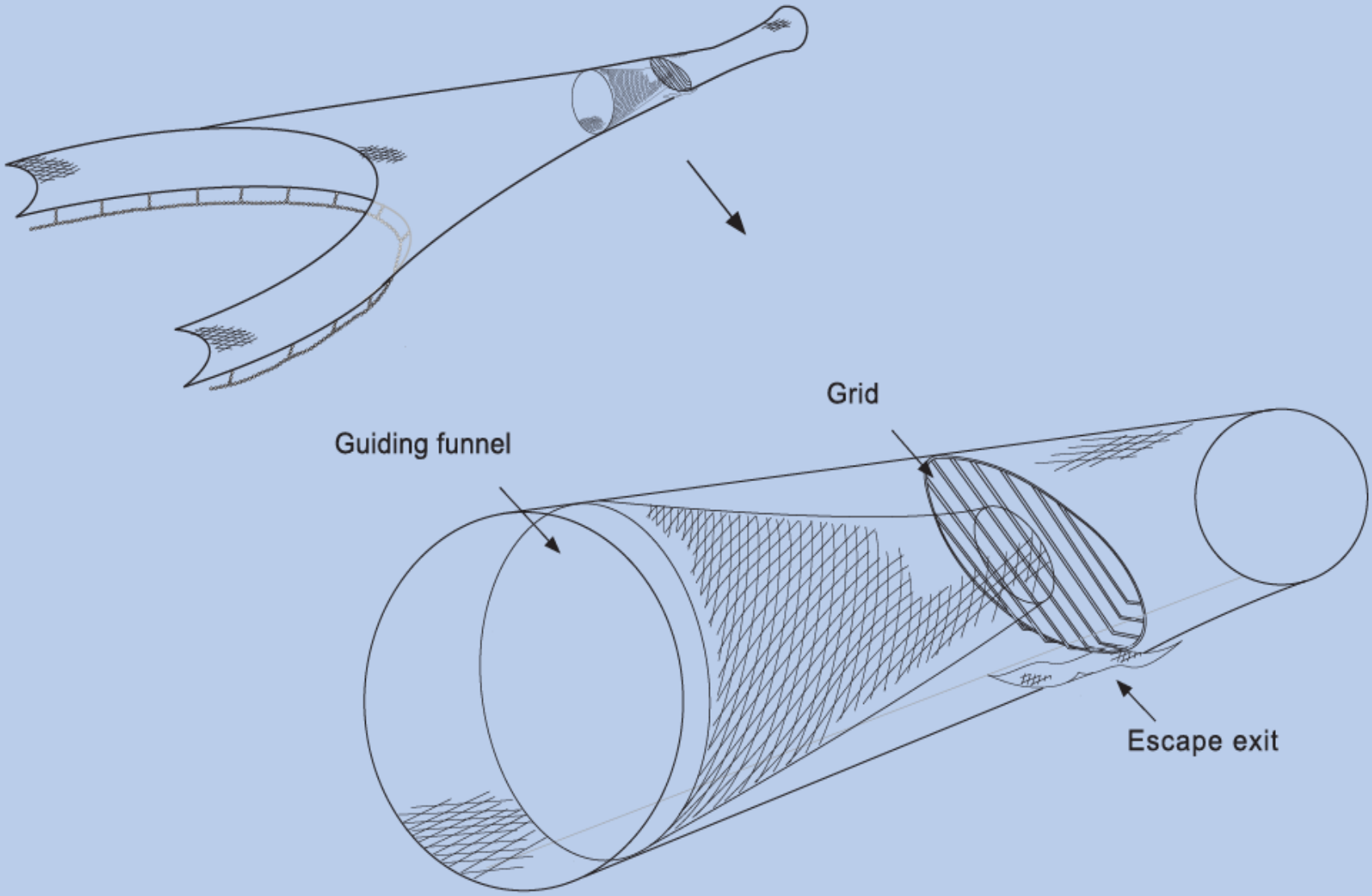
1989



1990



1992

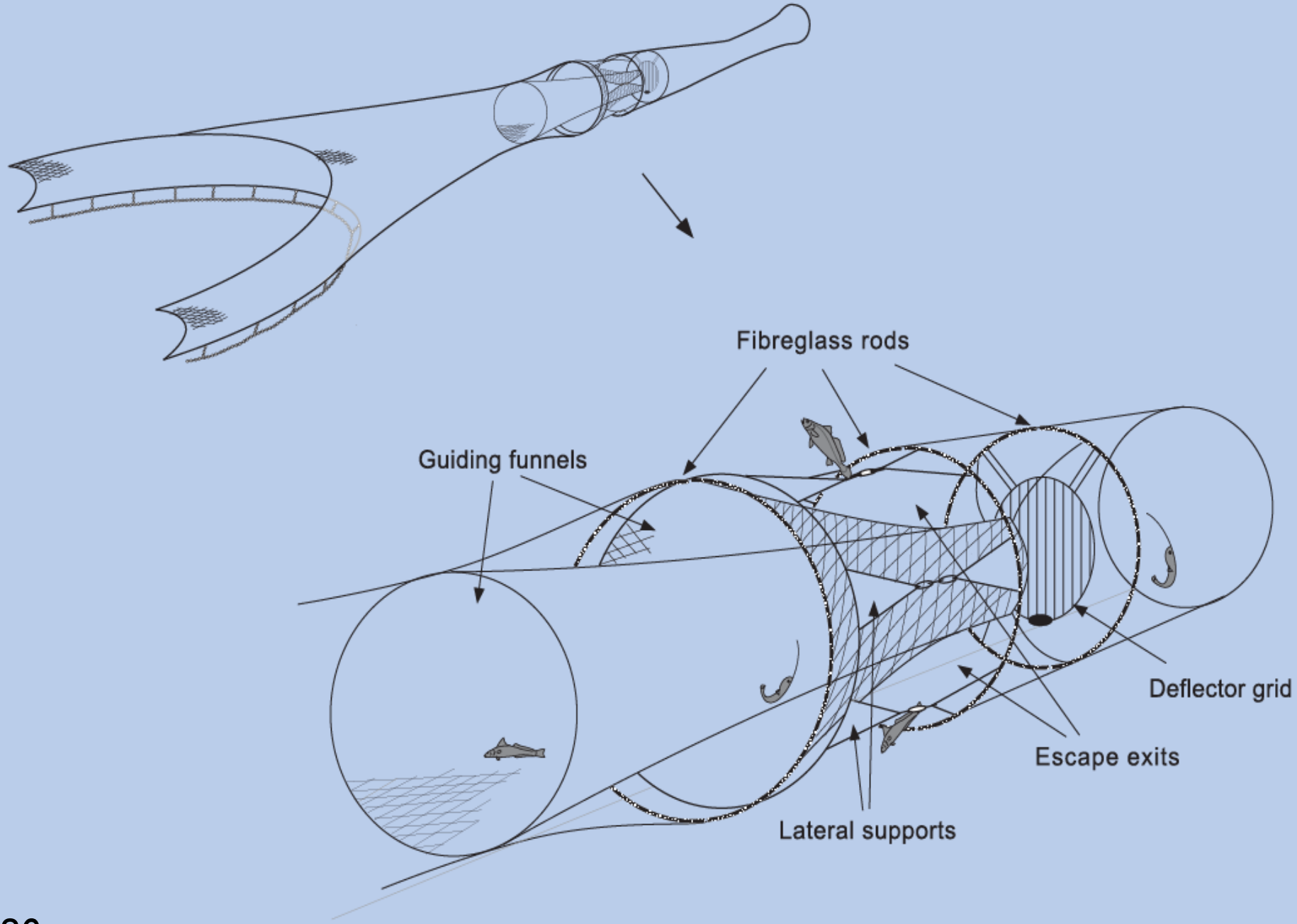


1993

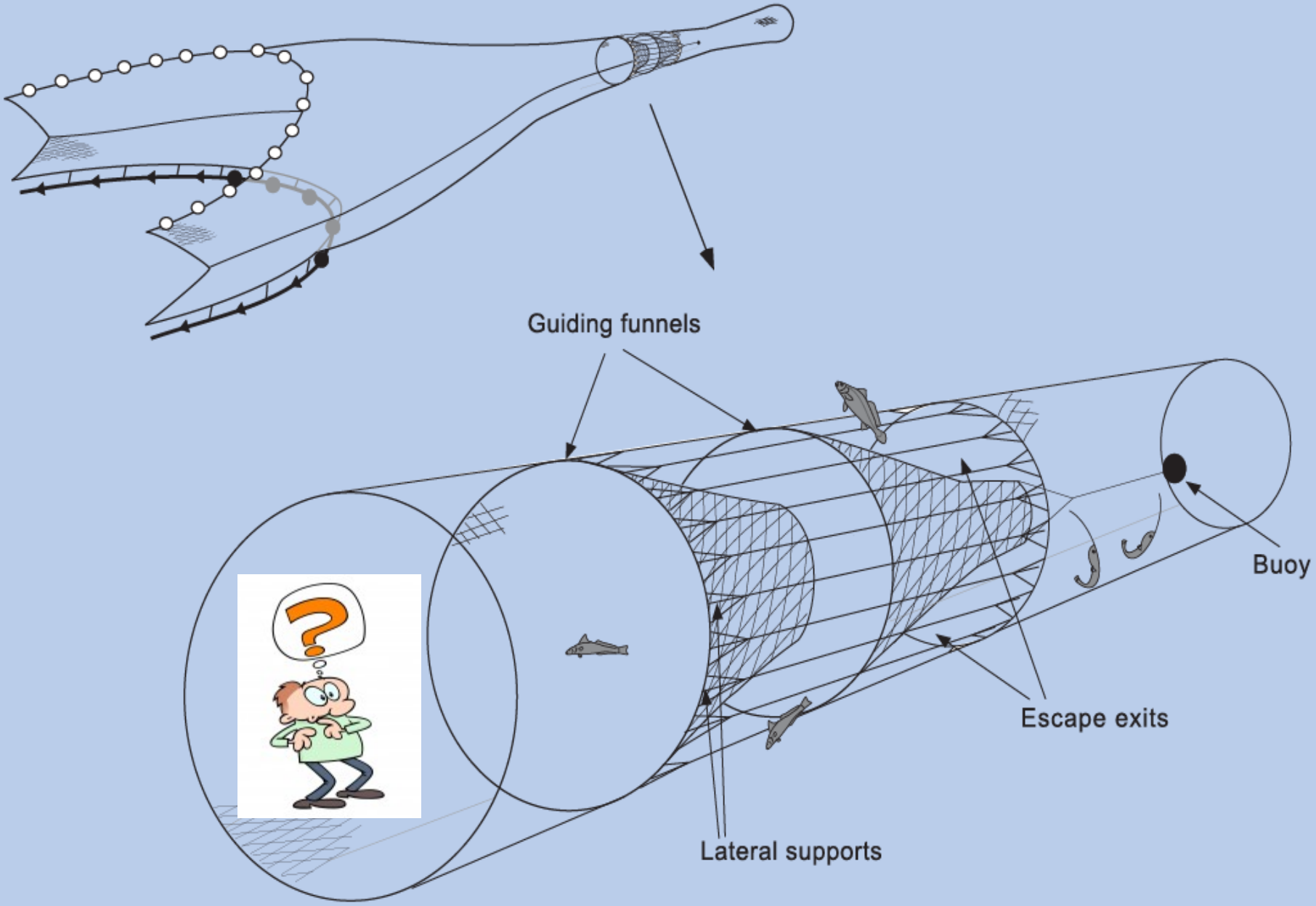
Behavioural separation

Includes strategically positioned openings in the codend that are designed to separate organisms (often smaller than the targeted shrimp) based on differences in behaviour.

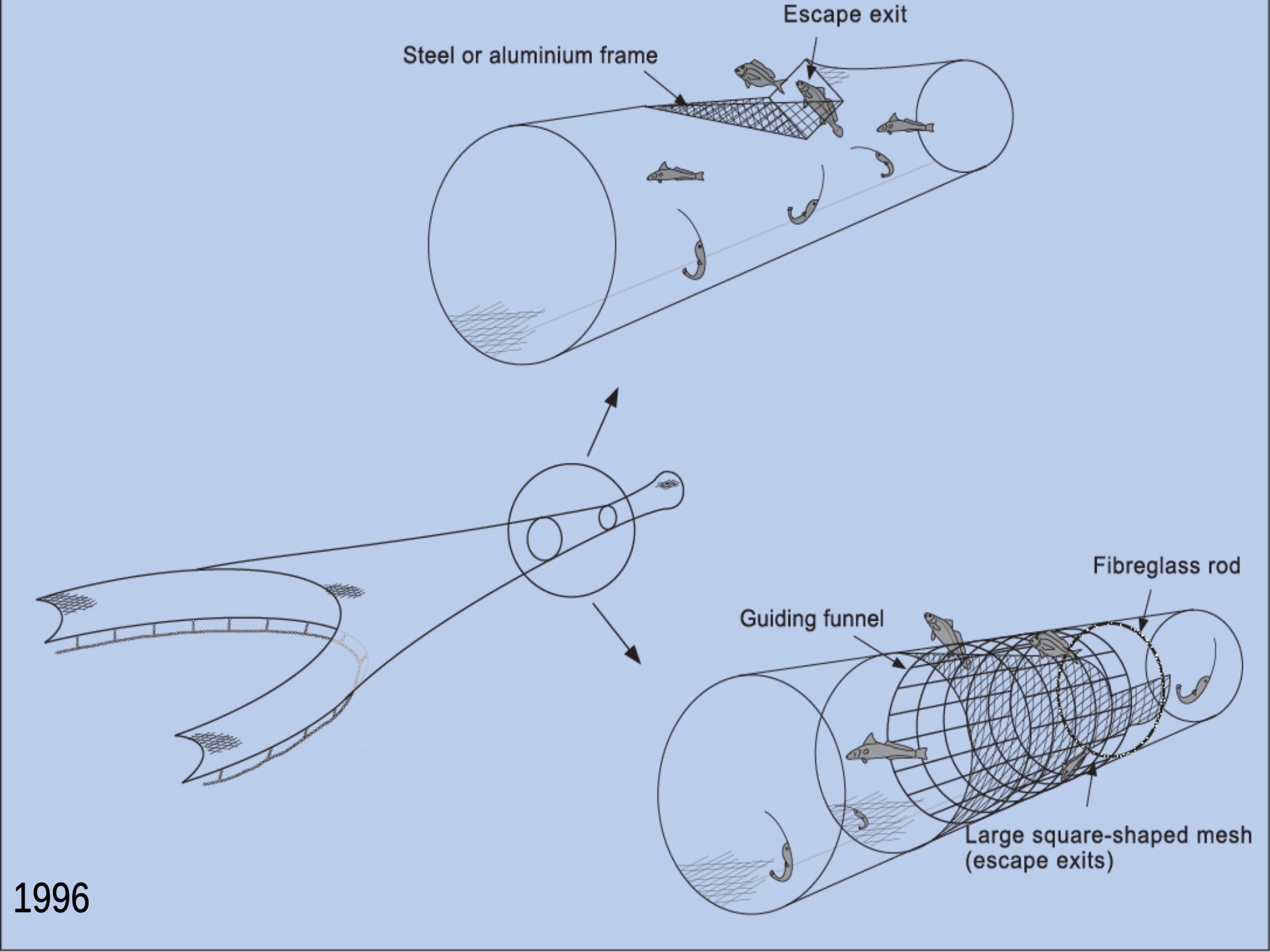
Typically reduce total bycatch by ~ 20-50%


Fibreglass rods
Guiding funnels
Deflector grid
Escape exits
Lateral supports

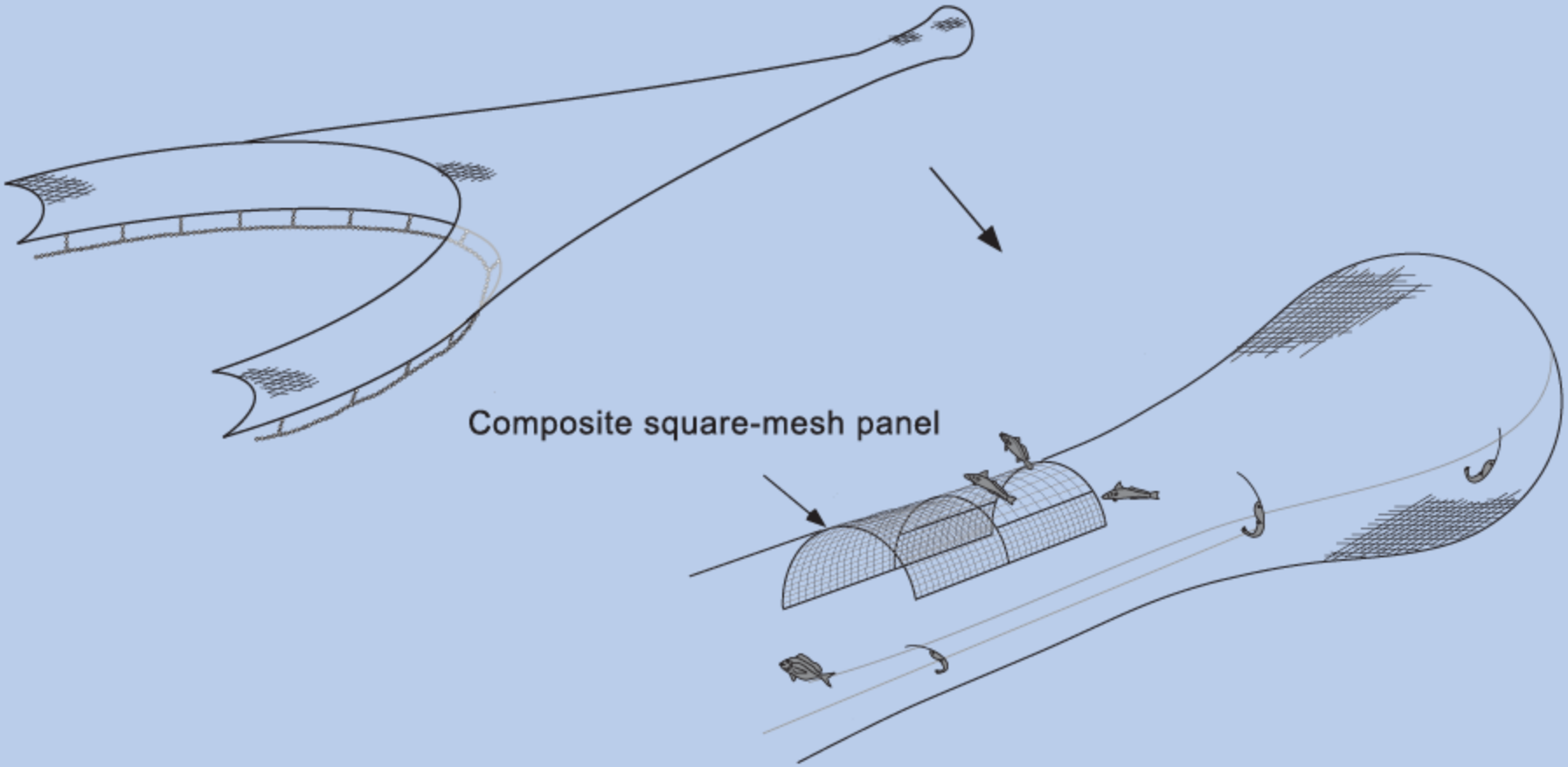
1986



1986

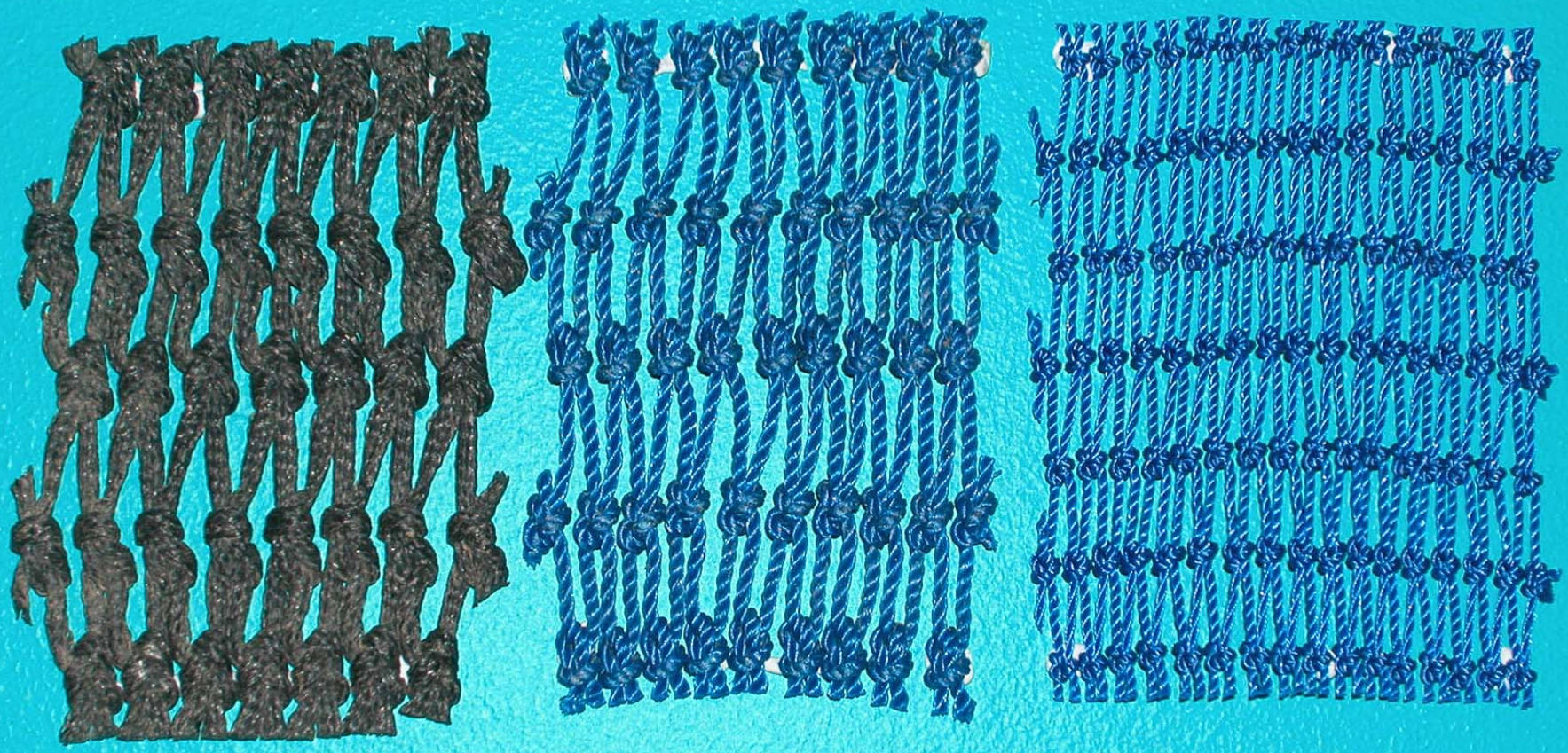

Escape exit
Steel or aluminium frame
Fibreglass rod
Guiding funnel
Large square-shaped mesh
(escape exits)

1996

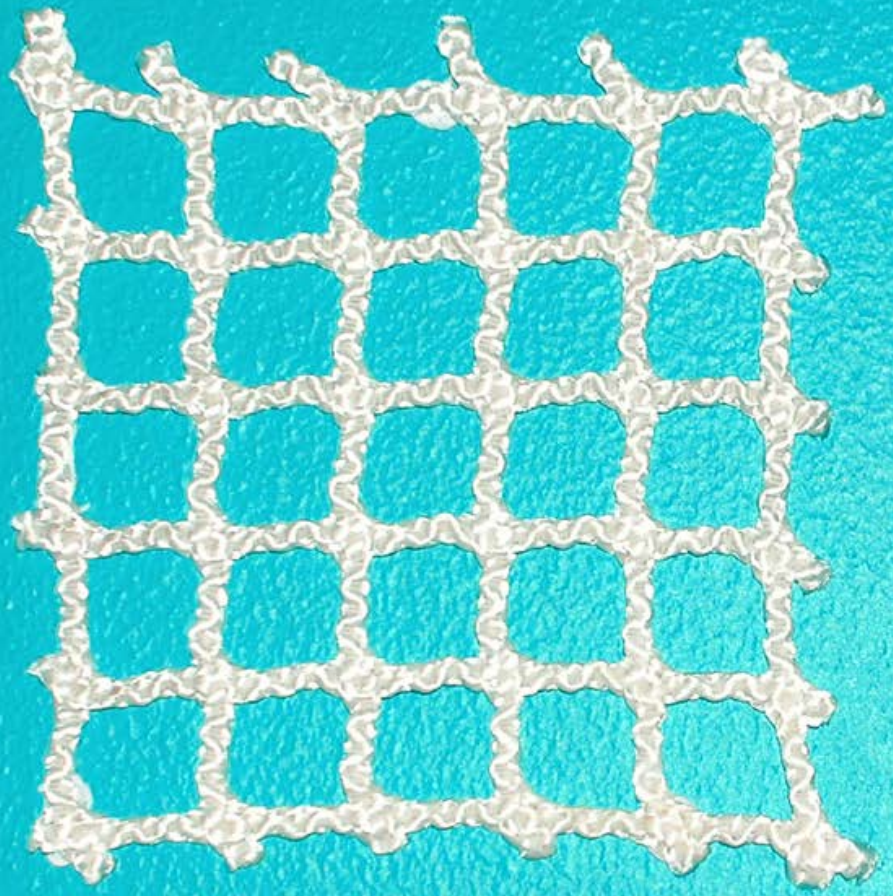


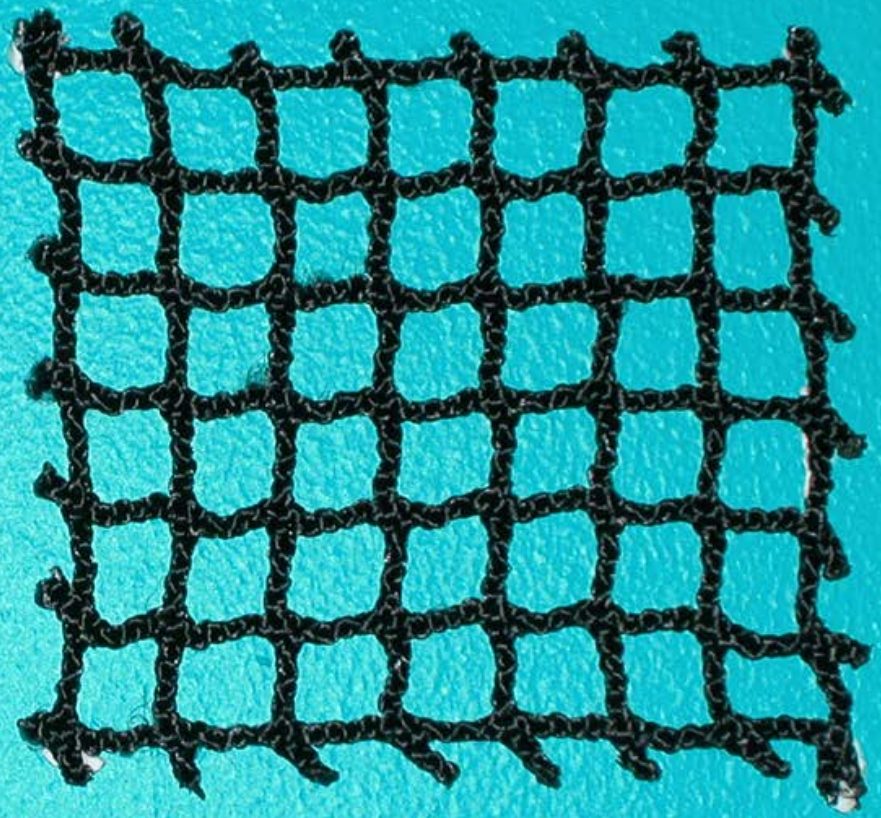
1994

T0 (diamond mesh)

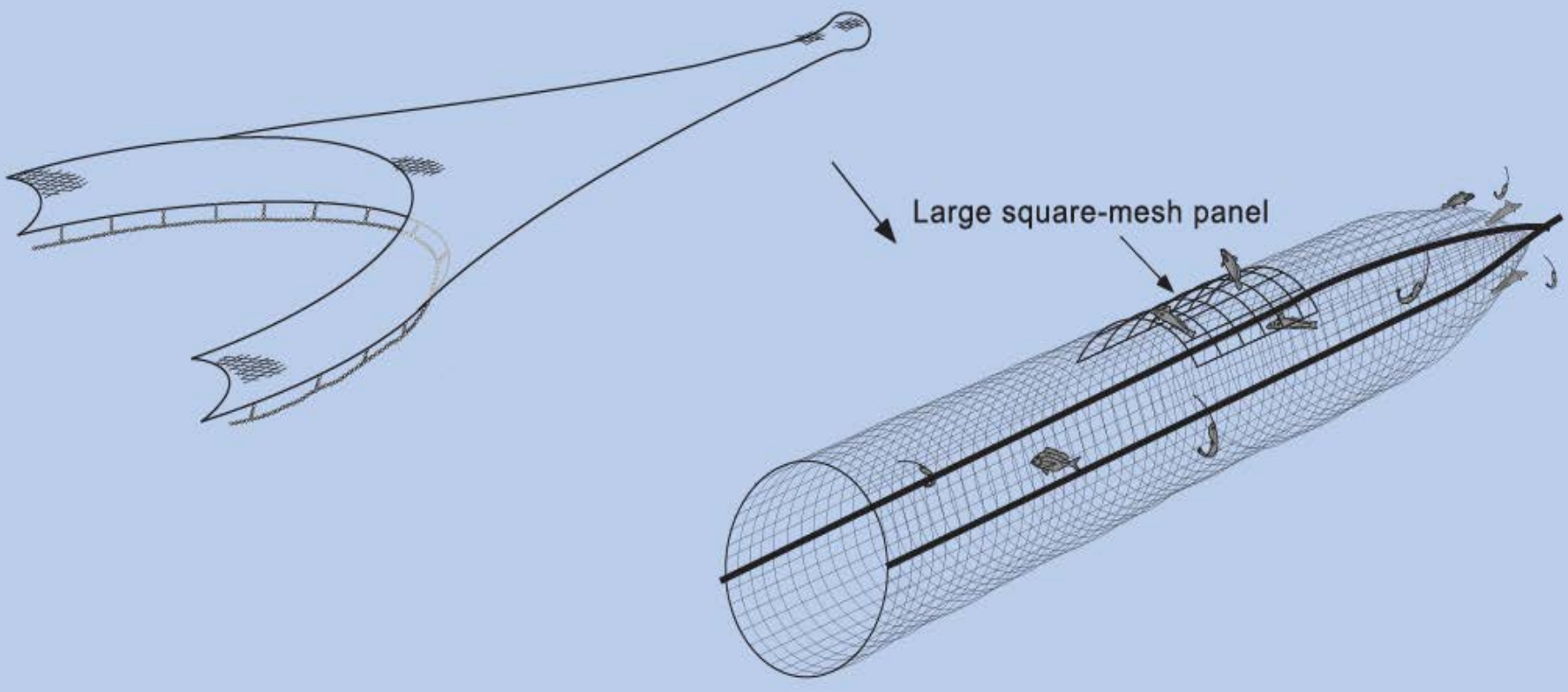


T45 (square mesh)





T90?

