Novel approaches to line-weighting in inshore surface longline fisheries

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CSP Technical Working Group 12-12-14

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Introduction

- Seabird bycatch reported from surface longline fisheries for > 20 years
- SLL gear light, long lines and snoods, attached baits
- Ongoing bycatch in NZ and overseas
- Existing measures may be:
  - Not implemented consistently
  - Not sufficient
  - Not compatible with fishing operations
- Research on new measures: safety a focus

Photo: D. Goad

Objectives

Overall objective:

- To test one or more mitigation measures that reduce the availability of surface-longline hooks to seabirds at line-setting

Specific objectives:

- To test the safe use and mitigation effectiveness of one or more mitigation methods that are not currently in common use in New Zealand surface longline fisheries and that reduce the availability of hooks at line-setting
- To assess and quantify any impacts on catch rates between target and bycatch species between snoods with and without the target mitigation method

Measures tested

Photos: D. Goad

Methods: 2013

- 2 vessels, government observers
- FMAs 1, 9
- 60-g safe leads, 0.5 m from hook
- 60-g lumo leads, 1.5 m from hook
- Novel weights on snoods in consecutive baskets
- TDRs to record sink rate, unbaited snoods
- Fish catch recorded
- Operational feasibility of weights monitored

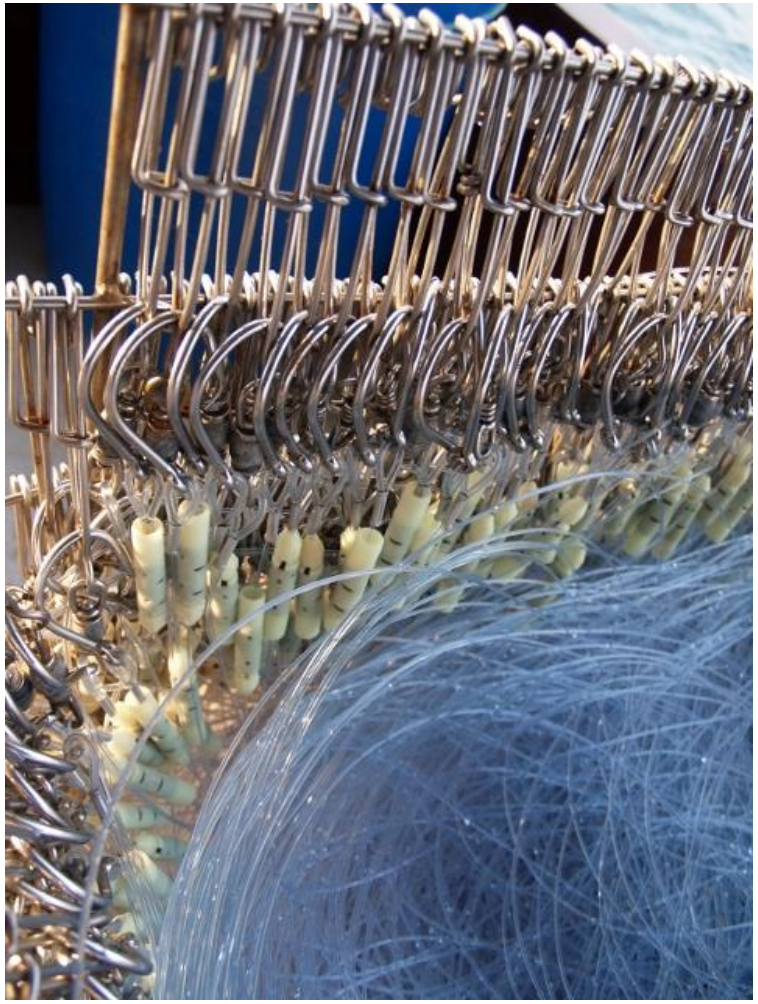


Photo: D. Goad

Methods: 2014

- 1 vessel, dedicated technician
- FMAs 1, 2
- 40-g lumo leads, 0.5 - 1 m from hook
- Separated from normal gear by backbone with no snoods (100 m – 1000 m)
- TDRs in place of hook
- Snood by snood records
  - Fish catch including loss types
  - Gear components

