

Assessment of *en route* hull-fouling survivorship on moving vessels

Richard Piola¹, Ashley Coutts² & Grant Hopkins¹

¹ Cawthron Institute, New Zealand

² Department of Agriculture, Forestry & Fisheries, Australia



Hull fouling

- Non-indigenous marine species introductions
 - **Transfer** between countries / bioregions
 - **Spread** within countries / bioregions
- Significant impacts
 - diversity
 - stability
 - economic potential



PHOTO: Steve Mercer

Factors affecting hull-fouling

- Maintenance history of vessel
 - anti-fouling paints
 - dry-docking
- Vessel type and speed
- Vessel activity
 - plying regular routes
 - extended lay-up periods



www.sailinport-services.co.uk/gallery.html



PHOTO: T. Dodgshun

Why look at *en route* hull-fouling survivorship?

- Vessel surveys can tell us what arrives in a port...

...but can't tell us assemblages characteristics before arrival

- Before / after survival studies aid predictive ability
 - Based on pre-voyage fouling
 - High risk vessel characteristics
 - High risk vessels routes
 - Potential organisms of risk



PHOTO: Cawthron Institute

MAGPLATEs

- Developed by Ashley Coutts

Coutts ADM, Taylor MD, Hewitt C (2004). Novel method for assessing the en route survivorship of biofouling organisms on various vessel types. *Marine Pollution Bulletin* 54: 97–116



PHOTO: Richard Piola

En route hull-fouling survivorship

- Attached fouling communities to:
 - Merchant vessel
 - Towed barge
- Photographed at **start** & **end** of voyage
- Analysed using 50 point count (image analysis)
 - Species % cover
 - Species richness
- *En route* water temperature recorded