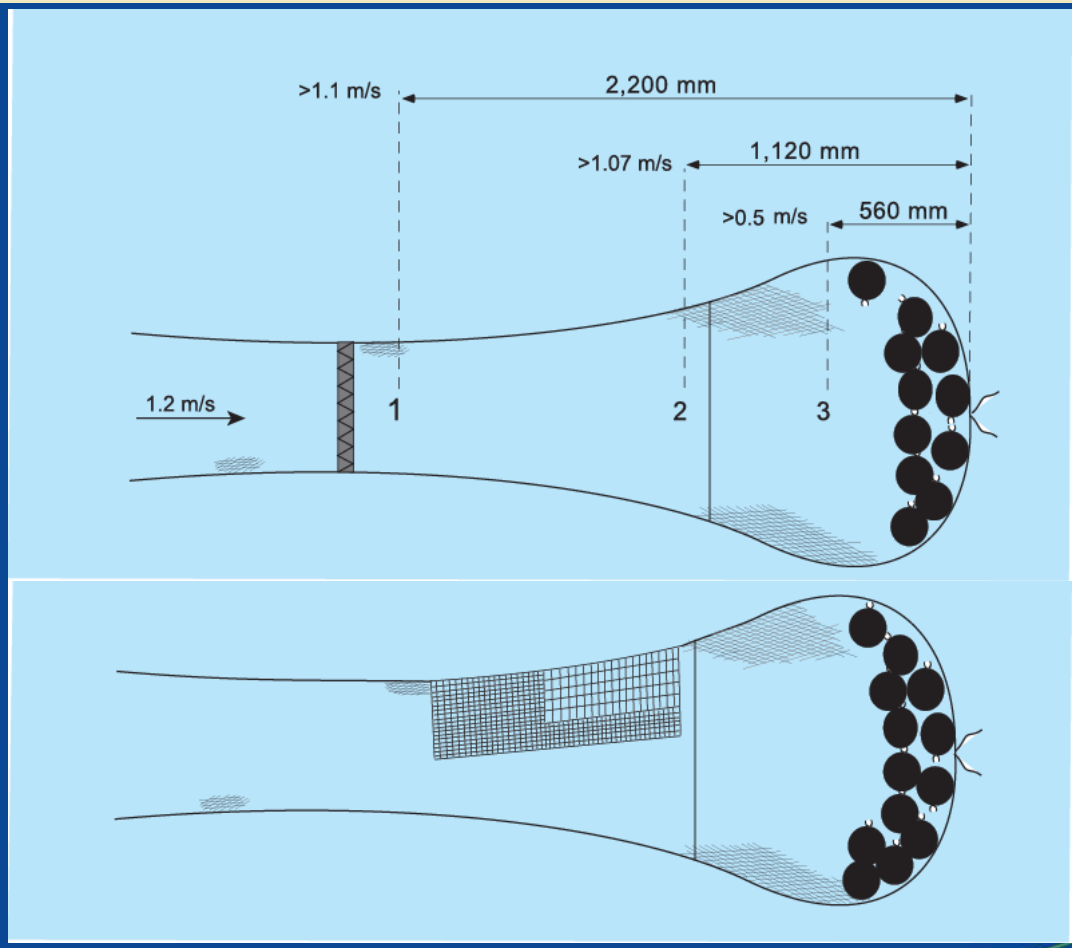


1998

Key requirements for behavioural-type BRDs

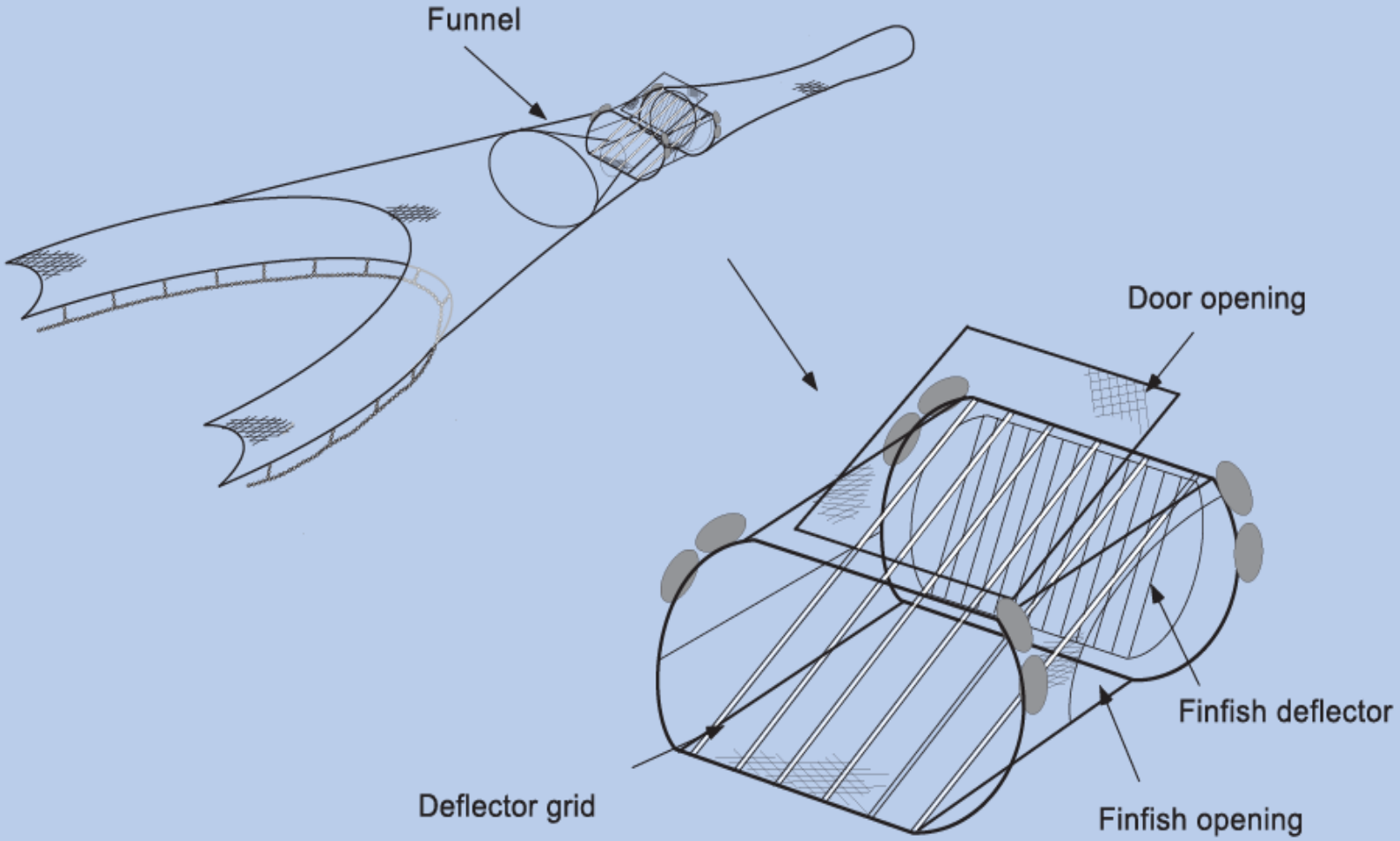
1). Reduce relative water flow to ~0.6-1.0 m/s; and

2). Provide sufficient openings in the top and sides of the codend.

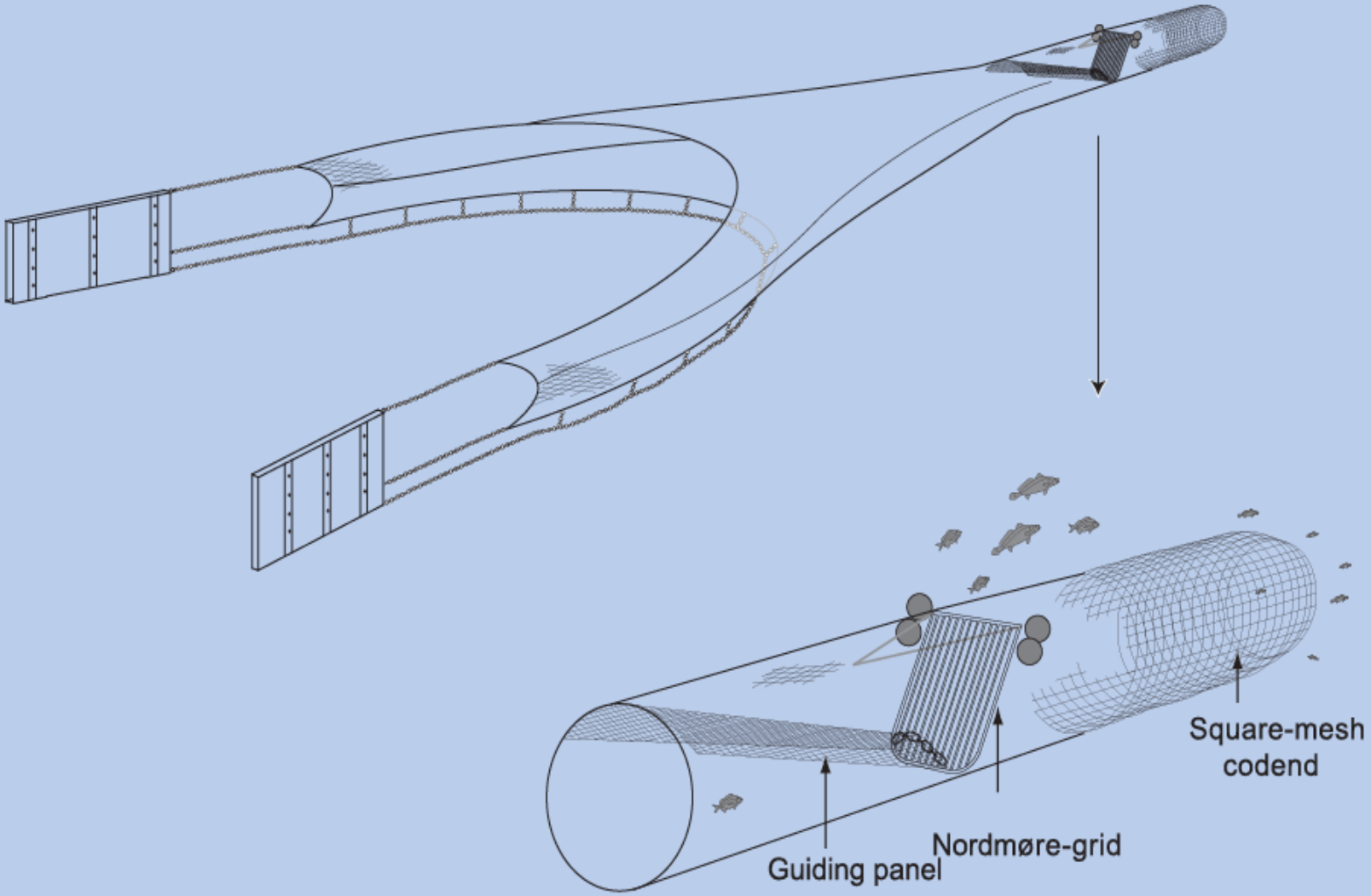


Combinations of BRDs

- Many shrimp-trawl fisheries require combinations of BRDs to reduce catches of various species.


Funnel
Door opening
Finfish deflector
Deflector grid
Finfish opening

1986



2003

The problem isn't completely solved…..

- BRDs can reduce total bycatch by ~60-90% and key species by up to ~70%...

- ….but in many fisheries there has been poor adoption.
- Escape mortalities? Ideally, unwanted organisms would never enter the trawl.
- Also, BRDs don't address the other key environmental issues associated with shrimp trawling, including: poor fuel efficiencies and perceived habitat impacts.

Aims of a concomitant approach during a recently completed FRDC project

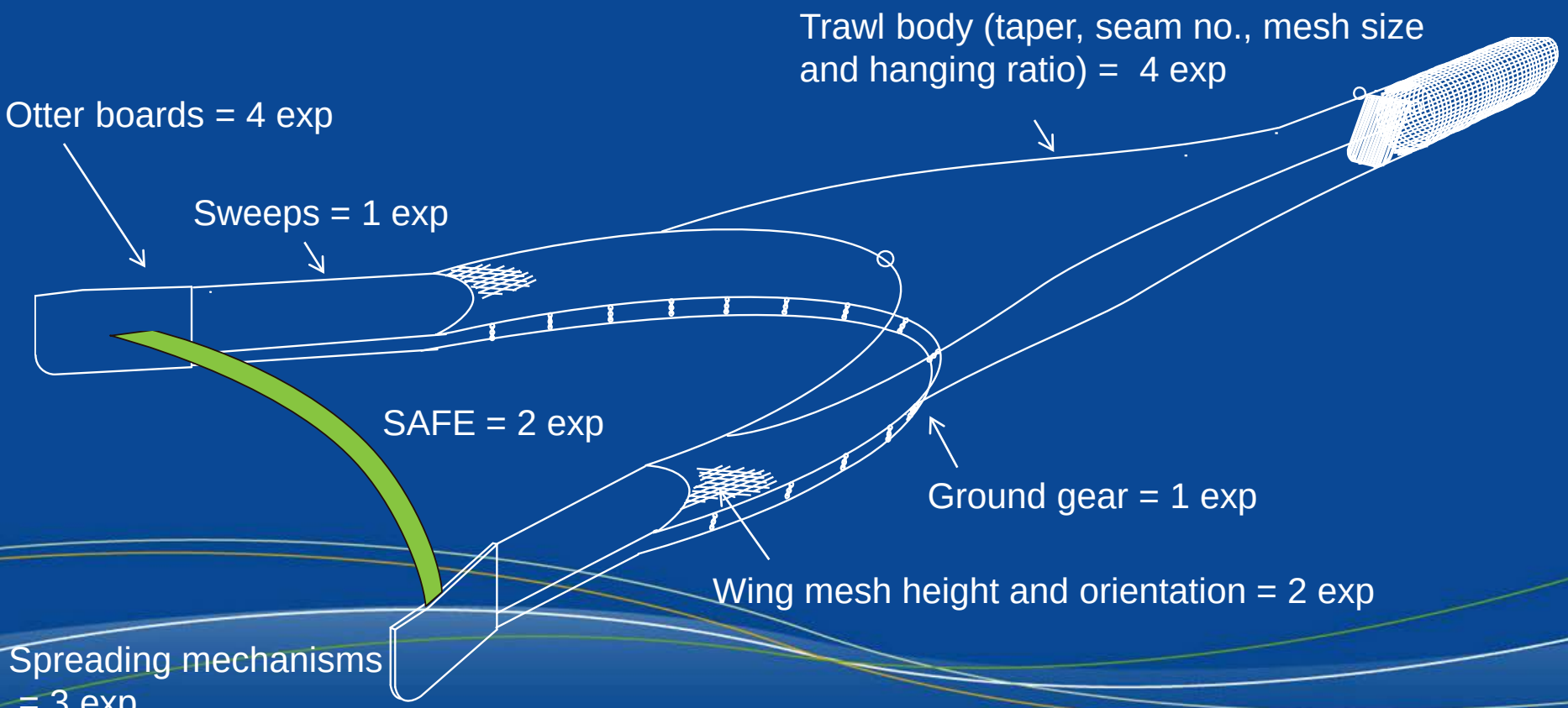
1. To identify anterior gear modifications that reduce the bycatch, drag and habitat impacts of shrimp trawls, while maintaining target catches, and isolate their mechanisms of action.

2. Using (1) above, provide a framework and direction for the future refinement of shrimp trawls.

Initial (first) project timeline

Phase 1 work with estuarine trawlers

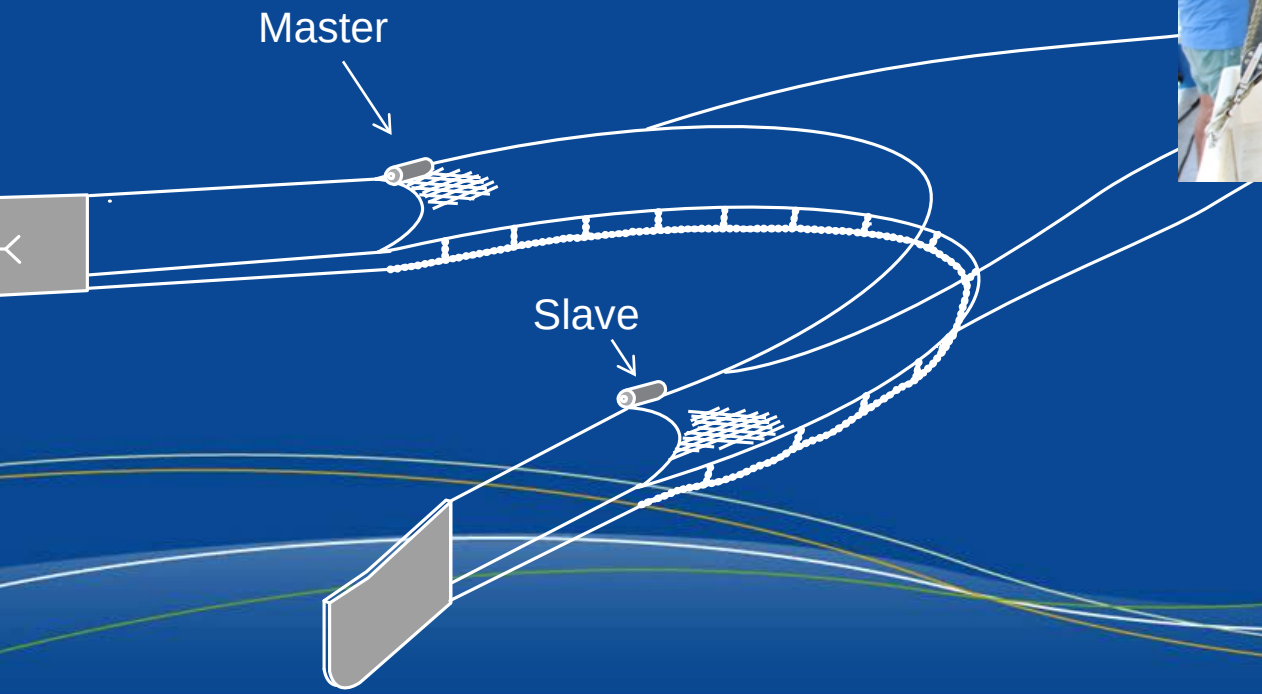
Seventeen experiments (exp) done over 179 days/nights to assess the utility of anterior modifications for reducing unwanted catches AND fuel, while maintaining catches of shrimp.



Trawl monitoring equipment

Trawl monitoring equipment

Trawl monitoring equipment



Spreading mechanisms

(a) Single rig

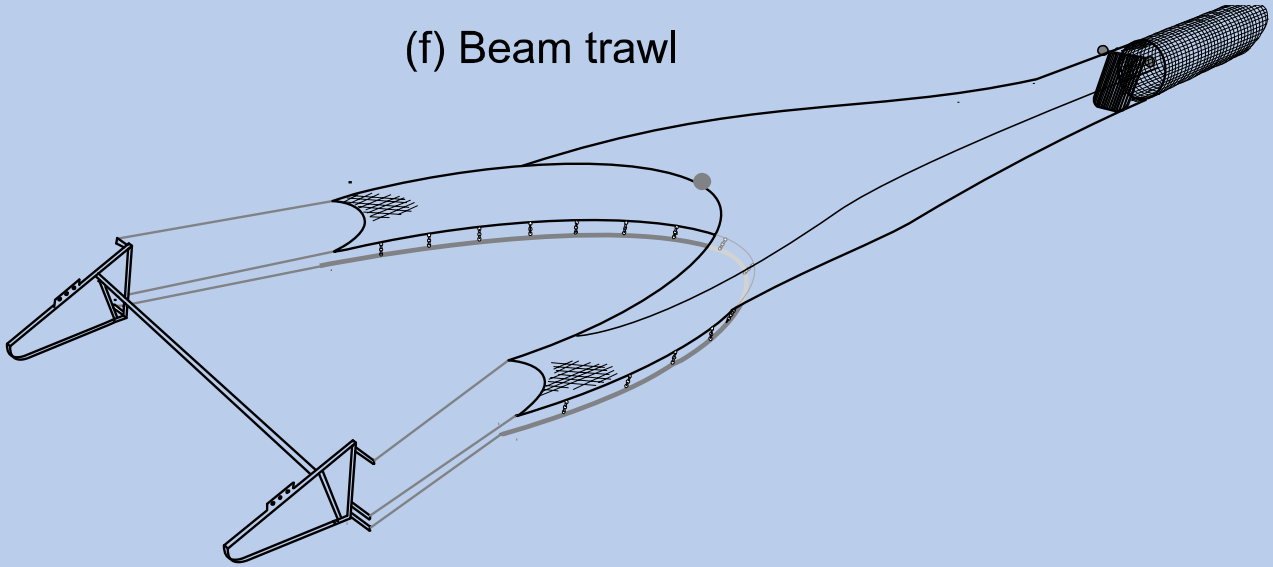
(b) Double rig

(c) Dual rig

(d) Triple rig

(e) Quad rig

(f) Beam trawl



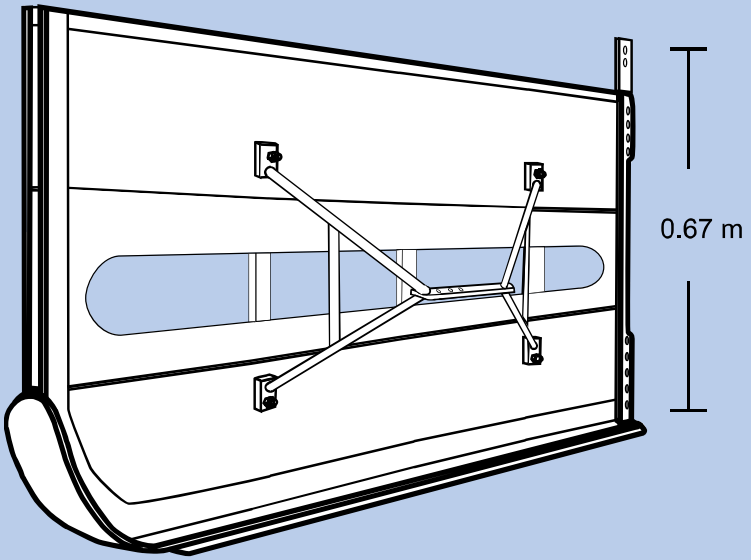
Spreading mechanisms – key results

System	Fuel efficiency (L/ha)	Fish bycatch
Single	2.88	Caught the most – especially bream
Double	2.44	↓26% compared to single
Triple	2.13	↓44% compared to single
Quad	2.21	↓26% compared to single
Dual	↓24% compared to double	↓60% (mulloway) compared to double
Beam	↓>30% compared to double	↓80% (herring) compared to double

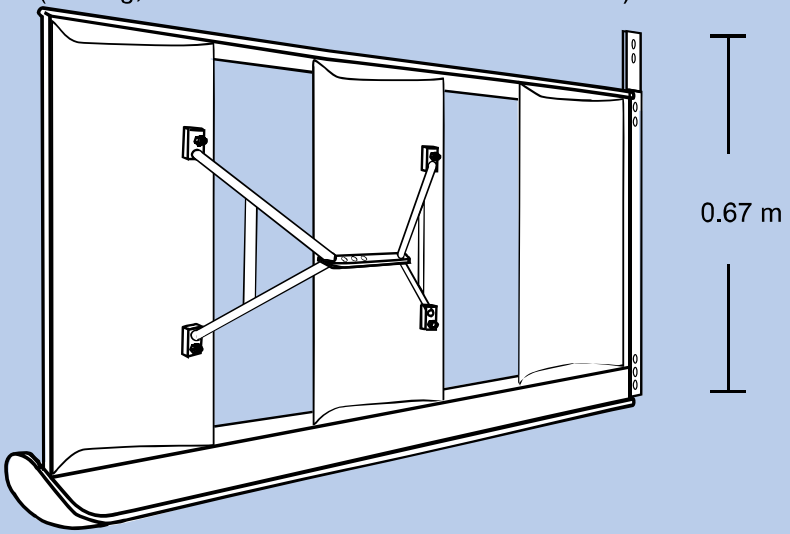
Otter-board bottom contact area potentially affects the catches of school prawns.

Otter boards (7.35-m double rig)

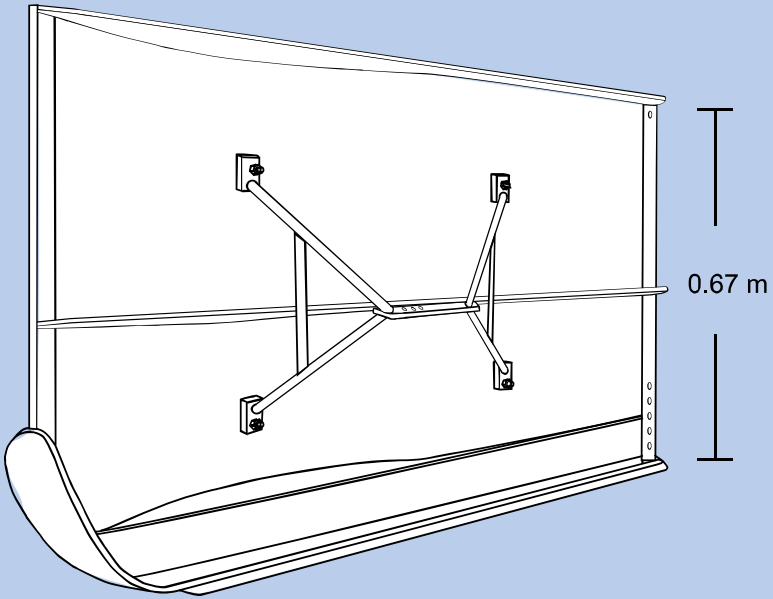
(a) Flat-rectangular
(52.5 kg, 1.39 × 0.61 m and solid area of 0.77 m^2)



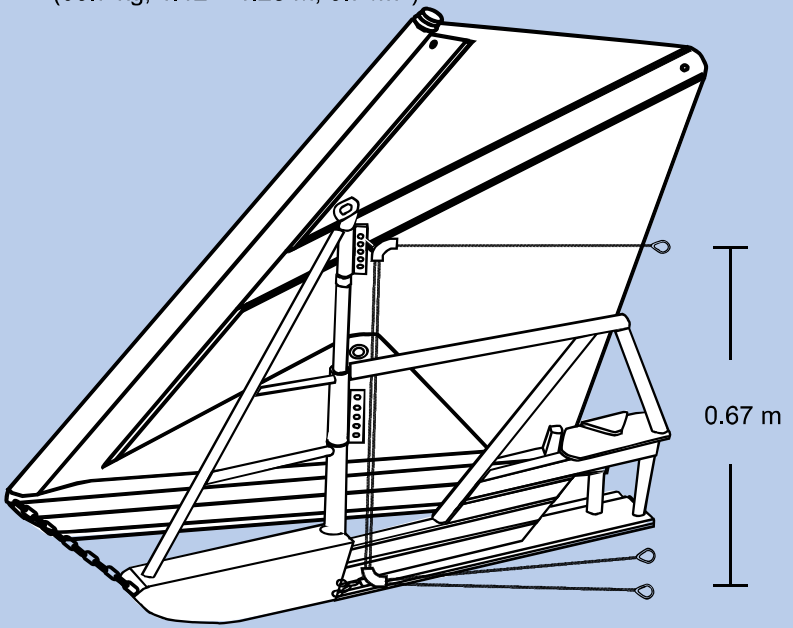
(b) Kilfoil
(63.0 kg, 1.25 × 0.63 m and solid area of 0.58 m^2)



(c) Cambered
(53.0 kg, 1.08 × 0.73 m and area of 0.79 m^2)



(c) Batwing
(60.7 kg, 1.12 × 1.23 m, 0.74m^2)

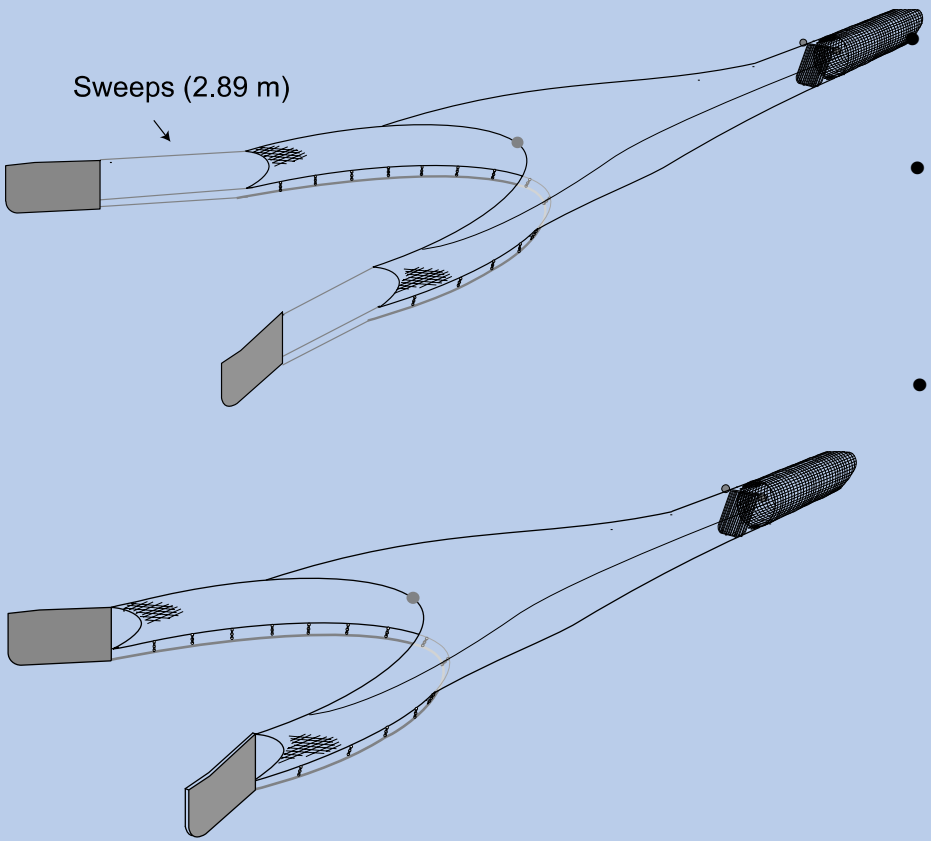


Otter boards – key results

Otter board	Fuel intensity (L/ha)	Fuel rate (L/h)
Flat rectangular	2.57	5.82
Kilfoil	2.66	6.13
Cambered	2.68	6.12
Batwing	**2.20 (18%↓)**	**5.00 (18%↓)**

- Otter boards can account for >50% of the total system drag.
- Compared to all other designs, the cambered otter boards caught more school prawns per ha trawled (by up to 1.2 x).
- Compared to conventional designs, the batwing had up to 87% less bottom contact and habitat disturbance (e.g. bivalves and debris).

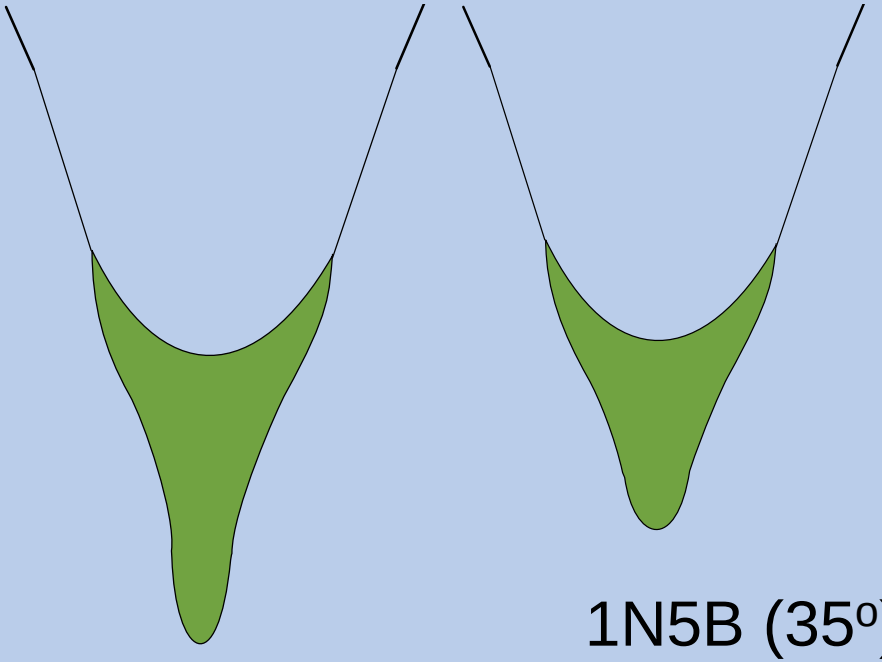
Sweeps



Removing sweeps:

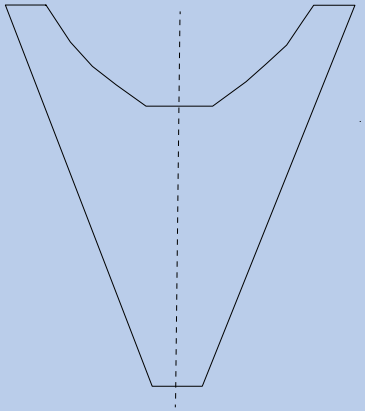
- increased the spread ratio from 0.67 to 0.71 (and also drag) in double rig;
- reduced the total bycatch (per ha trawled) by 44%, with no significant effect on catches of school prawns; and
- reduced the number of southern herring (per ha trawled) by 45%.