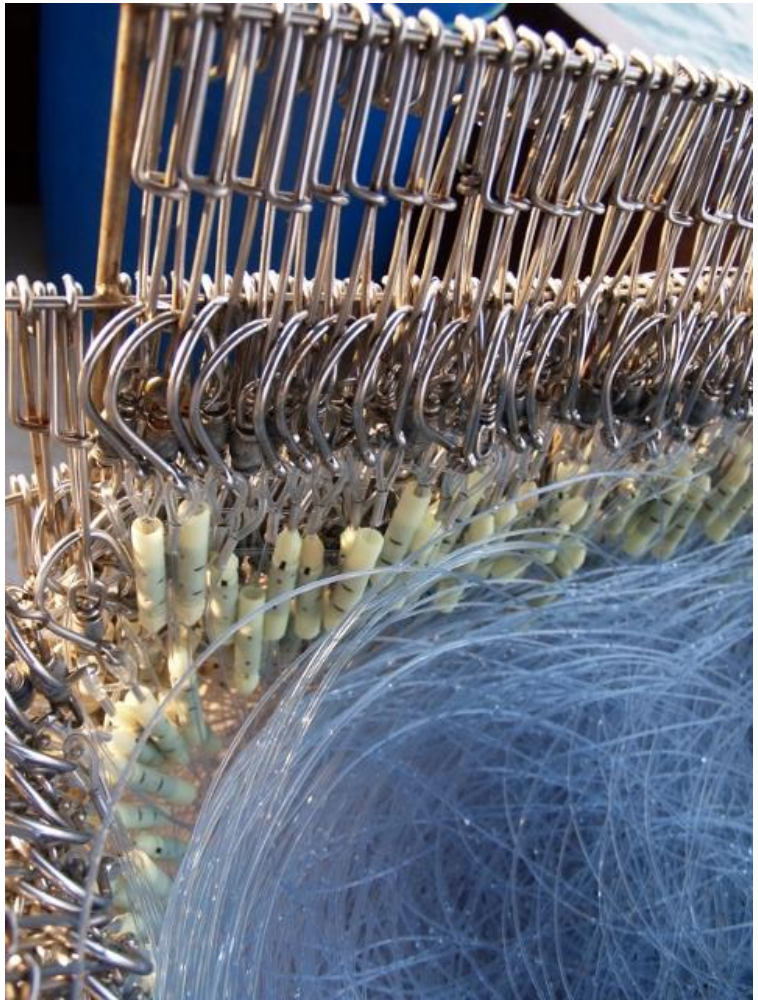


Photo: D. Goad

Treatments

- Novel weight vs. “normal” gear
  - What the fisherman normally used
- Could include:
  - Lightsticks
  - Weighted swivels
  - Deployment of these not standardised but a broadly balanced design
- ~500 hooks normal gear, ~500 hooks novel weight

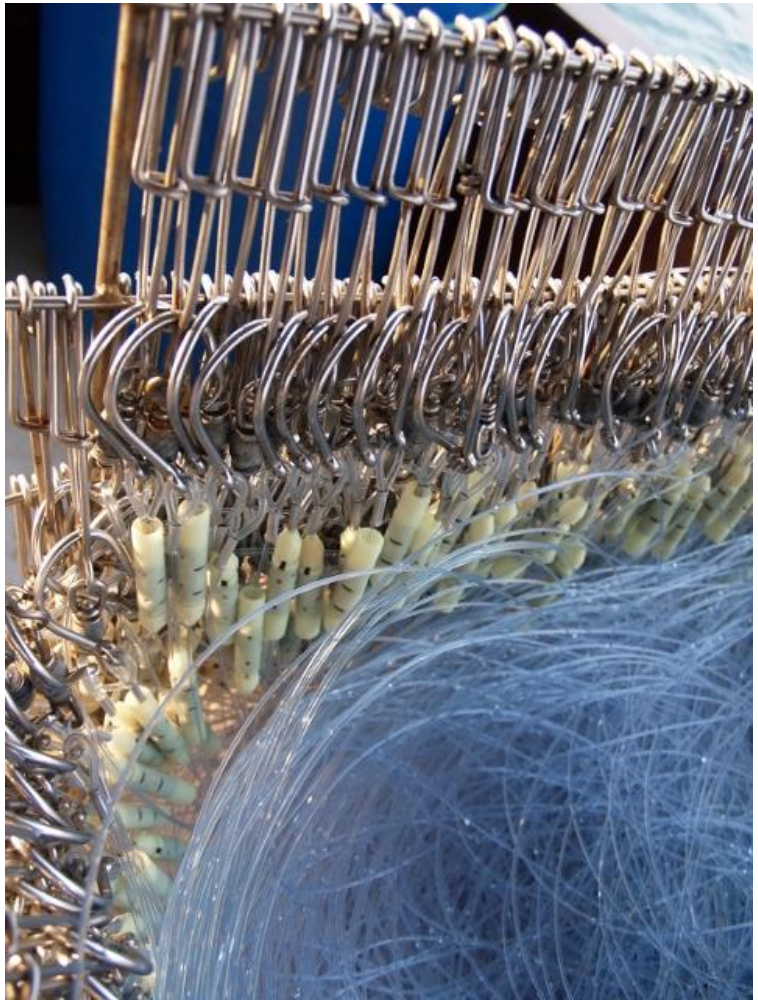


Photo: D. Goad

Methods: 2014

- Hook pods, 1.4 - 1.8 m from hook
  - Focus on pod performance and operational feasibility
  - TDRs to record sink rate
  - Catch on pod-carrying snoods recorded
  - No lightsticks
  - Weighted swivel at the clip
  - ~ 50 pods deployed per set

