MARINE BIOSECURITY TOOLBOX

Using Native Mussels and 3D Printing to combat Invasive marine species

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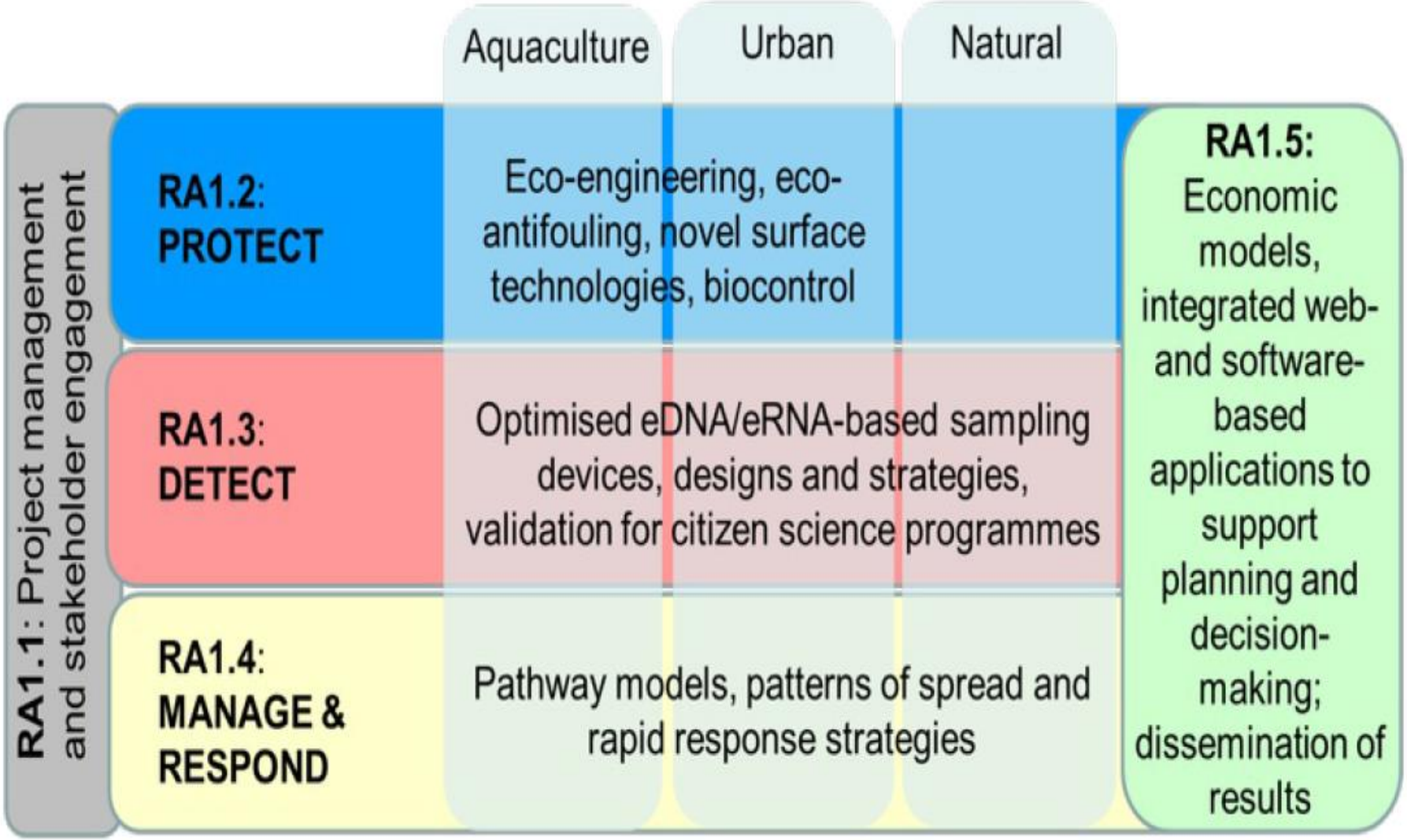
MBT programme's research areas