MAGPLATEs

Fouling assemblages attached

- >6 months old
- Diverse assemblage composition



PHOTO: Richard Piola



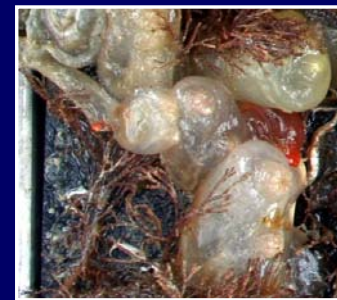
PHOTO: Richard Piola

Assemblage composition

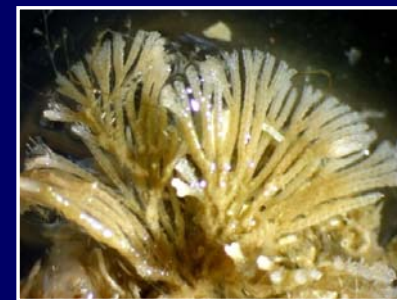
Soft bodied / upright taxa



Colonial ascidians

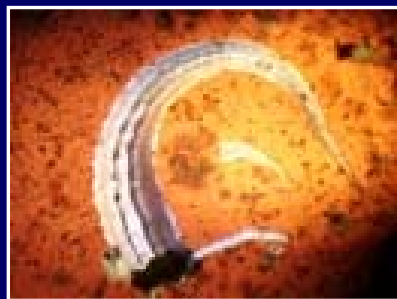


Solitary ascidians

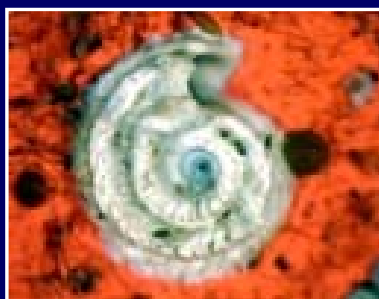


