MITIGATION TECHNIQUES TO REDUCE BENTHIC IMPACTS OF TRAWLING

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MIT2019-02 A Review for the Department of Conservation by Terra Moana Limited

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About US

Our company kaupapa

BRIDGING

We create connections that count, facilitating meaningful dialogue and activities across sectors, cultures and diverse groups.

WEAVING

We bring together the best of contemporary and traditional values, science and thought to deliver tailored, integrated strategic solutions.

DESIGNING

We deliver agile, manageable and measurable step-change, constantly working with you on your journey to sustainable success.

"IT'S THE RIGHT THING TO DO!"

The Terra Moana Team

Passionate about this project, we brought a strong team together.

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Project Background

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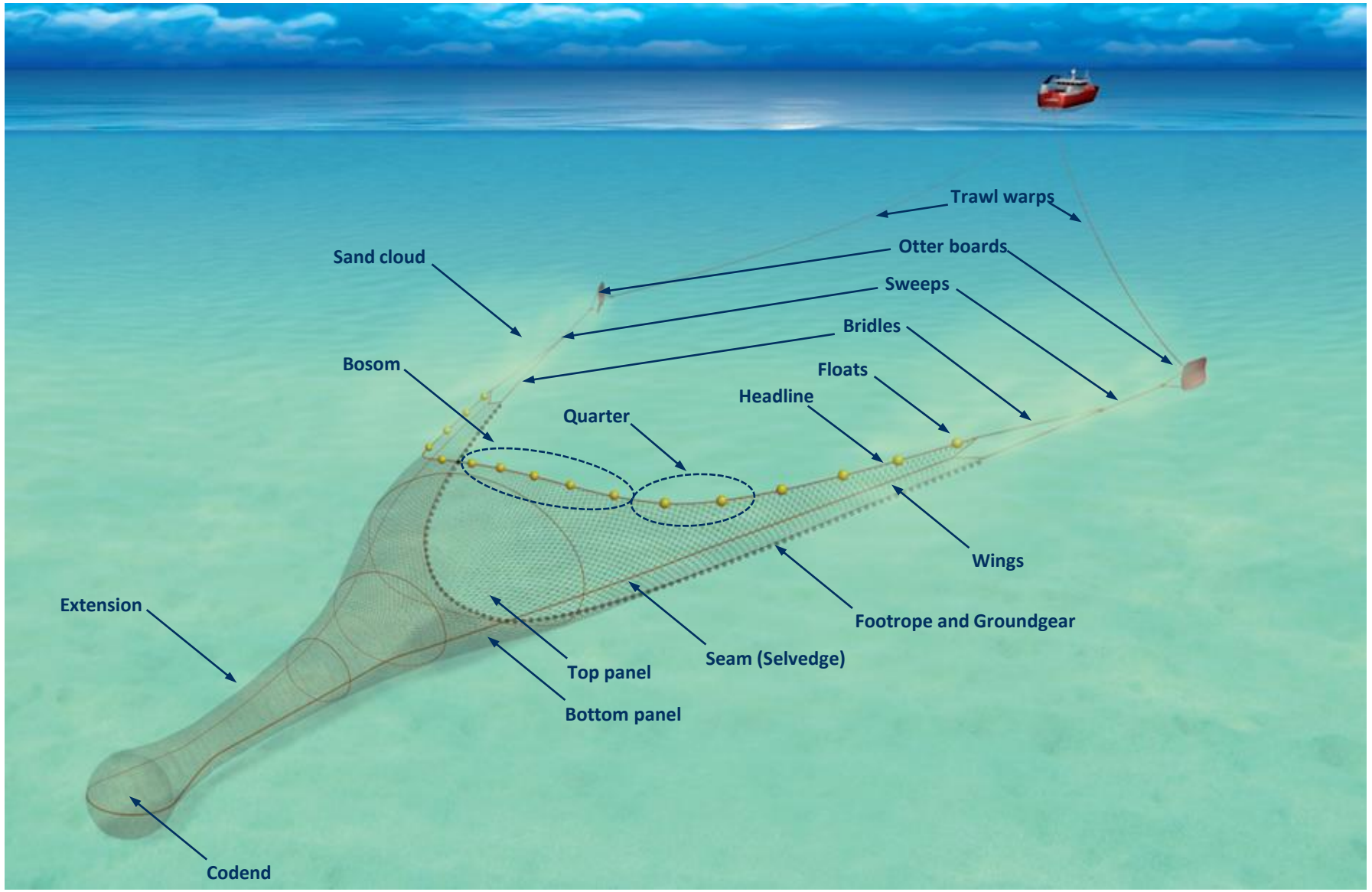
- Aims:
  - To review literature on mitigation techniques to reduce benthic impacts of trawling
  - To make recommendations that are relevant to New Zealand trawl fisheries
  - Provide all data collected in electronic format

- Desktop review available at www.doc.govt.nz for comment

- Milestones
  - Draft report to DOC on April 25, 2020
  - Final report due May 25, 2020

Bottom trawl design and components

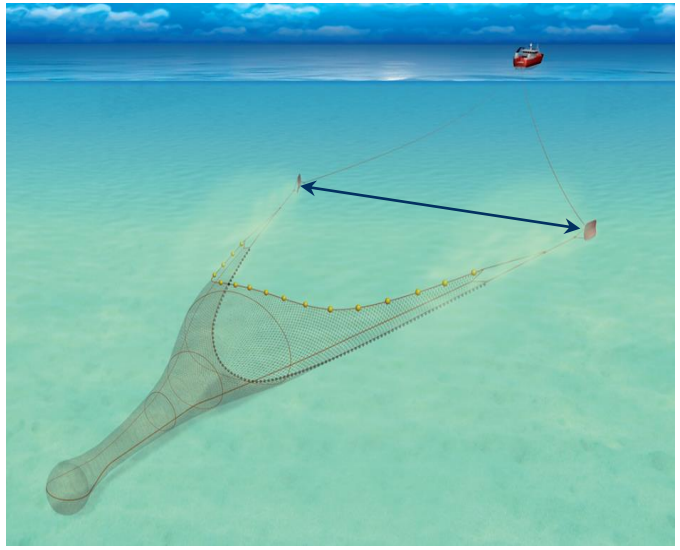
Bottom trawl design and components

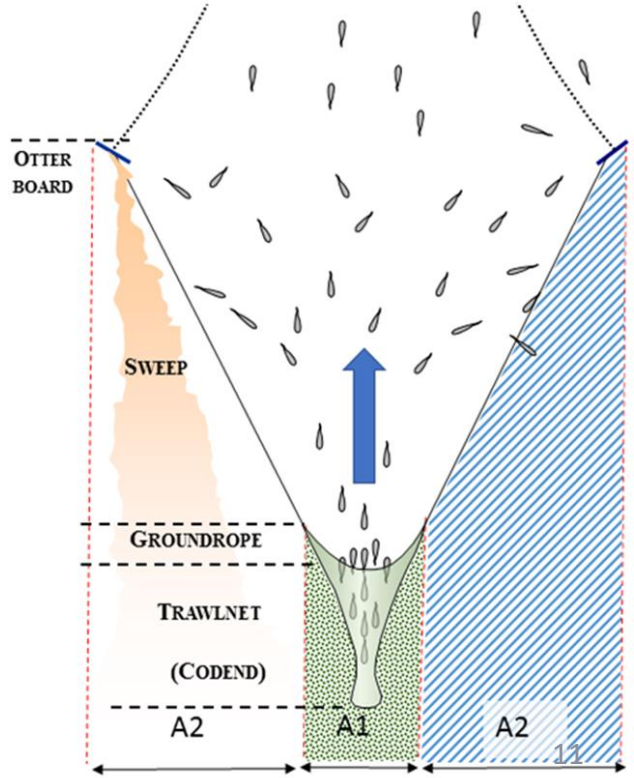


Assumptions

Assumptions

- Swept width is a proxy for seabed contact and a measure of trawl footprint
- Otter boards, sweeps, lower bridles, and groundgear are in seabed contact along their entire length
- Reduced seabed contact equates to reduced benthic impact