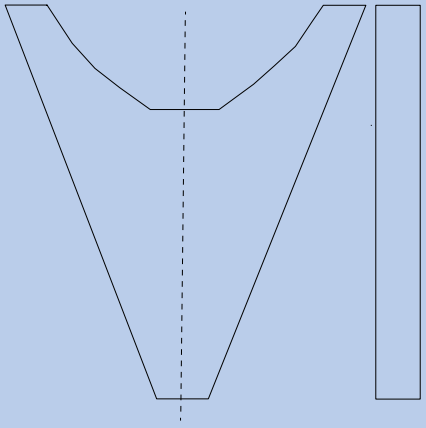
Trawl body taper, seam number, mesh size and hanging ratio

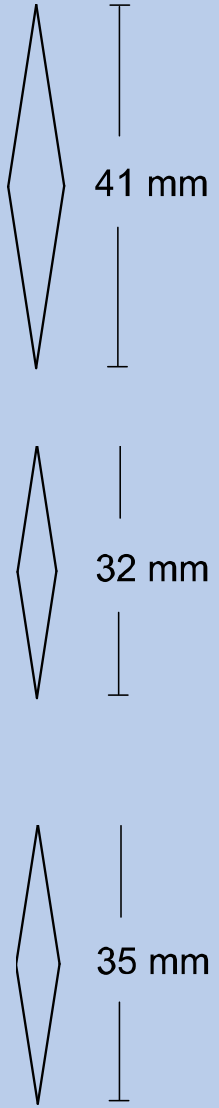


1N5B (35º)

1N2B (25º)/1P3B (28º)



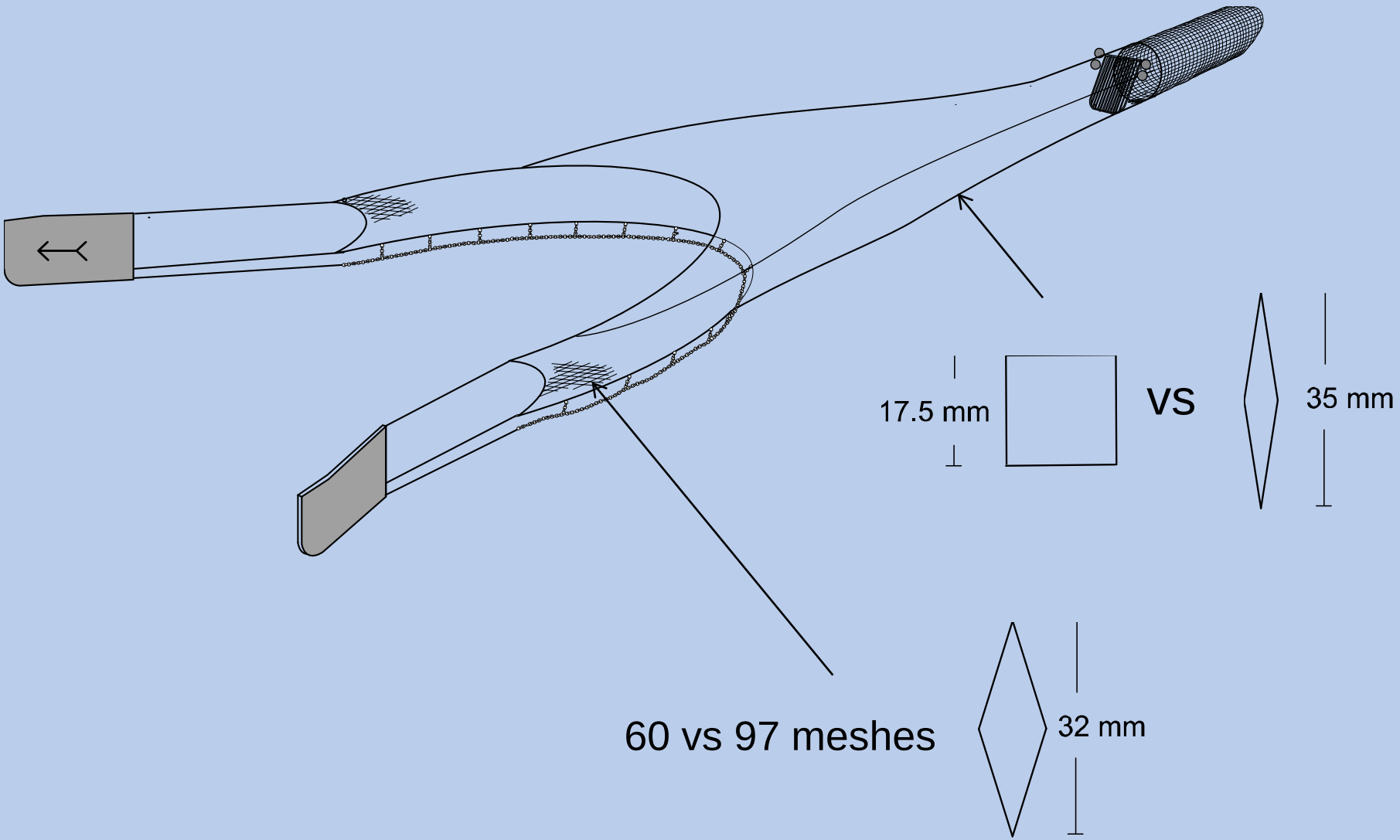




Trawl body taper, seam number, mesh size and hanging ratio–key results

- Steepening the side taper from 1P2B/1P3B (25-28^{o}) to 1P5B (35^{o}) consistently reduced the total bycatch by ~57% and the numbers of southern herring and tailor by ~95 and 67% (per ha trawled).
- The effectiveness of side taper on species selectivity depends on the available light.
- Steepening the side taper reduced drag and fuel per ha by up to 18 and 12%, respectively.
- Trawl body taper is much more important than mesh size in determining selectivity.
- Increasing the frame-line hanging ratio (35-mm mesh) from 0.550 to 0.707 minimally improved shrimp size selection.
- No effects of seam number on trawl performance.

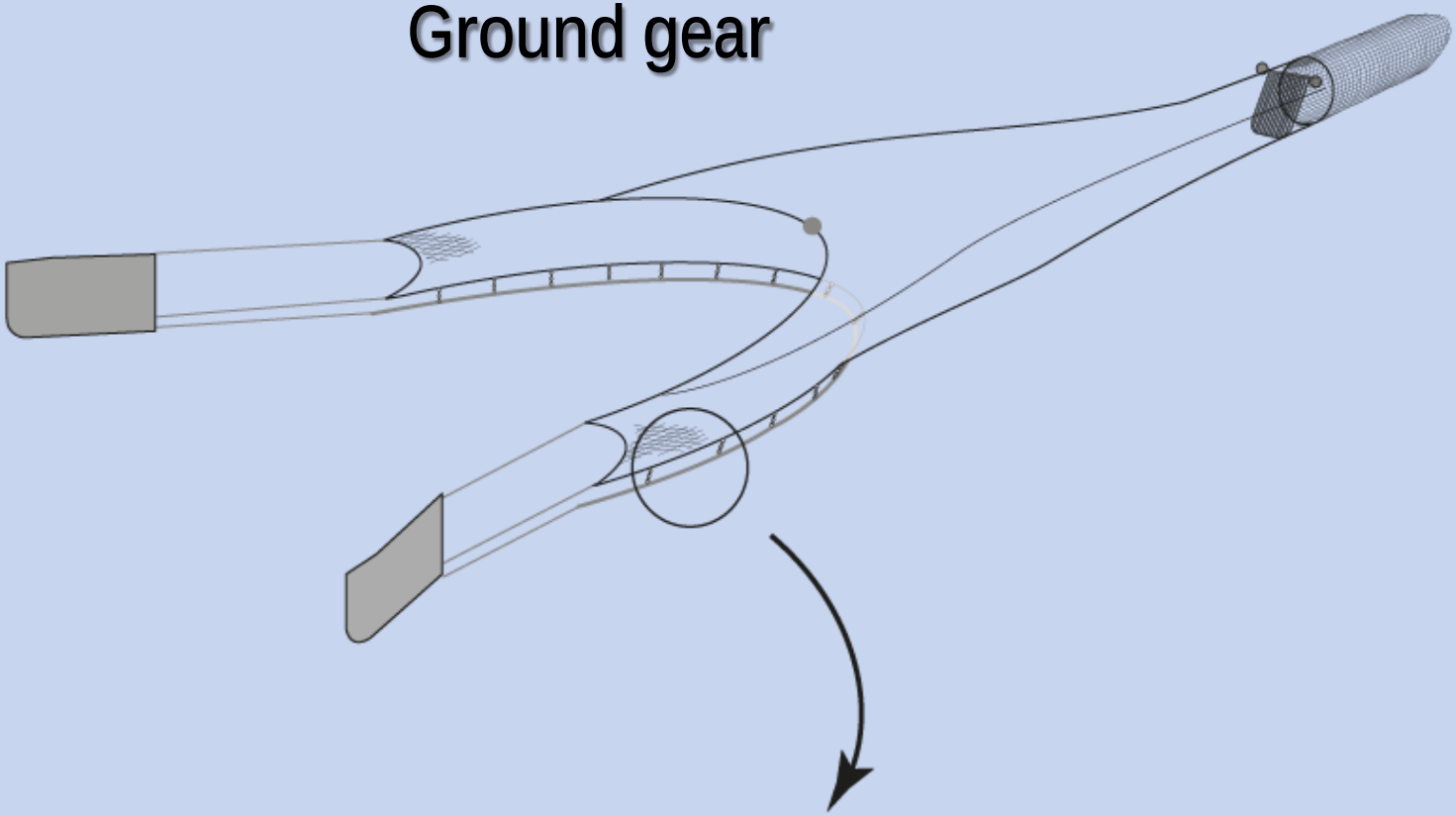
Wing mesh height and orientation

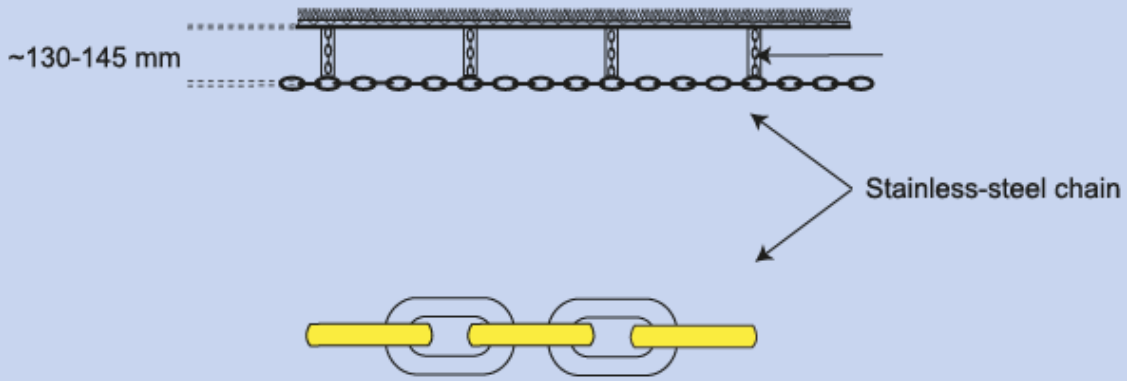


Wing mesh height and orientation – key results

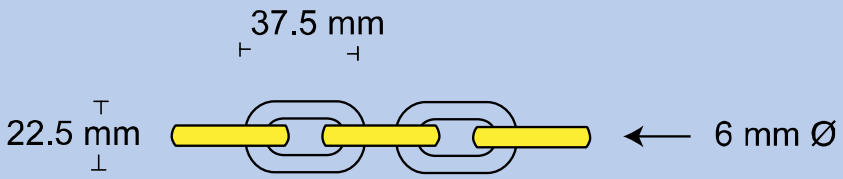
- Varying wing height (60 v 97 meshes) minimally affected the catches, but the lower twine area reduced drag and fuel per ha by up to ~10%.
- Compared to 35-mm trawls with wing panels comprising 20 diamond meshes, those with 20 bars caught up to 72% fewer smaller school prawns (i.e.<15 mm CL), thereby significantly improving size selectivity.
- Compared to a 41-mm conventional trawl, those made from 35-mm mesh (with 1P5B) body tapers and square-mesh wings caught up to 54% fewer smaller school prawns (<15 mm CL) and reduced drag and fuel per ha by up to ~10%.

Ground gear

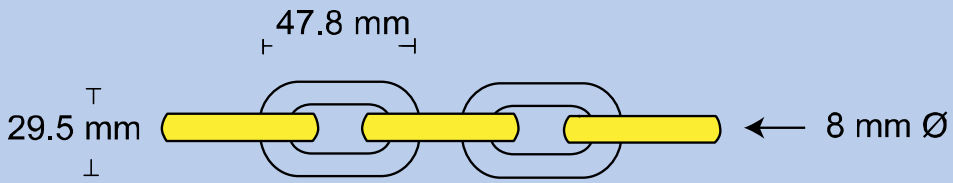




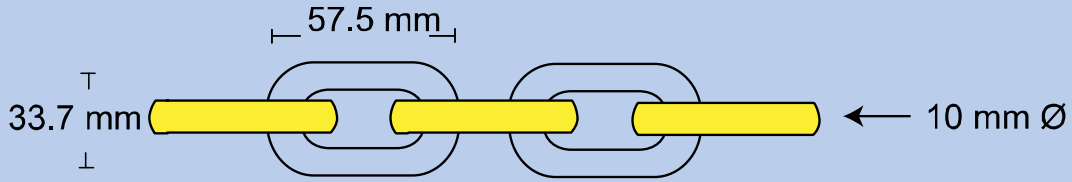
A) 6-mm chain



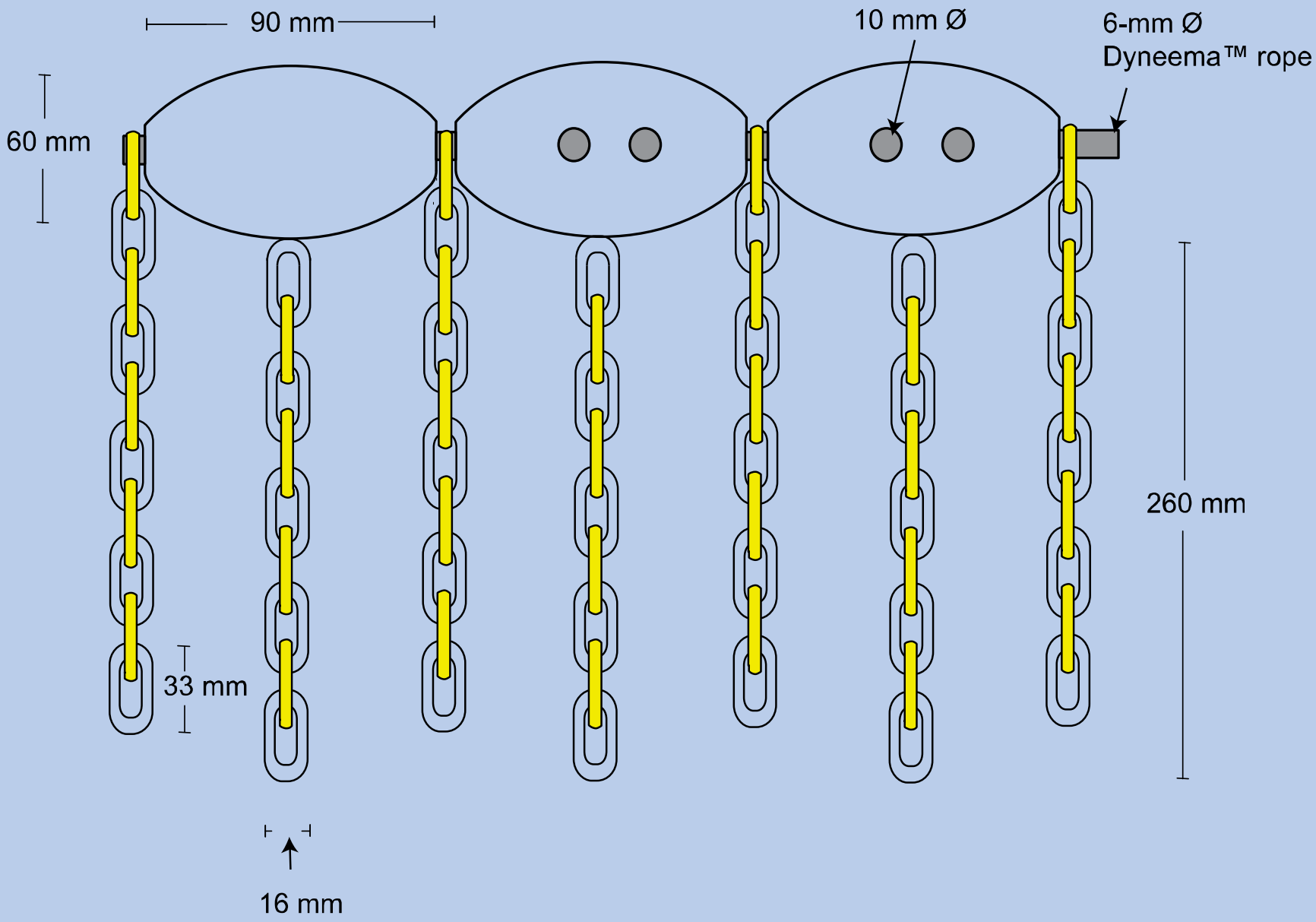
B) 8-mm chain



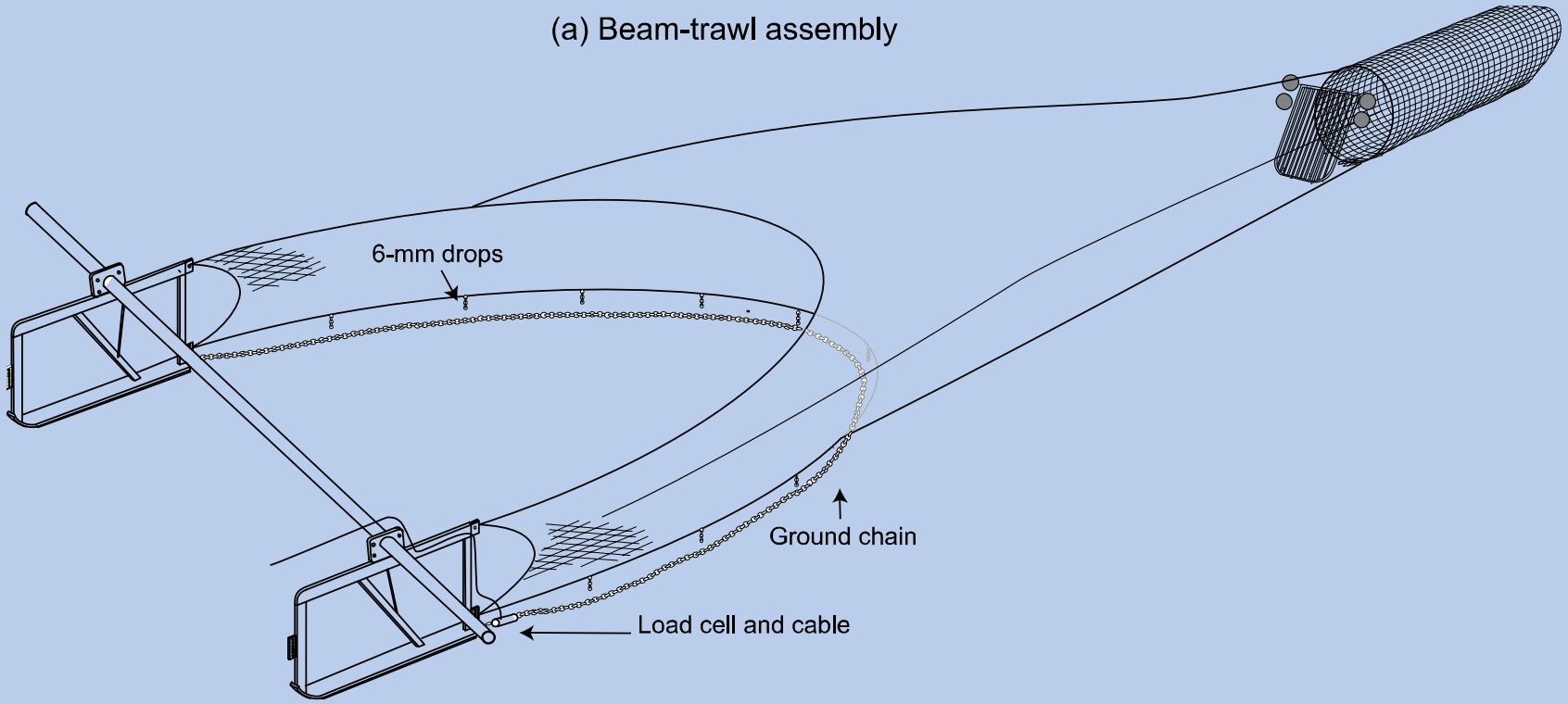
C) 10-mm chain



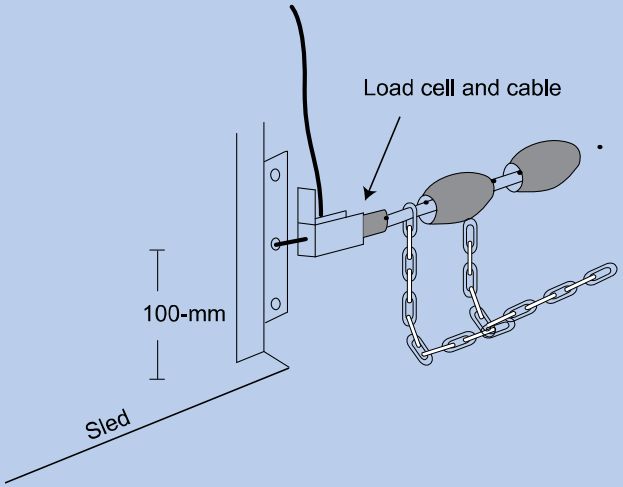
D) Soft-brush ground gear



(a) Beam-trawl assembly



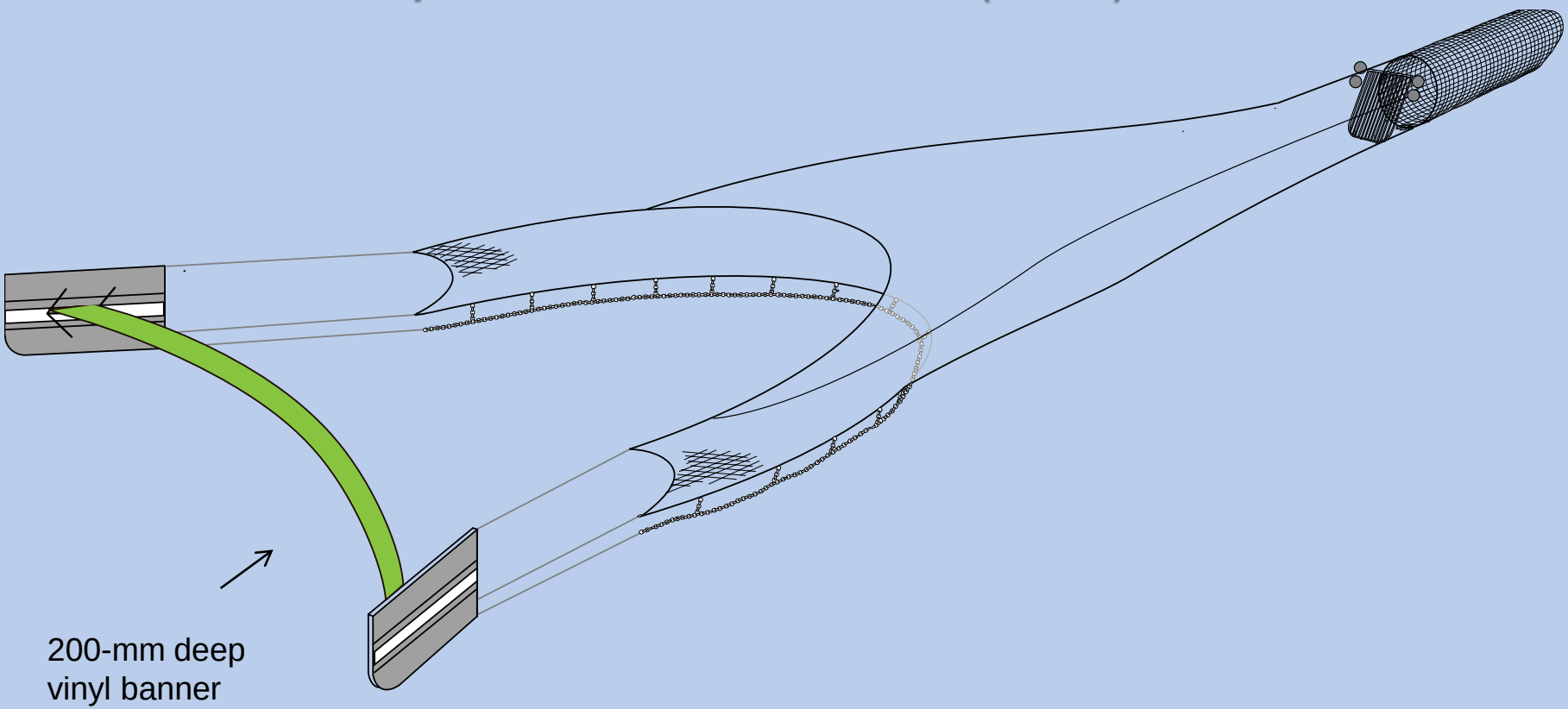
(b) Load cell and soft-brush attachment height



Ground gear – key results

- The 6-, 8-, and 10-mm ground gears had average drags of 22, 28 and 36 kg, or ~10, 12 and 14% of total system drag.
- The soft brush ground gear had the same drag as an 8-mm chain.
- There were no significant differences in shrimp catches, although the mean for the 6-mm chain was lower than the others.
- Compared to the 10-mm and soft brush, the 6-mm chain caught 49% fewer forktail catfish (5-9 cm TL).

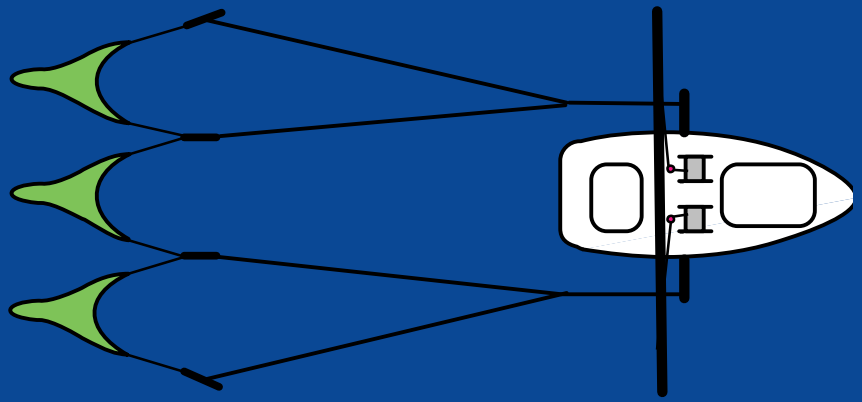
Simple anterior fish excluder (SAFE)



Reduced the catches of southern herring, tailor and mullet by up to 42%.

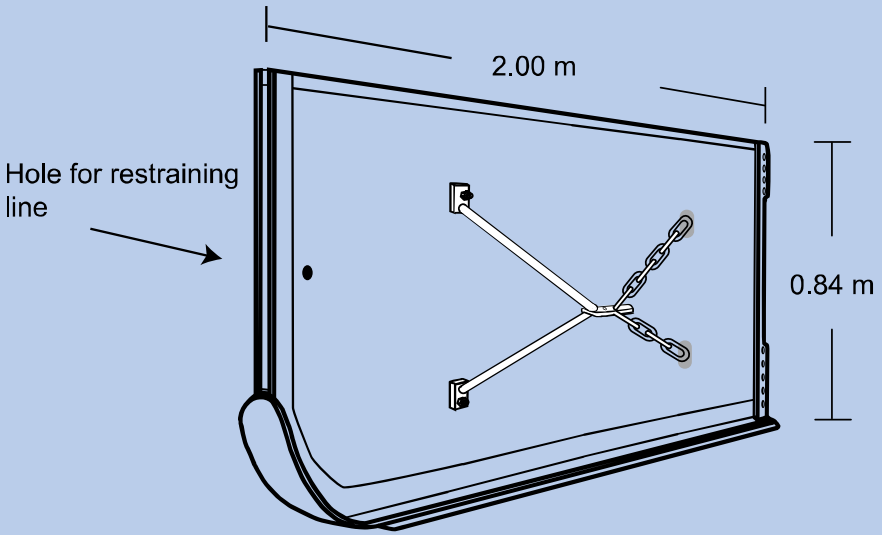
Phase 2 work with other trawlers and in other fisheries

Experiments to assess the utility of key anterior modifications to triple rig for reducing unwanted catches AND fuel, while maintaining catches of king prawns.

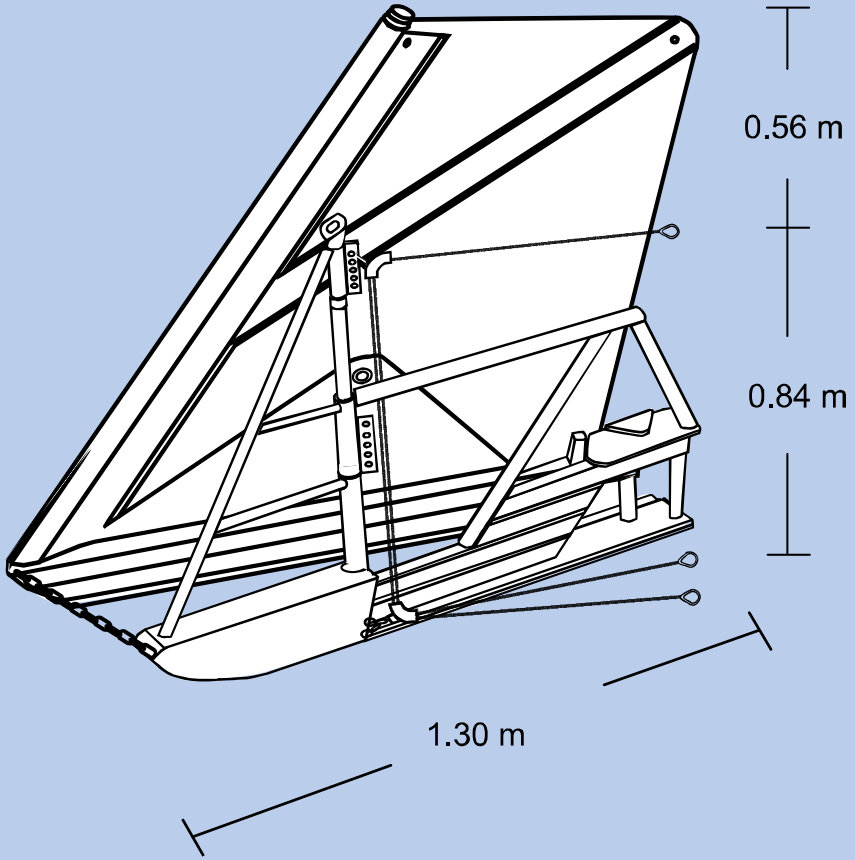


Otter boards (12.80-m triple rig)

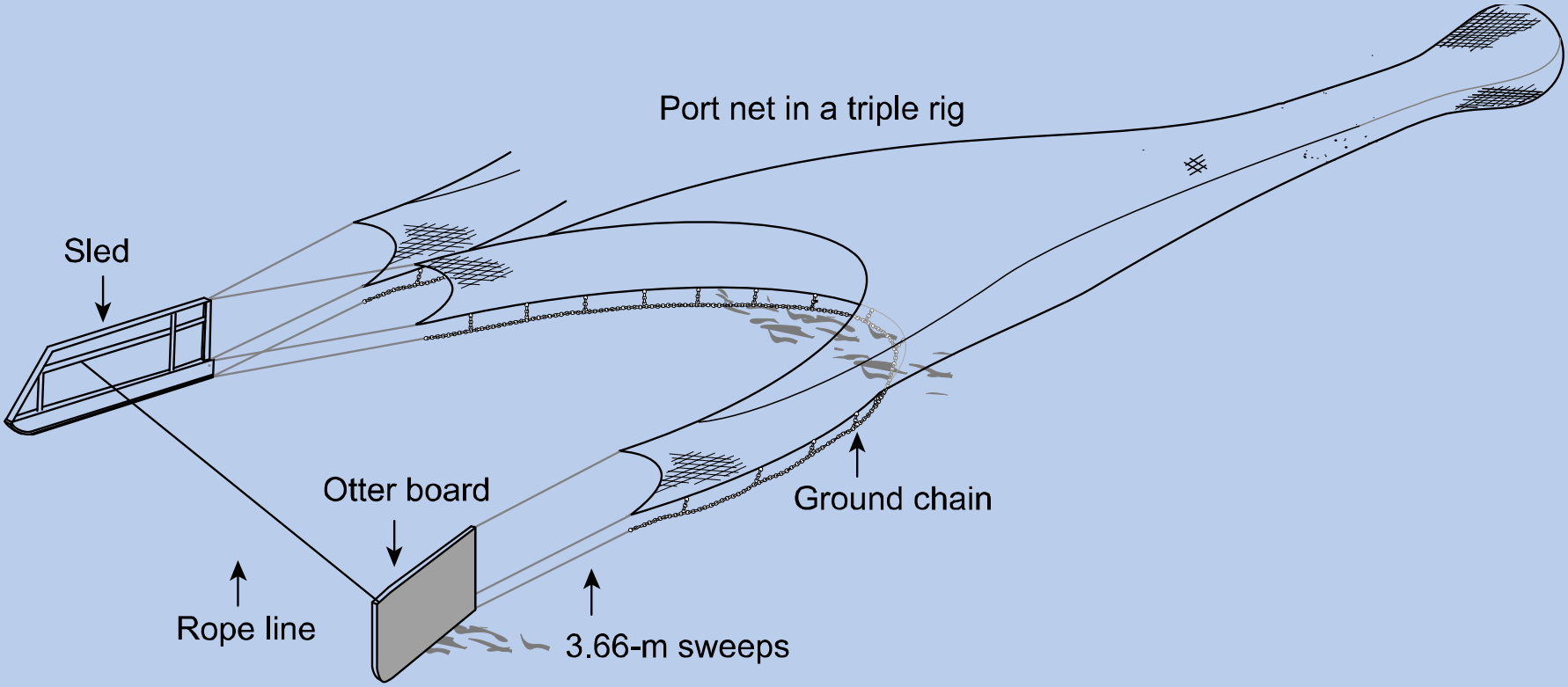
(a) Flat-rectangular
(180 kg, 2.00 × 0.84 m and 1.68 m^2)



(b) Batwing
(120 kg, 1.30 × 1.40 m and 1.15 m^2)



Restrained side trawls (triple rig)



Batwing and restrained flat-rectangular – key results

- The batwing had less drag (~5%), but a contributing factor was the lower spread ratio (the batwings were slightly too small).
- No differences in the catches (per ha) of eastern king prawns among any of the configurations.
- The batwing and restrained flat-rectangular otter boards caught more large (retained) flathead and leatherjacket per ha than the conventional, possibly due to an improved alignment of otter board and wing-end angles.
- The side trawls behind the restrained (SAFE?) flat-rectangular otter boards caught less bycatch per ha (by up to 37%).
- Using the batwing in the ocean trawl fishery could reduce the otter-board bottom contact of each vessel by ~8 ha per night.

