Science for Sustainable Fisheries

SPEAKERS:

Assoc. Professor Maren Wellenreuther, Plant and Food Research, University of Auckland

Dr Chris Cornelisen, Cawthron Institute

INVITED GUESTS

Peter van As, Manager Business Development, APAC Genomics

Professor Juliet Gerrard, Prime Minister's Chief Science Advisor

Dr Marc Lubbers, Operational Manager, Plant & Food Research

Dr Richard O'Driscoll, Fisheries Chief Scientist, NIWA

Dr George Slim, Consultant, Office of the Prime Ministers Chief Science Advisor

FORUM PARTNERS

Independent Research Association of New Zealand: **Dr Rob Whitney**, Executive Officer

Royal Society of New Zealand: **Paul Atkins**, CEO; **Ms Nancy de Bueger**, Senior Advisor; **Mrs Kahu Hotere**, Director; **Ms Tarah Nikora**, Director; **Dr Marc Rands**, Academy Executive Officer; **Dr Roger Ridley**, Director

Science New Zealand: **Mr Anthony Scott**, CEO

Universities New Zealand: **Dr Bronwen Kelly**, Deputy Chief Executive; **Guy Somerset**, Communications

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Cawthron Institute

Speaker's Science Forum

Aotearoa New Zealand

Plant & Food™ Research
Rangahau Ahumāra Kai

How can fisheries management benefit from genomics? Key insights from New Zealand species

Maren Wellenreuther
Science Group Leader, Plant & Food Research
Associate Professor, The University of Auckland

THE UNIVERSITY OF AUCKLAND

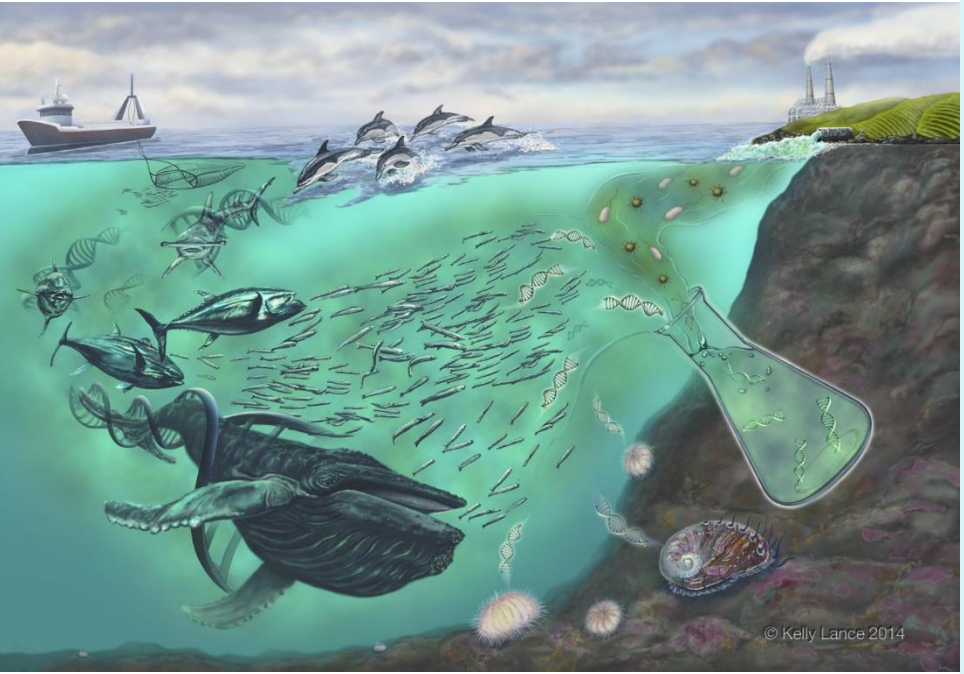
Google Earth

Data SIO, NOAA, U.S. Navy

Do we know what's under the surface?

- 98 species are in the Quota Management System (QMS), divided into 642 fish stocks and geographic areas
- We have limited information about the majority of species/stocks
- Knowledge gaps mean some decisions are based on uncertain information