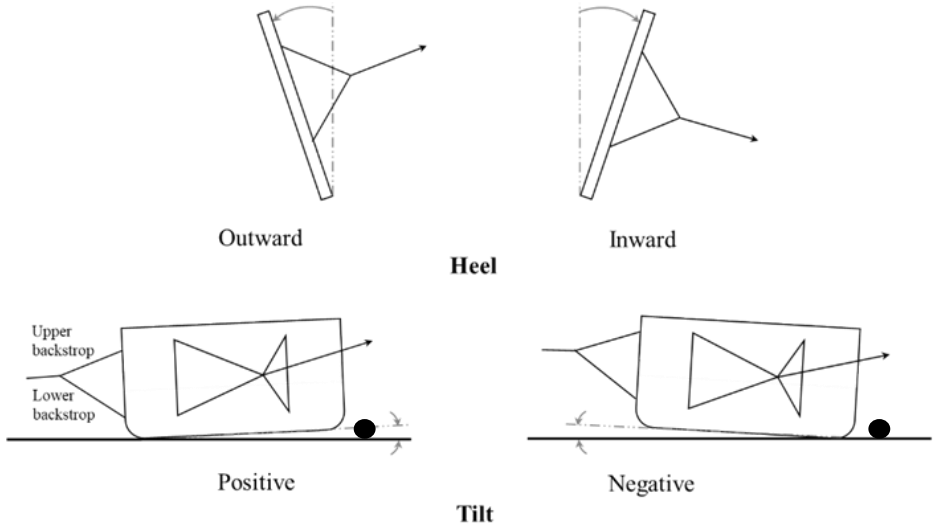




Options

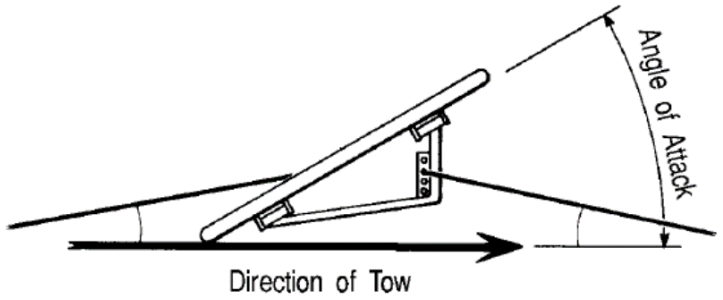
Otter board modification

- Reduced warp to depth ratio
- Increased towing speed
- Inward heel and positive tilt



Otter board modification

- Lighter materials, foam inserts (↓wt. by 83%)
- Reduced angle of attack

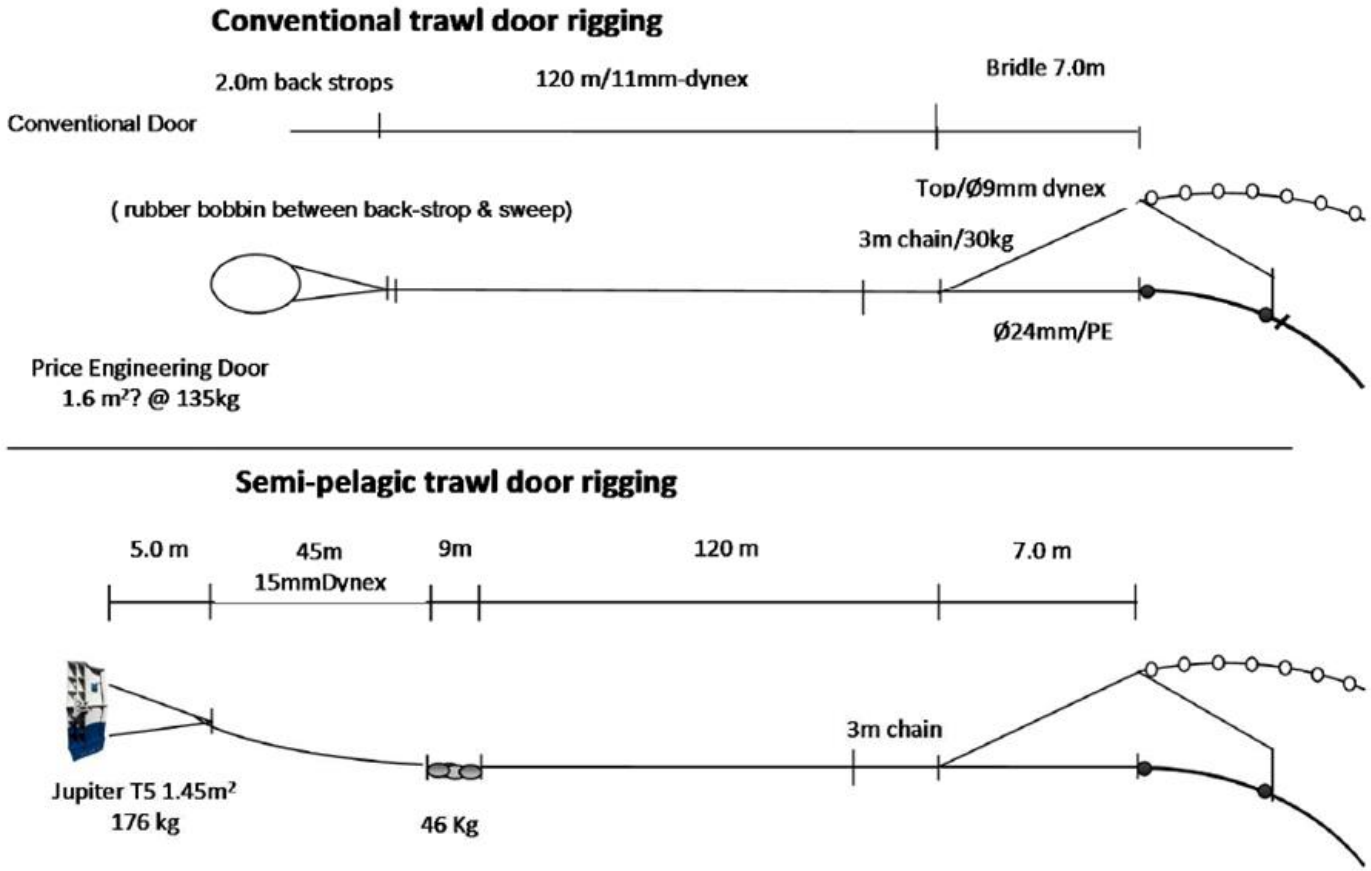


Otter board modification

- Semi-pelagic otter boards
  - US Study (Eayrs, 2014a)
    - Standard – 485 kg, 2.25 sq. m
    - SP boards (Thyboron) – 440 kg (↓ 9%), 1.75 sq. m (↓ 22%)
    - 95% of otter board shoe clear of the seabed
    - No sig. difference in groundfish
    - Fuel consumption ↓ 12%
    - Amortization period was 15 months
    - Fishers using these voluntarily for several years