Utility of a W trawl with batwing otterboards for reducing drag, while minimising habitat impacts

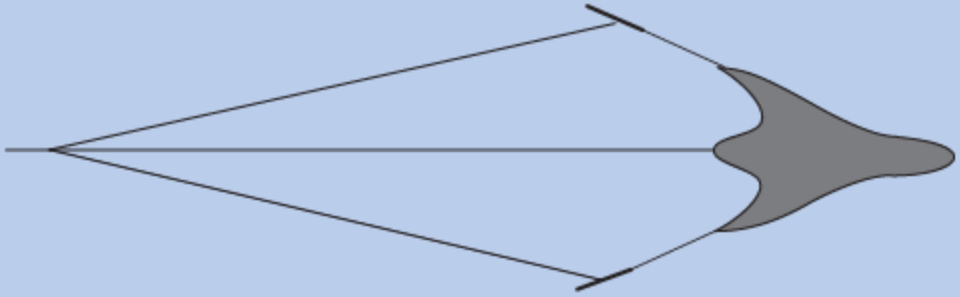
- The aim was to test a new trawl configuration that encompasses some of the key factors shown (in phase 1) to affect the engineering and biological efficiencies of trawls

- Done off southern Queensland

- A 7.2-m four-seam conventional trawl (Florida flyer); vs
- a 7.2 m W trawl

•Both rigged with suitable-sized batwing otter boards

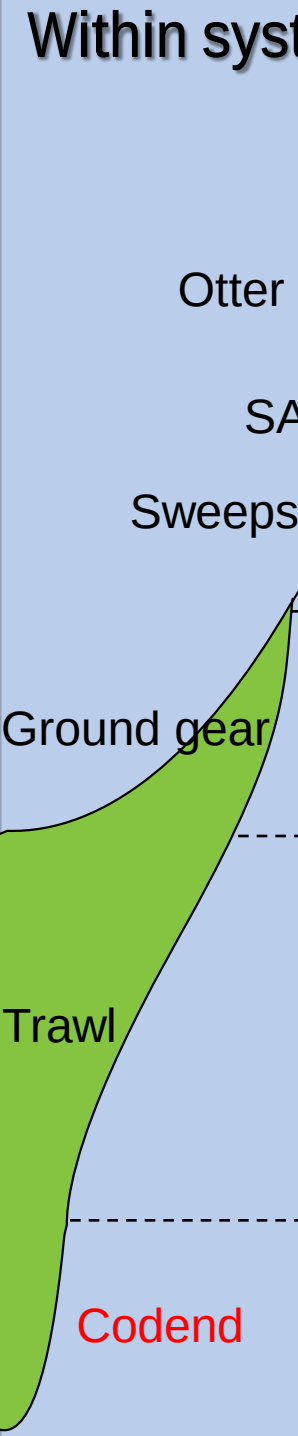
W-trawl



W-trawl and batwing – key results

- The W trawl had up to 11% less drag for 1.14 x more wing-end spread, and less habitat impacts
- No differences in the catches (per ha) of key by-product (brancyurans and cephalopods), but shrimp catches were lower in W trawl.
- More research to improve catching efficiency.

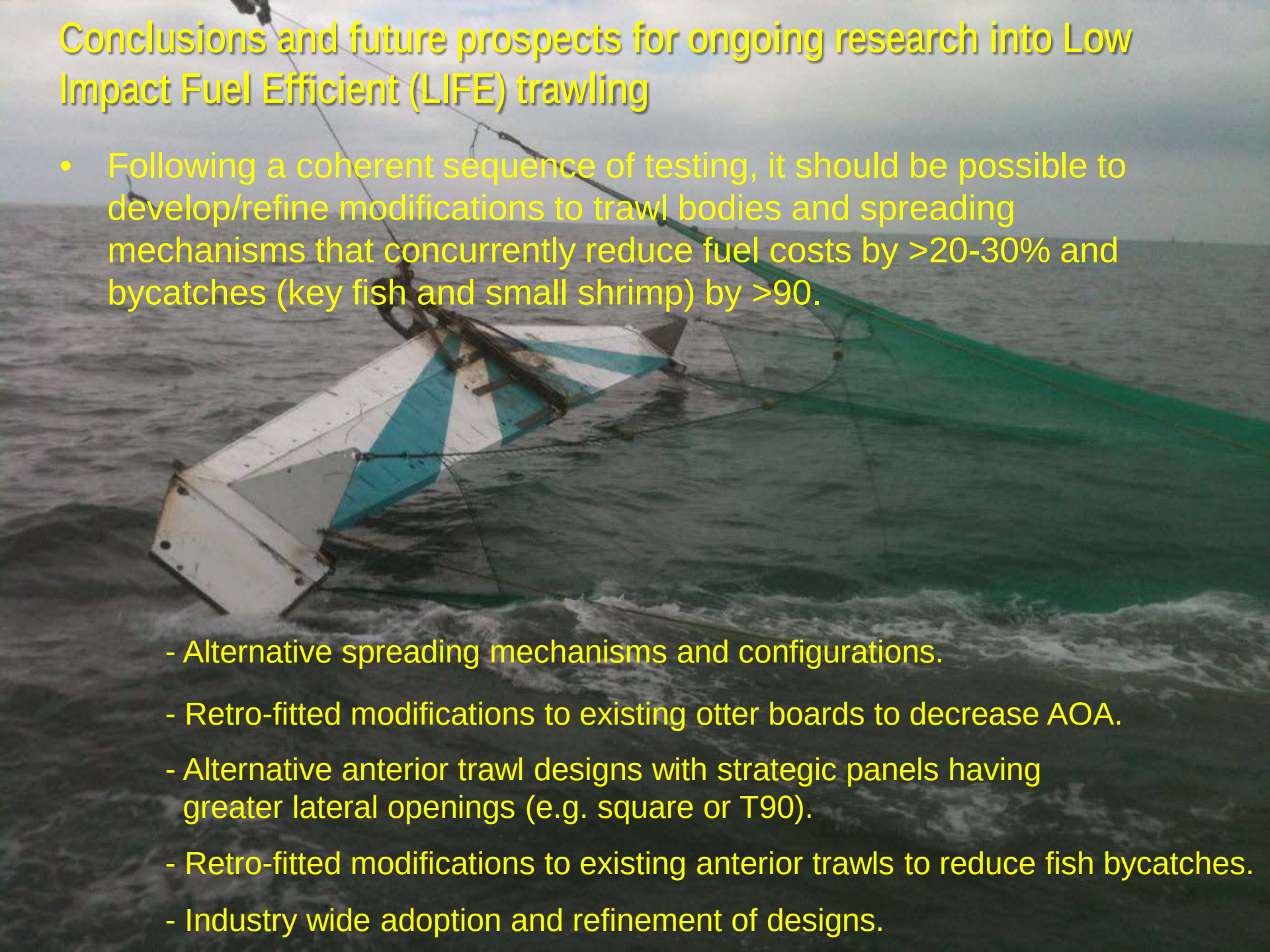
Within systems…..



	% of system drag	Potential for fuel savings	Potential for bycatch reduction
Otter boards	30-55%	Up to 20%	Negligible
SAFE	~2%	None	Key species = up to 42%
Sweeps	~5%	Negligible	Total = up to 44% Key species = up to 95%
Ground gear	10-15%	2%	Key species = up to 49%
Trawl	25-55%	5-18%	Total = up to 57% Key species = up to 95%
Codend	~5%	Negligible	Total = ~60-90% Key species = up to 70%

Conclusions and future prospects for ongoing research into Low Impact Fuel Efficient (LIFE) trawling

- Following a coherent sequence of testing, it should be possible to develop/refine modifications to trawl bodies and spreading mechanisms that concurrently reduce fuel costs by >20-30% and bycatches (key fish and small shrimp) by >90.



- Alternative spreading mechanisms and configurations.
- Retro-fitted modifications to existing otter boards to decrease AOA.
- Alternative anterior trawl designs with strategic panels having greater lateral openings (e.g. square or T90).
- Retro-fitted modifications to existing anterior trawls to reduce fish bycatches.
- Industry wide adoption and refinement of designs.


Questions?

The European Discard Ban and some recent work

European Discard Ban (or Landing Obligation - LO)

DiscardLess:
“To provide the science to underpin the policy‘s implementation“

4 year project, >5 million euro

Consortium of 30 partners

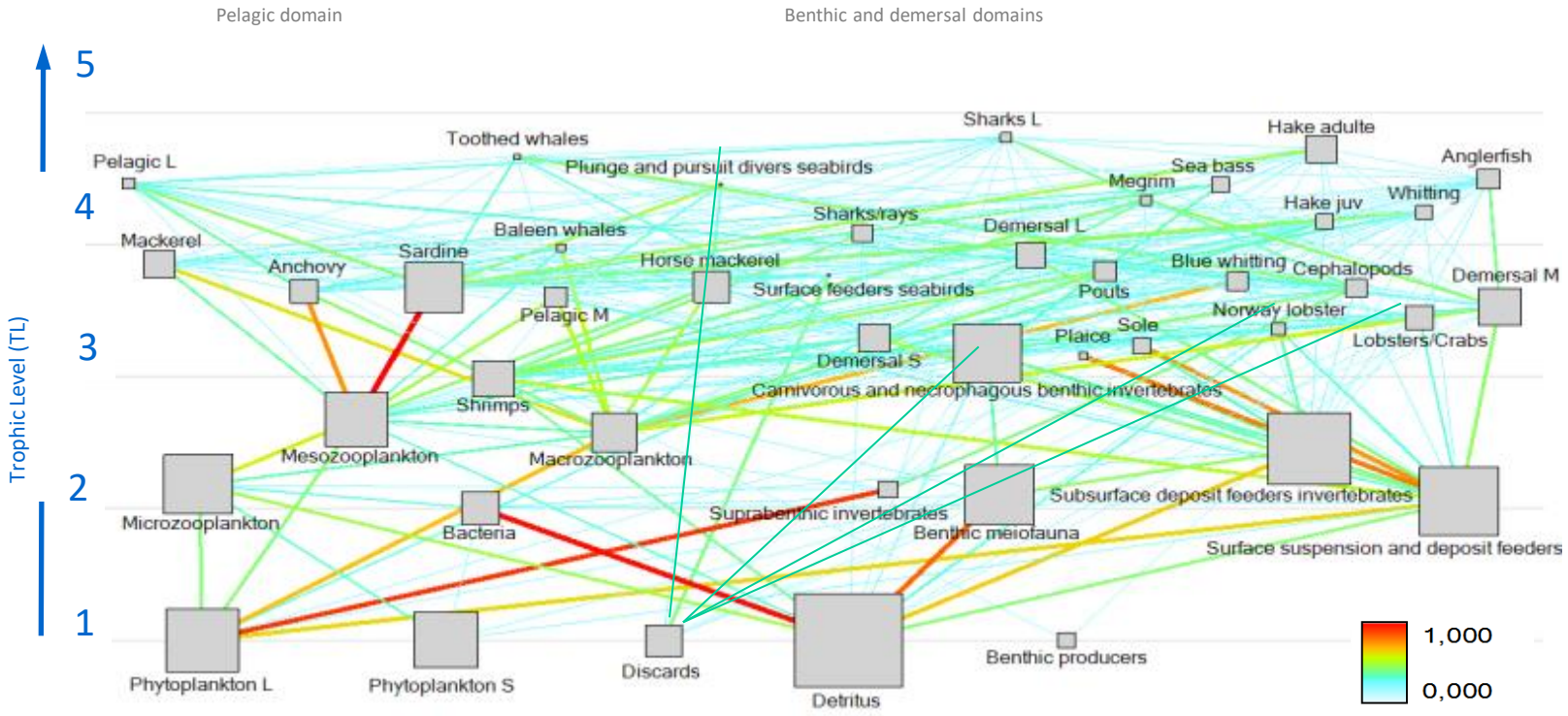
DiscardLess

PARTICIPANT ORGANISATION NAME	COUNTRY
DTU Aqua	Denmark
IFREMER	France
Instituto Español de Oceanografía	Spain
University of Bergen	Norway
Strathclyde University	UK
IFRO-University of Copenhagen	Denmark
Université de Bretagne Occidentale	France
Seafish Industry Authority	UK
Marine Scotland Science	UK
UN Food and Agriculture Organisation	Intergov.
Simrad Spain SLU	Spain
Hampiðjan hf	Iceland
SafetyNet Technologies LTD	UK
Marine Institute	Ireland
Lamans Management Services SA	Greece
Pôle AQUIMER	France
IMAR-University of Azores	Portugal
CEFAS	UK
Matís ltd. - Icelandic Food and Biotech	Iceland
MAREL	Iceland
ShipCon	Poland
TRACE Wildlife Forensics Network Ltd	UK
AZTI-Tecnalia	Spain
BARNA	Spain
NUSCIENCE	Belgium
University of Tromsø	Norway
Marine Natural Resources Governance	Ireland
FishFix	Belgium
Agrocampus Ouest	France
AlphaFilm	Denmark
Marine Institute of Memorial University	Canada

8 Work Packages:

1 - Ecosystem-Scale impact assessment:

Evaluate the ecological consequences of the LO and subsequent changes in fishing practices



8 Work Packages:

2 - Fishery-Scale impact assessment

Estimates of the likely economic and social impacts of the implementation of the LO at the fishery scale (individual and fleet).

8 Work Packages:

3 - Adaptation of gear technology

Avoidance of unwanted catches through technology

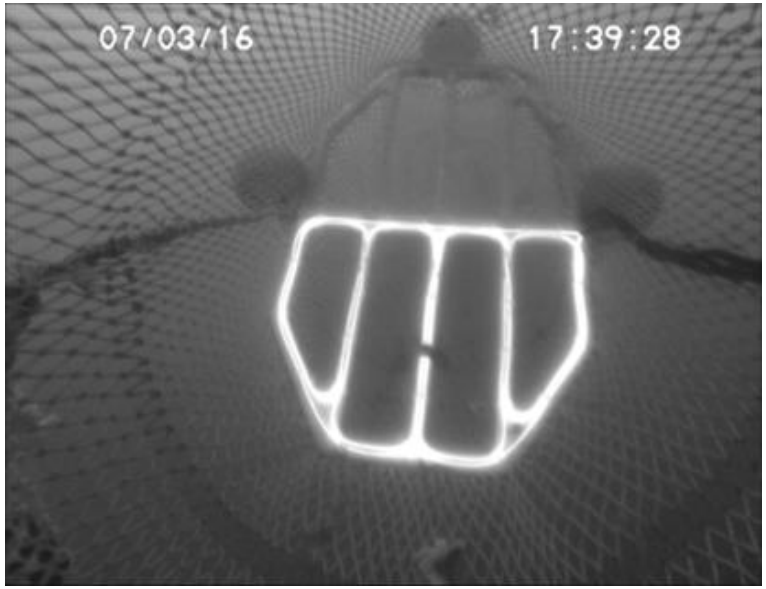
Publishing a Selectivity Manual, which has gathered knowledge collected over decades of research on gear technology and translated it into an easy-to-read document.

8 Work Packages:

3 - Adaptation of gear technology

Avoidance of unwanted catches through technology

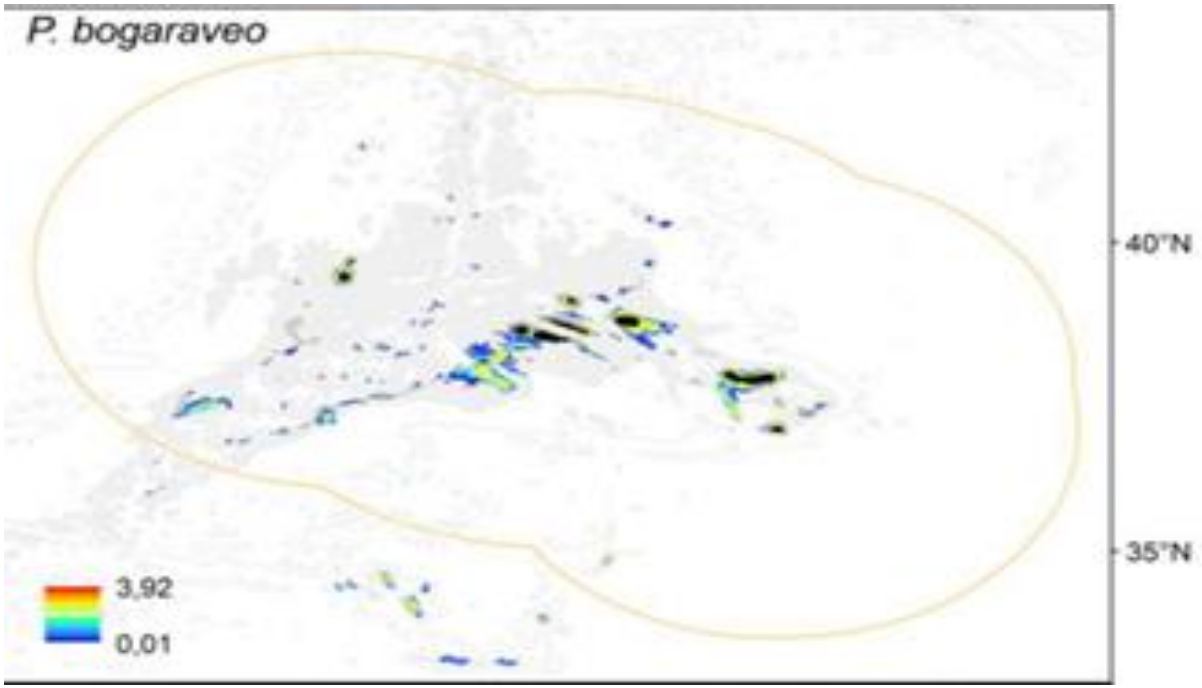
Experiments to assess how various fish react to light, and whether various types and colors of LED lights can enhance the escape behaviour of unwanted species.



8 Work Packages:

4 - Adaptation of fishing strategies

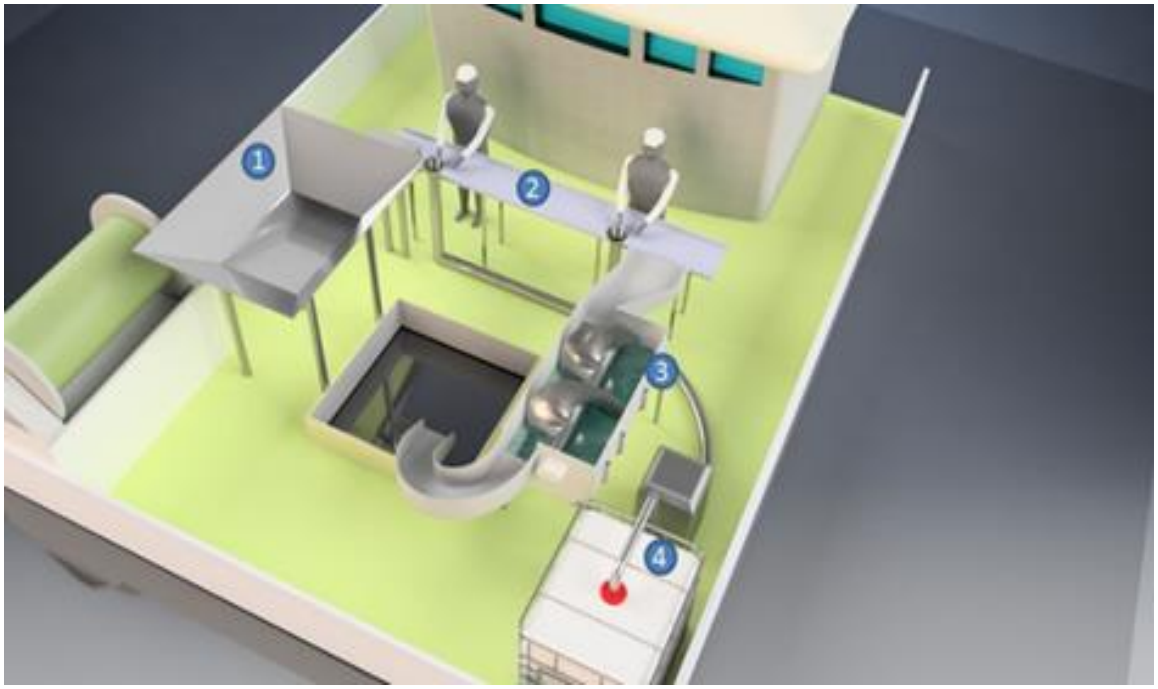
Using fishers' and scientists' knowledge into the understanding of where and when to fish, to avoid unwanted catches.



8 Work Packages:

5 - From deck to first sale

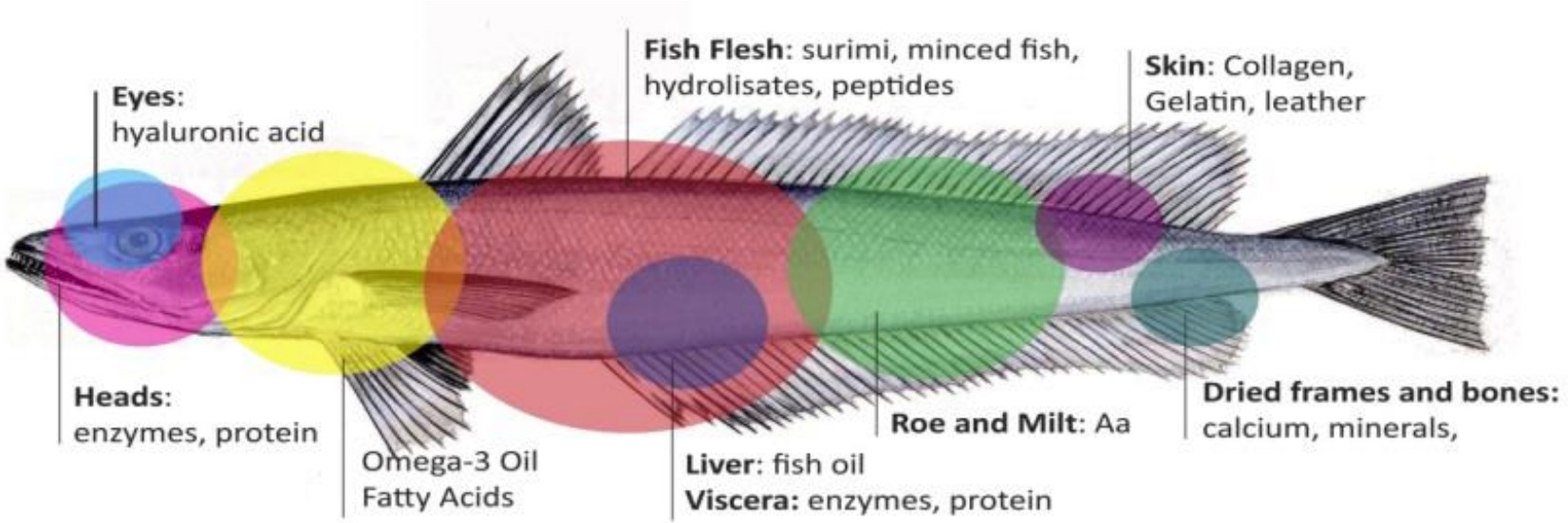
Onboard solutions to meet the LO. Onboard handling and Monitoring, Control & Surveillance



8 Work Packages:

6 - Products to the value chain

Make best use of unwanted catches through new products



All Ingredients: For foods, dietary supplements, animal nutrition, medicine, cosmetic Ingredients, and what cannot be used previously , can go ultimately to bioenergy (biogas)

8 Work Packages:

7 - Framing and implementing the discard policy

Institutional and policy aspects of the LO, bringing together the results of the other work packages.

8 Work Packages:

8 - Bringing results to users and spreading the word

Communication and the dissemination of the project's results, both inside and outside the consortium.

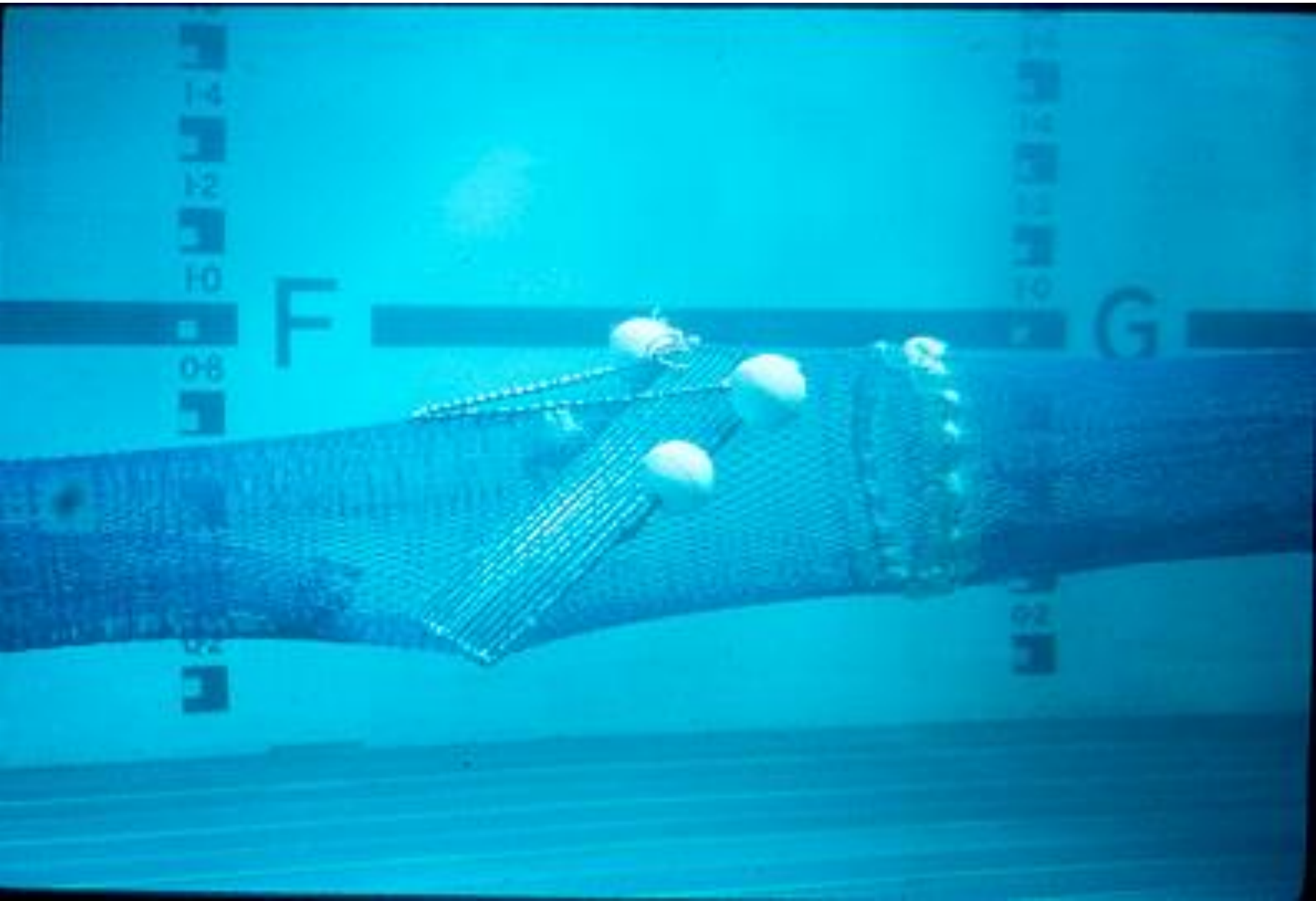
Also,
There is a Six-person External Scientific Advisory Board

Other things:

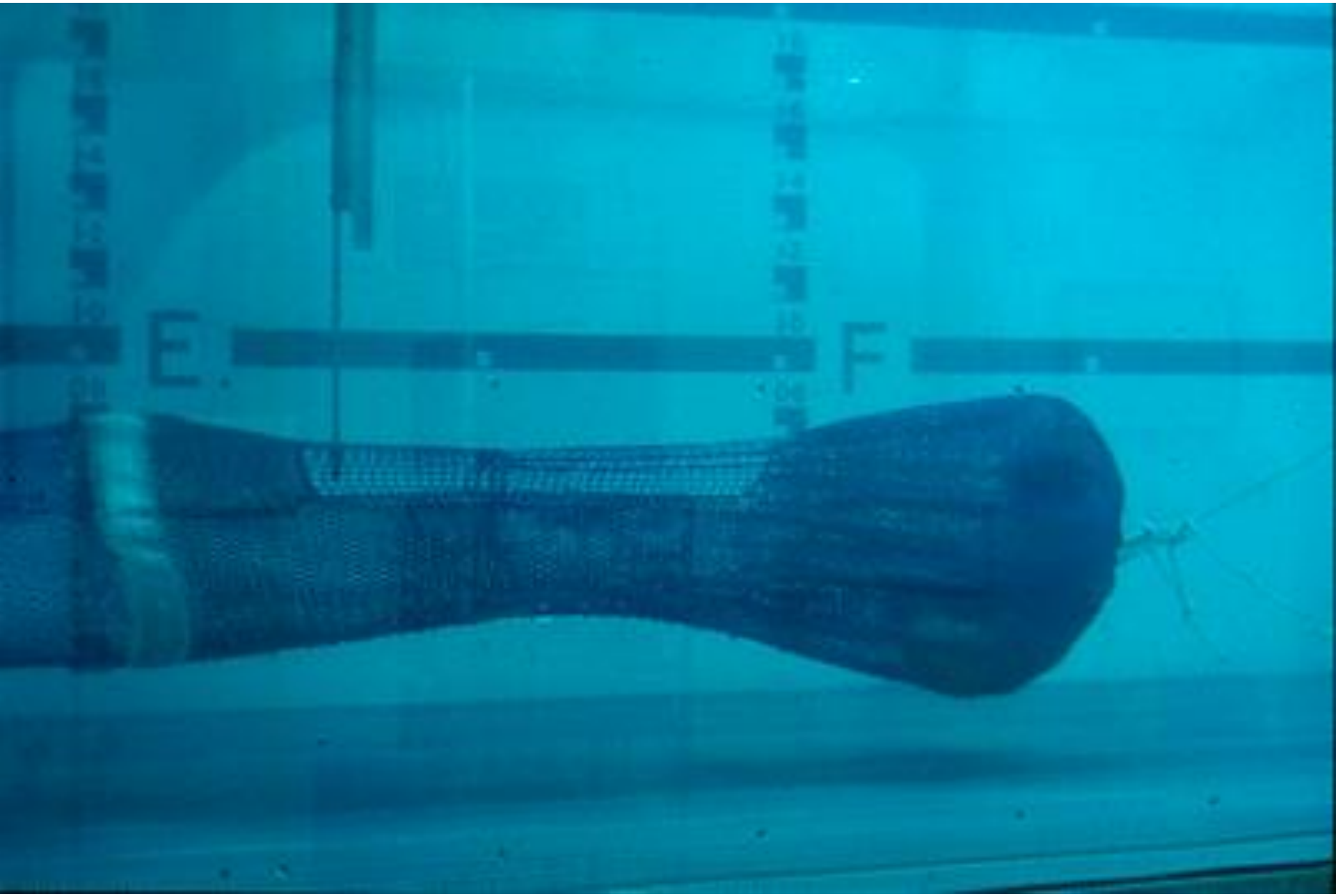
Automatic species recognition, length measurement and sorting of fish in the trawl using the underwater CatchMeter computer vision system (Norway).