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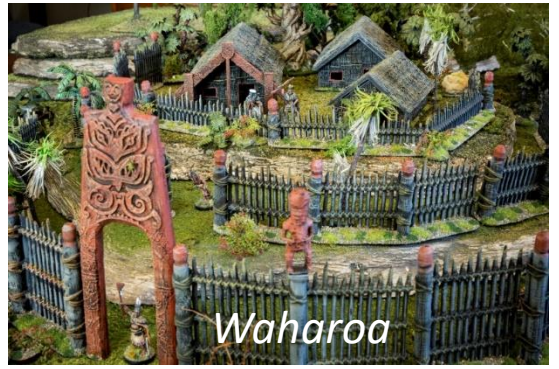

Improving ecosystem services provided by marine infrastructure and increasing their resilience to colonisation by marine pests

Grant Hopkins

Marine Biosecurity Toolbox Programme Annual Meeting,
28 October 2021

RESEARCH THEMES

- Keeping structures free of biofouling (SANITISATION)
- Engineering surfaces to enhance settlement and retention of native species (ENHANCEMENT)

RA1.2 ENHANCE ARTIFICIAL STRUCTURES TO PROMOTE NATIVE SPECIES AND REDUCE INVADERS

- Focus…
  - Developing surfaces that favour native species
  - Model species: kutai, *Perna canaliculus*, green-lipped mussels
  - Increasing understanding of processes that affect colonisation and survival of kutai
  - Using this understanding to inform surface design

Kutai/*P.canaliculus*, Waipū Cove

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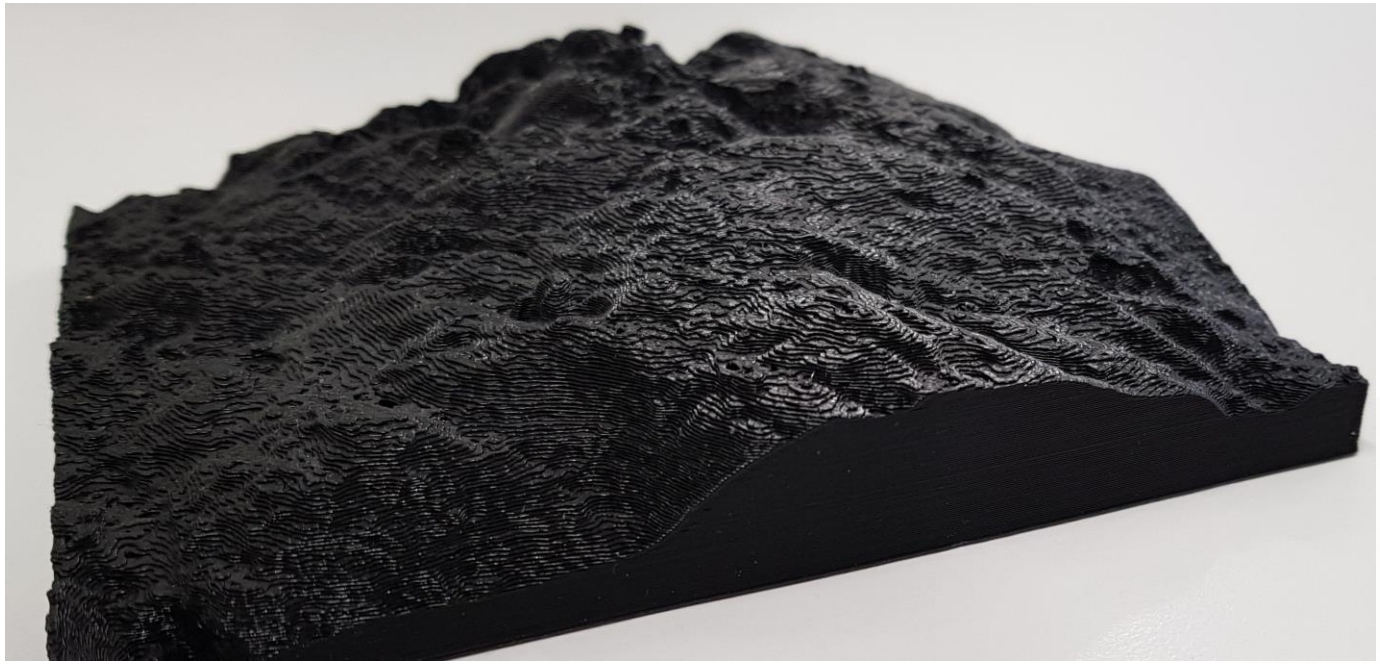
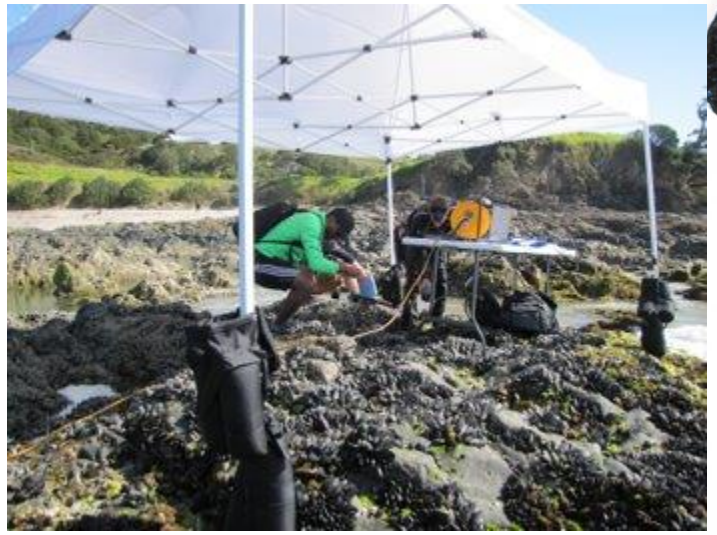