Erect bryozoans

Hard bodied / encrusting taxa



Serpulids



Spirorbids



Encrust Bryozoans



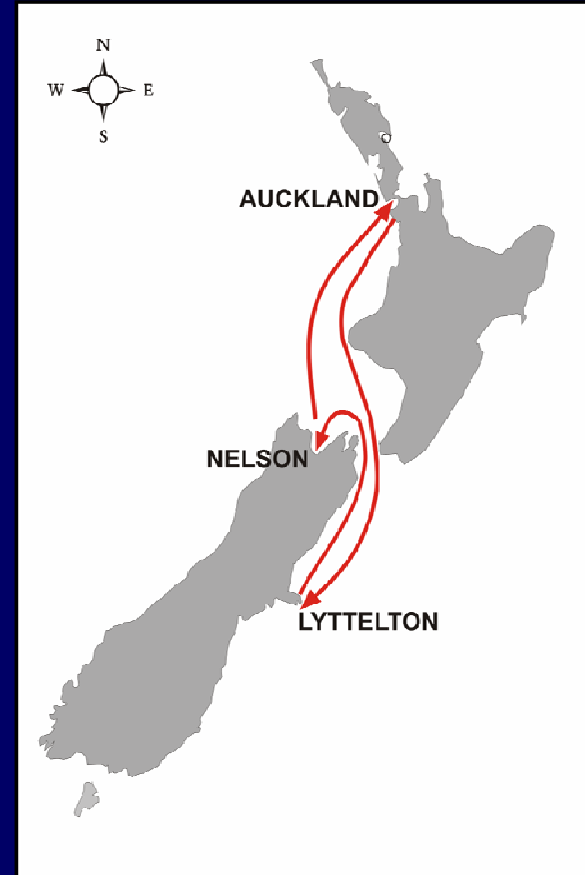
Bivalves

Merchant vessel: fouling survivorship



PHOTO: Richard Piola

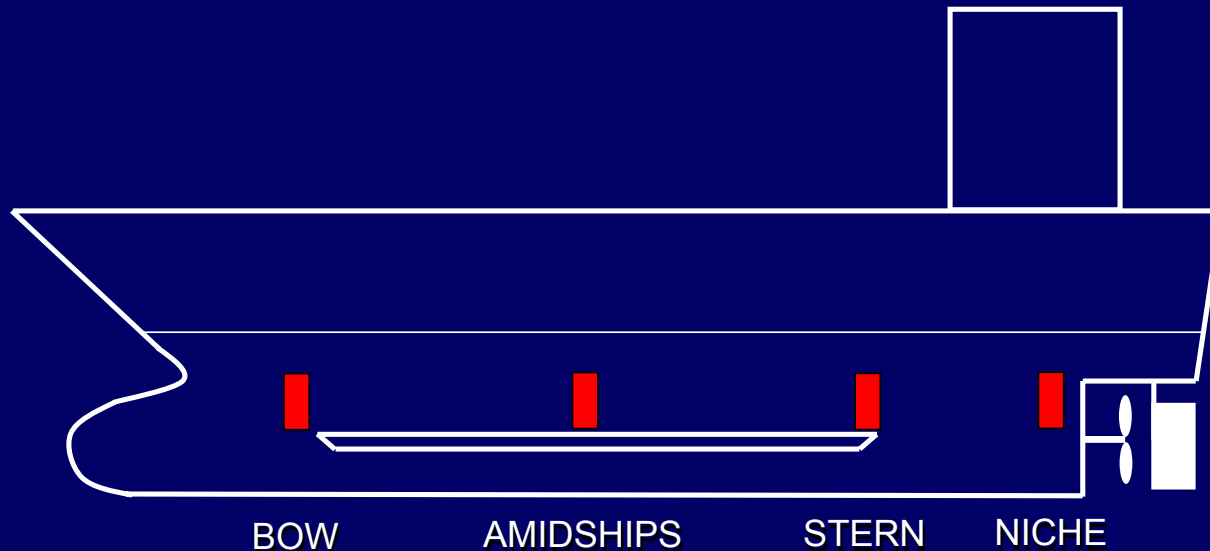
- “Spirit of Resolution”
 - 100m container vessel
 - Average speed: 15 knots
- Regular 7 days voyage of NZ
 - Plying time ~ 85 hr/week
 - Distance: 1000 NM