Deep Vision
Under development is a system that can be programmed for species and length of desired catch and automatically sort the catch in the trawl.

GRIDS



SQUARE MESH PANELS



FISH EYES

Some more international initiatives

Marine Stewardship Council‘s

Principle 2 –

Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

United Nations Food & Agriculture Organisation

Low impact and fuel efficient (LIFE) fishing

- Increasing fuel costs are making many fishing practices uneconomic.
- Low-impact and fuel-efficient (LIFE) fishing offers scope to lower fuel costs and decrease ecosystem impacts.
- Barriers to uptake of LIFE fishing techniques are identified and discussed.
- Successful transition depends on developing and applying appropriate measures and incentives.
- Global research and development priorities to support development of LIFE fishing are identified.

European Union

Horizon 2020 call of 2017 for projects:

Smart fisheries technologies for an efficient, compliant and environmentally friendly fishing sector

- Evaluation of Proposals over the next month. Brussels meeting clashes with:

ICES (mainly USA and Europe)

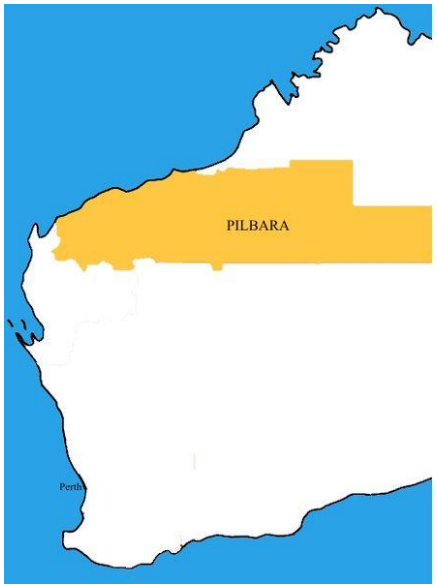
2017 ICES Working Group on Fishing Technology and Fish Behaviour (WGFTFB)

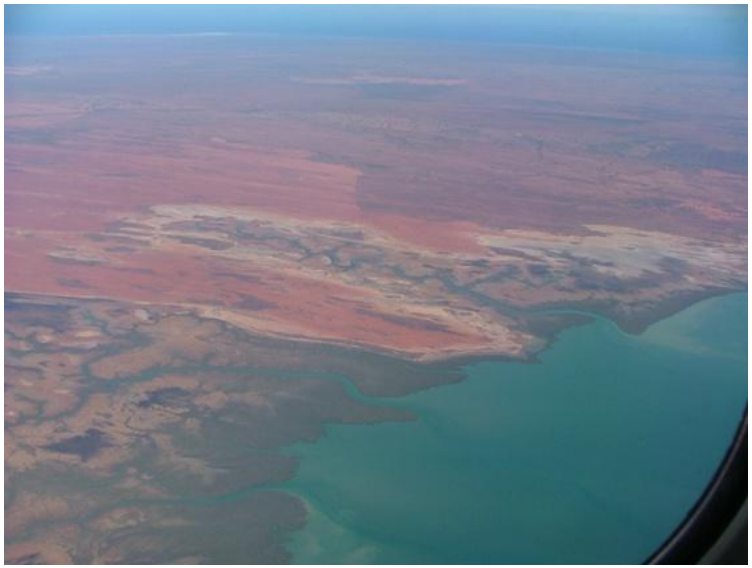
4 - 7 April 2017, Nelson, New Zealand

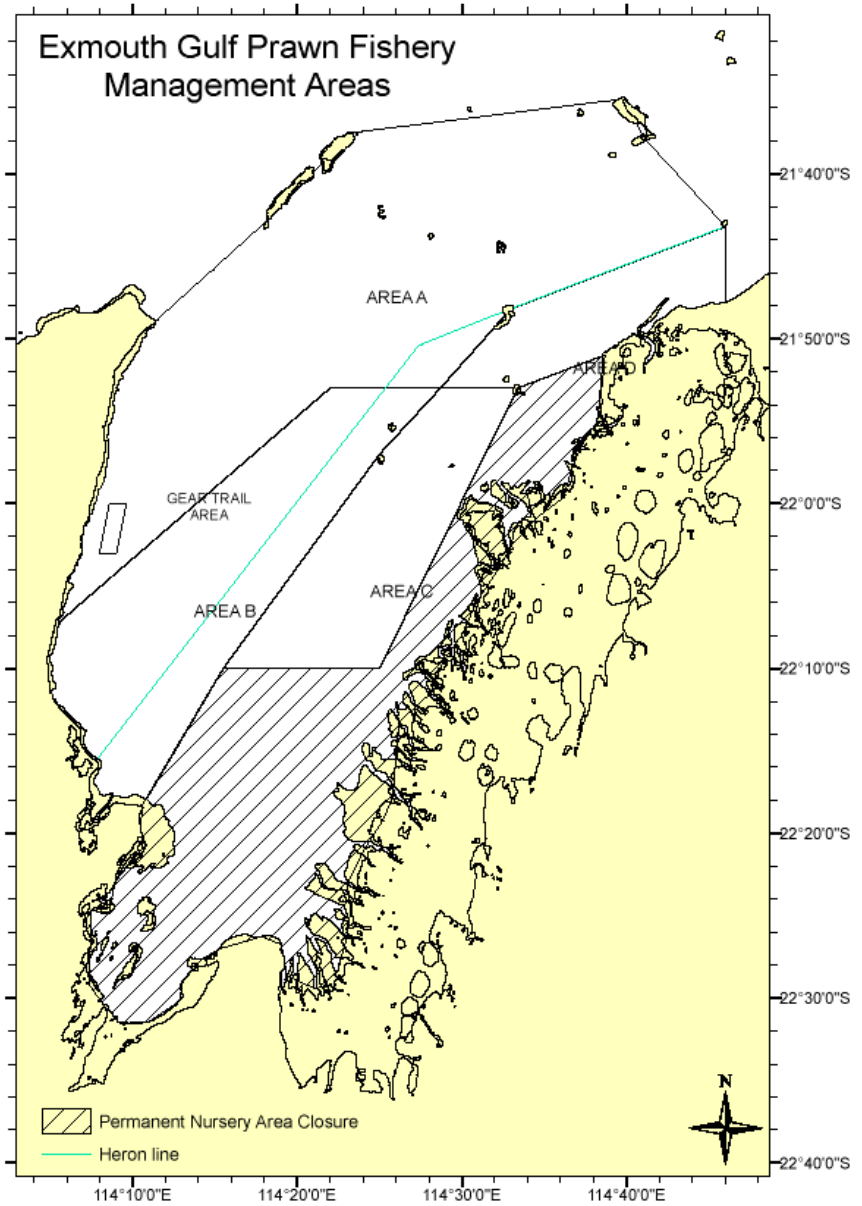
Topics:

- Selective fishing gears for the reduction of bycatch, discard and unaccounted mortality, especially as they relate to EU Landing Obligation
- Environmentally benign fishing gears and methods
- Improving fuel efficiency and reduction of emission from fisheries, and
- Summaries of research activities by nation

PRAWN TRAWL BYCATCH REDUCTION ACTIVITY IN THE EXMOUTH GULF PRAWN MANAGED FISHERY (EGPMF)

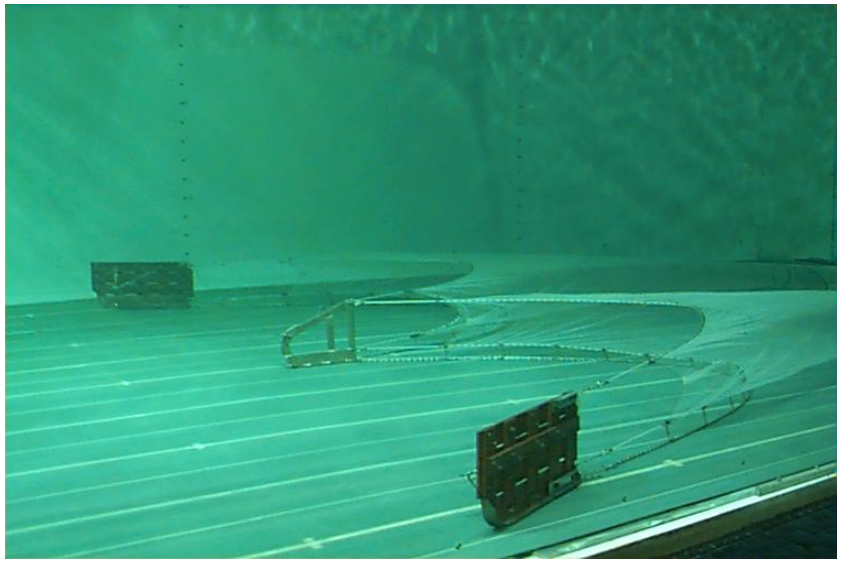






2. BYCATCH ACTION PLAN (BAP)

- spatial/area closures
- temporal closures
- gear regulations
- reporting via logbook
- bycatch regulations linked to Managed Fishery License
- ETP species – turtle, sawfish, seasnake, pipefish, dolphin, seahorse



2. BAP (cont.)

- risk assessment and monitoring

The flora and fauna that are vulnerable to EGPMF trawl gear have been identified (Kangas & Thompson 2004; Kangas et al 2007), and include a wide range of marine animals extending from numerous teleost finfish through to epibenthic invertebrates. Also present are several Endangered, Threatened and Protected species such as turtle, sawfish, seasnake, and pipefish.

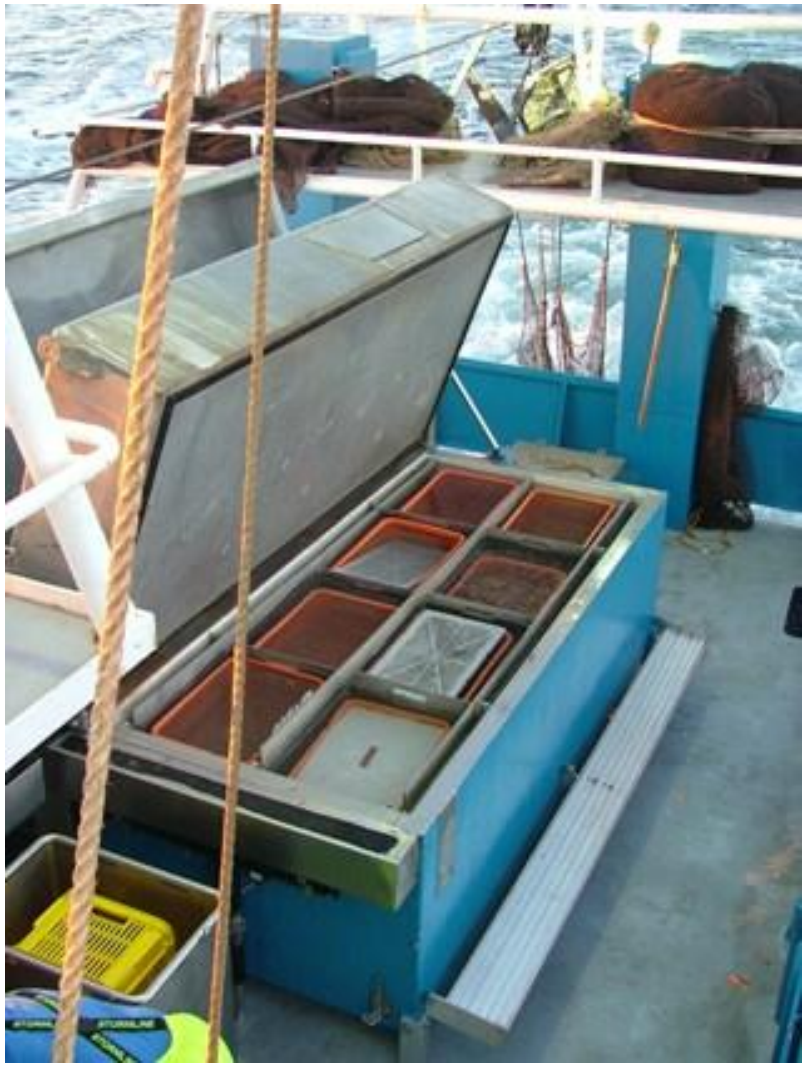
An Ecological Risk Assessment (ERA) for the EGPMF was undertaken in 2001, and the necessary risk abatement measures to ensure the threat posed to the sustainability of all vulnerable species is kept at or below an acceptable level were subsequently implemented (Kangas et al 2006; Fletcher & Santoro 2013).

A review of the ERA ratings was conducted in 2008, with risk ratings and mitigation processes adjusted accordingly (refer Appendix 2 of the EGPMF BAP). Again, none of the vulnerable species were found to be at an unacceptably high risk from the fishery and associated activity.

3. MSC PRE-ASSESSMENT IN 2014

- found to be well positioned on the criteria assessed with both target and non-target species

- ETP species - seasnake of most concern

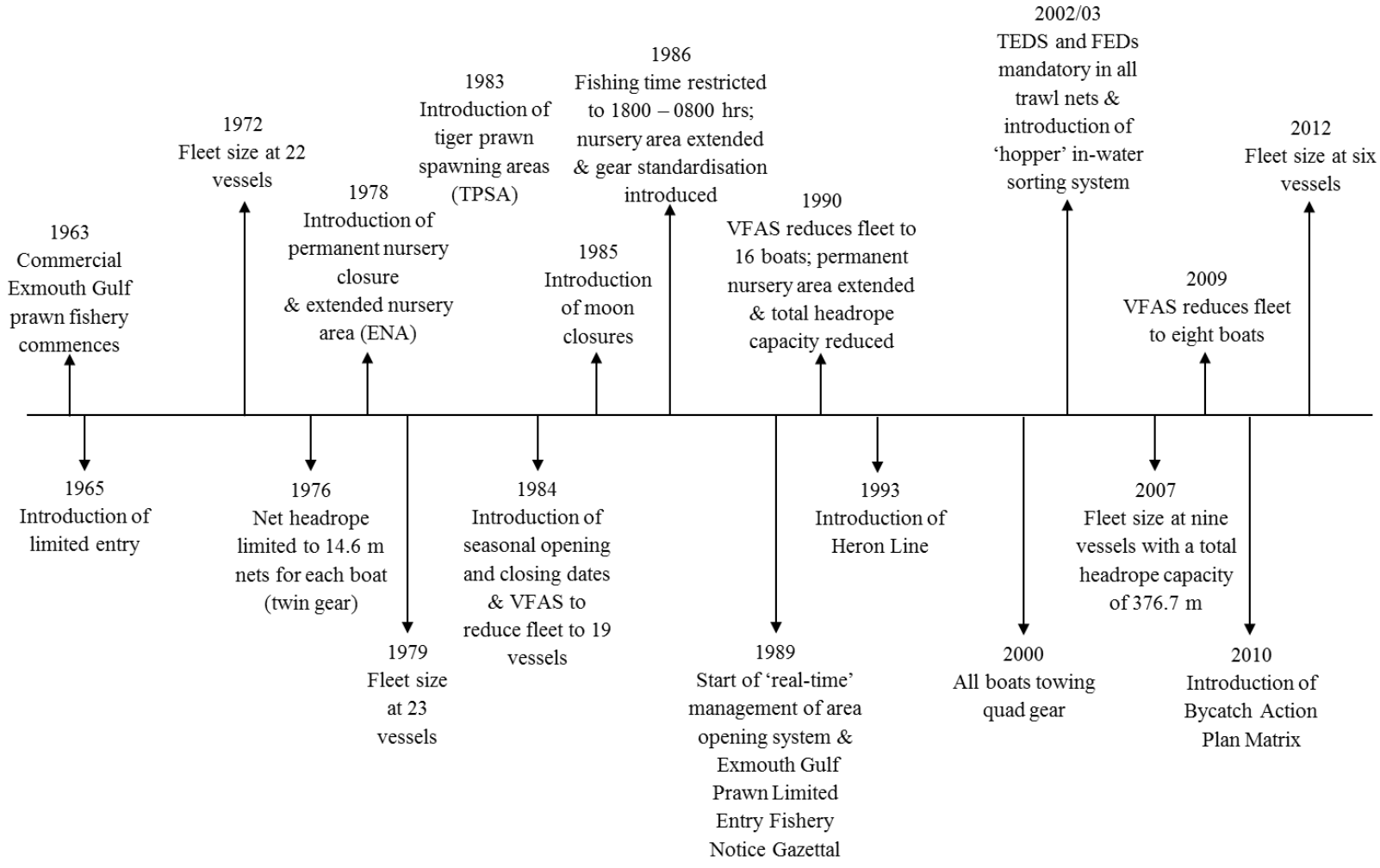


4. MSC ACCREDITATION

- all criteria met and MSC achieved Oct 2015 in both EGPMF and Shark Bay

- MSC Audit undertaken in Nov 2016

5. KEY MANAGEMENT AND OPERATIONAL CHANGES IN THE EGPMF



5B . KEY MANAGEMENT AND OPERATIONAL CHANGES (cont.)

- similar transition to other Australian prawn fisheries; vessel numbers reduced, multiple net configurations (quad rig) used with multi-foil boards and low drag dynice/plateena nets equipped with TEDs

- currently six vessels, 'freezer' boats, quad rigged, 2 x vessel on 8 fathom HL gear, remainder on six fathom HL gear

6. TED/GRID DEVELOPMENT

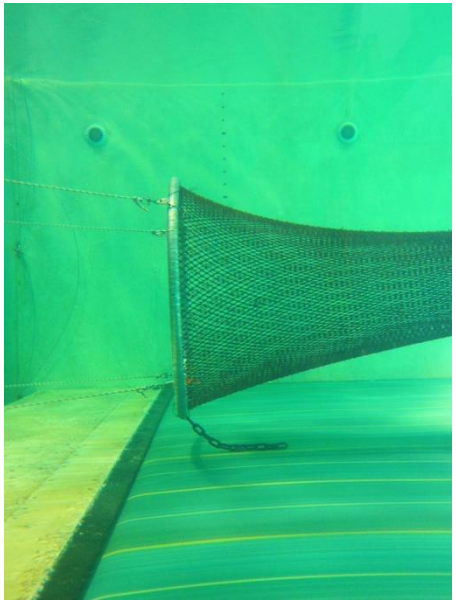
Standard MGK grid used from 2003 to 2015

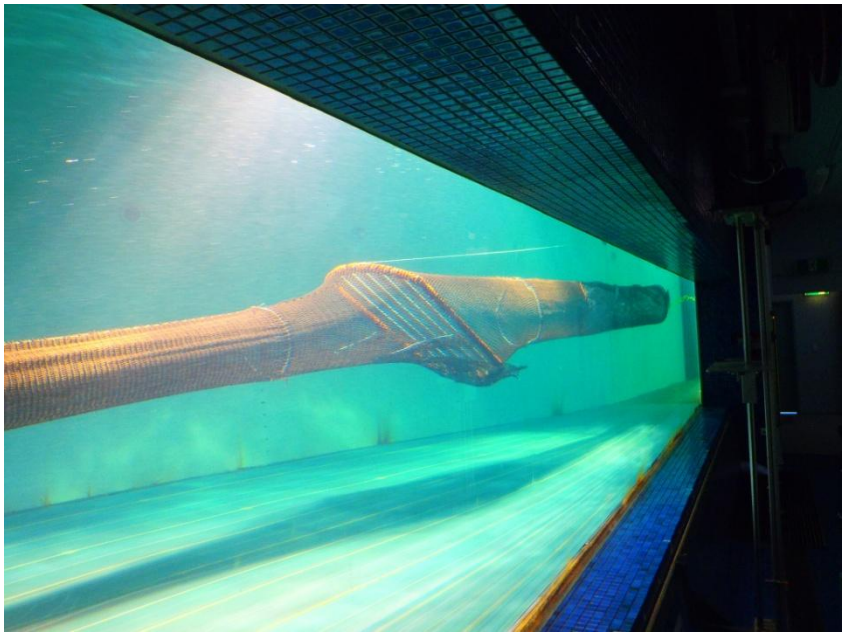
- aluminium tube (32mm o.d. with 2.5mm wall)
- 95mm internal bar spacing
- positively buoyant
- relatively robust; generally good for a five seasons
- double flap with flap insert
- netting ramp anterior to grid
- used as a downward excluder

6. TED/GRID DEVELOPMENT (cont.)

V2 6-fathom grid introduced in 2016:

- standard MGK grid with elongated bars (300 mm longer)
- new grid netting tube materials trialled; twisted PE v Braid (2 types)
- flap configuration altered (simplified construction)
- net ramp anterior to grid removed for 2016 fishing season
- preseason refinements in the AMC flume tank in 2015

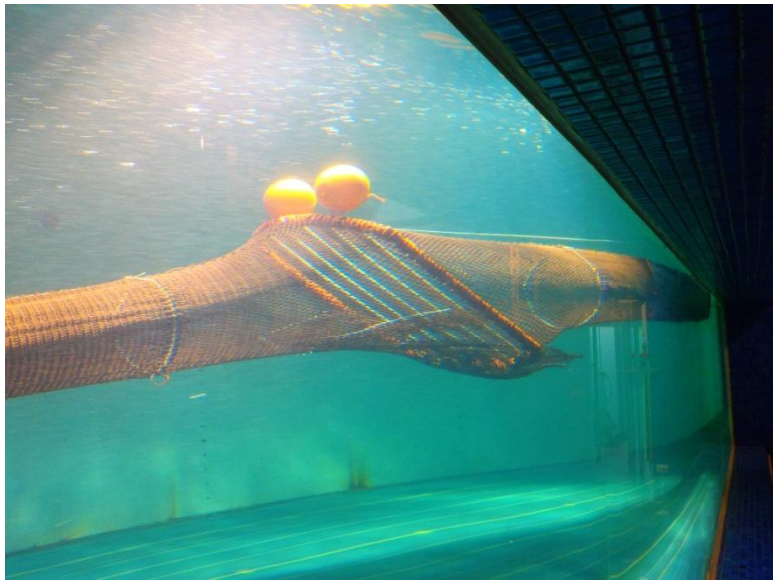


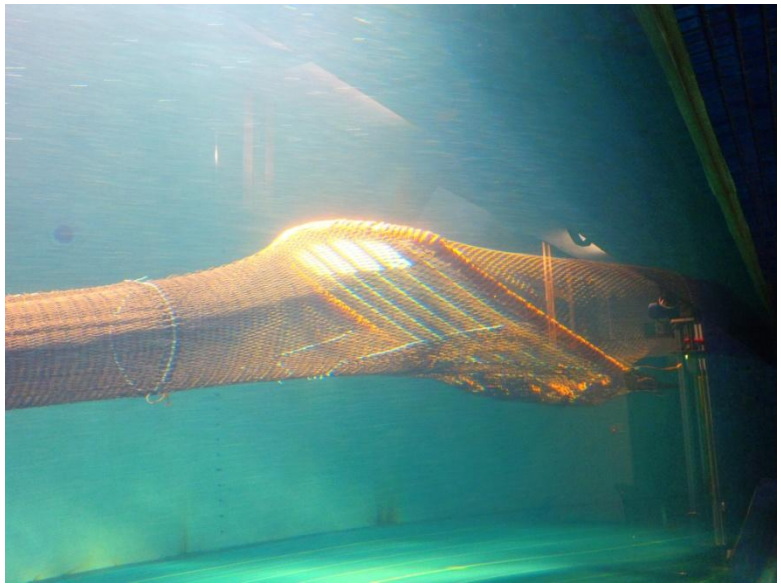


6. TED/GRID DEVELOPMENT (cont.)

V2 6-fathom grid trials in AMC flume tank:

- dispensing with the need for a netting ramp
- checking grid flap performance, grid angle, grid clearance
- dispensing with the need for flotation





6. TED/GRID DEVELOPMENT (cont.)

V2 6-fathom grid introduced in 2016:

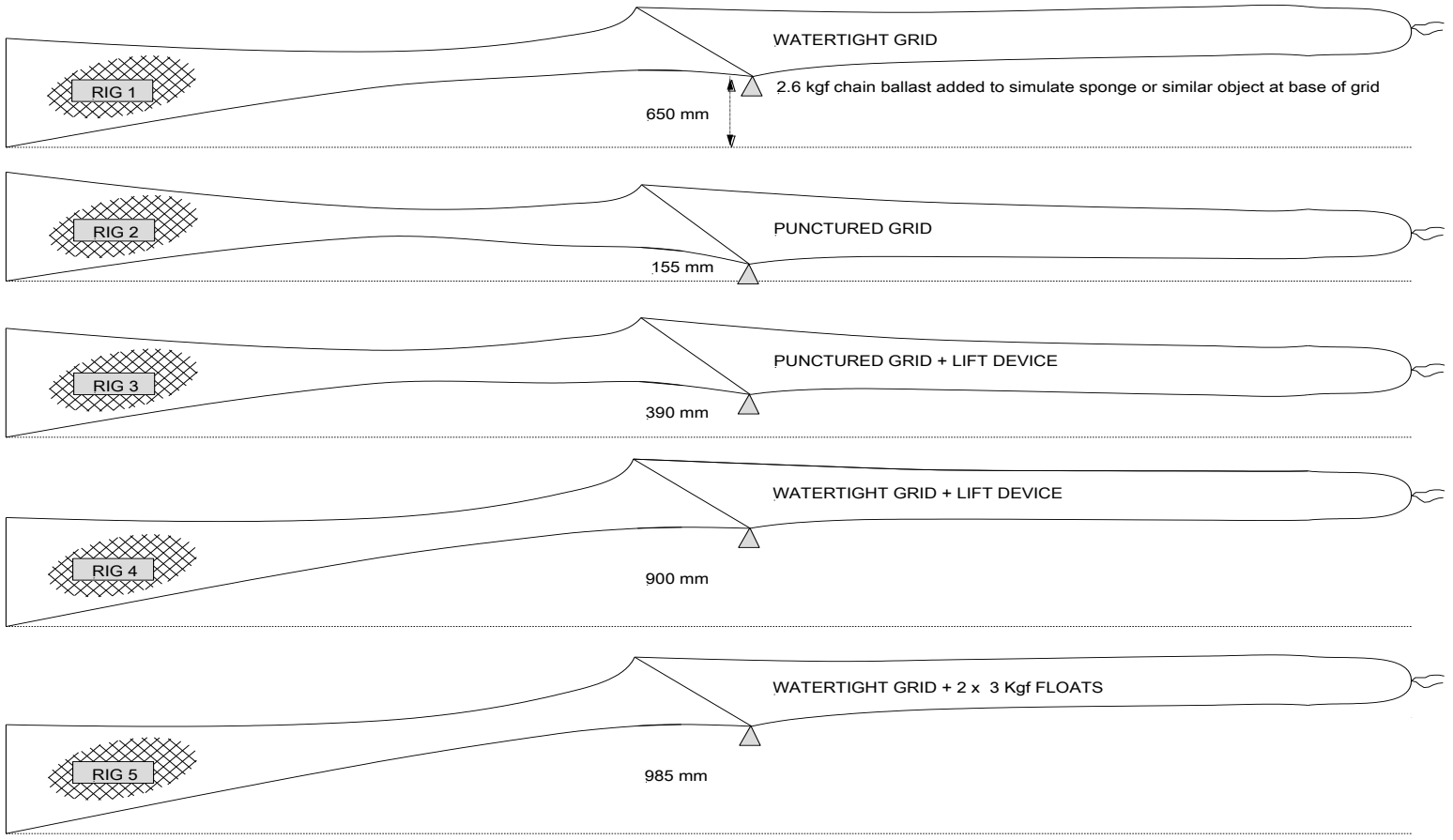


Figure x. The spatial position and shape of a prawn trawl grid and codend streamed at 3 knots in a flume tank from a 1m diameter towing hoop. Five rig configurations were tested to determine the impact certain changes have on the underside clearance of the grid away from the seabed. Drawn to scale.