Scanning and 3D printing

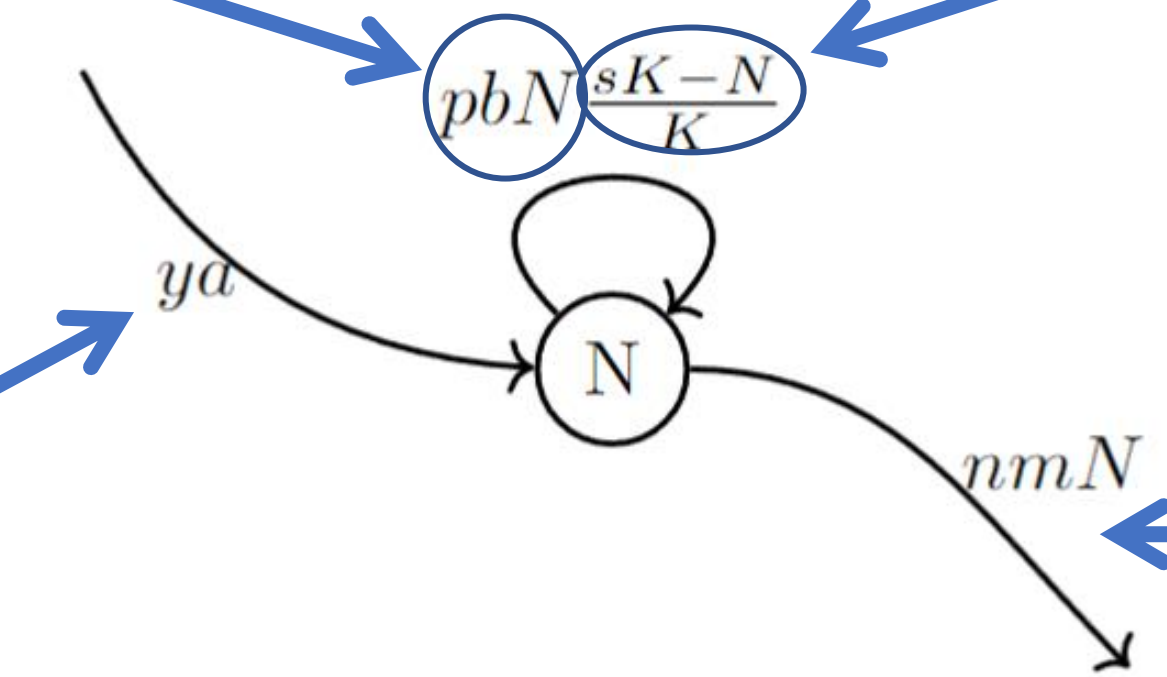
Based on scans of actual mussel beds in Waipu cove, Northland