Otter board modification

- Semi-pelagic otter boards
  - NZ Study (Jones, 2015)
    - SP boards – ↑ 30% heavier, ↓ 22% smaller
    - 95% of otter board shoe clear of the seabed
    - Commercial catch rate ↓ 13%
    - Fuel consumption ↓ 16%



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Otter board modification

- Controllable otter boards
  - Upper and lower foils adjustable on demand
  - Acoustic link
  - Limited evidence of industry uptake
  - Limited evidence of improved performance
  - Problems with acoustic link have been reported
  - $$$

Application to NZ bottom trawl fisheries

L-Low, M-Medium, H-High.

GEAR (OTTER BOARDS)	OPERATIONAL CONSIDERATION					
	Reduction in Seabed Contact	Impact on Catch	Fuel Saving	Capital Cost	Immediacy of application[1]	Ease of use[2]
Reduced warp to depth ratio	L	L	L	L	H	H
Increased towing speed	L	M	L	L	H	H
Adjusted otter board heel & tilt	L	L	L	L	H	H
Use of lighter materials	L	L	L	M	L	M
Reduced angle of attack	M	L	M	L	H	M
Use of semi-pelagic otter boards	H	L	H	H	L	M
Use of controllable otter boards	H	L	H	H	L	L

1. Defined broadly as how quickly fishers can apply the gear modification and achieve optimal performance.
2. Defined as the ease with which the gear modification can be applied on a day-to-day basis.

Application to NZ bottom trawl fisheries

L-Low, M-Medium, H-High.

Little/no evidence of persistent industry use to reduce seabed contact by otter boards

GEAR (OTTER BOARDS)	OPERATIONAL CONSIDERATION					
	Reduction in Seabed Contact	Impact on Catch	Fuel Saving	Capital Cost	Immediacy of application[1]	Ease of use[2]
Reduced warp to depth ratio	L	L	L	L	H	H
Increased towing speed	L	M	L	L	H	H
Adjusted otter board heel & tilt	L	L	L	L	H	H
Use of lighter materials	L	L	L	M	L	M
Reduced angle of attack	M	L	M	L	H	M
Use of semi-pelagic otter boards	H	L	H	H	L	M
Use of controllable otter boards	H	L	H	H	L	L

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Application to NZ bottom trawl fisheries

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	Reduction in Seabed Contact	Impact on Catch	Fuel Saving	Capital Cost	Immediacy of application[1]	Ease of use[2]
Reduced warp to depth ratio	L	L	L	L	H	H
Increased towing speed	L	M	L	L	H	H
Adjusted otter board heel & tilt	L	L	L	L	H	H
Use of lighter materials	L	L	L	M	L	M
Reduced angle of attack	M	L	M	L	H	M
Use of semi-pelagic otter boards	H	L	H	H	L	M
Use of controllable otter boards	H	L	H	H	L	L

Some evidence of sporadic industry use to reduce seabed contact and/or fuel consumption

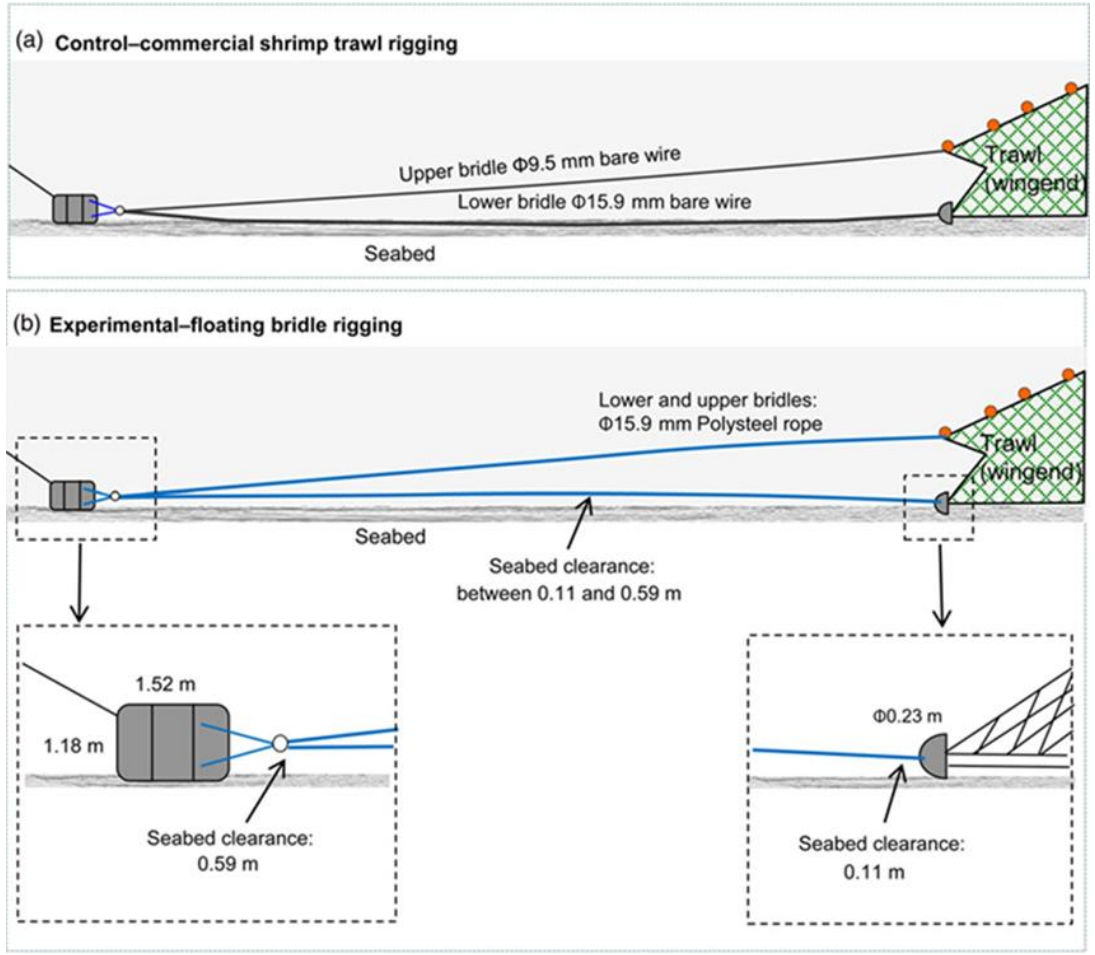
1. Defined broadly as how quickly fishers can apply the gear modification and achieve optimal performance.
2. Defined as the ease with which the gear modification can be applied on a day-to-day basis.