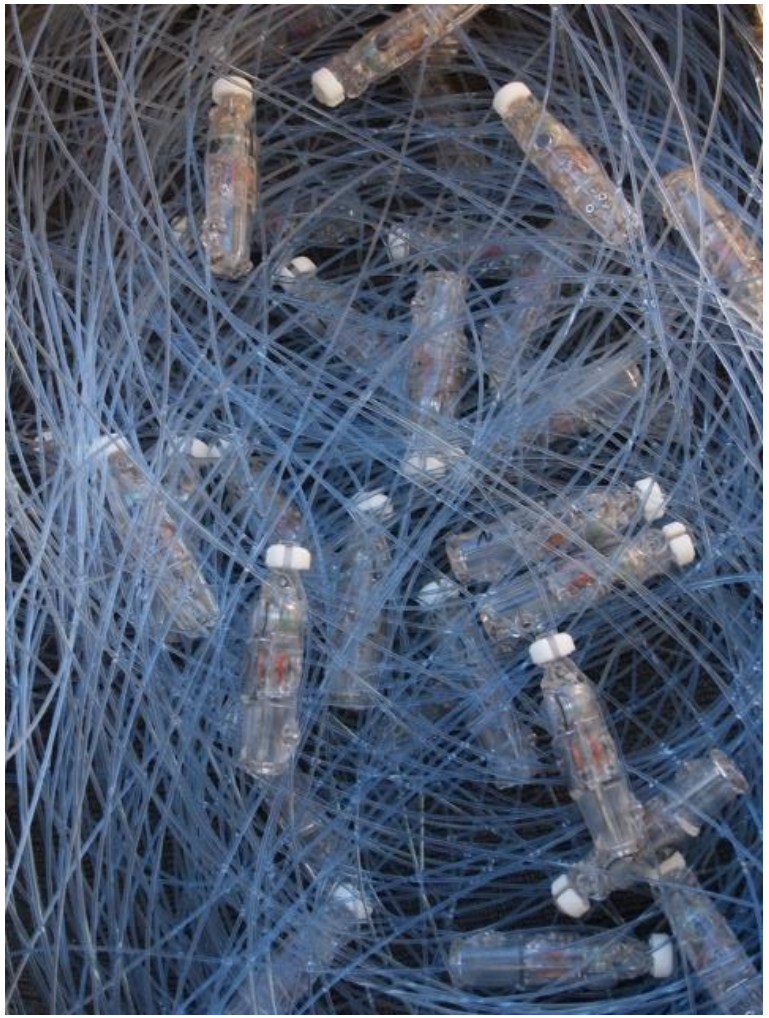


Photo: D. Goad

Methods: Data analysis

- Fish catch, 2014, 23 sets
- Catch: “Tuna-group”, “Shark”
- Permutation analysis:
  - Catch rate calculated across data set: Lumo vs Normal
  - Ratio of catch rate L:N determined
  - Baskets then reshuffled, catch rate calculated x 10,000
  - Distribution of catch rates generated
  - Catch rate within distribution = difference not detected

Photo: D. Goad

Methods: Data analysis

- Catch rate: “Tuna-group”, “Shark”
- Binomial logistic generalised linear model
  - Treatment, lightstick, weighted swivel
  - Set number as random and linear effect
  - Model-fitting using Bayesian methods
  - Burn-in 10,000 iterations
  - Run 100,000 iterations
  - Only snoods with complete information on gear components, catch

Photo: D. Goad

Results: Summary of trials

- Each weighting method examined on 6 – 21 sets
- 10 - 80 days implementing trials of each method
- 600 – 1400 hooks per line set
- 41 – 194 TDR records
- 3 seabirds caught
  - White-capped, Campbell albatross
- 2 fur seals caught
- No captures on novel weights