Merchant vessel: fouling survivorship

MAGPLATE locations

- 3 – 5 MAGPLATEs per location



Merchant vessel: fouling survivorship



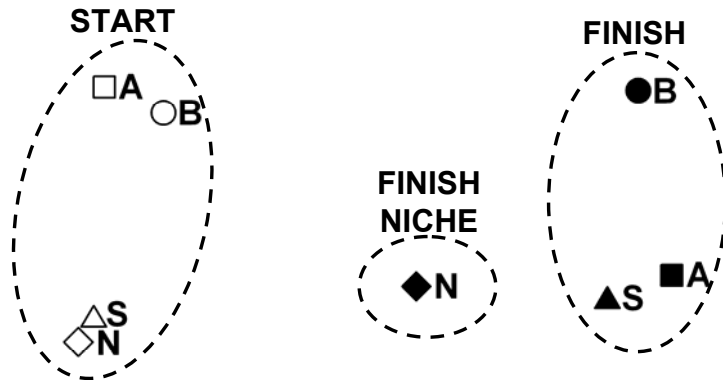
PHOTO: Ashley Coutts



PHOTO: Ashley Coutts

Merchant vessel: fouling survivorship

Stress: 0.1



STARTING ASSEMBLAGES

- Colonial ascidians (33%)
- Solitary ascidians (25%)
- Calcareous tubeworms (16%)
- Encrusting bryozoans (6%)
- Mussels (4%)

FINAL ASSEMBLAGES

[Bow, Mid, Stern]

- Bare space (59%)
- Calcareous tubeworms (17%)
- Encrusting bryozoans (4%)
- Solitary ascidian remnants (5%)