Sweep and bridle modification

- Reduce sweep and bridle weight
  - Limited evidence of reduced benthic impact, or impact on catch
- Shorter sweeps and bridles
  - Improves manoeuvrability
  - Anecdotal evidence of reduced benthic impact

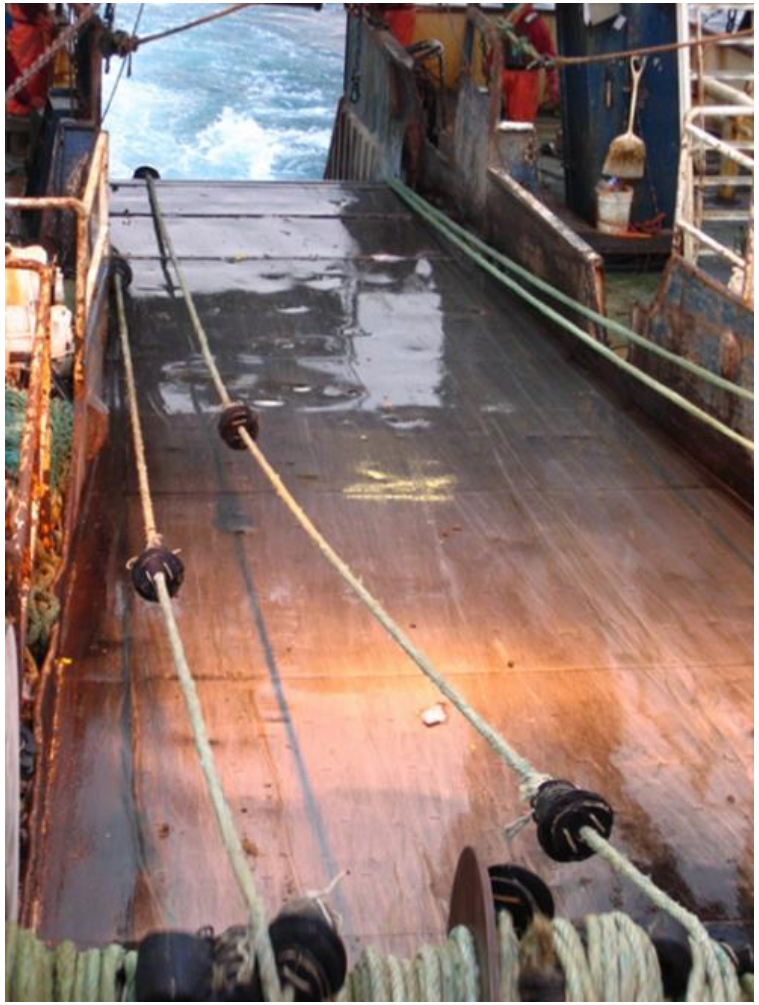
Sweep and bridle modification

- Add flotation
  - US Study (He *et al*., 2015)
    - Control & Experimental – bridles measuring 27.7 m
    - Polysteel = Polypropylene rope
    - Little difference in wingend spreads
    - Little difference in catch of northern shrimp
    - Bycatch ↓ 15%



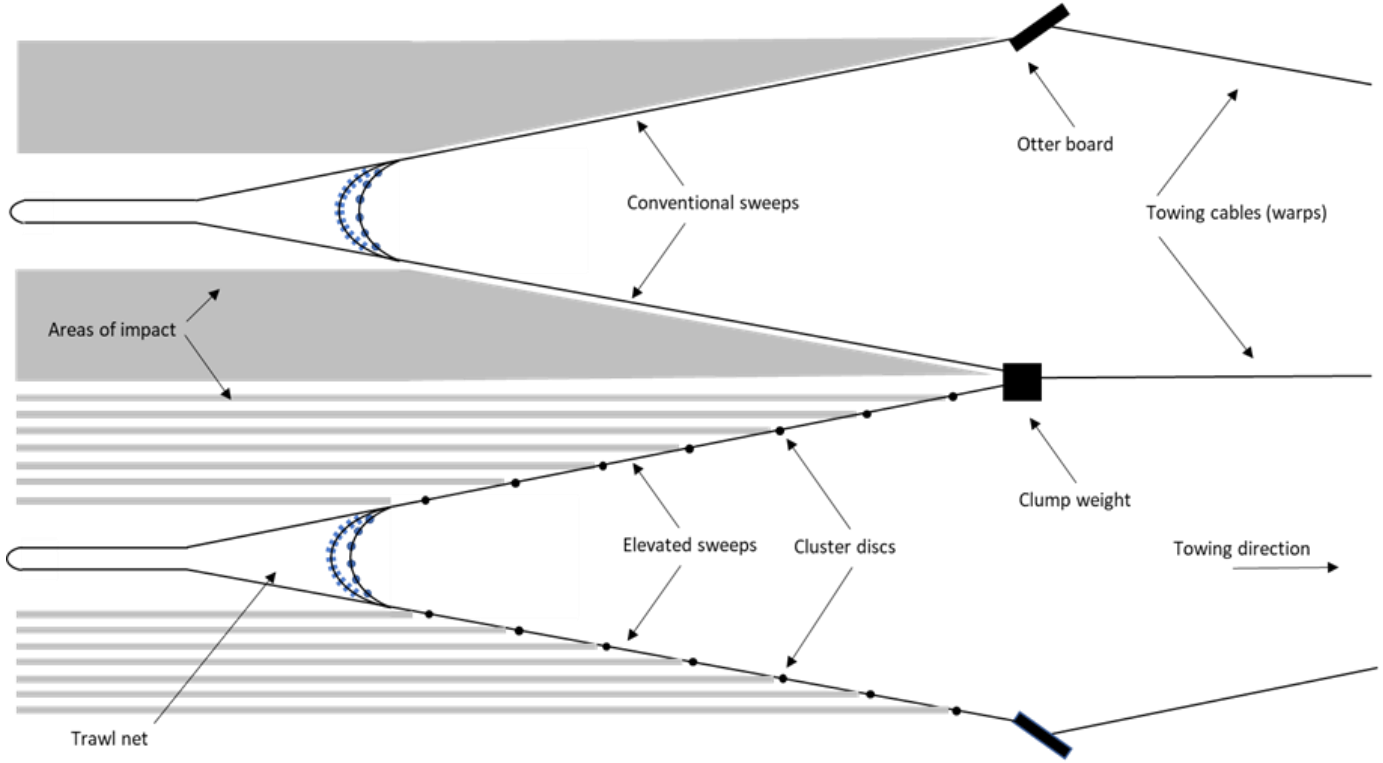
Sweep and bridle modification

- Elevate sweeps and bridles (cluster discs)
  - US Study (Rose *et al*., 2010a)
    - Control & Experimental – Combination rope 180 m and 5 cm ∅
    - Experimental – Multiple discs attached to sweep every 9 m.
    - 3 treatments: Disc ∅ 25, 20, and 25 cm.