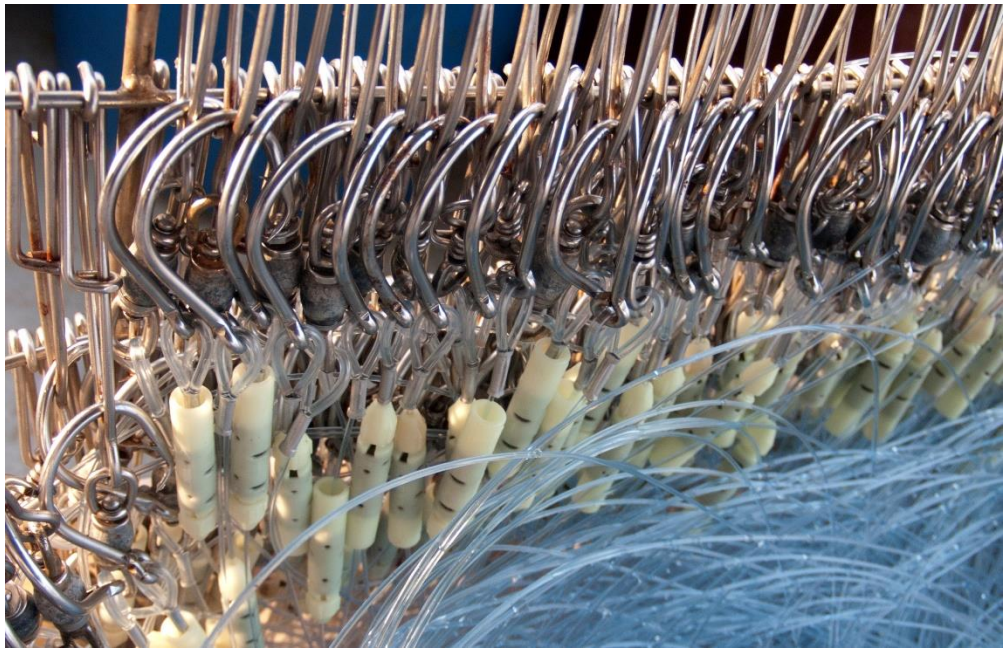
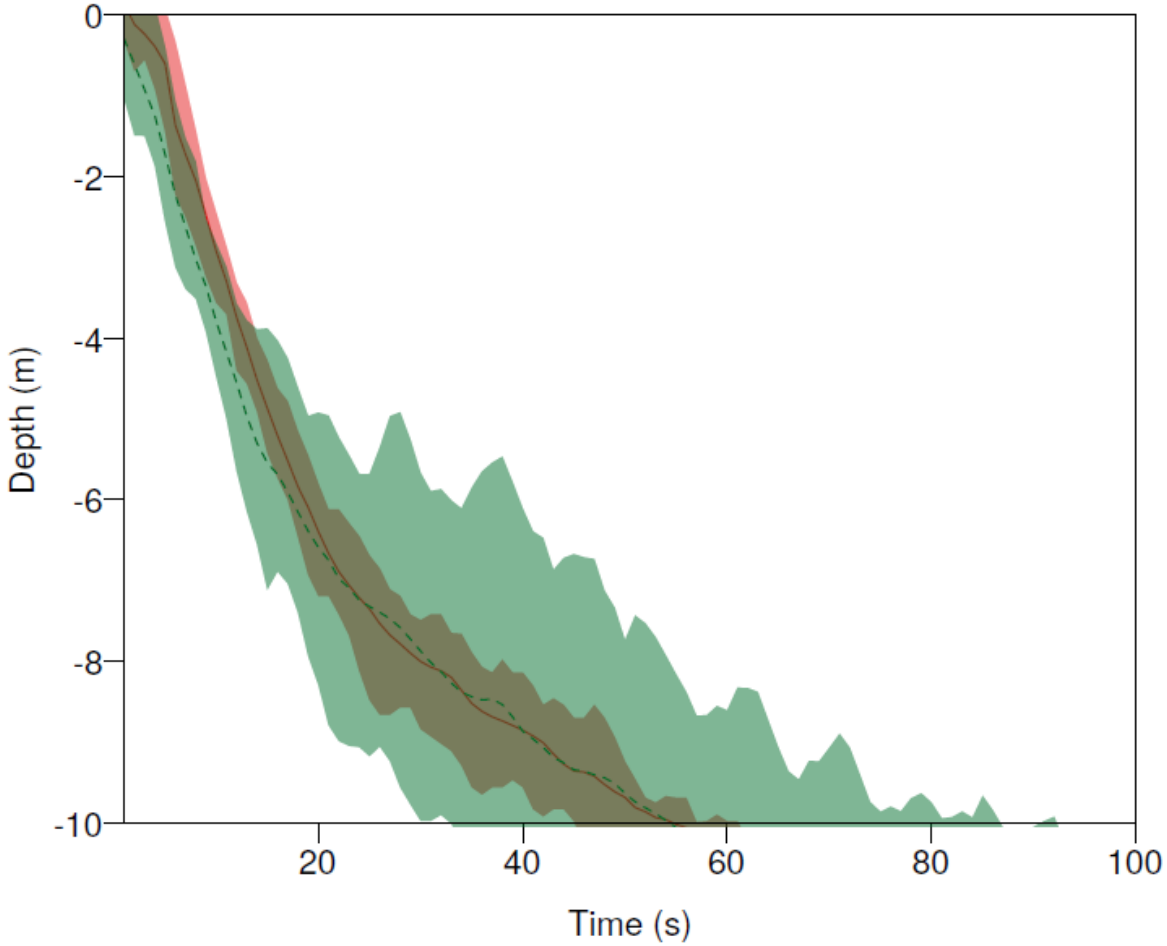