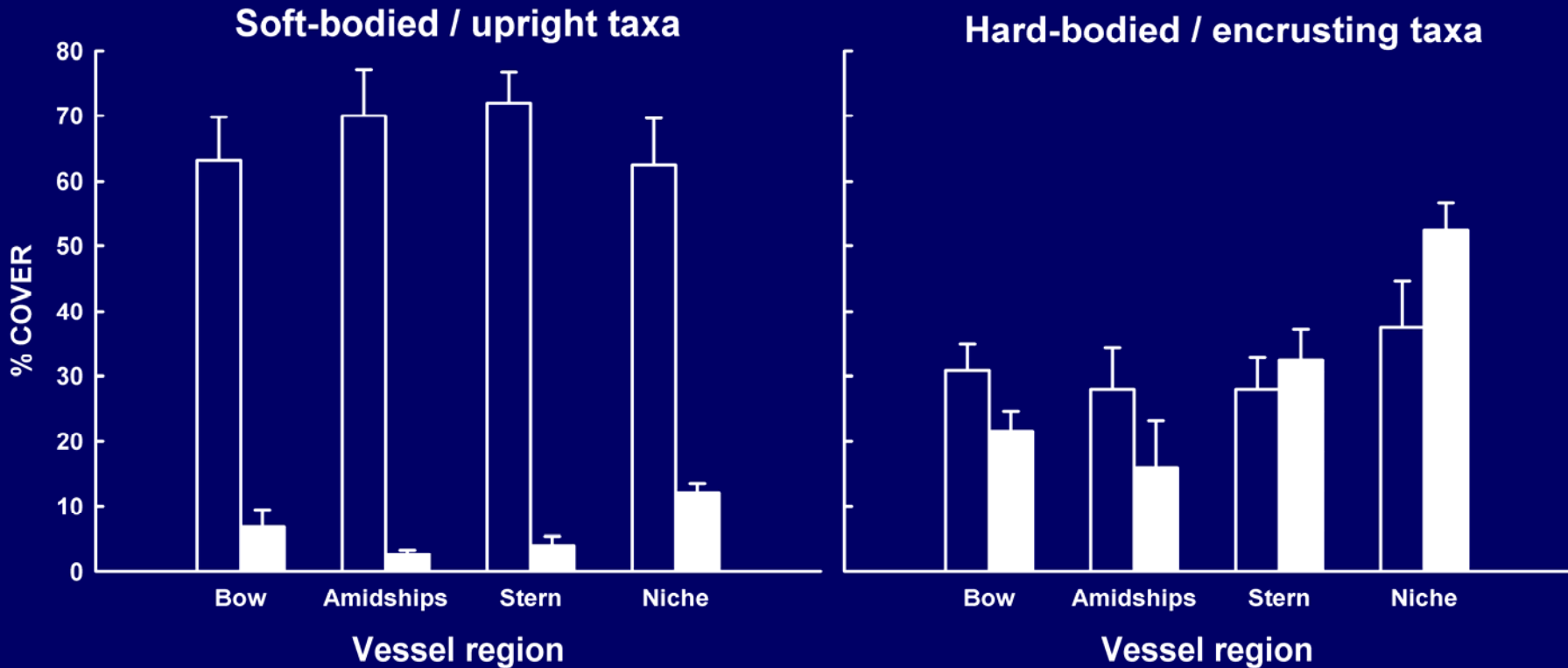
FINAL NICHE ASSEMBLAGE

- Bare space (31%)
- Calcareous tubeworms (36%)
- Encrusting bryozoans (12%)
- Colonial ascidians (6%)

STARTING ASSEMBLAGE
FINAL ASSEMBLAGE

Circles = Groups with >70%
Bray-Curtis similarity

Merchant vessel: fouling survivorship



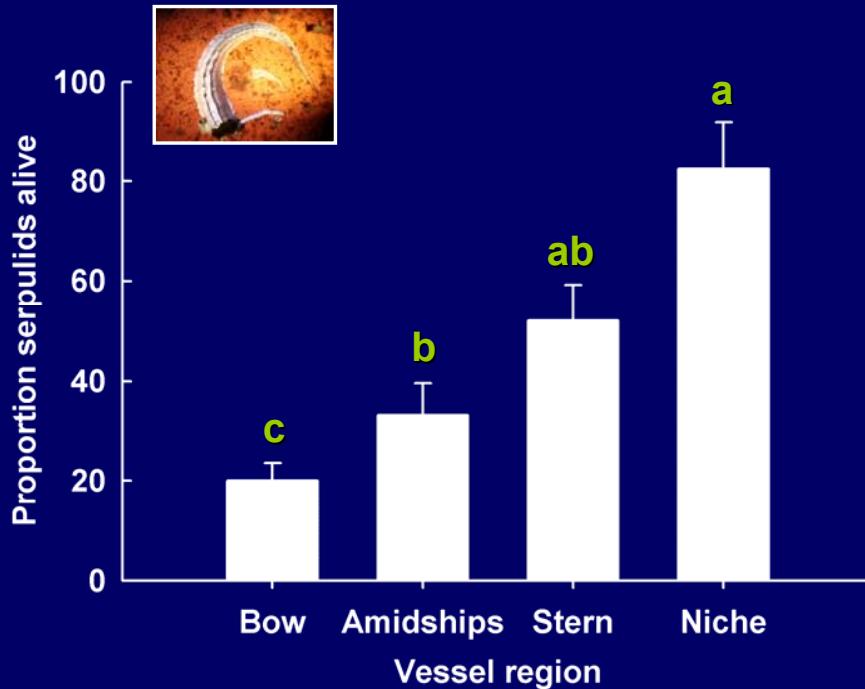
80–95% reduction soft / upright cover
45–65% more soft / upright cover in niche