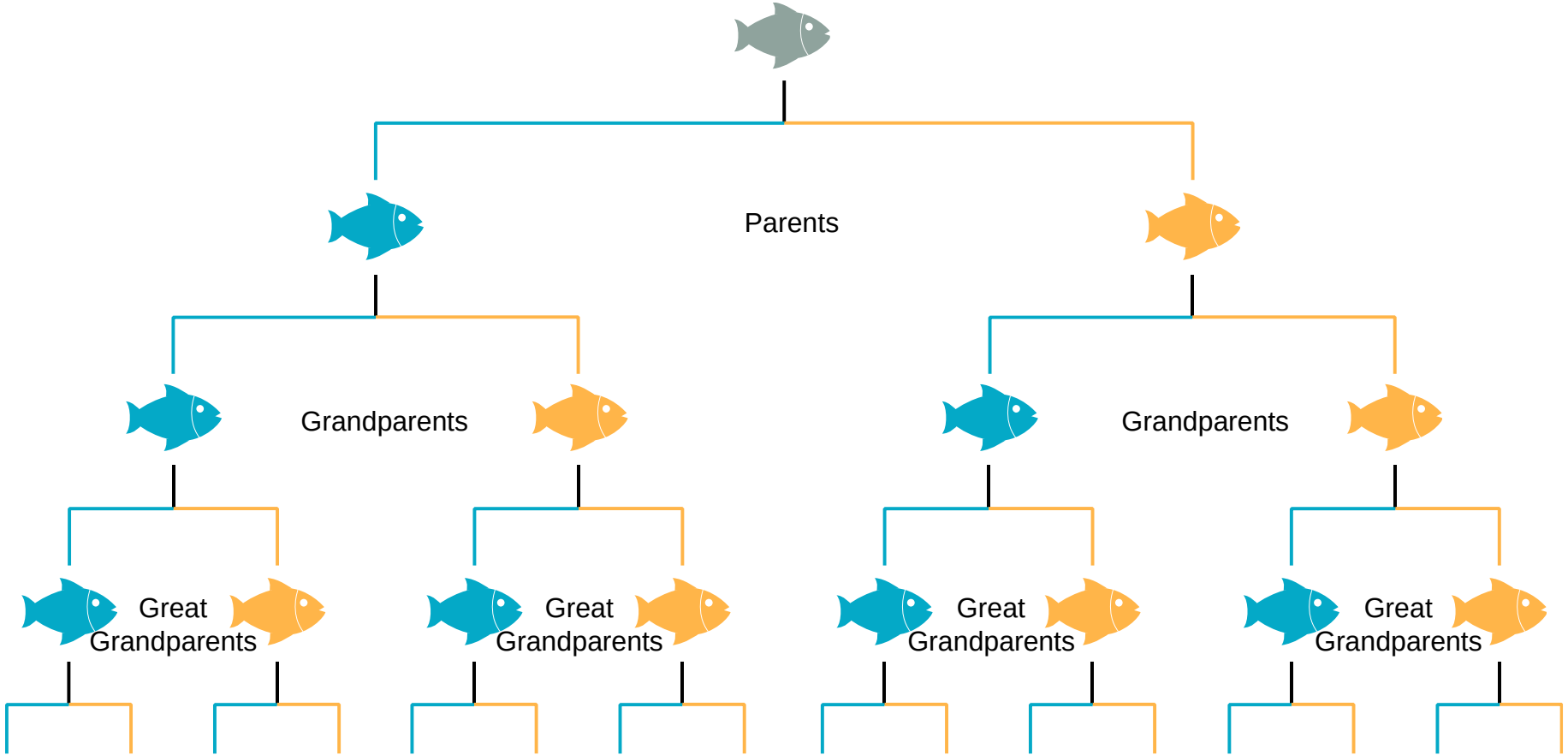
DNA is an information treasure trove



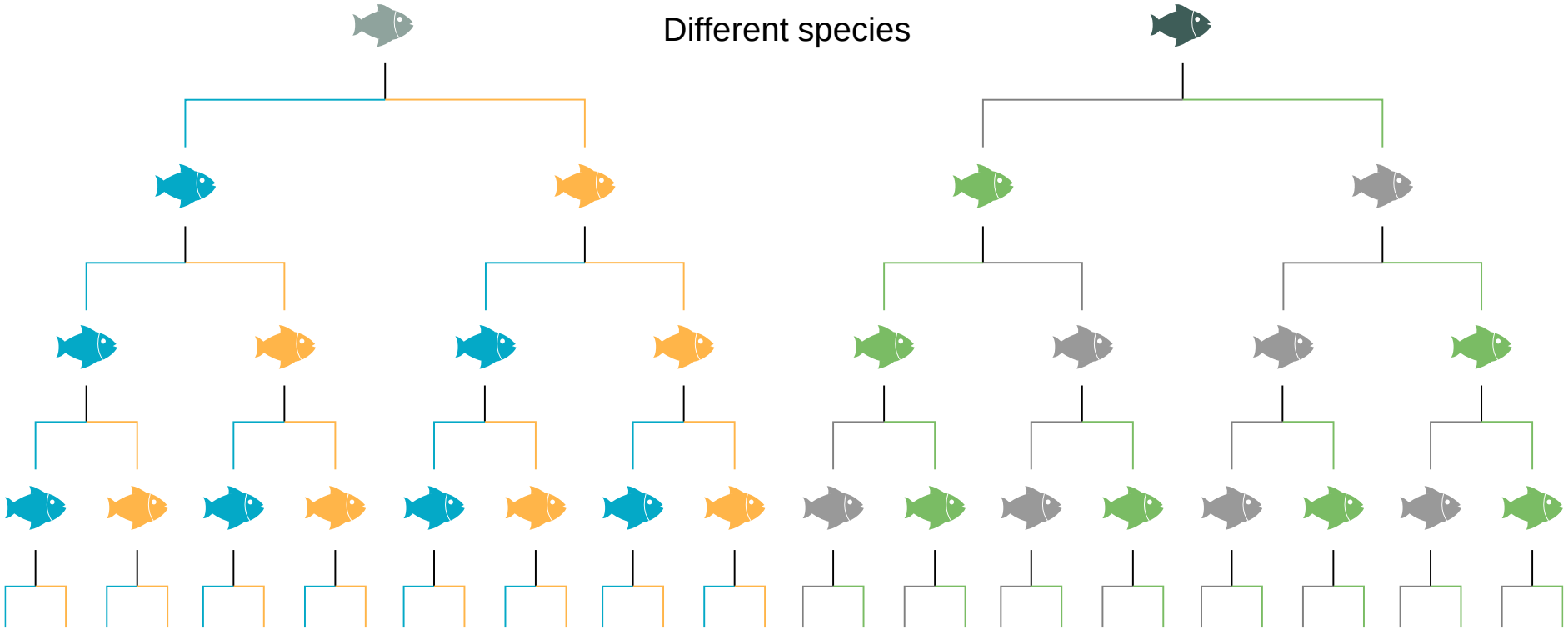
Kelly Lance

- COVID sequencing has showed us the power of genetics
- Genetic sequence data can reveal where you come from, and who you are related to
- Similar to mouth swabs, you can take a non-lethal tissue sample of a fish and extract DNA from it