Photo: D. Goad

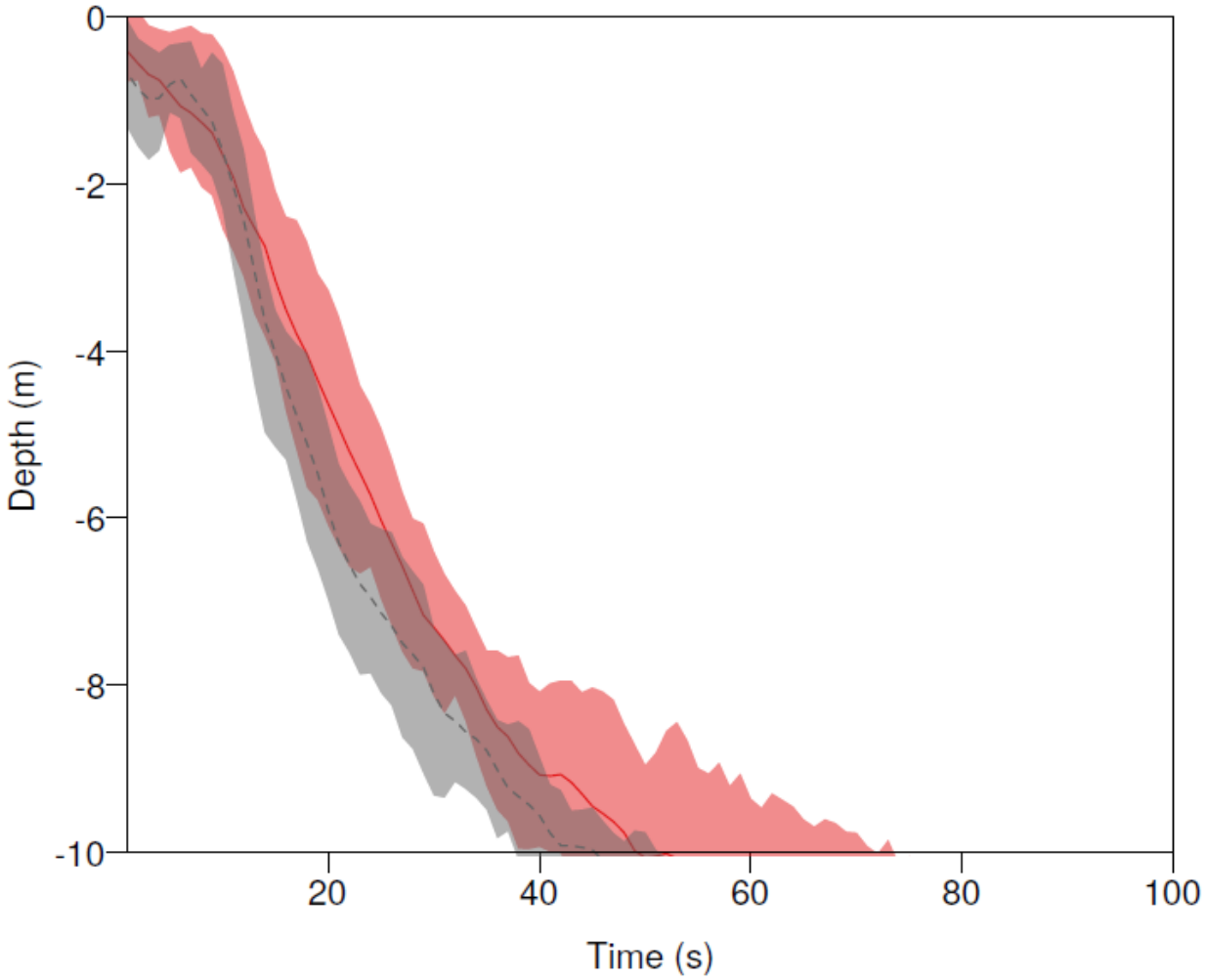
Results: Sink profiles

- Gear with 60-g safe leads sank faster than normal gear to 7 m depth
- Below 7 m, average sink rate similar
- More variability in safe lead sink rate