6. TED/GRID DEVELOPMENT (cont.)

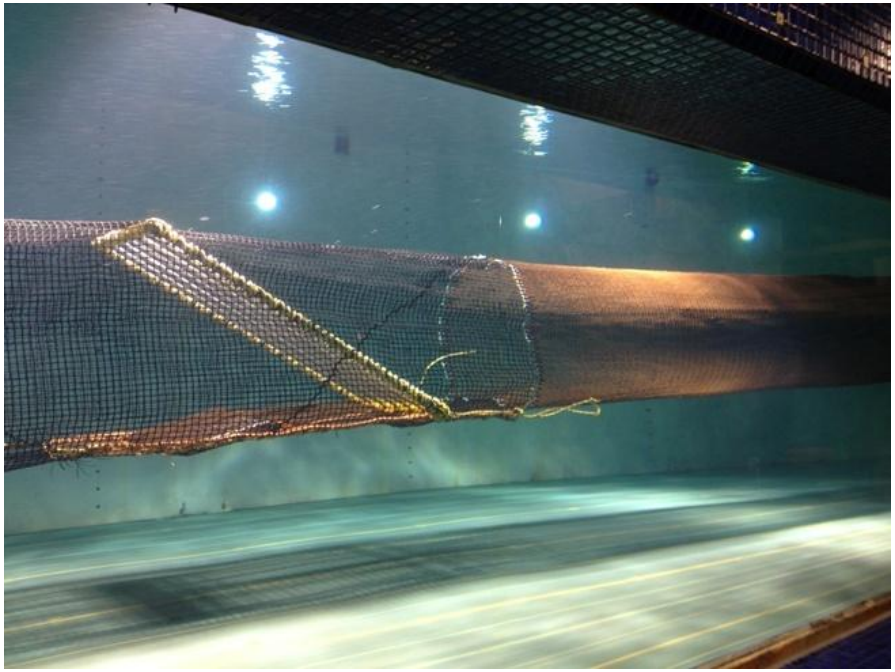
Austral grids for 8 fathom nets introduced in Sept 2014

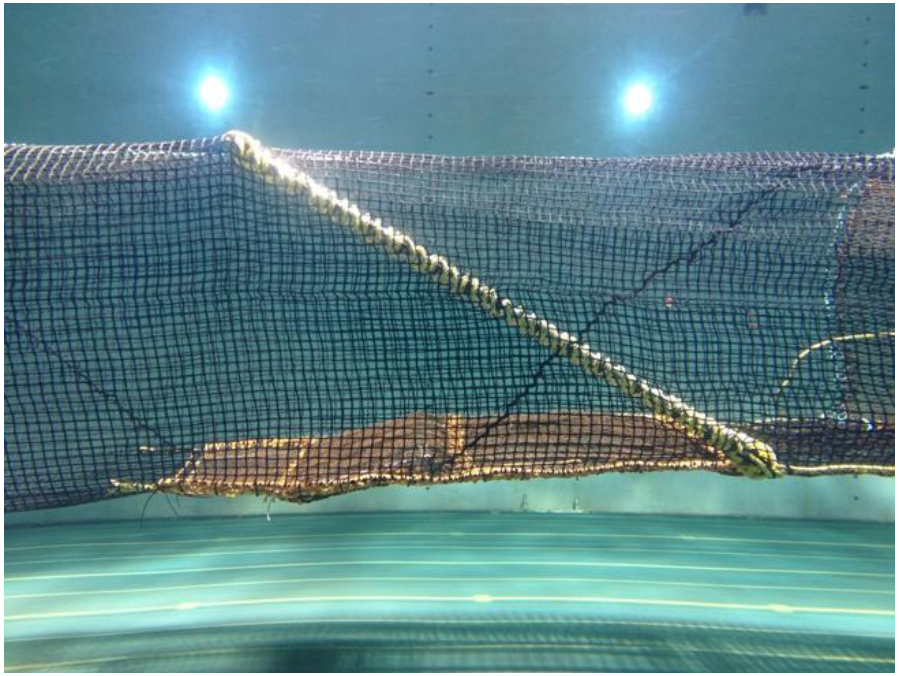
- used as downward excluders on 2 x 8 fathom nets initially

- both 8 fathom boats on larger Austral grids in Nov 2014 and used thereafter

6. TED/GRID DEVELOPMENT (cont.)

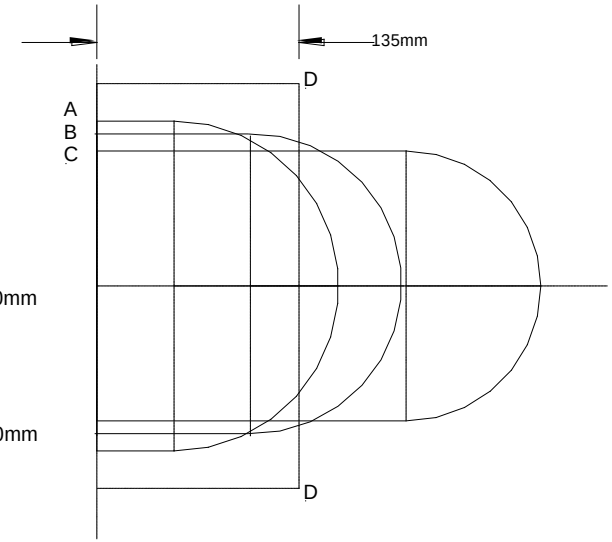
- JW grid in square mesh tube with new ramp design (2013)





6. TED/GRID DEVELOPMENT (cont.)

- JW grid in square mesh tube with new ramp design



A. CODEND JOINING ROUND
Circumference = 898mm
Radius = 110mm
Curved section = 346mm
Straight section = 103mm

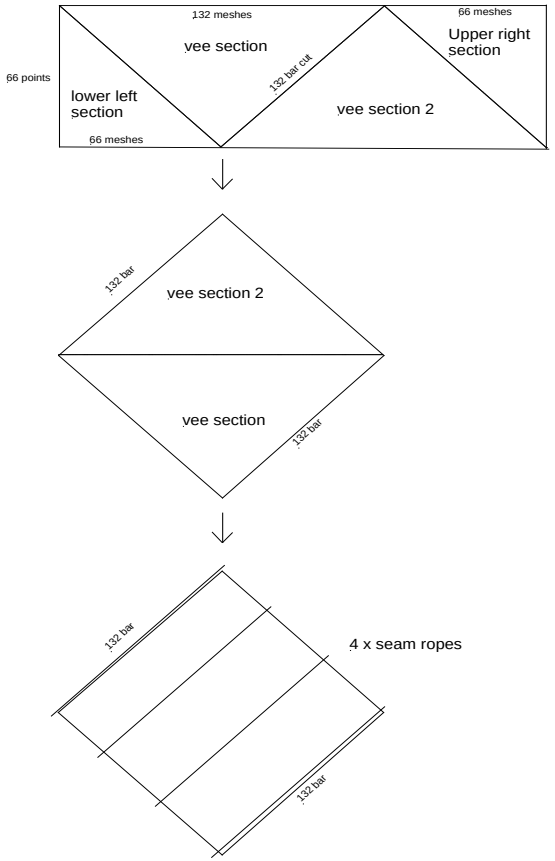
B. CODEND JOINING ROUND + 250mm
Circumference = 1038mm
Radius = 100mm
Curved section = 314mm
Straight section = 205mm

C. CODEND JOINING ROUND + 500mm
Circumference = 1392mm
Radius = 90mm
Curved section = 283mm
Straight section = 413mm

D. APPROXIMATE POSITION OF GRID CORNERS

6. TED/GRID DEVELOPMENT (cont.)

- JW grid in square mesh tube with new ramp design



6. TED/GRID DEVELOPMENT (cont.)

- JW grid in square mesh tube with new ramp design

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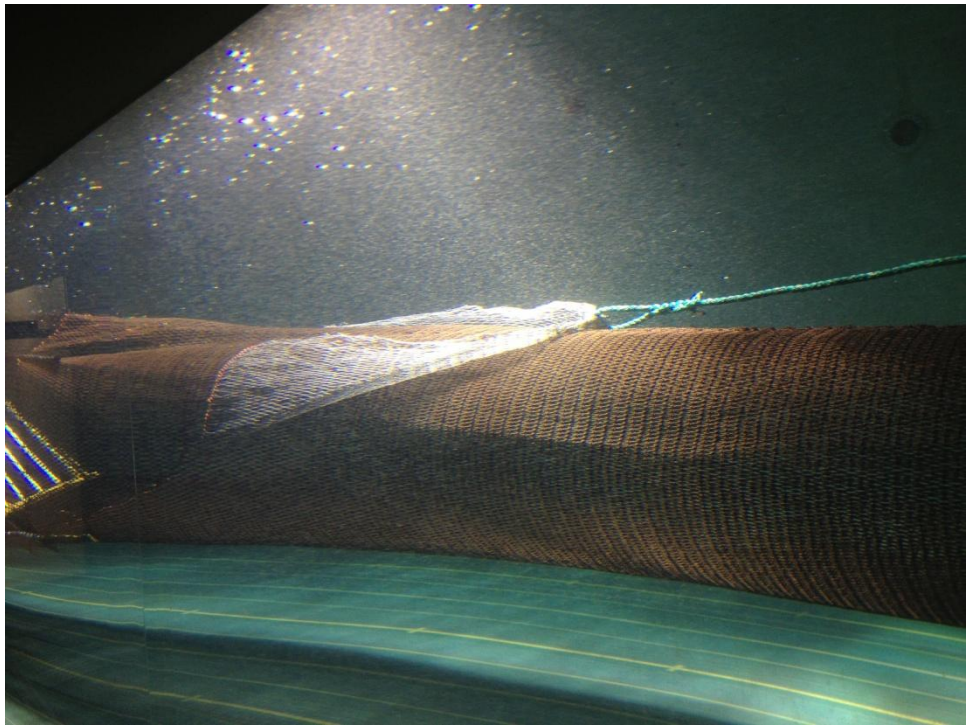
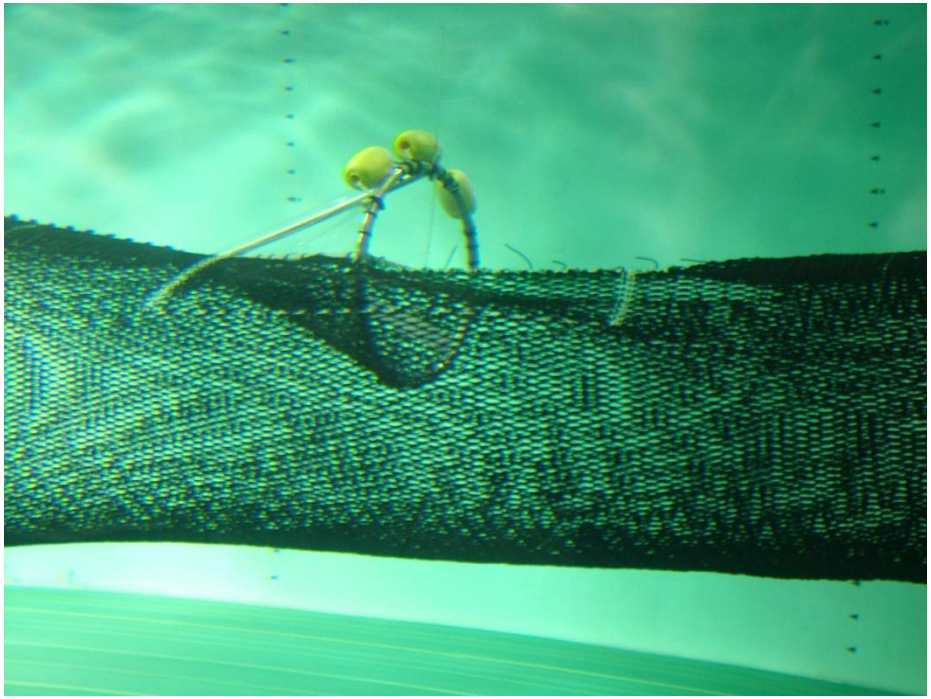
7. Fish Exclusion Device or SQMW

- FED configuration was standardised in 2016
- witch-hat BRD enhancer to be trialled in 2017

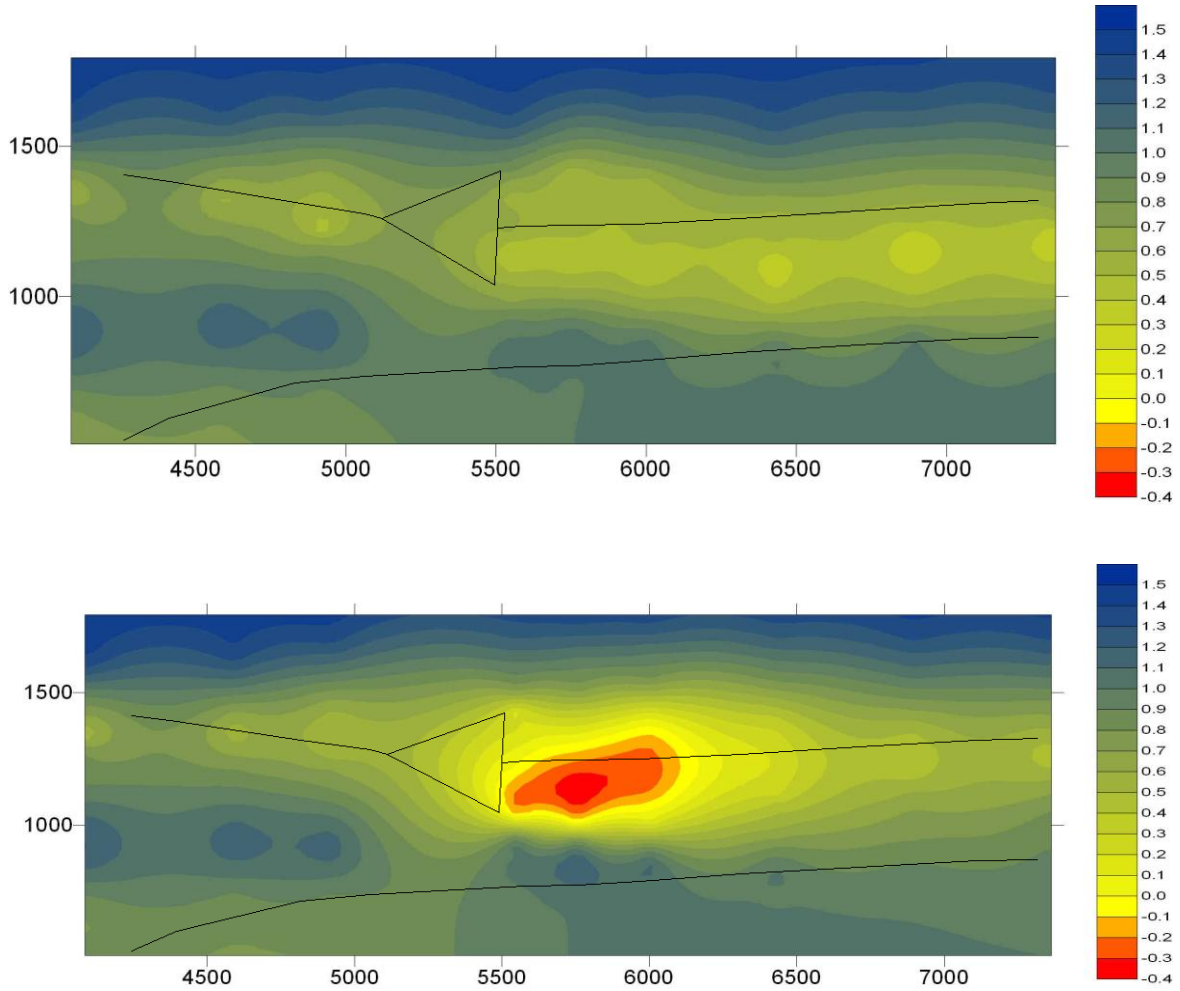


7. Fish Exclusion Device or SQMW with Witch-hat BRD enhancer



7. Fish Exclusion Device or SQMW

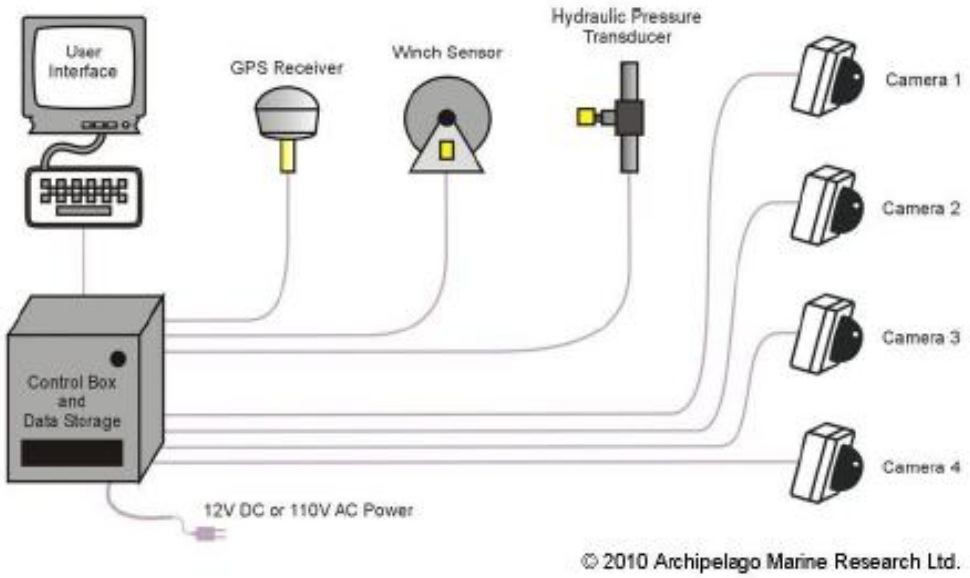
- witch hat BRD enhancer flow field



8. Electronic Observer System

- in 2017 a fully functional EOS, similar to what currently runs on the company's fish trawler operation in the PFT, will be introduced on one or more of the prawn trawlers

- the EOS will compliment and/or replace human observers and reduce observer coverage costs, and importantly, provide very informative data



9. CONCLUSIONS

Prawn trawling is inherently unselective for two reasons:

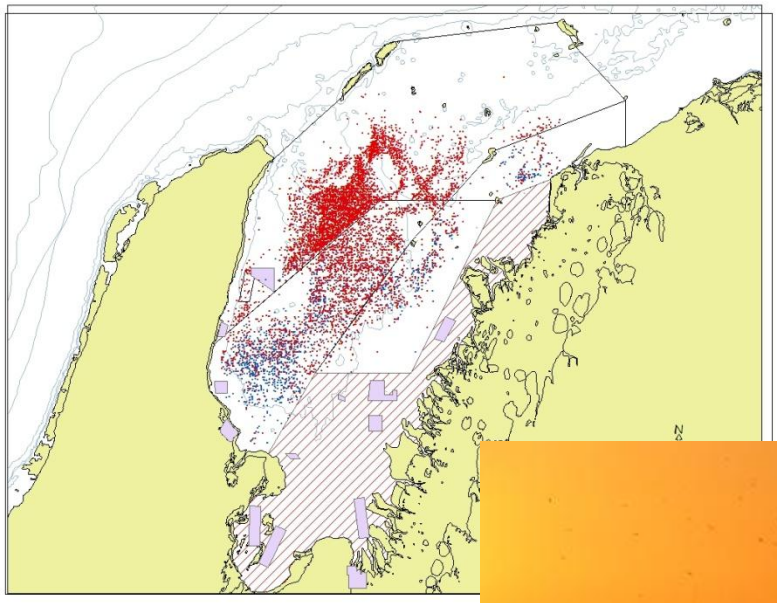
Firstly, because the trawl net must be made from relatively small mesh netting to ensure commercial sized prawn (themselves quite small) are retained, and consequently, flora and fauna larger than a prawn find it difficult or impossible to escape via the mesh openings on offer.

Secondly, because the trawl net must be towed in close proximity to the seabed in order to catch sufficient quantity of prawn, and consequently, other flora and fauna unable to avoid the net are also scooped up in the process.

9. CONCLUSIONS (cont.)

However, through spatial and temporal management of fishing effort we reduce the amount of bycatch, including ETP species, that is impacted upon.

On the fishing gear front the sole operator in the fishery, namely MG Kailis Group, is by no means inactive, and has over the last five years made some promising progress.



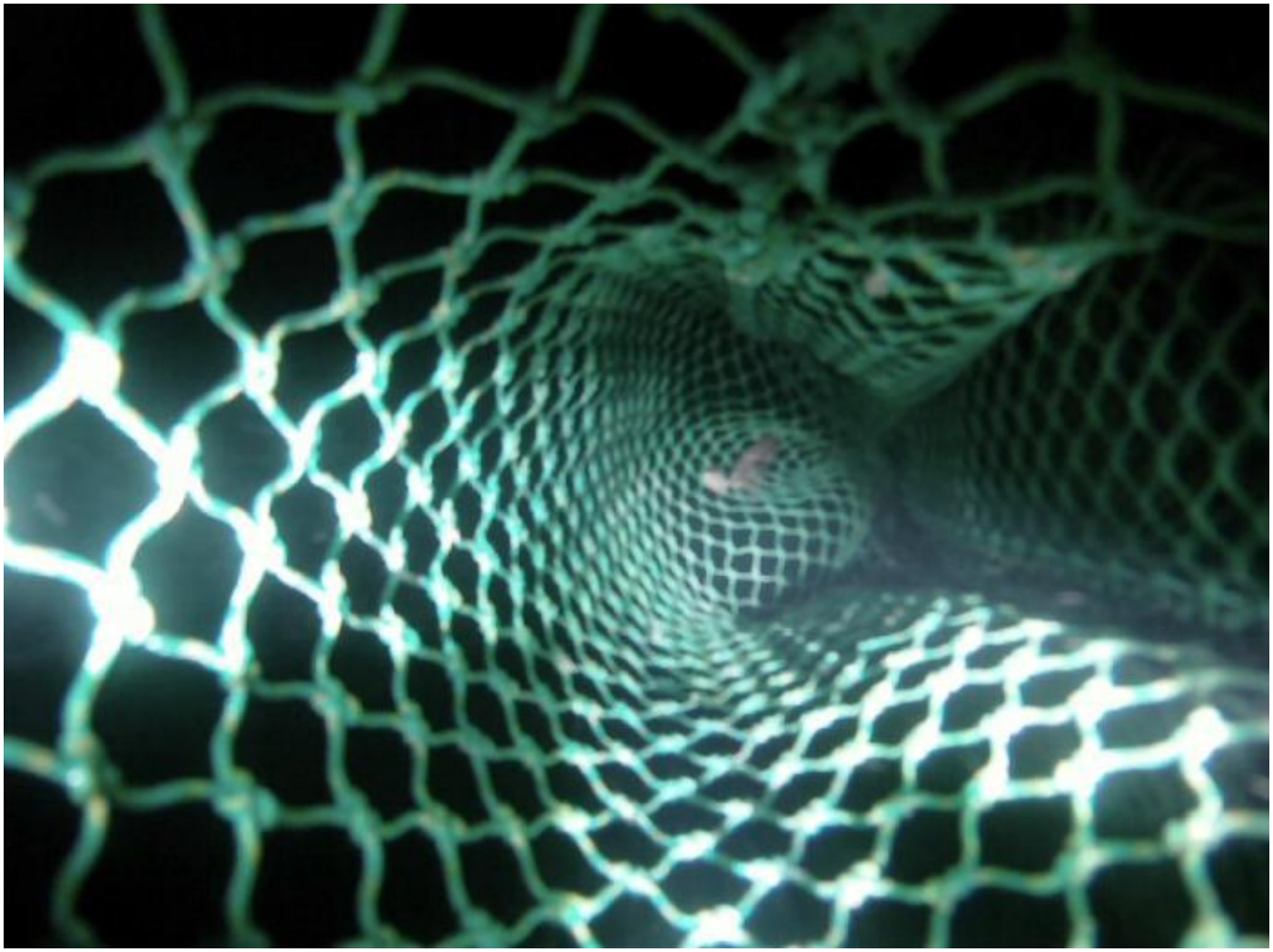
Securing MSC accreditation in 2015 supports these claims, yet there remains a commitment to drive things further through an EOS system and further improvements in gear design, particularly in the aft section of the nets.

SAINT VINCENT GULF
PRAWN BOAT OWNER'S ASSOCIATION INC.

ACPF
BY-CATCH WORKSHOP
February 2017

Jim Raptis

SAINT VINCENT GULF
PRAWN BOAT OWNER'S ASSOCIATION INC.



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PRAWN BOAT OWNER'S ASSOCIATION INC.

Key Objectives

- Develop a BRD system which is tailored to the species and fishing techniques particular to the Gulf St. Vincent (GSV) Prawn Fishery
- Implementation of the *Innovation Framework* (below) to formalise the existing co-management procedures and provide a clear and transparent process from extension to endorsement to foster innovation now and into the future
- Provide Industry an opportunity to apply their local knowledge and experience to the evolution of the proposed BRD system to expedite is evolution
- Further strengthen the partnerships developed between stakeholders to date
- Ensure new gears are both practical and effective in - improving bycatch reduction efficiency with current fishing operations
- Generating ownership of the process and outcomes within industry to improve acceptance and uptake of any gears endorsed by management

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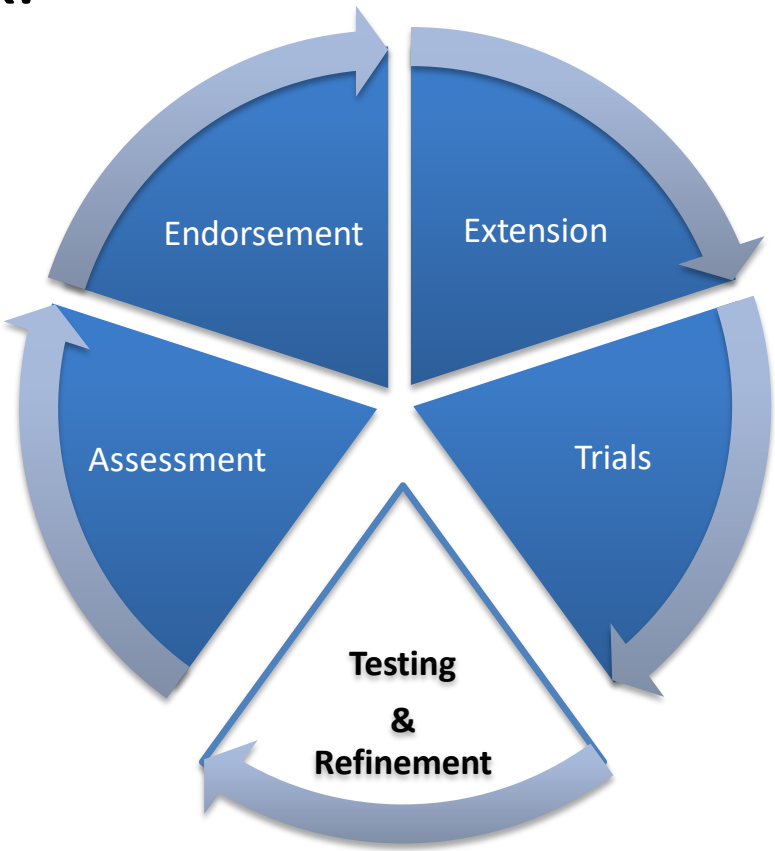
Gulf St Vincent industry sought to enhance its by-catch capacity through an Innovation Framework.



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The BRD process included 2 studies in one project :

SeaNet / AMLRNRM – Testing & Refinement of a Gulf St Vincent Prawn Fishery By-catch Reduction System

FRDC 2009/069 – A collaborative approach to novel by-catch research for rapid development, extension and adoption into a commercial prawn trawl fishery. C Dixon, J Raptis et al. (2013)

The studies were based upon a process of design, testing and modification using real time data and video evidence from catches and catch rates / size. Evidence was based on results from a twin rig trawl, run side by side with a traditional net v T90 or T90 & grid configurations.

The design concepts were developed and built by Lankhorst Euronet & Wally Hill.

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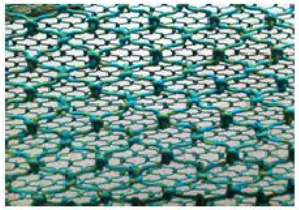
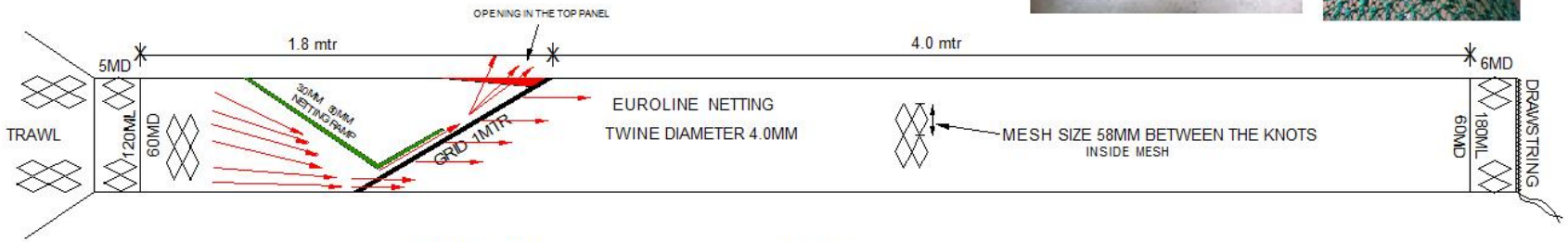
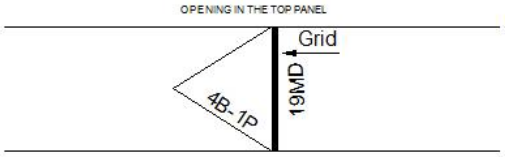


T90 CODEND AND GRID FOR GULF VINCENT





DESIGN : LANKHORST EURONETE AUSTRALIA 11.January 2012

www.leaustralia.com.au Email tben@leaustralia.com.au
Tel 07-5593-4661 Fax 07-5593-5709

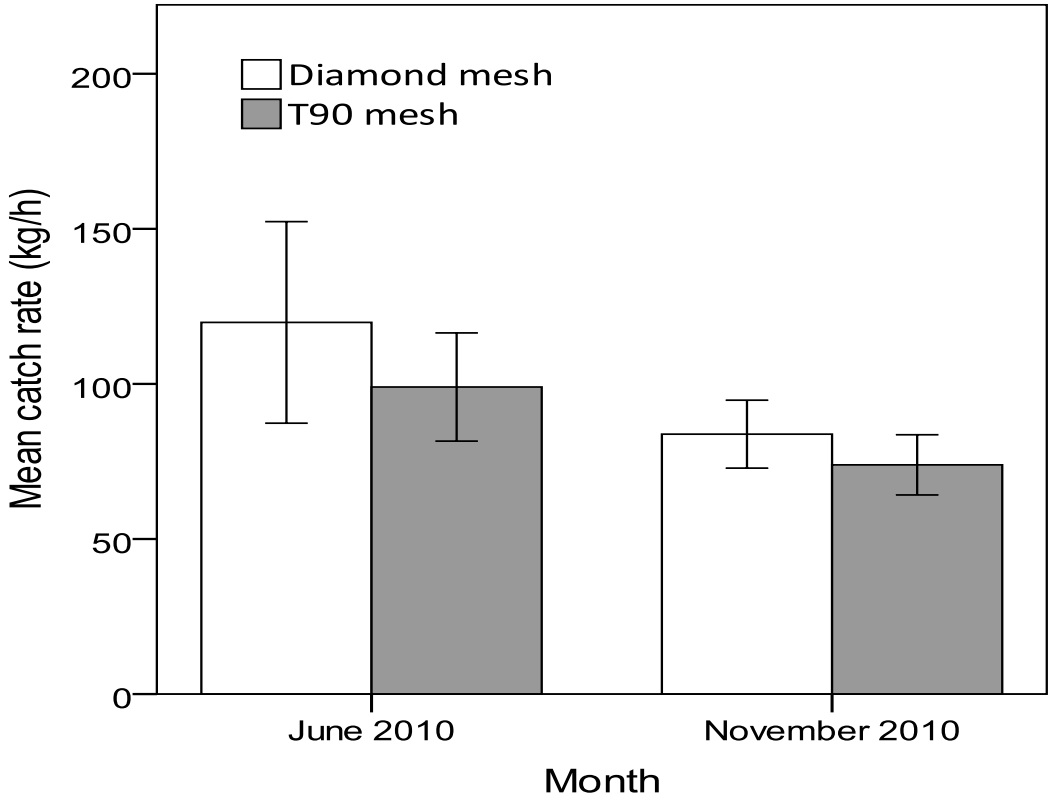


Figure 5. Mean (SE) catch rates for *P. latisulcatus* using trawl gear comprising **diamond** and **T90** (configuration F) cod-ends trialled during two survey periods.

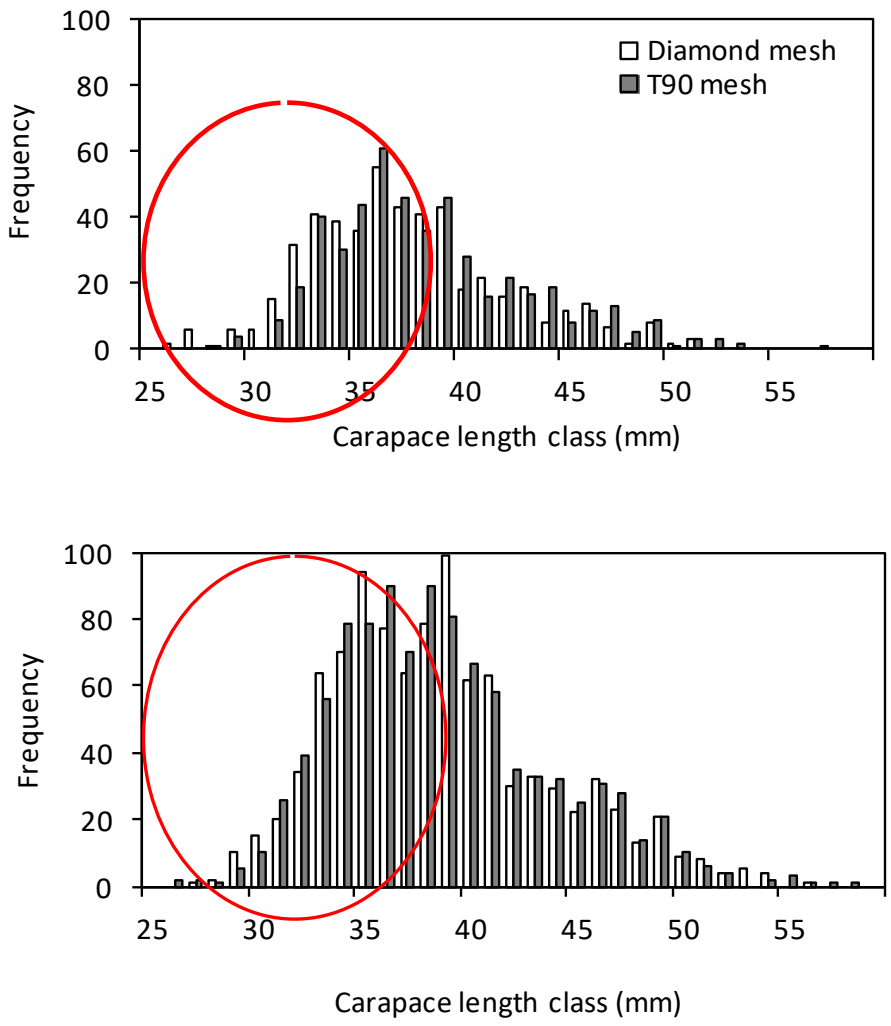


Figure 6. Length-frequency distributions for *P. latisulcatus* caught using **conventional diamond** and **T90 mesh cod-ends** during (A) June and (B) November 2010.