Bioeconomic Modelling – Native Mussel interaction with engineered substrate

How Native mussel **reproduction** is affected by Substrate

How the **Carrying Capacity** of site for Native mussels is affected by Substrate



How Native mussel **recruitment** is affected by Substrate

How Native mussel **Mortality** is affected by Substrate

Bioeconomic Modelling – Native Mussel interaction with engineered substrate and Invader

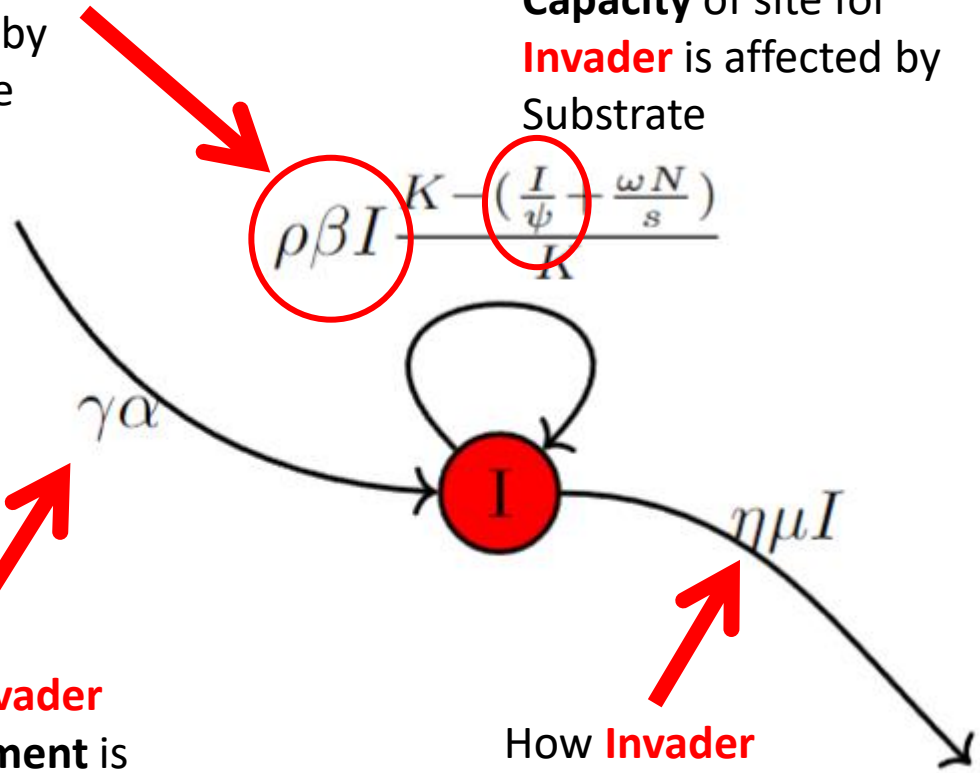
How **Invader reproduction** is affected by Substrate