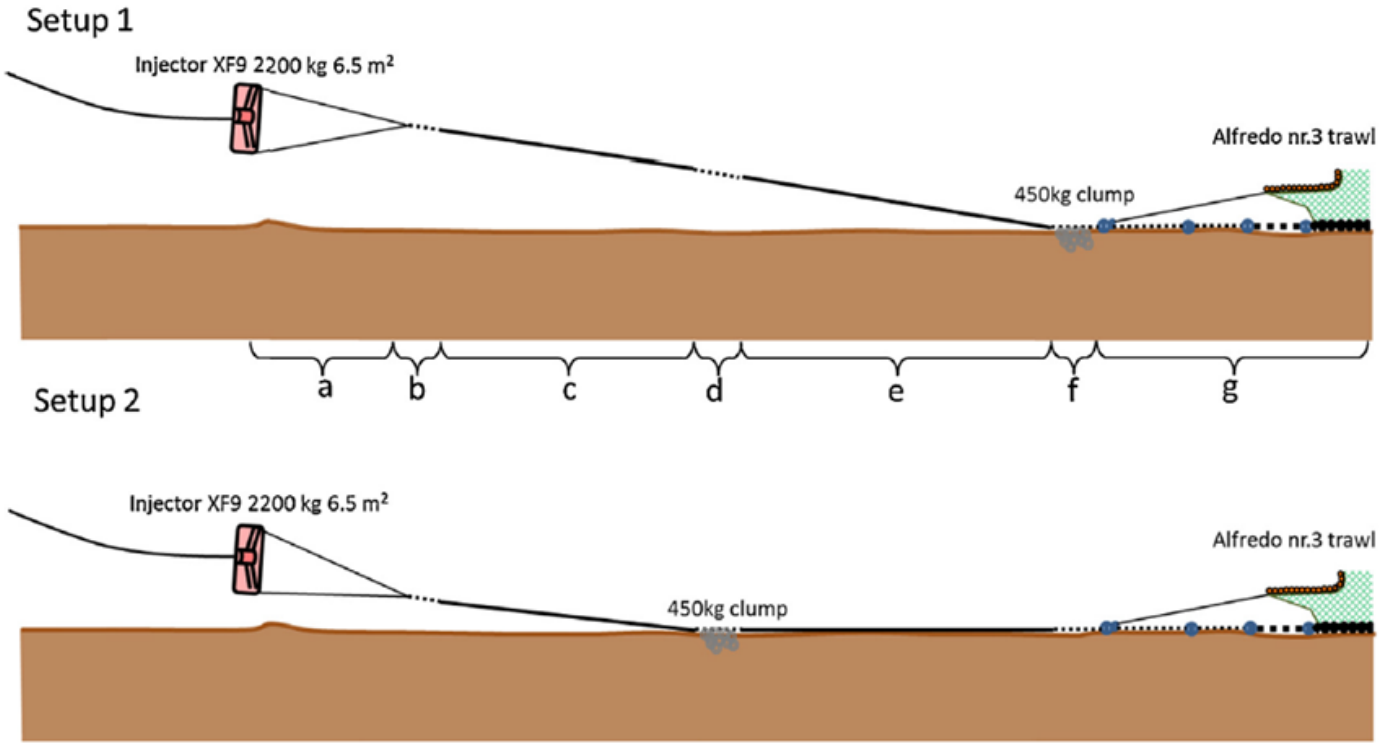
Sweep and bridle modification

- Elevate sweeps and bridles (cluster discs)
  - US Study (Rose *et al*., 2010a)
    - Contact area ↓ 95%
    - Sig. ↓ in proportion of undamaged sea whips (after 1 year)
    - No sig. difference in catches species
    - Crab mortality reduced (20 cm discs)



Sweep and bridle modification

- Semi-pelagic otter boards
  - Norwegian study (Sistiaga *et al*., 2015)
    - Aim: Use SP otter boards to elevate sweeps and evaluate effect on Atlantic cod
    - Benthic impact not documented
    - Significant catch loss



Application to NZ bottom trawl fisheries

L-Low, M-Medium, H-High.

GEAR (SWEEPS AND BRIDLES)	OPERATIONAL CONSIDERATION					
	Reduction in Seabed Contact	Impact on Catch	Fuel Saving	Capital Cost	Immediacy of application[1]	Ease of use[2]
Reduced diameter & weight	L	M	L	L	M	H
Shorter sweeps & bridles	M	M	L	L	M	H
Additional flotation	H	M	L	L	M	H
Cluster discs	H	M	L	M	L	M
Use of semi-pelagic otter boards	H	M	H	H	L	L

1. Defined broadly as how quickly fishers can apply the gear modification and achieve optimal performance.
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Application to NZ bottom trawl fisheries

L-Low, M-Medium, H-High.

Little/no evidence of persistent industry use to reduce seabed contact by sweeps and bridles

GEAR (SWEEPS AND BRIDLES)	OPERATIONAL CONSIDERATION					
	Reduction in Seabed Contact	Impact on Catch	Fuel Saving	Capital Cost	Immediacy of application[1]	Ease of use[2]
Reduced diameter & weight	L	M	L	L	M	H
Shorter sweeps & bridles	M	M	L	L	M	H
Additional flotation	H	M	L	L	M	H
Cluster discs	H	M	L	M	L	M
Use of semi-pelagic otter boards	H	M	H	H	L	L

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Application to NZ bottom trawl fisheries

One known example of persistent industry use to reduce seabed contact

L-Low, M-Medium, H-High.

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	Reduction in Seabed Contact	Impact on Catch	Fuel Saving	Capital Cost	Immediacy of application[1]	Ease of use[2]
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Shorter sweeps & bridles	M	M	L	L	M	H
Additional flotation	H	M	L	L	M	H
Cluster discs	H	M	L	M	L	M
Use of semi-pelagic otter boards	H	M	H	H	L	L