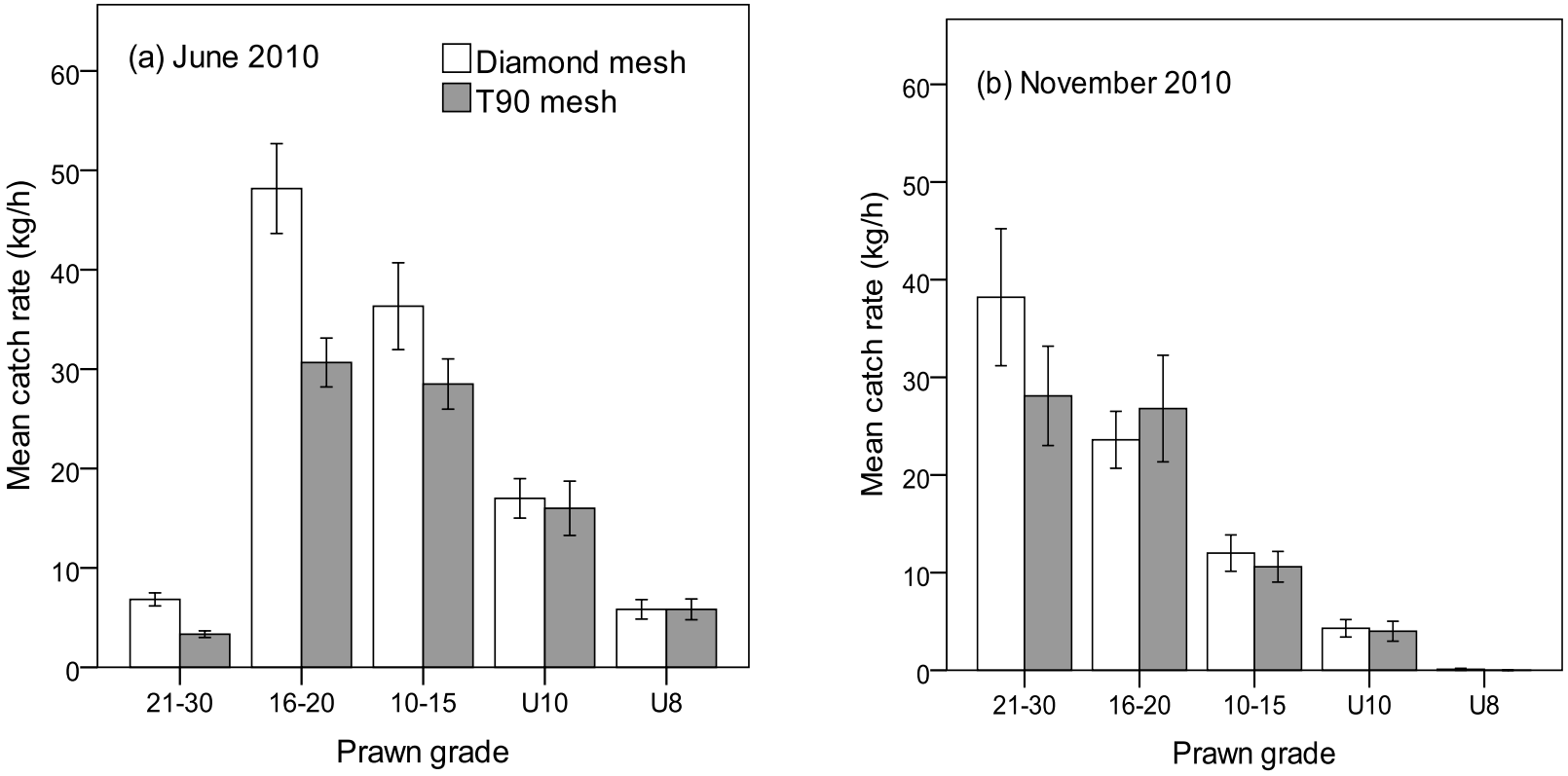


Figure 7. Mean (SE) catch of prawns by commercial size-grade captured during fishery independent trials of **diamond** and **T90 mesh cod-ends** conducted during (a) June and (b) November 2010.

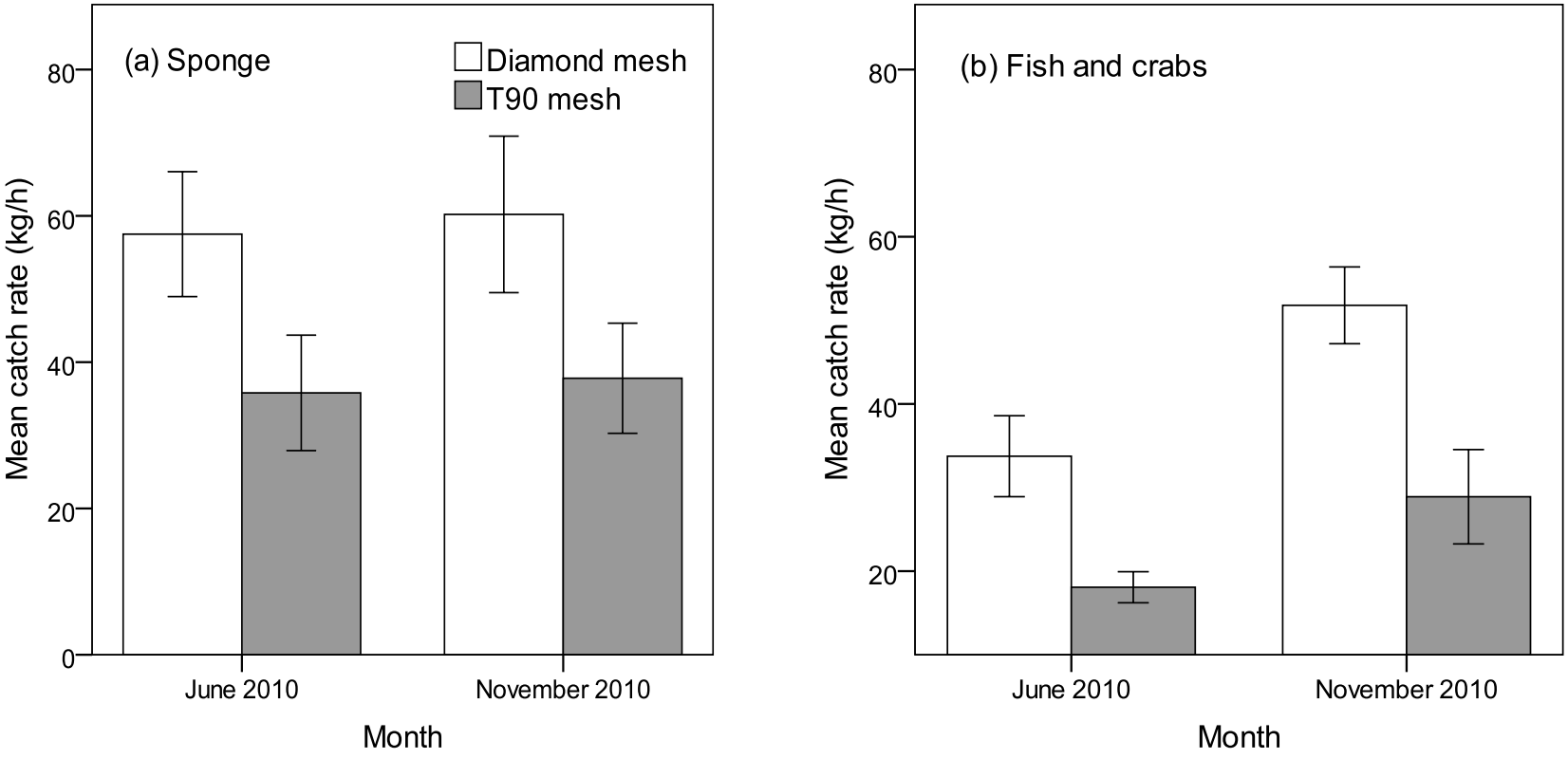


Figure 8. Mean (SE) catch of; (a) 'sponge' and (b) 'fish/crabs' caught during June and November 2010, using **conventional diamond** and **T90 mesh cod-ends**.

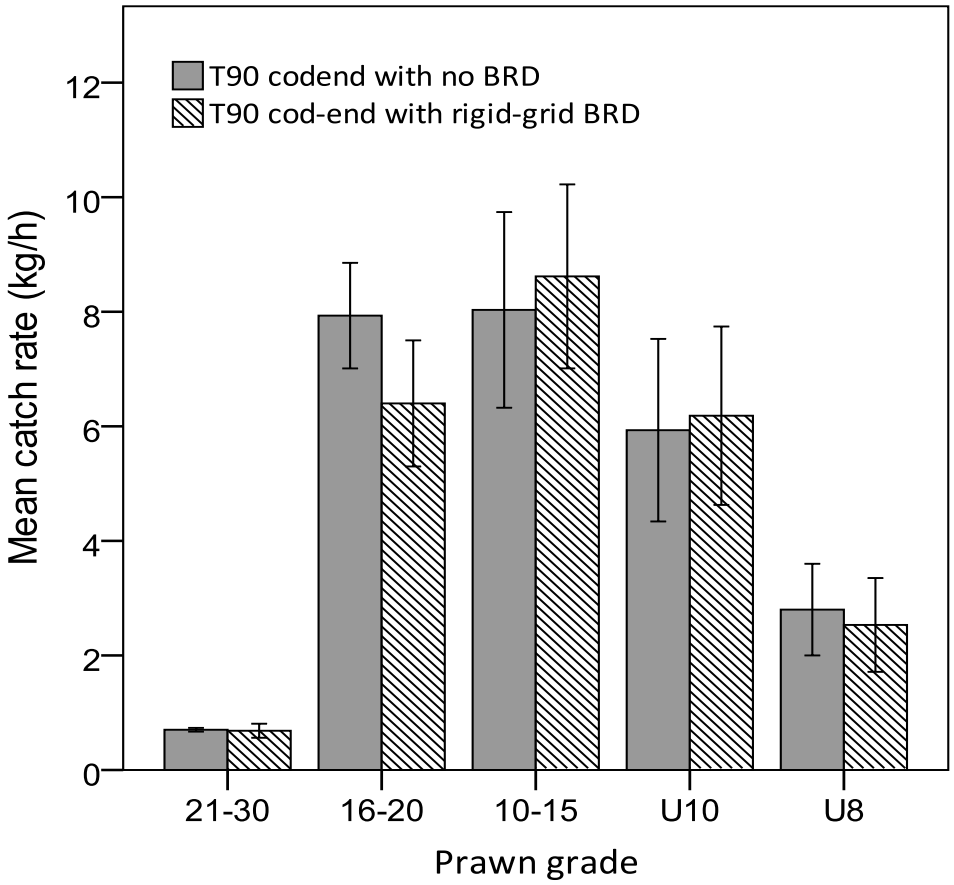


Figure 11. Mean (SE) catch rate by prawn grade using trawl gear comprising of a **T90 mesh cod-end** only and one that included a **rigid-grid BRD anterior to the T90 cod-end** (configuration 7).

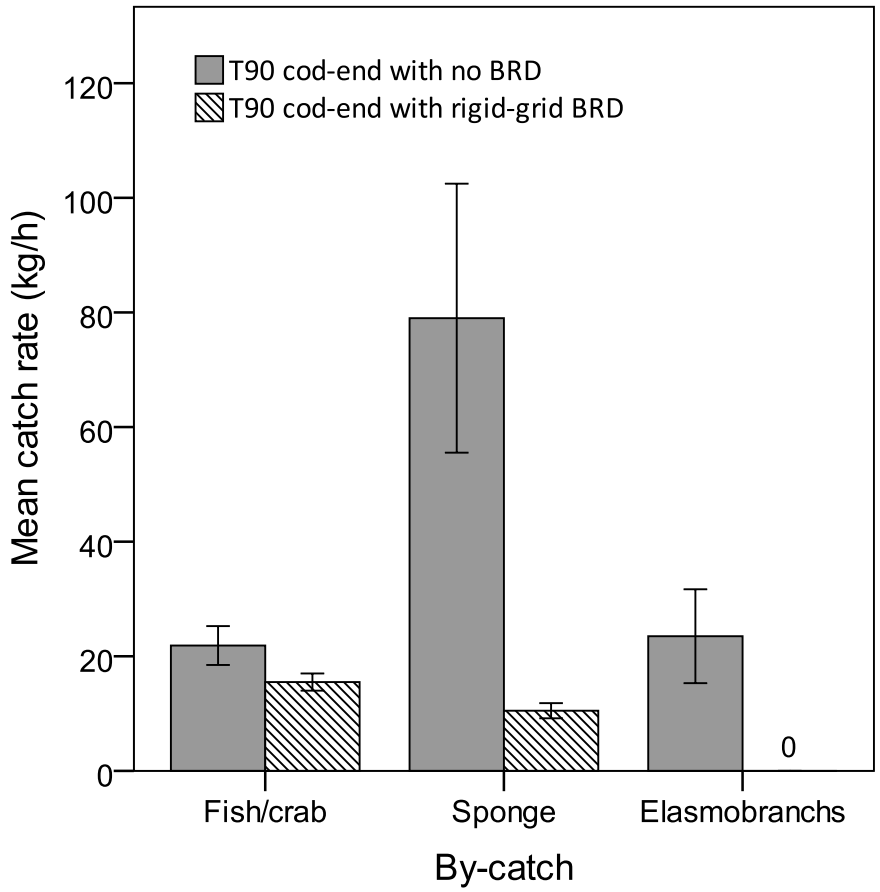


Figure 12. Comparison of the estimated weight of 'fish/crabs', 'sponge' and elasmobranchs caught using trawl gear comprising of a **T90 mesh cod-end** only and one that included a **rigid-grid BRD anterior to the T90 cod-end** (configuration 7).

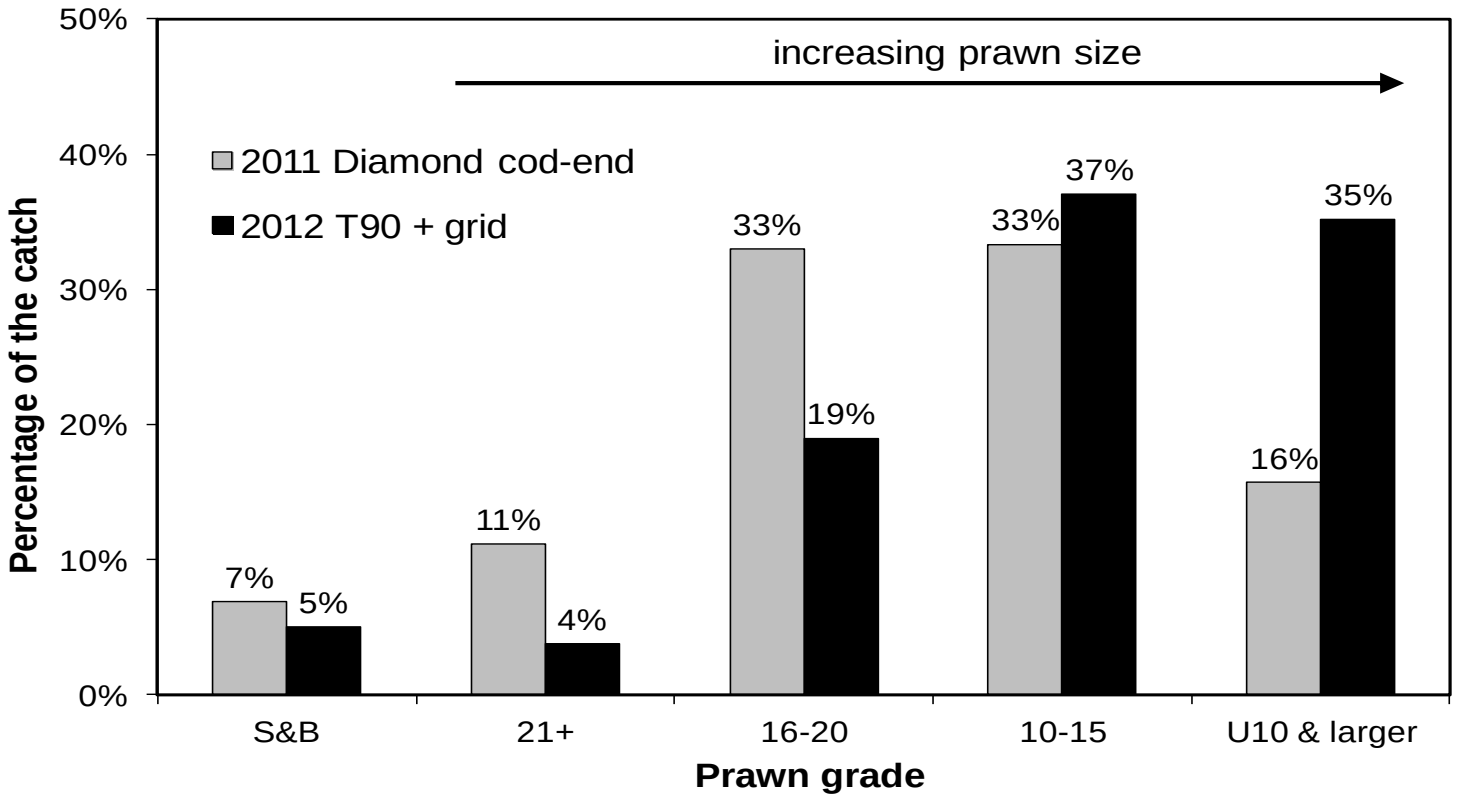


Figure 15. Percentage of the catch in various prawn grades during commercial fishing in March using **diamond cod-ends in 2011** and **T90 cod-ends with grid** in 2012. S&B is Soft and Broken.

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2010/11 second year of decline in bio-mass, with increased biomass of mixed prawns (10/15 & 16/20's). 2011/12 declining catches. 2012- 2014 fishery closed.

March 2014 - new management arrangements provided for greater flexibility for industry to choose areas to fish and optimise target catch rates and size to maximise fishery performance.

This approach was supported by I Cartwright and G Morgan (2013) management review which identified the decline in fishery performance was in part driven by the management framework that tightly locked fishers into small areas in part to reduce the catch of small prawns in order to meet the prescribed size targets.

The adoption of the T90 and grid BRD system was the basis to replace the need for spatial closures and a spatially managed target size fishing strategy.

SAINT VINCENT GULF
PRAWN BOAT OWNER'S ASSOCIATION INC.

- After a period of 2 years a modification was made to the original specification to reduce the loss of target sized fish due to the suboptimal pressure in the net near the draw string zone.

- This was addressed by increasing the size of the smaller standard mesh near the draw string to 33 meshes.

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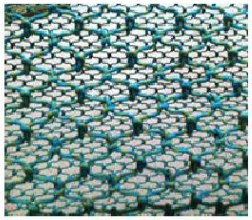
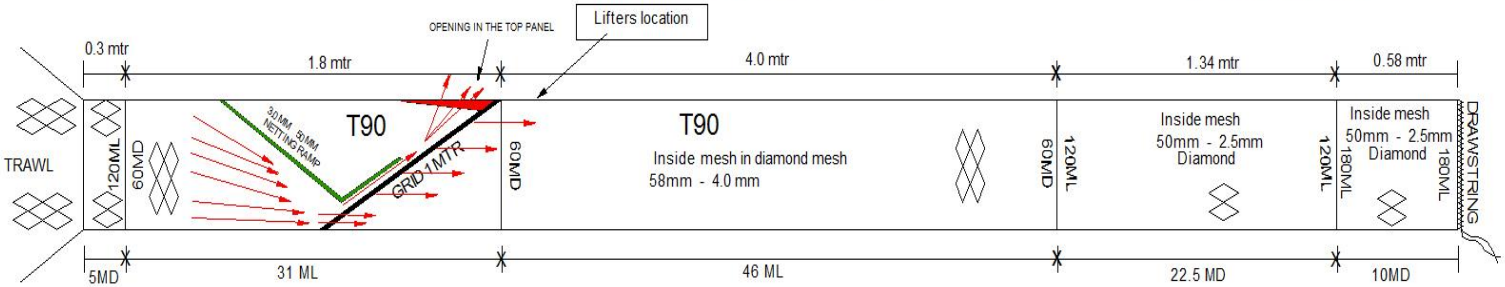
T90 CODEND AND GRID FOR GULF VINCENT

New version with max 33 diamond meshes in the codend





Inside mesh means the stretched length between the knots in one diamond mesh

Design: Thorstein Ben - 19.02.2015
Ph. 0430-599-295 Email tben@tben.com.au

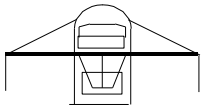
SAINT VINCENT GULF
PRAWN BOAT OWNER'S ASSOCIATION INC.

- The Licence Conditions governing the net design are:

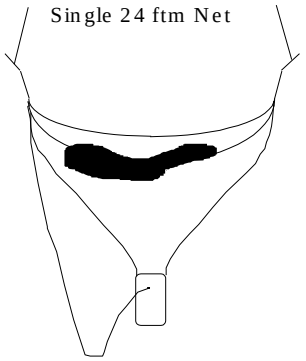
Notwithstanding the requirements of the Fisheries Management Act 2007, a prawn trawl net used pursuant to this licence must meet the following specifications: a) The cod end of the net must be made of netting known as T90 mesh (in which the orientation of the stretched mesh is turned 90 ° to that of diamond mesh), except for the final part of the cod end that is drawn together and closed off, where no more than the last 33 meshes may be made up of diamond mesh; and b) The T90 mesh must be made from twine with a minimum diameter of 4.0mm, and must have a minimum mesh size of 58mm (measured from centre of knot) when stretched perpendicular to the length of the net.

Notwithstanding the requirements of the Fisheries Management Act 2007, a prawn trawl net used pursuant to this licence must meet the following specifications: a) A by-catch reduction grid must be positioned and secured to the net so that aquatic resources must pass through the grid before entering the cod end of the net; and b) The cod end of a prawn trawl net used in the Gulf St Vincent Prawn Fishery should contain a by-catch reduction grid made of rigid material with a top opening escape panel; and c) The by-catch reduction grid should be set with vertical bars spaced no more than 50 mm apart.

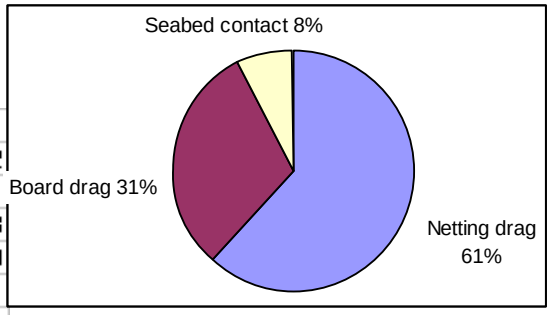
Contemporary prawn trawling rigs



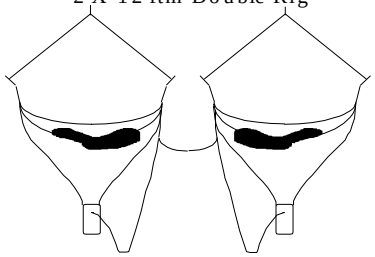
Single 24 ftm Net



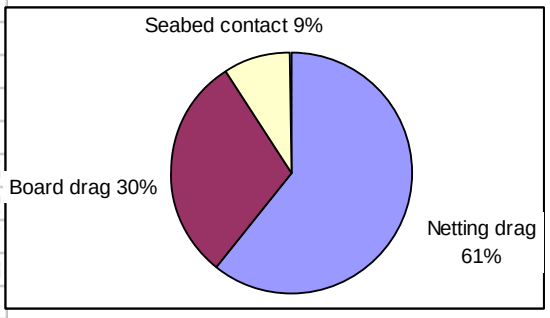
netting drag	0.62
Board drag	0.31
Seabed contact drag	0.08
TOTAL DRAG	**1.00**



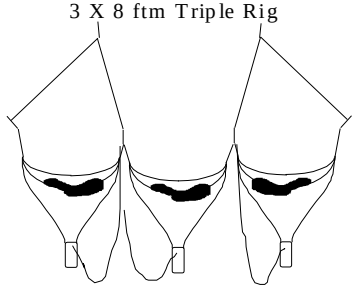
2 X 12 ftm Double Rig



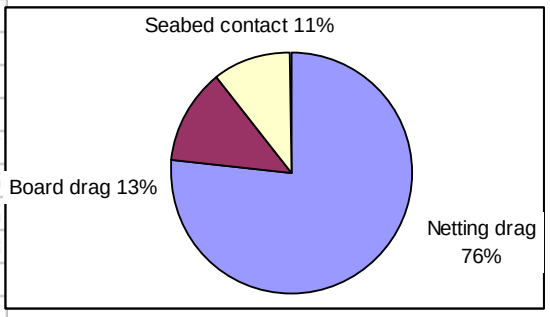
netting drag	0.45
Board drag	0.22
Seabed contact drag	0.07
TOTAL DRAG	**0.73**



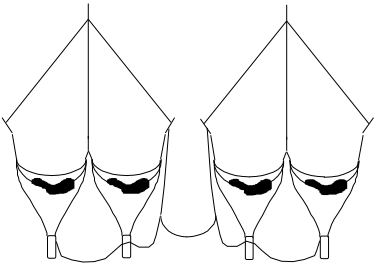
3 X 8 ftm Triple Rig



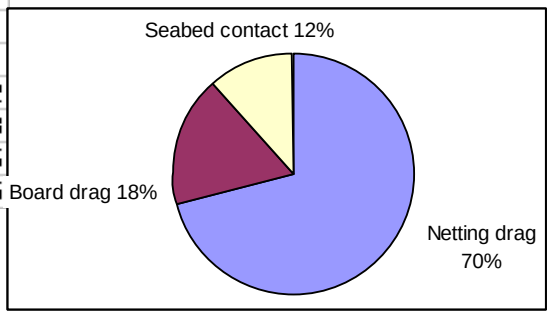
netting drag	0.37
Board drag	0.06
Seabed contact drag	0.05
TOTAL DRAG	**0.48**



4 X 6 ftm Quad Rig

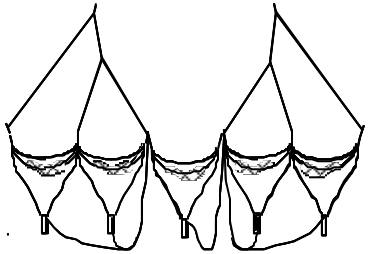


netting drag	0.32
Board drag	0.08
Seabed contact drag	0.05
TOTAL DRAG	**0.45**

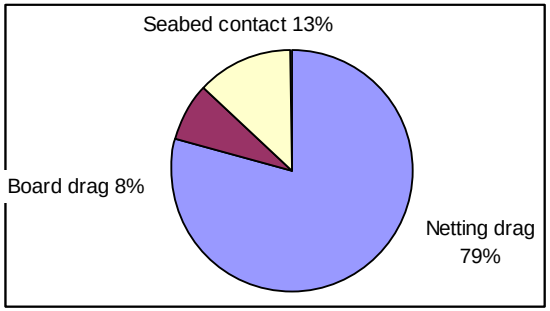


Going one step further?

5 X 4.8 ftm Five Rig



netting drag	0.29
Board drag	0.03
Seabed contact drag	0.05
TOTAL DRAG	**0.37**

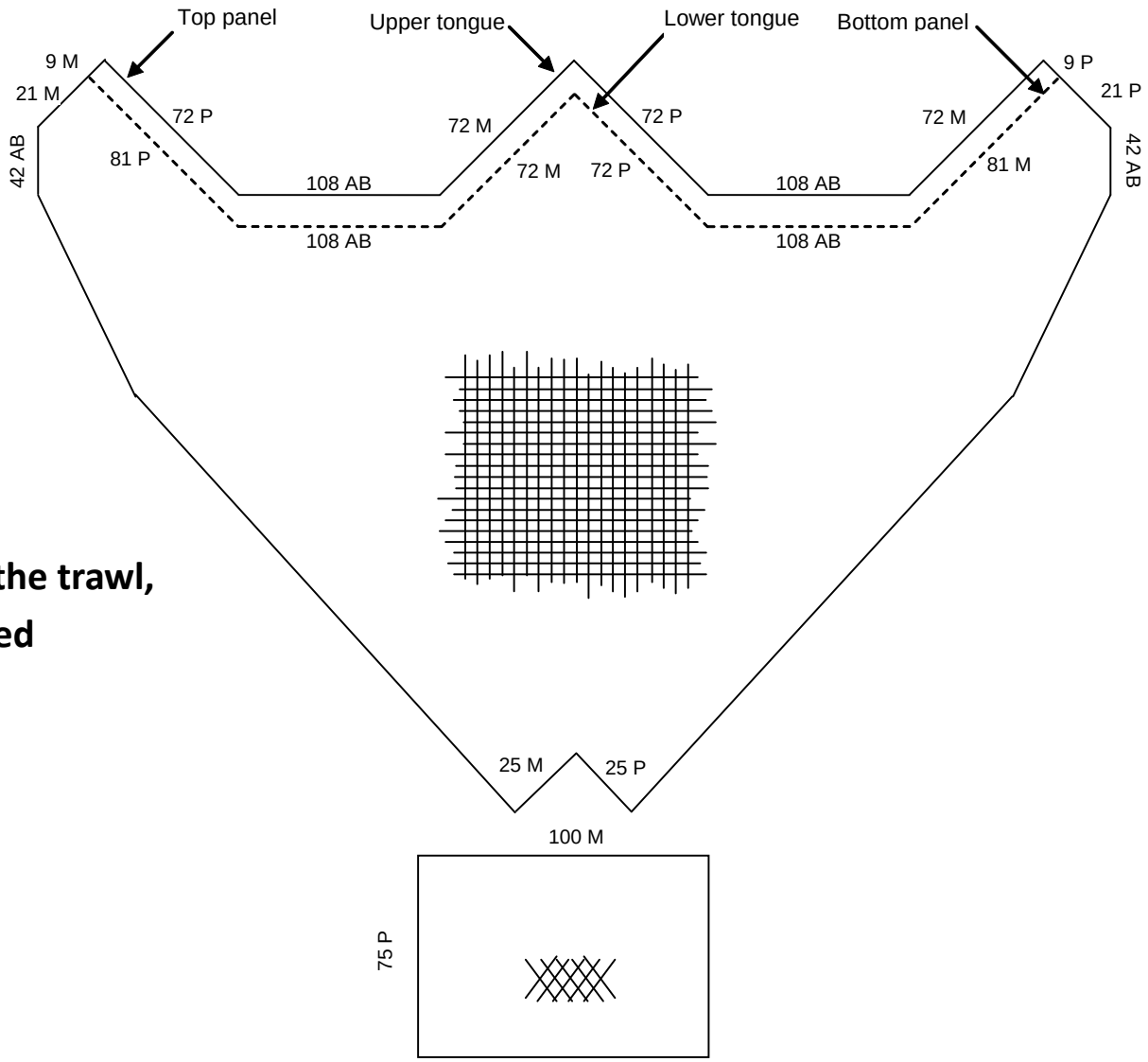


What is the effect of reducing twine diameter?

What is the effect of improving otter board efficiency?