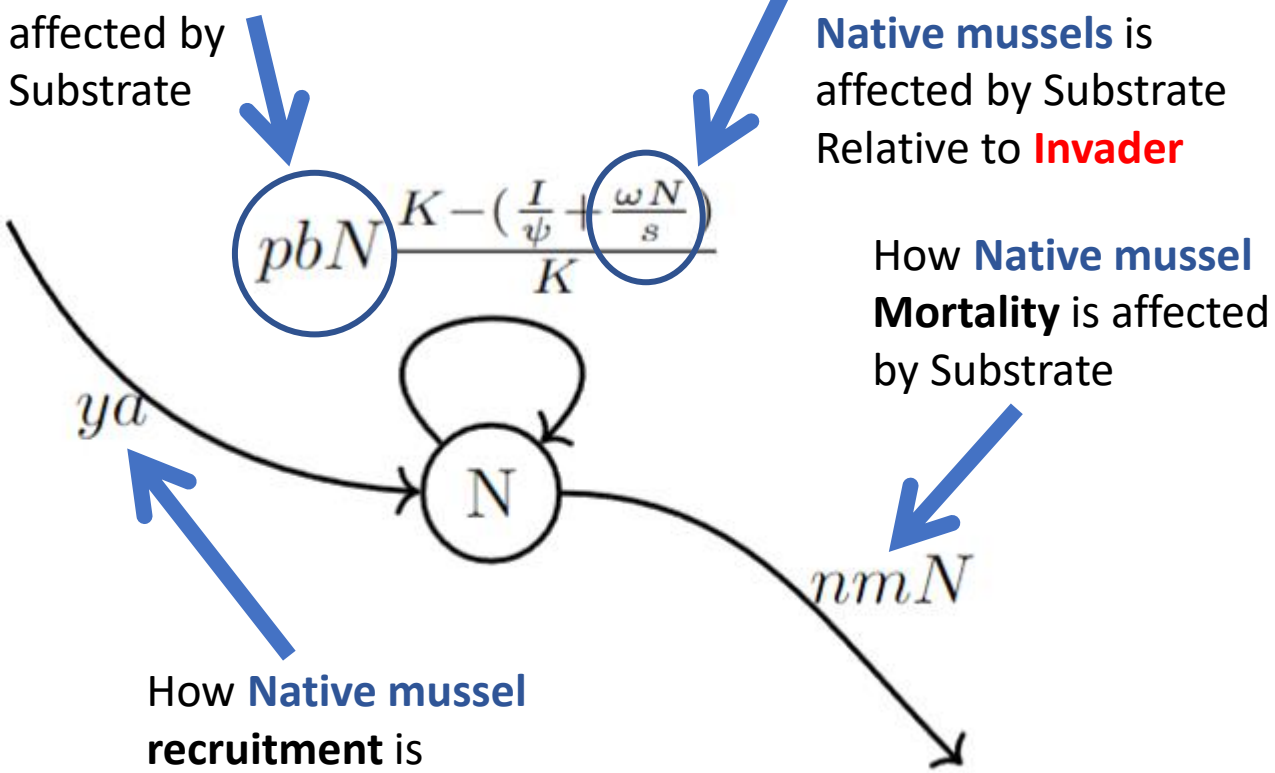
How the **Carrying Capacity** of site for **Invader** is affected by Substrate

How **Native mussel reproduction** is affected by Substrate

How the **Carrying Capacity** of site for **Native mussels** is affected by Substrate Relative to **Invader**