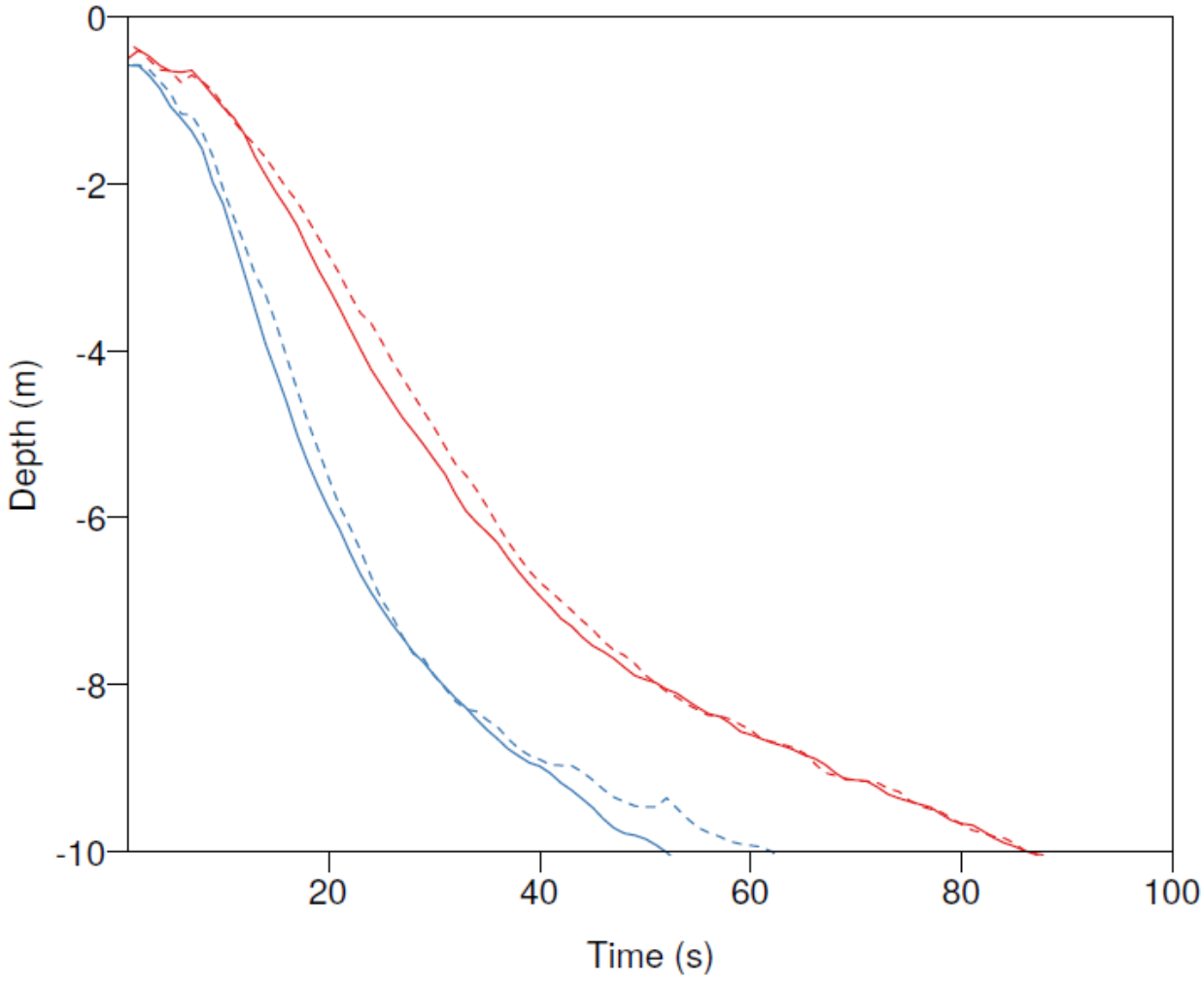
Results: Sink profiles

- Gear with 60-g lumo leads sank faster than normal gear from 2 m depth



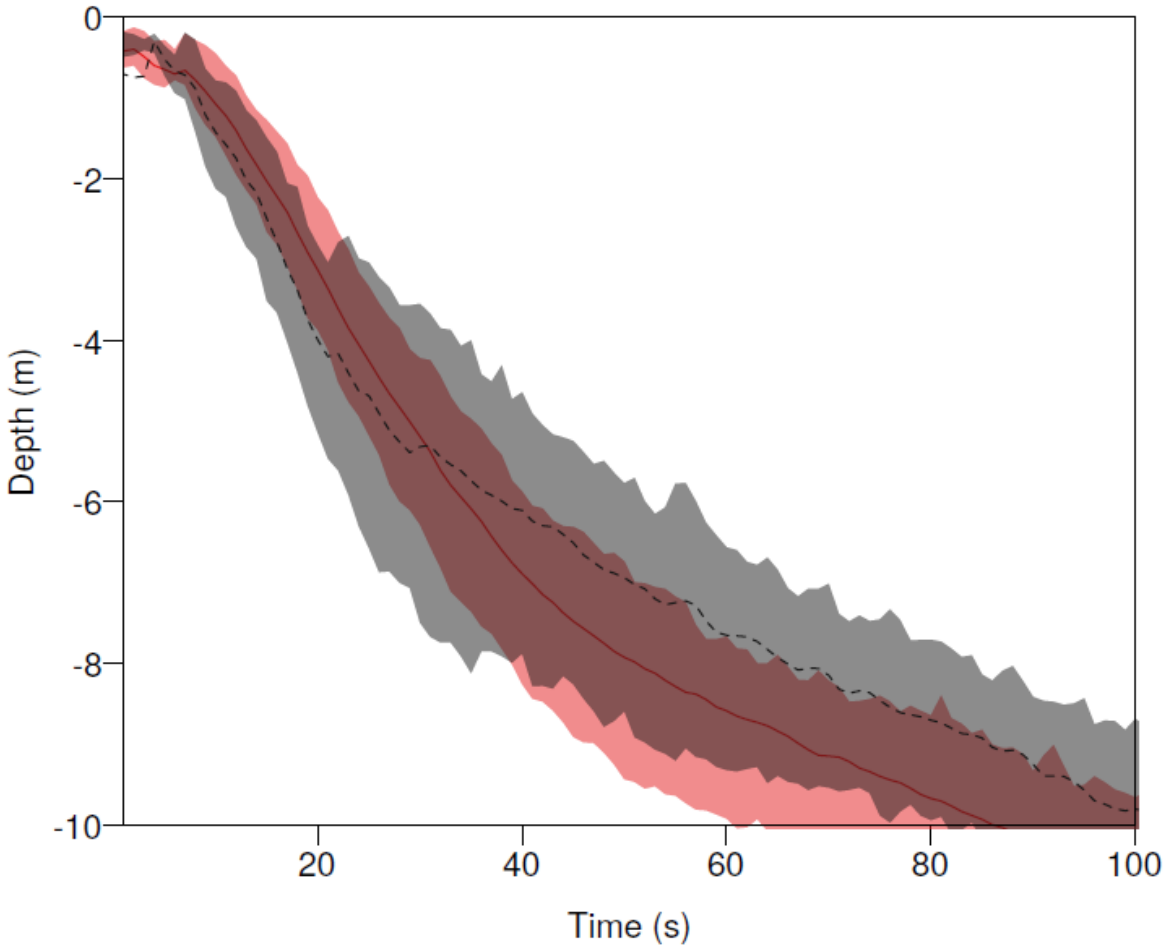
Results: Sink profiles

- Gear with 40-g lumo leads sank faster than normal gear
- Lightsticks affected sink rate