Double-tongue square-mesh trawl - a design concept

- **tongues take tension**
- **longitudinal bars transfer strain directly to central towing wire**
- **trawl easier to spread**
- **hence smaller otter boards required**
- **as netting folds around sides of the trawl, meshes become diamond-oriented**



Double-tongue T0 trawl - a tested prototype

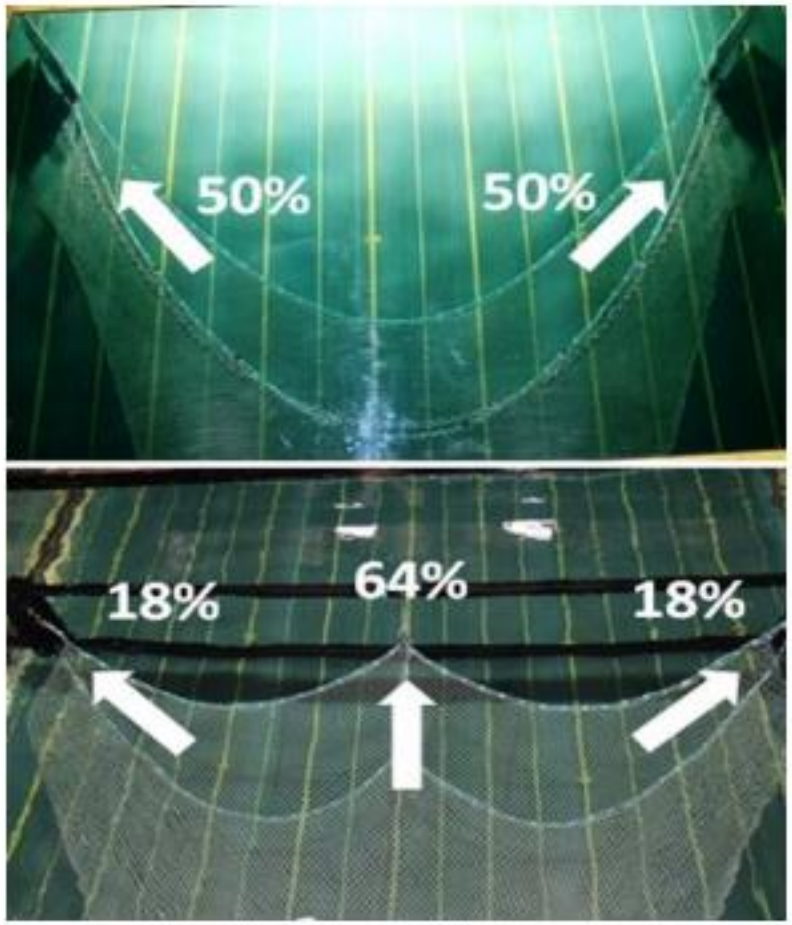


Figure 6. Standard and 'W' trawls of two-fathom headline length tested in flume tank.

Figure 5. Bracing rope installed at the hanging ratio of 0.707 along the longitudinal centre line of the trawl to increase the stain transfer to the tongues.

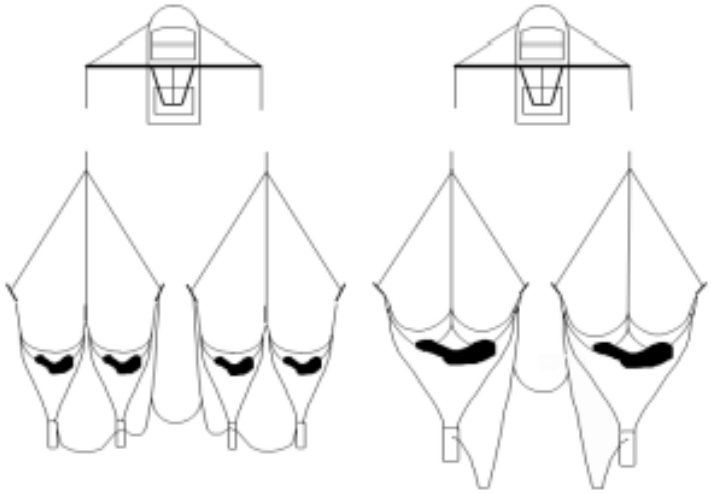
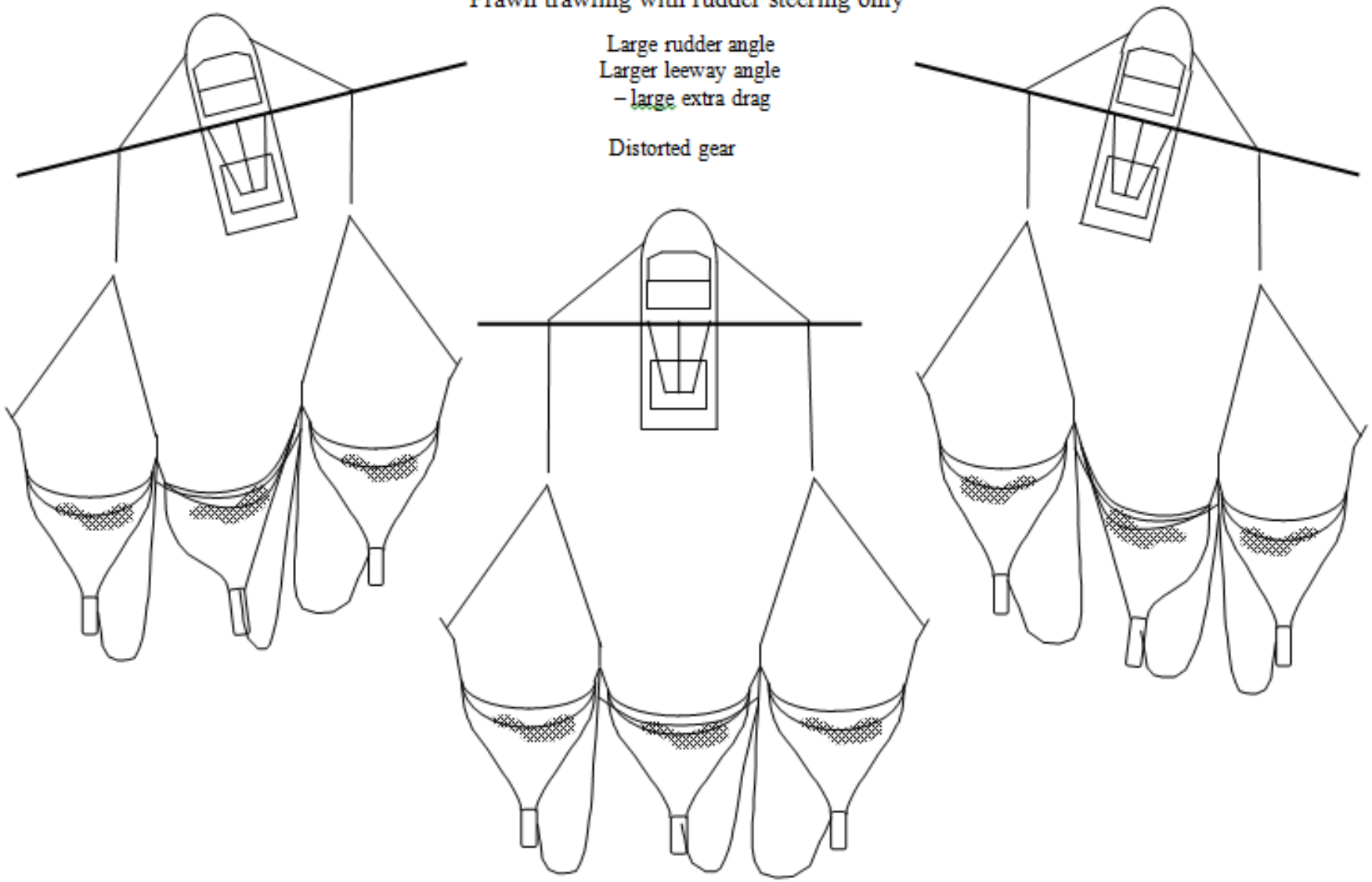


Figure 7. Traditional quad rig and 'W' trawl in a twin rig.

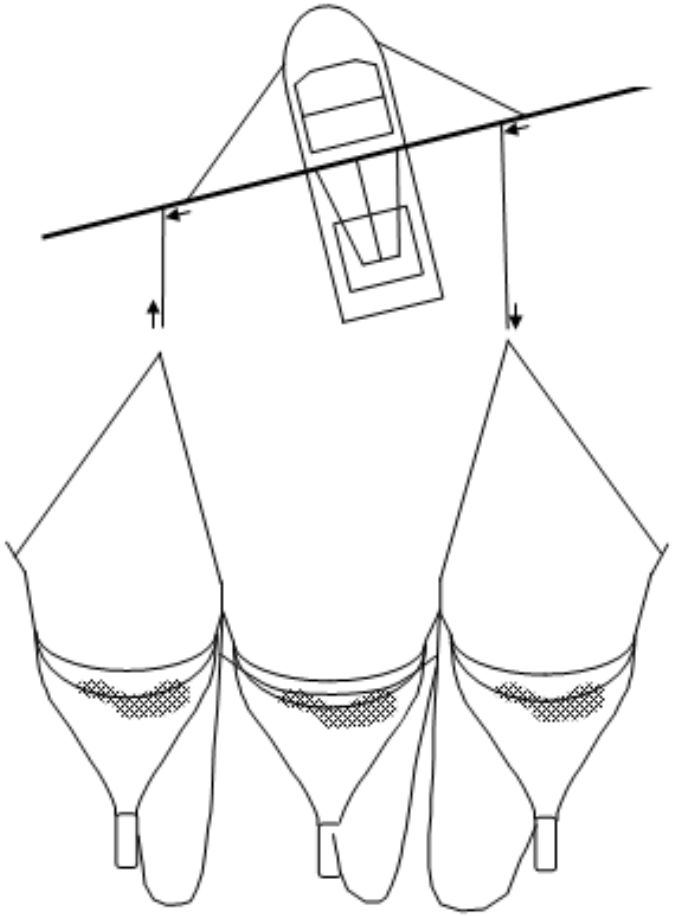
Prawn trawling with rudder steering only

Large rudder angle
Larger leeway angle
– large extra drag

Distorted gear

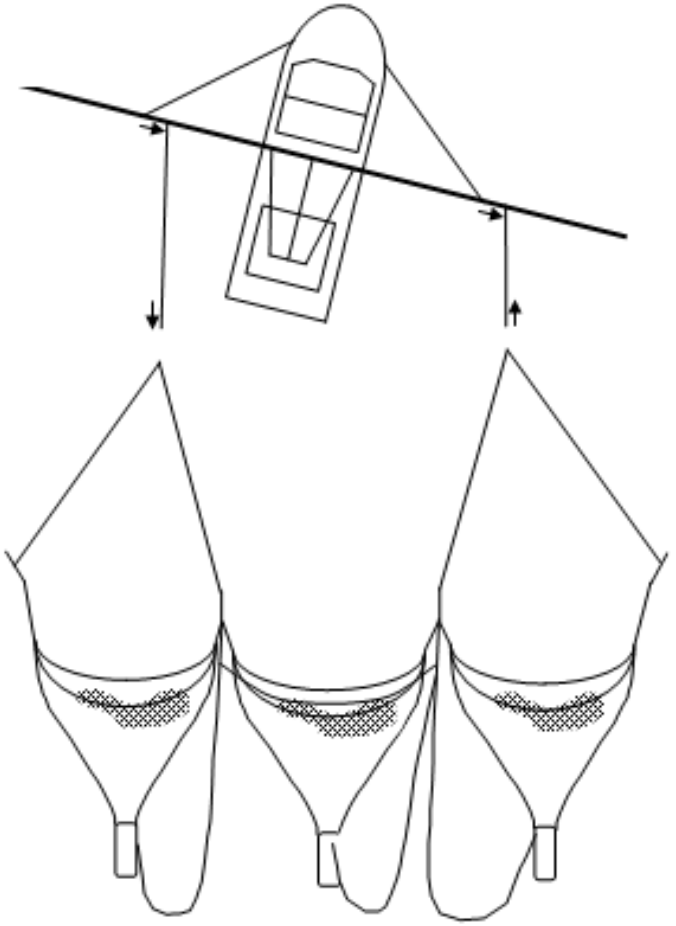


Prawn trawling with adjustable tow-points



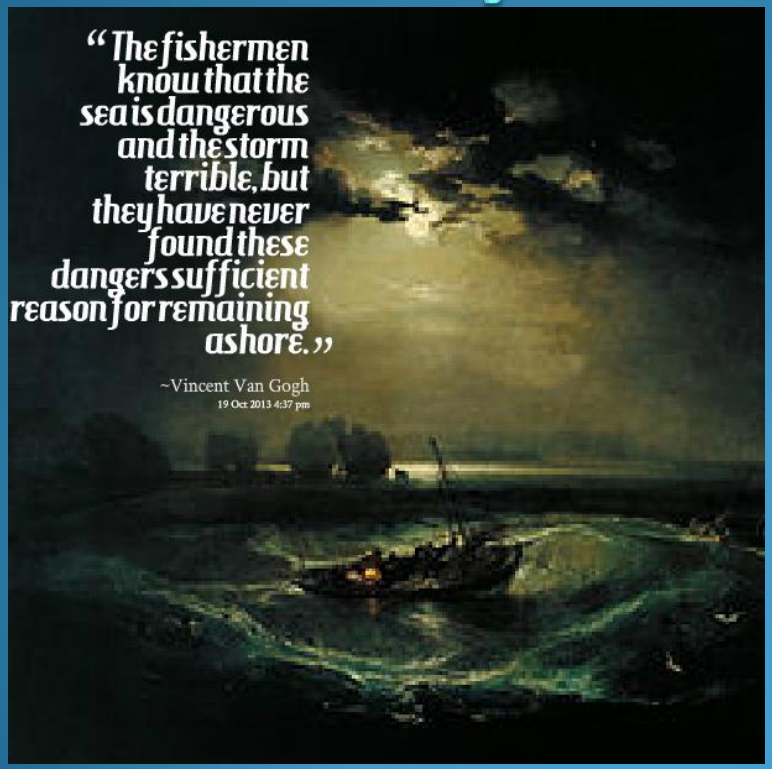
No rudder angle required
Reduced leeway angle
– low extra drag

Gear towed square



PFA presentation 2017

NSW Trawl Bycatch Reduction Workshop



Background

- Ocean Trawl
  - Prawn Trawl
  - Deepwater Prawn Trawl
  - Fish Trawl
- Estuary Prawn Trawl
  - Clarence Estuary Prawn Trawl (oct – may)
  - Hunter Estuary Prawn Trawl (oct – may)
  - Hawkesbury Estuary Prawn Trawl
- All otter board setup – no beam
- Use of bycatch reduction devices mandatory in EPT

Ocean Trawl Bycatch Reduction Strategies

BRD's reduce incidental catch, minimise handling, improve survival of non-retained catch and improve quality of retained catch

BRDs are a requirement in the OPT fishery in accordance with a closure notice prepared under s8 of the Fisheries Management Act 1994

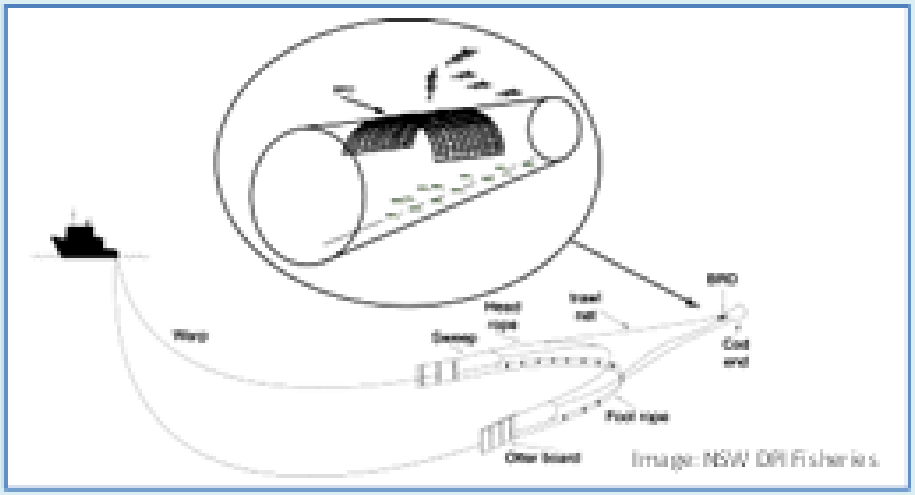


Image: NSW DPI Fisheries

BRDs listed in legislation:

- Nordmore grid
- Big eye
- Ocean square mesh panel
- Radial escape panel
- Deepwater square mesh panel

Ocean Trawl Fishery BRDs and specifications
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/353233/Bycatch-closure.pdf

Gear selectivity refers to a fishing method's ability to target and capture organisms by size and/or species during fishing operations

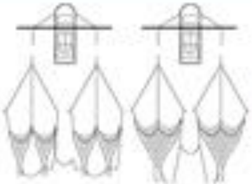
Ocean Trawl Bycatch Reduction Strategies

Keep an eye out for recent research final reports

http://frdc.com.au/research/final-reports/Pages/recent_final_reports.aspx

Minimising fuel consumption, reducing operating costs and minimising seabed disturbance

W trawl 3 x towing connections reduces drag by around 20% in comparison to Y trawl (2 x TC)



Twin rig 'W' trawl can reduce drag by 11% in comparison with a standard 'Quad' rig

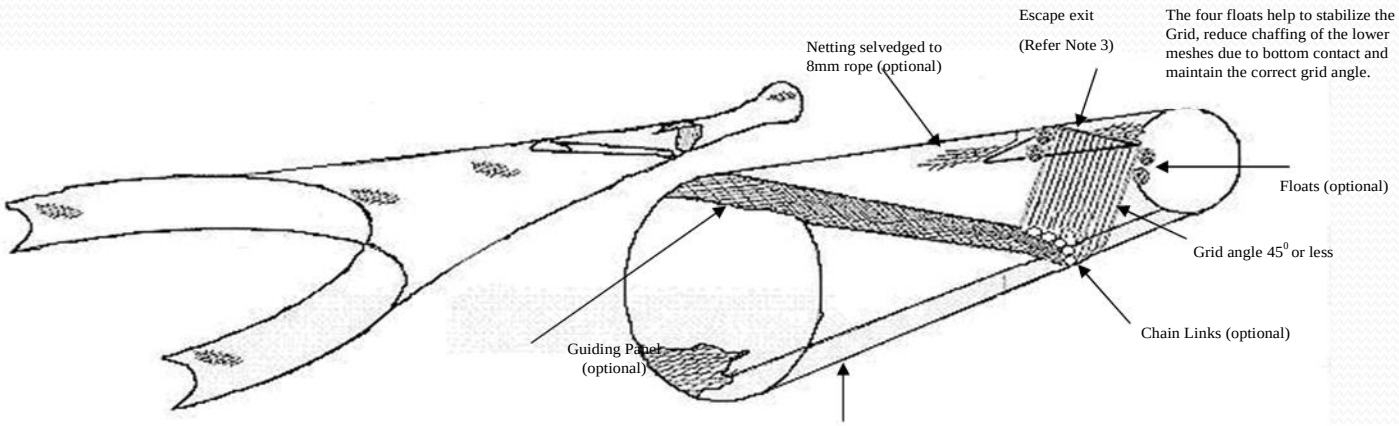
Batwing otter boards reduce drag by changing the angle of attack from 40° to 20°

Adjusting tow points on outriggers to reduce drag and improve gear shape

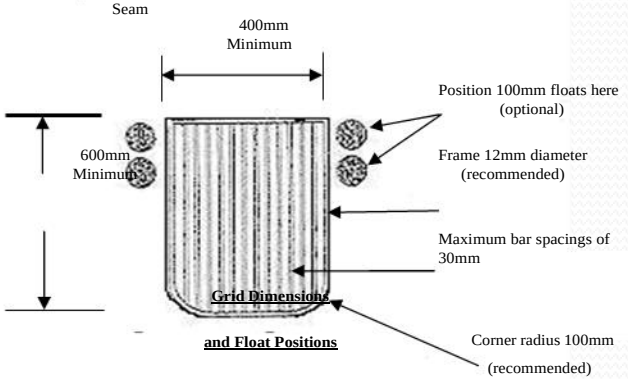
High strength netting with thinner twine diameter reduced drag in the NPF by 27%

NSW GOVERNMENT | Industry & Investment

NSW Ocean Trawl Fishery
Nordmore Grid Bycatch Reduction Device (BRD) Specification
(for use in NSW Ocean Waters)



Assembled Nordmore Grid

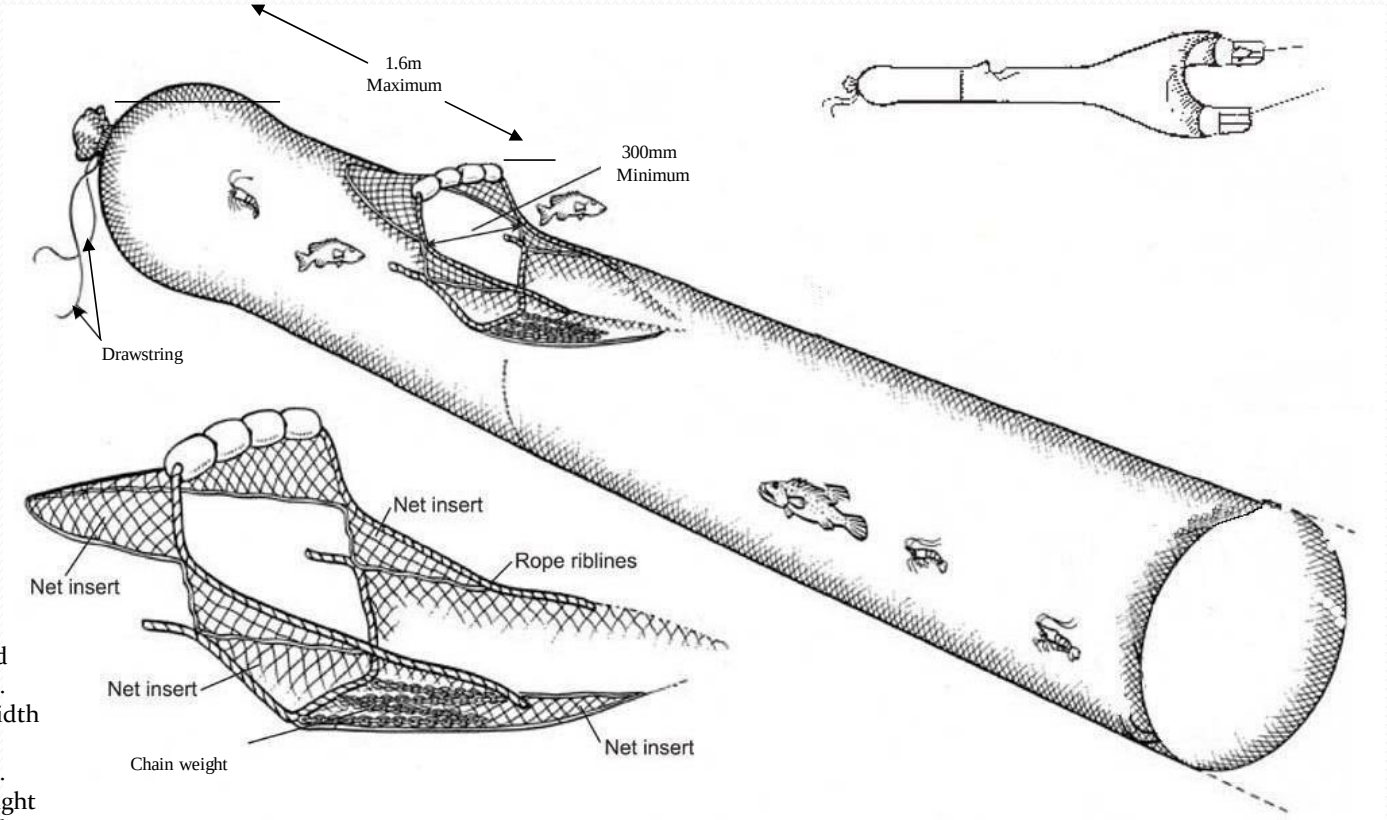


Grid Dimensions and Float Positions

Compulsory Specifications;

1. The perimeter of the grid must be fully sewn onto the inside of the net.
2. Grid dimension of minimum 600mm long and minimum of 400mm wide.
3. Maximum spacing of 30mm between bars.
4. Grid positioned at an angle of 45° from horizontal plane or less.
5. The escape exit must be immediately forward of the uppermost edge of the grid and may consist of:
   a) A triangle of not less than 20 bars per side (base 25 meshes across), or
   b) A single cut not less than 25 meshes across the top of the net.

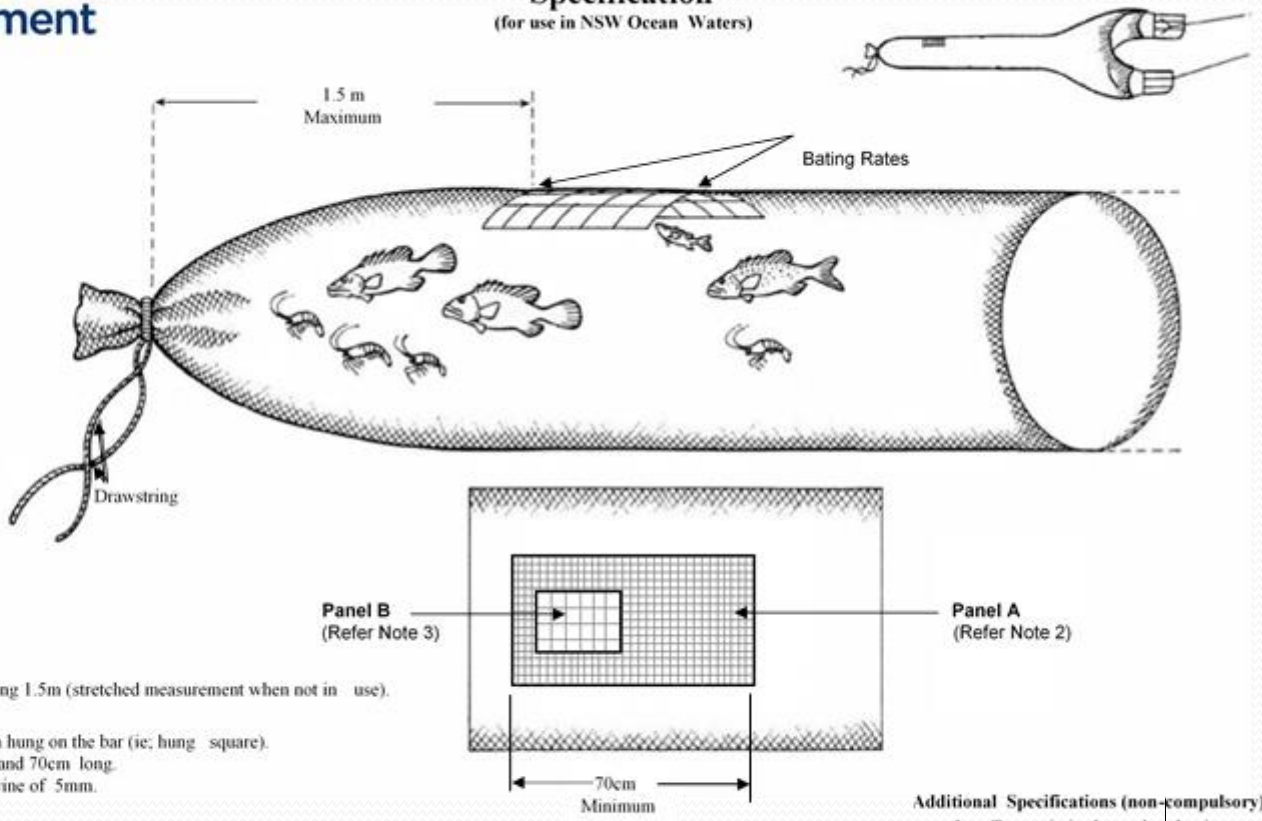
NSW Ocean Trawl Fishery
Big-Eye Bycatch Reduction Device (BRD) Specification
(for use in NSW Ocean Waters)



Compulsory Specifications;

1. Maximum distance from drawstrings to opening (floats) 1.6m (stretched measurement when not in use).
2. Minimum width of opening 300mm (stretched measurement when not in use).
3. Chain or weight on front panel (preferably weight to avoid spooking fish) – diagram indicative only.
4. Floats on rear panel – diagram indicative only.

NSW Ocean Trawl Fishery
Ocean Square-Mesh Panel Bycatch Reduction Device (BRD)
Specification
(for use in NSW Ocean Waters)



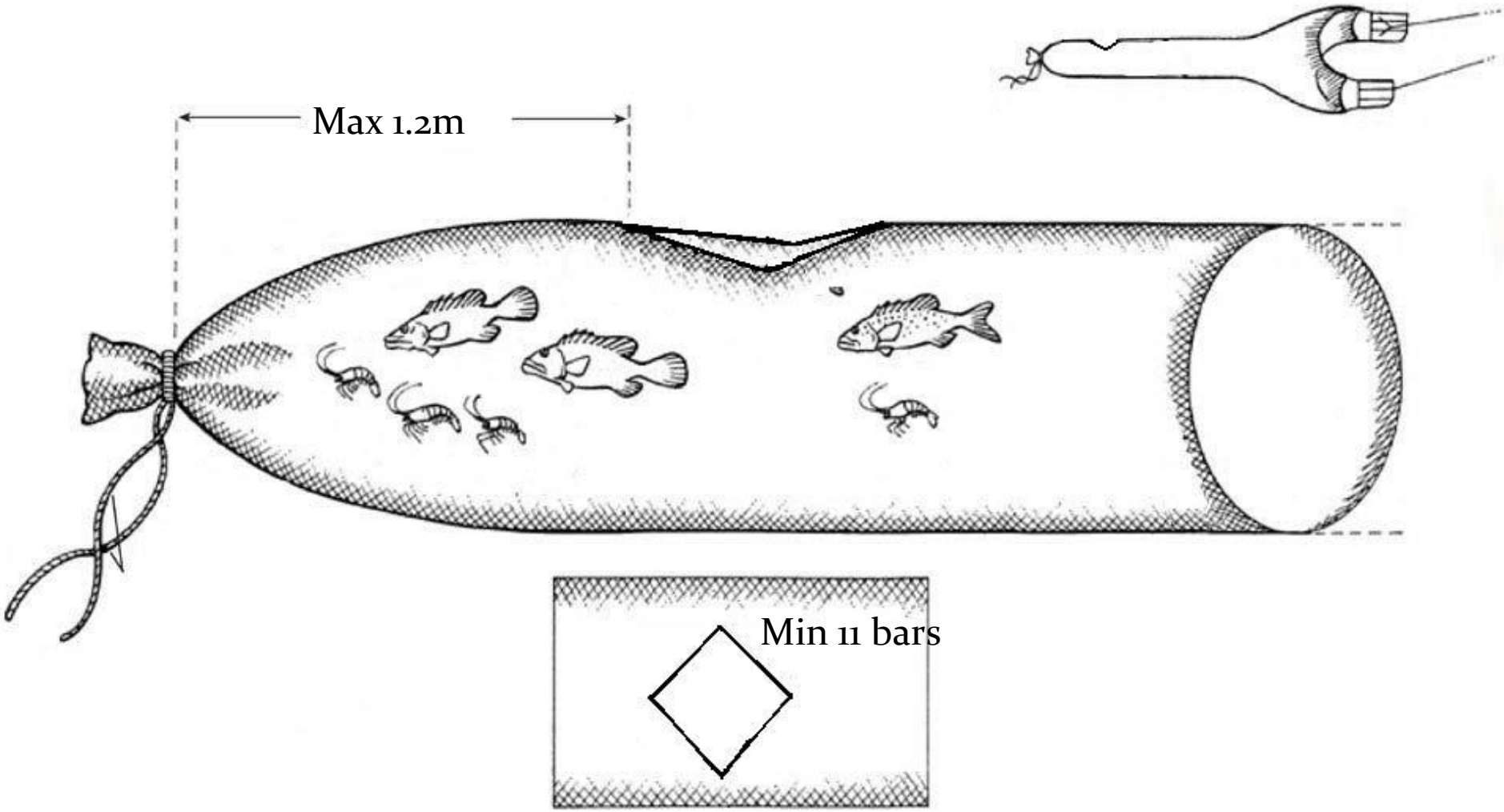
Compulsory Specifications;

1. Maximum distance from drawstring 1.5m (stretched measurement when not in use).
2. **Panel A (surrounding panel):**
   - a) Minimum 45mm mesh hung on the bar (ie; hung square).
   - b) Minimum 55cm wide and 70cm long.
   - c) Maximum diameter twine of 5mm.
3. **Panel B (centre panel):**
   - a) Minimum 55mm mesh hung on the bar (ie; hung square).
   - b) Minimum 25cm wide and 30cm long.
   - c) Maximum diameter twine of 5mm.
   - d) Maximum 1.6m forward of codend drawstring and inserted into Panel A.

Additional Specifications (non-compulsory);

1. To maximise bycatch reduction consider increasing mesh size of panels or move BRD closer to the codend drawstring.
2. May comprise rigid frames within which panels of rigid mesh (plastic, stainless steel, etc), soft mesh or combinations thereof may be used.

NSW Estuary Prawn Trawl Fishery
Diamond Bycatch Reduction Device (BRD) Specification




THERES A LOT TO SAY
ABOUT A LITTLE COMMON SENSE


THANK YOU FOR YOUR ATTENTION
YESSSS, FINALLY OVER!
Posted at www.bajiroo.com