Hard / encrusting cover unchanged

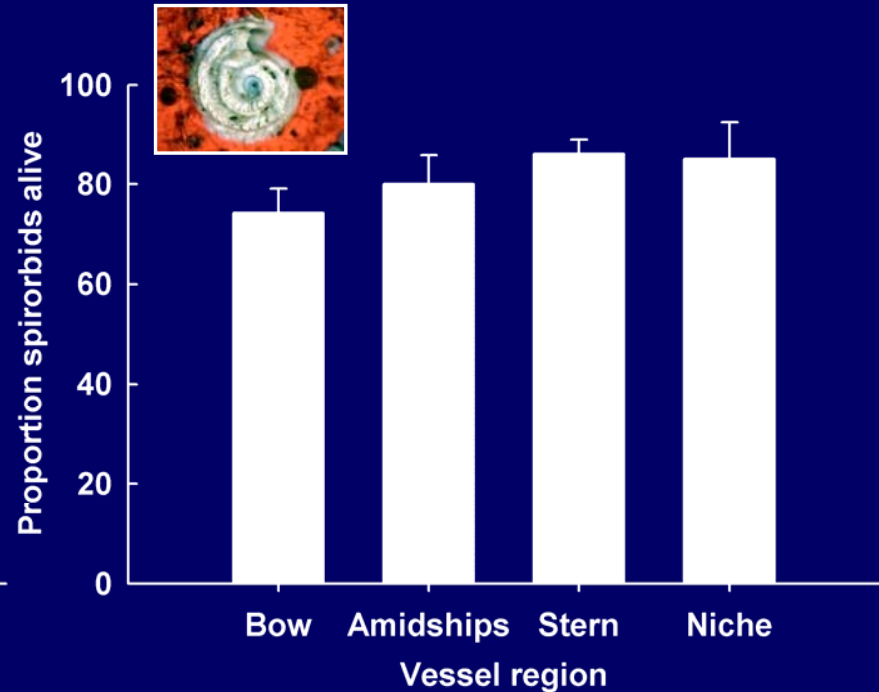
START
FINISH

Merchant vessel: fouling survivorship

Proportion of serpulids alive



Proportion of spirorbids alive

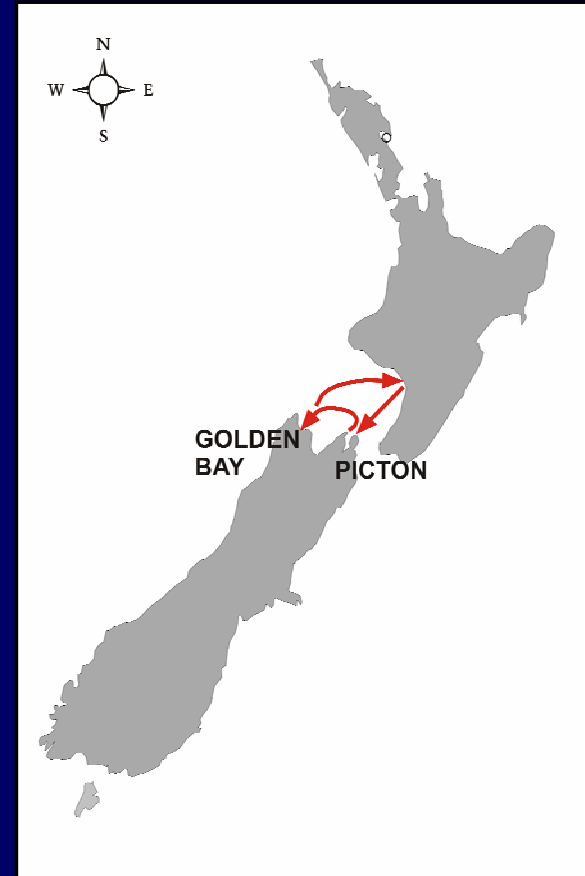


Barge: fouling survivorship



PHOTO: Richard Piola

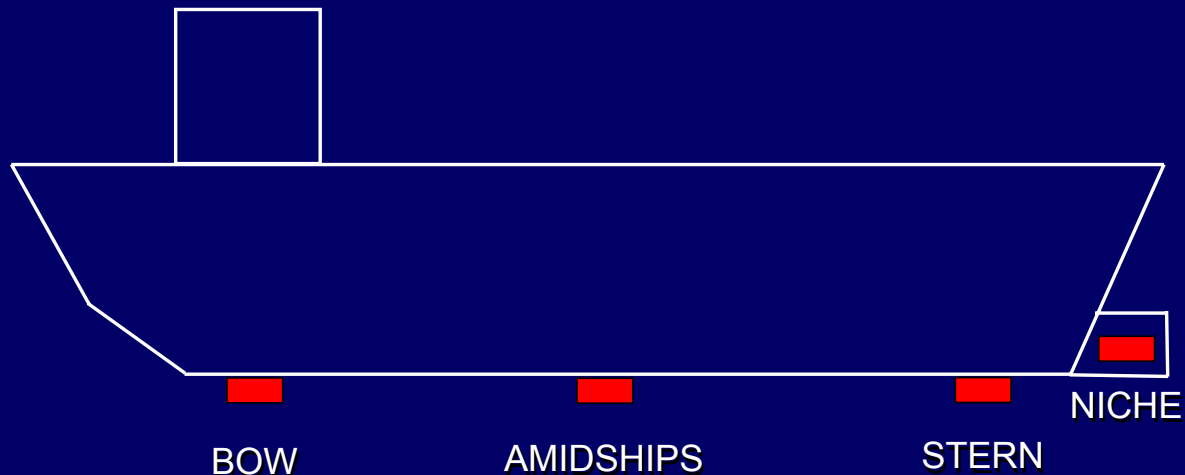
- “Kimihi”
 - 30m towed barge
 - Average speed: 5 knots
- 3 day voyage
 - Plying time 66 hr
 - Distance: 330 NM