1. Defined broadly as how quickly fishers can apply the gear modification and achieve optimal performance.
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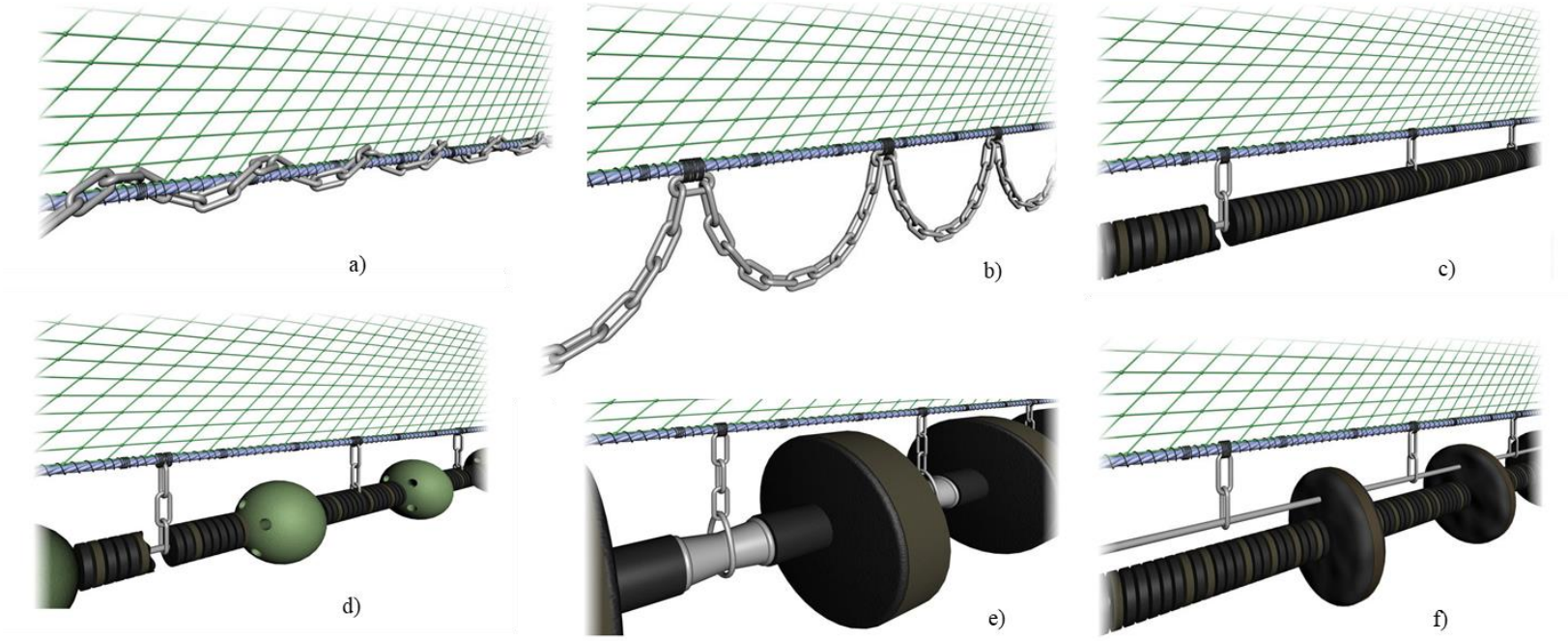
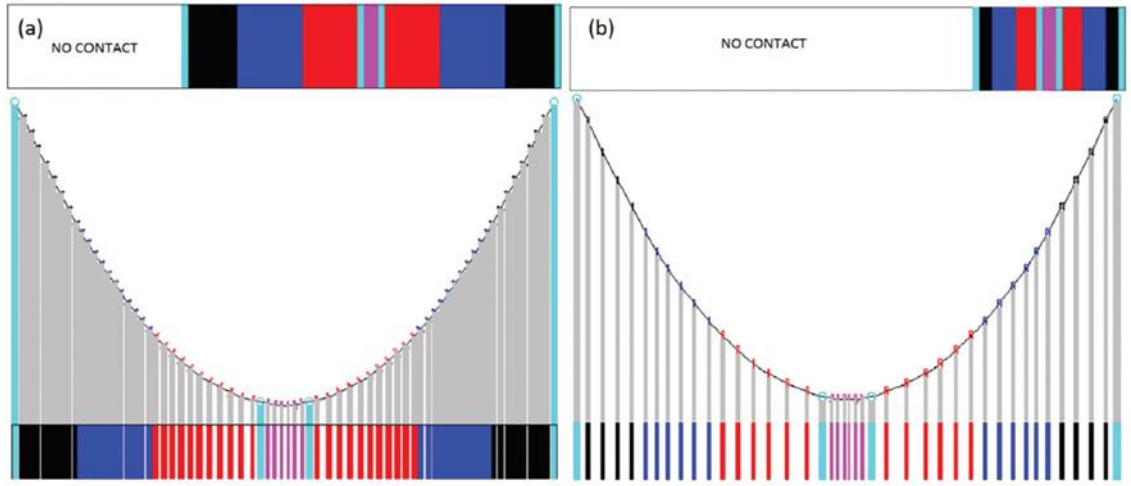
Ground gear modification

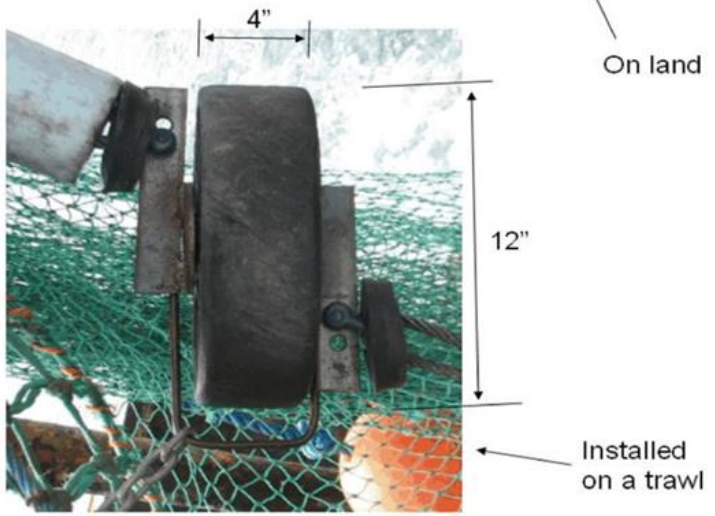
- Reduced ground gear weight
- Increased distance between bobbins



Ground gear modification

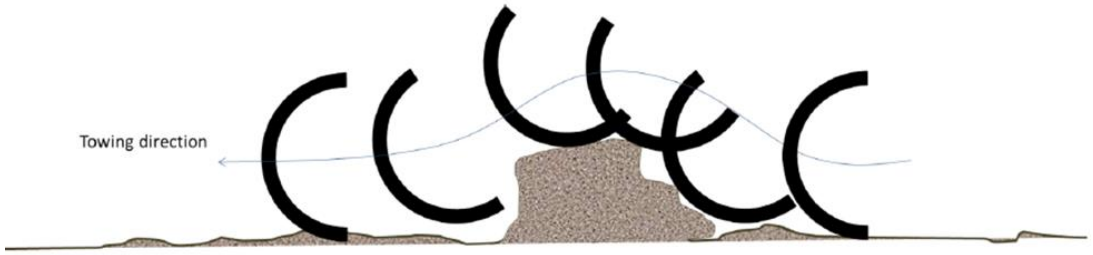
- Wheels and rollers
  - Canadian study (Winger *et al*., 2018)
    - Control – 32.9 m rockhopper ground gear
    - Experimental – Same ground gear with ‘aligned’ rubber discs
    - Otter board spread ↑ 4%
    - Shrimp catch ↑ 23%