How **Native mussel Mortality** is affected by Substrate





How **Invader recruitment** is affected by Substrate

How **Invader Mortality** is affected by Substrate

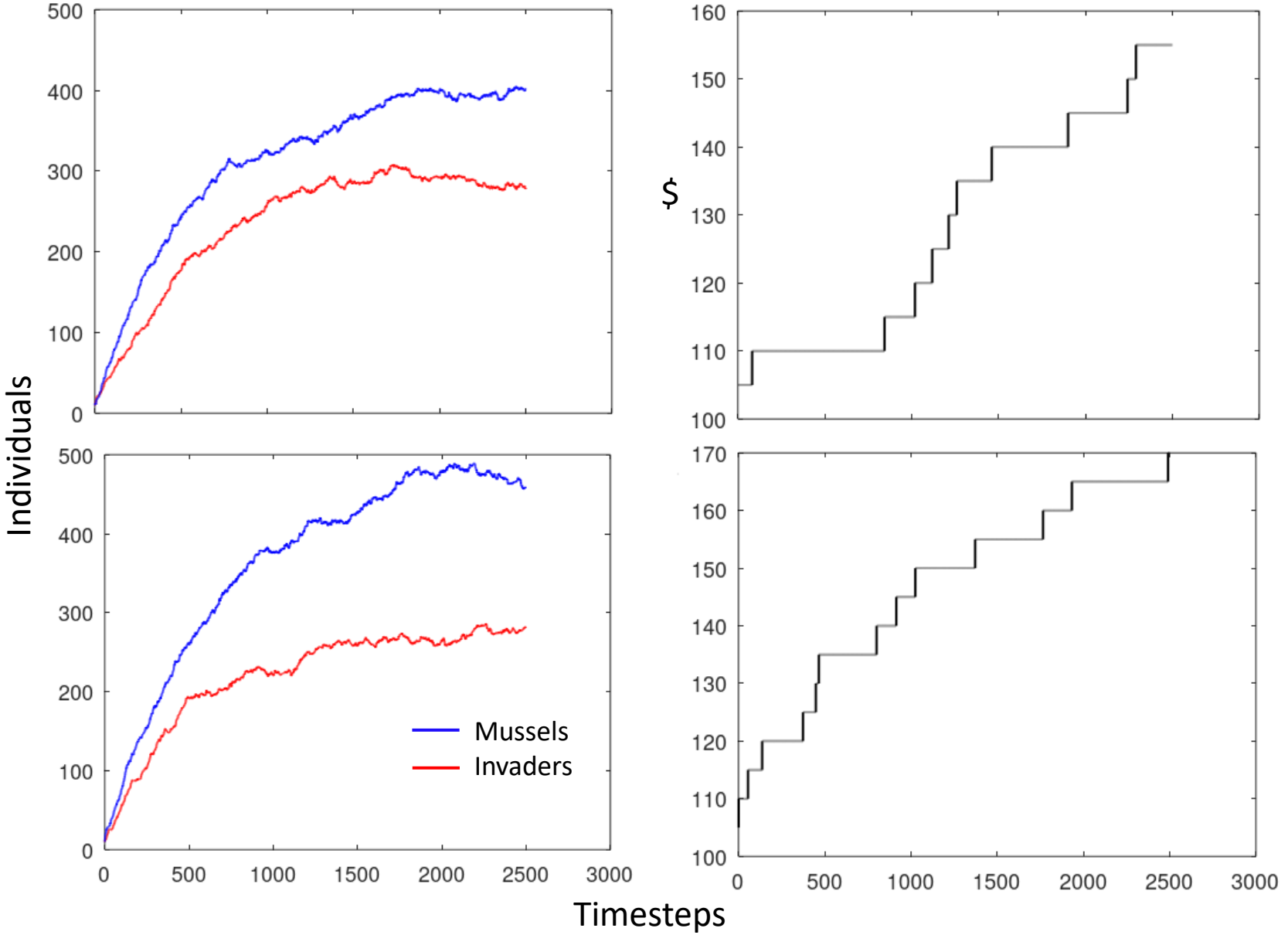
How **Native mussel recruitment** is affected by Substrate

Bioeconomic Modelling - Substrate economics

Substrate Costs

F	Fixed cost of installing any artificial substrate	\$	Flat rate independent of area installed
V	Variable cost of installing artificial substrate	$\$/m^2$	Relative to area being covered (May be non-linear if appropriate)
D	Maintenance Costs	$\$/m^2$	Costs to keep substrate in a working condition
E	Maintenance frequency	events/year	frequency needed to working condition
L	Substrate lifespan/ time to replacement	years	How long until the substrate needs to be replaced?

Bioeconomic Modelling - Simulations



- Mussel and Invader populations start equal
- Mussels advantaged by 10% on Artificial substrate
- All other population dynamics the same

- Mussels advantage by 20% by artificial substrate

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Further Model Development

- Ongoing discussions with marine biologists and materials engineers
  - Provided Spreadsheet of data want/needs and accompanying descriptive document
  - Discussion to refine models based on available/obtainable data
  - Influence on experimental design

- Working to incorporate benefits on thriving mussel populations/ decreased invader population
  - Links to survey of boaters on hull cleaning behaviour
    - Includes preferences and motivations
  - Developing a general public survey to understand the wider value of artificial substrate installation and other developing marine biosecurity tools and initiatives

Thank you and other news

- Fixed Term position currently being advertised

- Marine biosecurity toolbox
  - Working closely with Richard Yao and Other project partners including Cawthron and Patuharake
  - Conduct economic modelling for investment decisions in potential management techniques
  - Prevention, Detection, Spread pathways, Wider impacts of Invasive Marine species

- Forestry harvesting logistics and economics
  - Working with Scion's Value Chain team and Industry partners including FGR and Forestry companies
  - Conduct economic modelling for investment decisions in new technology implementation within the forest sector.
  - Harvesting Methods, Transport, and Storage decisions

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