Results: Sink profiles

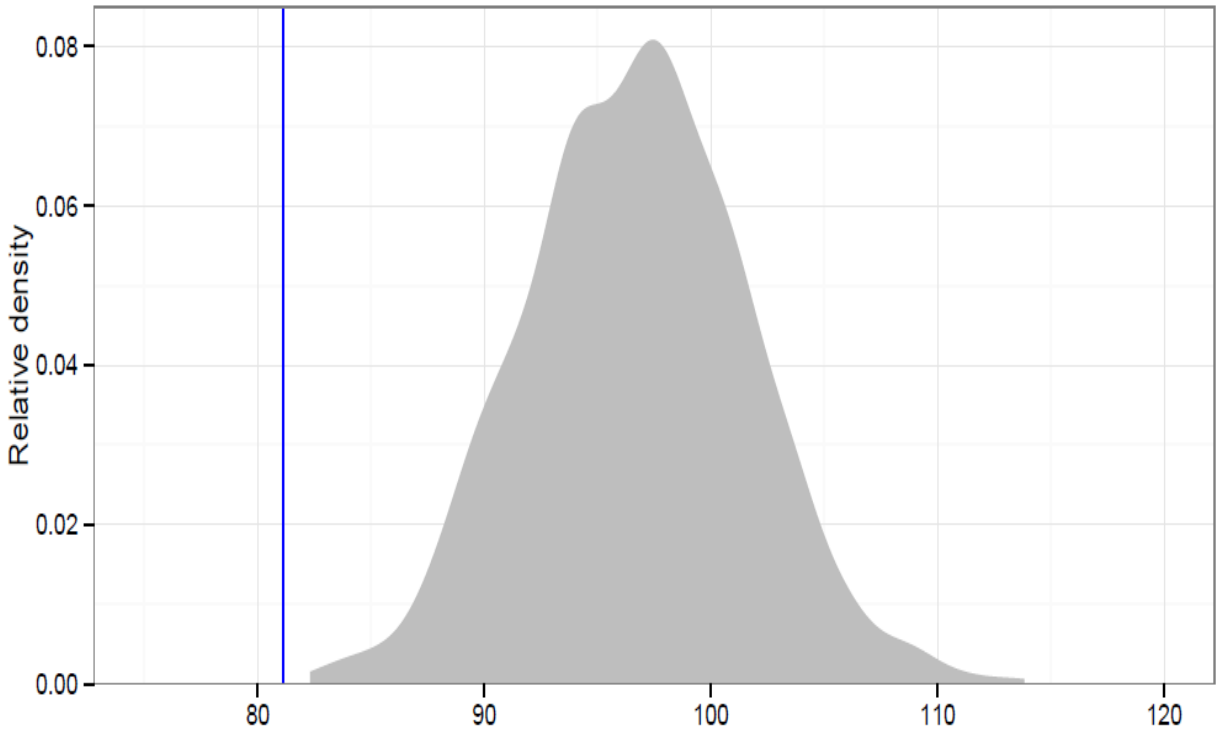
- Gear with hook pods sank faster than normal gear to ~ 6 m
- Below ~ 6 m, normal gear sank faster



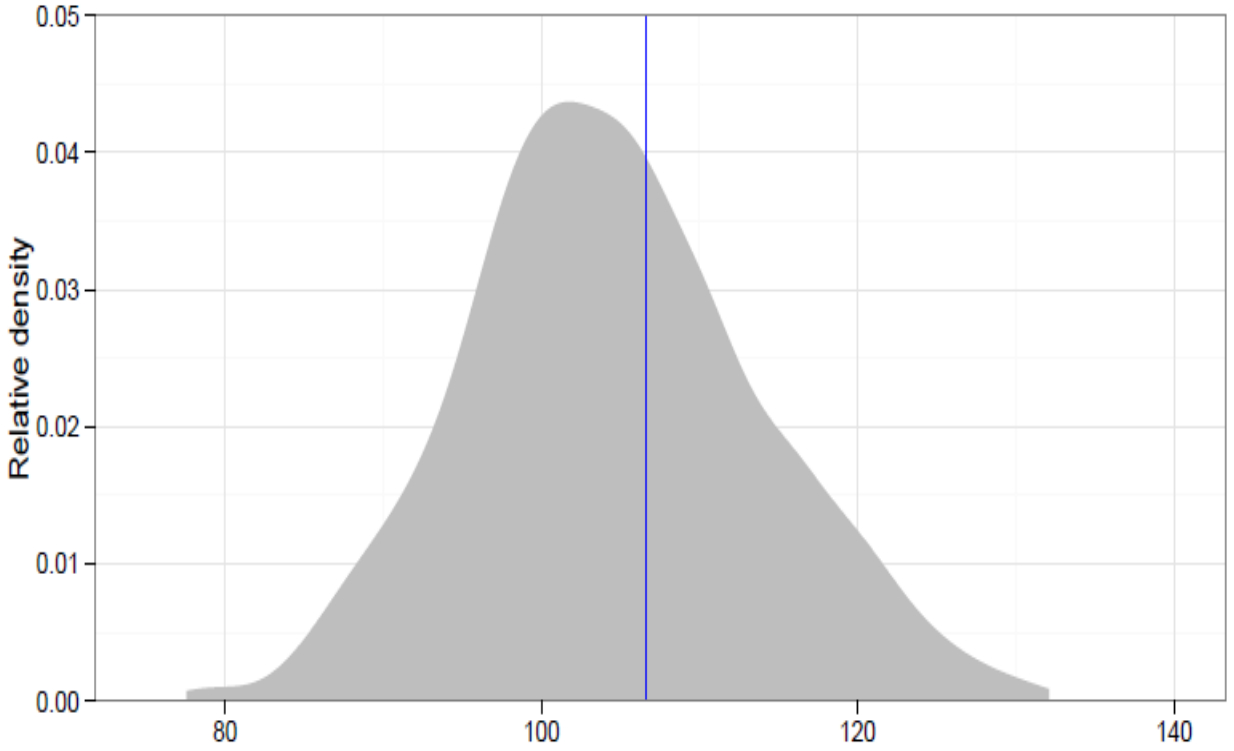
Results: Fish catch

- 18 700 snoods
- 1 652 shark captures
- 476 tuna-group (incl. SWO) captures
- Permutation analysis:
  - Lumo leads: lower shark catch rate
  - No effect on tuna-group

Results: Fish catch



Relative shark catch with lumo



Relative tuna-group catch with lumo

Results: Fish catch

- GLM tuna-group model
  - Lumo: ns
  - Weighted swivel: < 25%
  - Lightsticks: < 50%
- GLM shark model
  - Lumo: < ~20%
  - Weighted swivel: < 15%