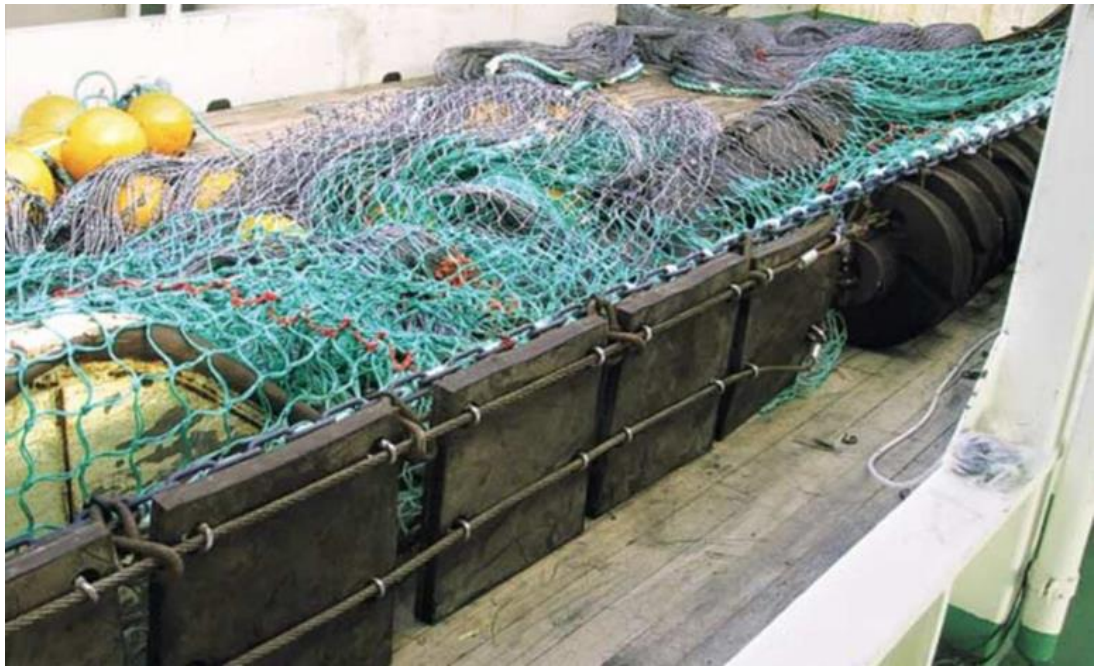


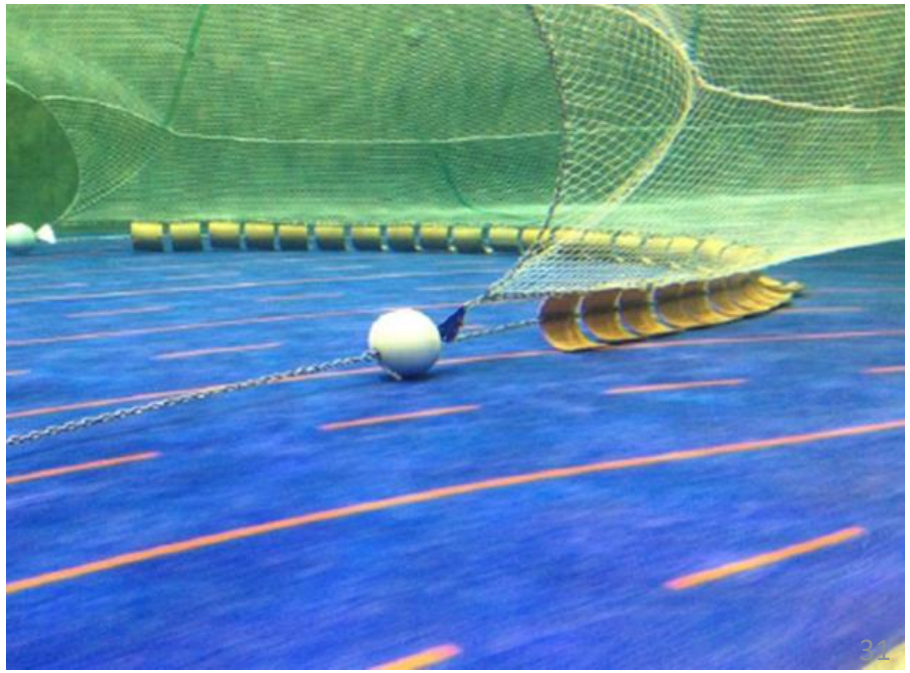


Ground gear modification

- Plate gear/semi-circular ground gear







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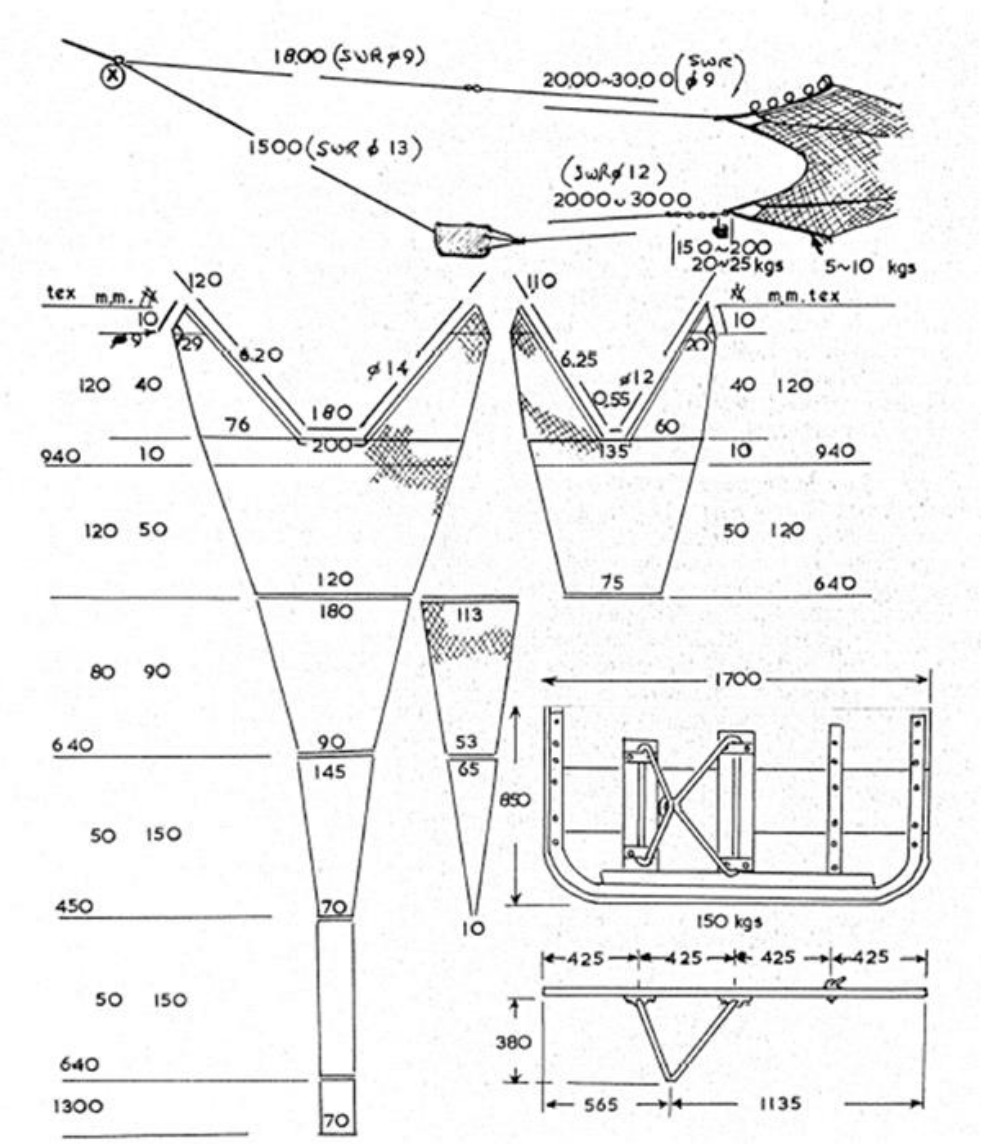
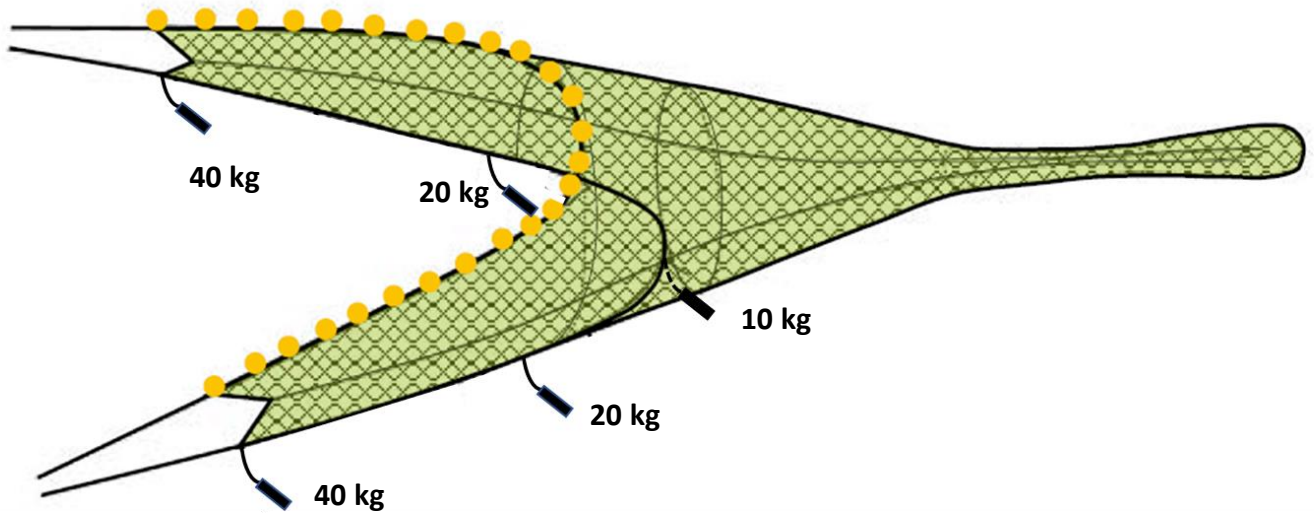
Ground gear modification