Barge: fouling survivorship

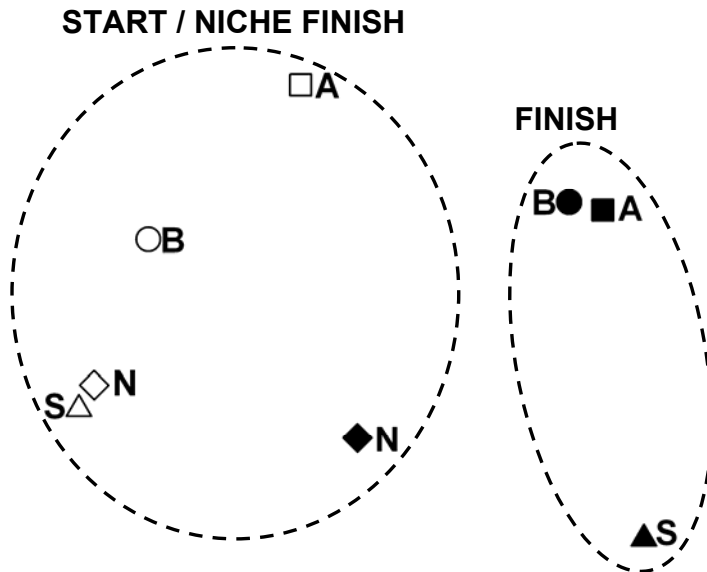
MAGPLATE locations

- 3 MAGPLATEs per location



Barge: fouling survivorship

Stress: 0.1



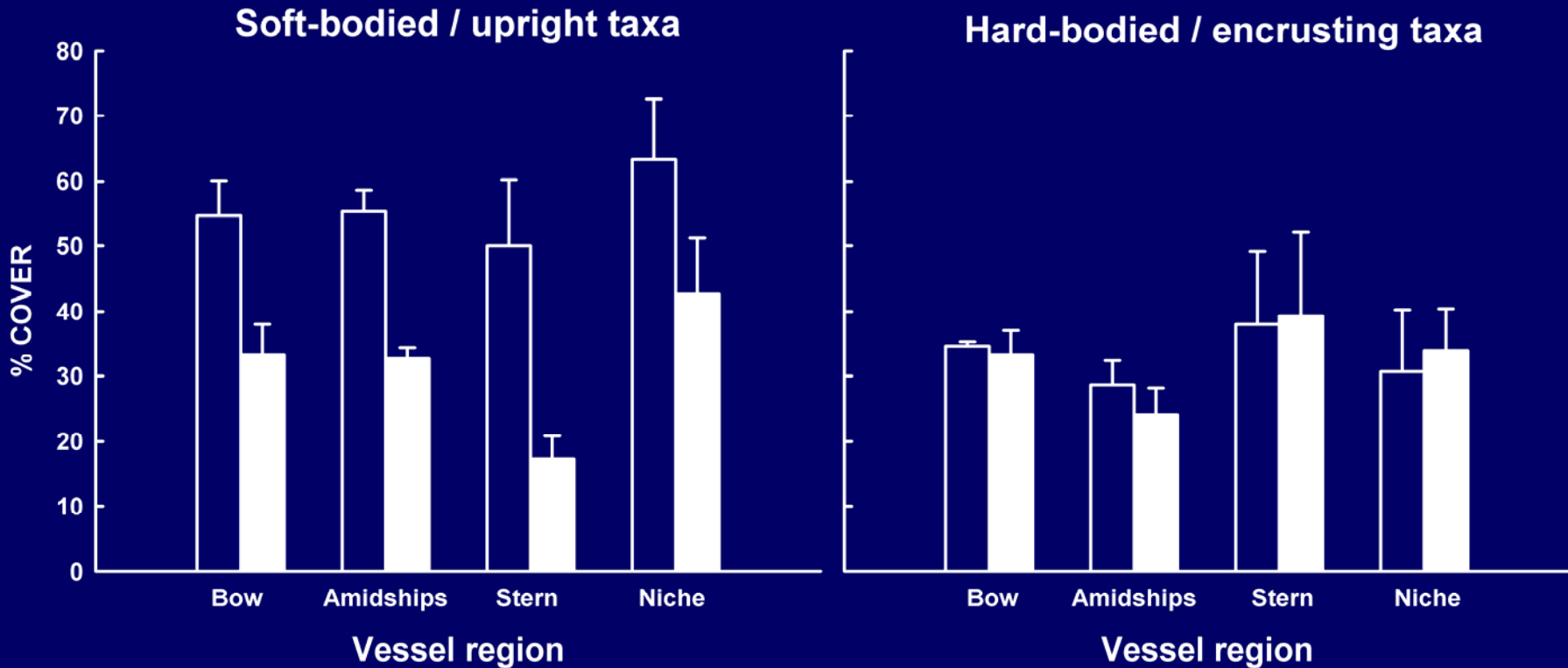
STARTING ASSEMBLAGES & FINAL NICHE ASSEMBLAGES

- Calcareous tubeworms (26%)
- Colonial ascidians (15%)
- Bare space (12%)
- Solitary ascidians (15%)
- Sabellids (12%)
- Arborescent bryozoans (5%)

FINAL ASSEMBLAGES

- Bare space (30%)
- Calcareous tubeworms (27%)
- Colonial ascidians (15%)
- Empty sabellid tubes (6%)
- Solitary ascidians (5%)
- Arborescent bryozoans (2%)