Species	Parameter	Expression	Mean	Median	95% c.i.
Shark	Intercept	$\exp(\beta_0)$	0.01	0.01	0.01–0.02
	Lumo	$\exp(\beta_1)$	0.80	0.80	0.71–0.90
	Weighted swivel	$\exp(\beta_w)$	0.85	0.84	0.75–0.95
	Trend	$\exp(\beta_y)$	1.18	1.18	1.14–1.22
	Set variability	$\exp(\sigma_s)$	1.63	1.61	1.40–2.03
Tuna	Intercept	$\exp(\beta_0)$	0.01	0.01	0.01–0.03
	Lumo	$\exp(\beta_1)$	0.98	0.98	0.80–1.20
	Weighted swivel	$\exp(\beta_w)$	0.77	0.77	0.62–0.95
	Lightstick	$\exp(\beta_f)$	0.55	0.55	0.41–0.72
	Trend	$\exp(\beta_y)$	1.06	1.06	1.00–1.12
	Set variability	$\exp(\sigma_s)$	2.08	2.05	1.65–2.91

Results: Operational performance

- Safe leads
  - Fiddly to fit on snoods
  - Worked into normal crew routine
  - One bite-off while observer not on vessel (BWS)
  - Crimp remained after bite-off so lead could not slide off
  - Lead recoiled and hit vessel

Results: Operational performance

- Lumo leads
  - Snoods stored with lumo on hook
  - Lead moved up snood at setting
  - Crew handling streamlined
  - Lumo leads abraded snoods
  - 12 fly-backs
  - Some lumos slid
  - Movement stopped by hook, knots
  - Force of recoil variable

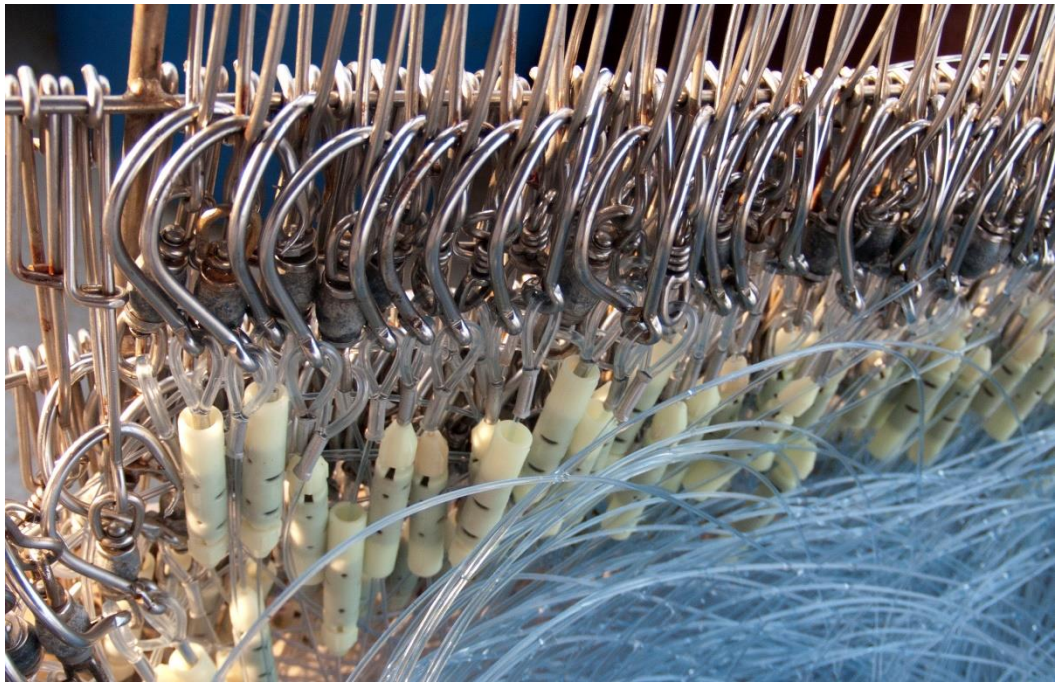


Photo: D. Goad

Results: Operational performance

- Hook pods
  - Pods didn’t open on 12/292 deployments
  - Crew streamlined handling of pods
  - Pods caught SBT, SWO
  - Pods moved on snoods
  - One fly-back occurred

Photo: D. Goad

Conclusions

- Crew worked the weights into their normal regime
- Safety risks must be considered with “safer” leads
- Lumo leads, lightsticks and weighted swivels were found to affect fish catch
  - Findings on lightsticks differ from other work
- Gear is well within seabird reach at 75 m astern and greater distances
- Hook pods address this – cover the hook
- Combinations of mitigation measures valuable to deal with components of bycatch risk

Photo: D. Goad

Conclusions

- Design improvements recommended for novel measures tested
- Hook pods: establish opening depth
- All methods: Monitor fish catch rates over time
  - Novel devices + gear components

Photo: D. Goad

Acknowledgements

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Data entry: J. Marshall, M. Baird, S. Chalmers, P. Cameron, J. Clouston, N. McAulay, M. Pickett

Sink profiles: Y. Richard

Previous reports on this project:

Pierre, JP & Goad, DW (2013) Seabird bycatch reduction in New Zealand's inshore surface longline fishery. Progress report for Department of Conservation, MIT2012–04.