- Semi-pelagic trawl (French- or fork-rigged)
  - Aust study (Ramm *et al.*, 1993)
    - 7 x 10 kg wts. in bosom
    - Seabed contact ↓ 97%
    - Little difference in catch
    - Handling challenges



Ground gear modification

- Raised footrope and drop chains (no fork rigging)
  - Aust study (Brewer *et al*., 1996)
    - Traditional wing trawl with ground gear removed
    - Oversized otter boards
    - 5 clump weights
    - Chain droppers to regulate height
    - Two treatments 0.4-0.5 m, 0.8-0.9m
    - No difference in snapper
    - Sig. ↓ in bycatch
    - ~95% ↓ seabed contact



Application to NZ bottom trawl fisheries

L-Low, M-Medium, H-High.

GEAR (GROUND GEAR)	OPERATIONAL CONSIDERATION					
	Reduction in Seabed Contact	Impact on Catch	Fuel Saving	Capital Cost	Immediacy of application[1]	Ease of use[2]
Reduced ground gear weight	L	M	L	L	H	H
Increased distance between bobbins	L	M	L	L	M	H
Wheels and rollers	M	L	M	M	M	H
Plate gear/semi-circular ground gear	M	L	M	M	L	M
Semi-pelagic trawl	H	H	H	H	L	L
Raised footropes and drop chains	H	H	H	M	L	L

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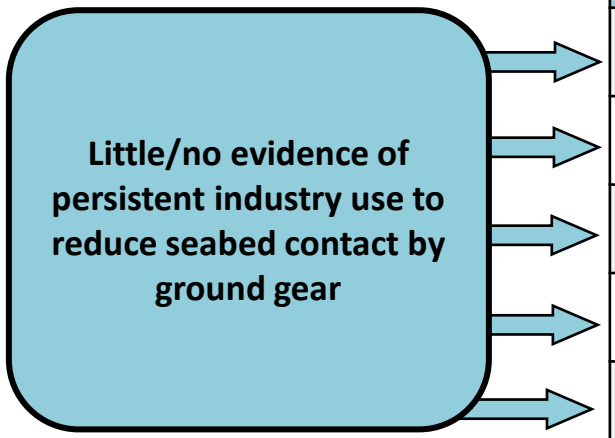
Application to NZ bottom trawl fisheries

L-Low, M-Medium, H-High.



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Reduced ground gear weight	L	M	L	L	H	H
Increased distance between bobbins	L	M	L	L	M	H
Wheels and rollers	M	L	M	M	M	H
Plate gear/semi-circular ground gear	M	L	M	M	L	M
Semi-pelagic trawl	H	H	H	H	L	L
Raised footropes and drop chains	H	H	H	M	L	L

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Application to NZ bottom trawl fisheries

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Wheels and rollers	M	L	M	M	M	H
Plate gear/semi-circular ground gear	M	L	M	M	L	M
Semi-pelagic trawl	H	H	H	H	L	L
Raised footropes and drop chains	H	H	H	M	L	L

Some examples of persistent industry use to reduce seabed contact

1. Defined broadly as how quickly fishers can apply the gear modification and achieve optimal performance.
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Conclusions & Recommendations

Conclusions & Recommendations

1. Assumptions:
   - Allow for simplified evaluation of all gear modifications to reduce seabed contact
   - Are important first step in mitigating trawl impact
2. Five promising gear modifications have been identified

L-Low, M-Medium, H-High.

Order of priority	GEAR	OPERATIONAL CONSIDERATION	
		Reduction in seabed contact	Reduction in footprint
1	Semi-pelagic otter boards	H	L
5	Controllable otter boards	H	L
2	Cluster discs	H	H
4	Semi-pelagic trawl	H	M
3	Raised footropes and drop chains	H	M

Conclusions & Recommendations

3. Application to NZ bottom trawl fisheries

a) What are the relative merits of each gear modification to reduce seabed contact?

- Done

b) Which gear modifications could conceivably be applied by the NZ fleet?

- All, although may be constrained by expense, concerns for catch loss, seabed topography, other

c) Does this fleet have the skill and expertise to introduce and apply these modifications?

- No reason why not. Some initial instruction from net maker, otter board manufacturer, or other may be required.

d) Does this fleet have the incentive to introduce and apply these modifications?

- A great question!!

Conclusions & Recommendations

3. Share review
   - Seek industry feedback - concerns, ideas, and needs in the context of reducing seabed contact?

4. Conduct a trawl-gear audit to quantify variation in trawl gear and:
   - Provide baseline re design, size, weight, and use of trawl gear
   - Help refine estimates of swept area, establish swept area seabed impact models
   - Help prioritise remedial efforts

5. Forge close relationship with industry bodies, companies, and individuals to:
   - Establish lines of communication
   - Build trust
   - Search for win-win outcomes, including potential incentives to change gear

Conclusions & Recommendations

6. Test prioritised gear modifications

7. Make modified trawl gear available to test at low-cost or free of charge
   - Low-risk opportunity to gain experience and knowledge

8. Consider holistic approach to improving efficiency of trawl fleet
   - Exploit the link between efficiency and reduced trawl footprint
   - Understand coherent national spatial policy direction which respects and enables trawl sector to evaluate the implications of design options
   - Need for a fundamental regenerative approach that underpins the quota rights framework