Barge: fouling survivorship

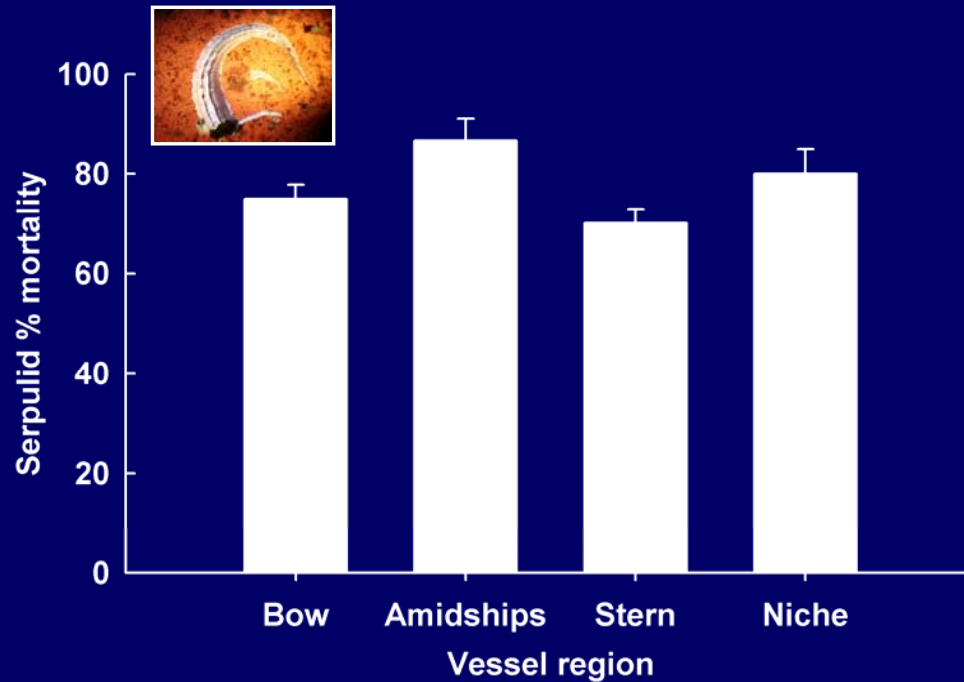


30–65% reduction soft / upright cover
22–60% more soft / upright cover in niche

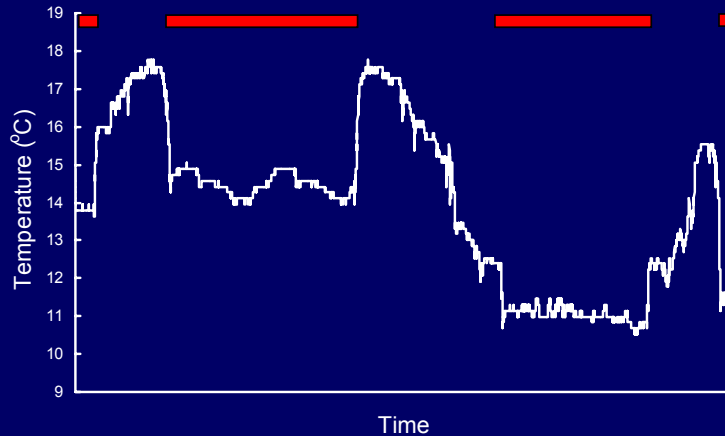
Hard / encrusting cover unchanged

Barge: fouling survivorship

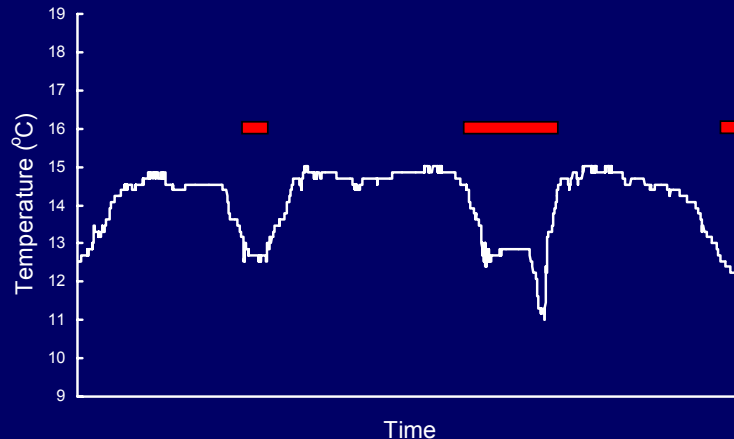
Proportion of serpulids alive



Temperature tolerance



Merchant vessel
 $\Delta 3.8^{\circ}\text{C}$ in ~3 hours



Barge
 $\Delta 3.7^{\circ}\text{C}$ in ~2 hours

 Time in port

Conclusions

- Survival and species cover
 - Greater on slower barge hull
 - Greater overall attachment & survival in niche area
- Morphology
 - Hard encrusting taxa showed superior survival
 - Soft-bodied taxa survived in niche areas
- Substantial temperature tolerance observed

Ongoing research

- Concentrating on slower vessels (e.g. barges)
 - Greatest levels of fouling survival
 - Pose the greatest threat
- Different niche areas
- Flume studies to separate confounding factors
- Longer voyage times
 - Trans-Tasman
 - Trans-equatorial

Acknowledgements

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- Pacifica Shipping
- *Spirit of Resolution* skipper and crew
- McManaway Marine
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- James Brodie (Marlborough Commercial Diving Services)
- Nelson Port Authority
- Operator & residents Nelson Marina