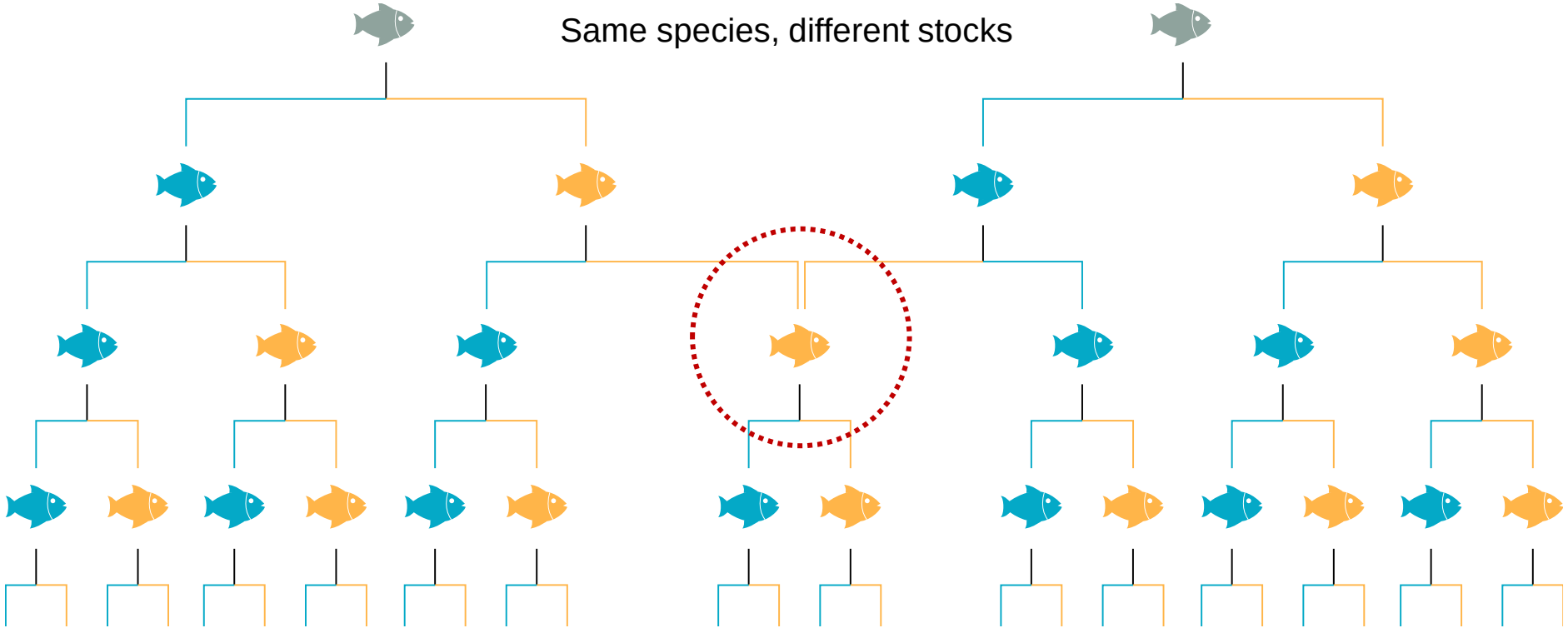
DNA has a time travelling ability



Different family trees - different species



Shared family trees-substructure within a species



Three examples

Genomics can inform…

1. Cryptic species identification

Tarakihi (*Nemadactylus macropterus)*

2. Stock structure

Hoki (*Macruronus novaezelandiae)*

3. Seafood traceability

Snapper/tāmure (*Chrysophrys auratus)*

Cryptic species identification

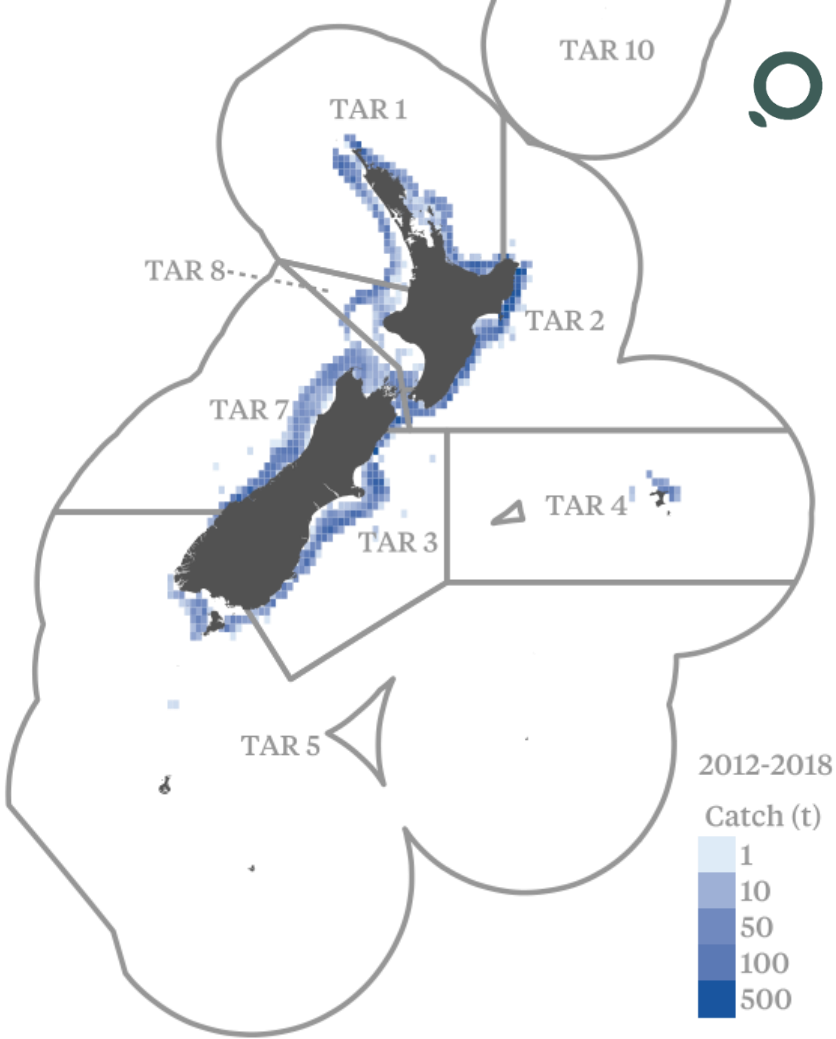
- Tarakihi vs King tarakihi: different species but very similar morphology
- King tarakihi is reported and managed as part of tarakihi to avoid erroneous catch reports

Managed as one fishery

- Overlap is strongest in TAR1
- Estimated to make up a ~2% proportion of tarakihi catches in TAR1 (~30 tons/year)
- 18 sampling sites, 188 individuals

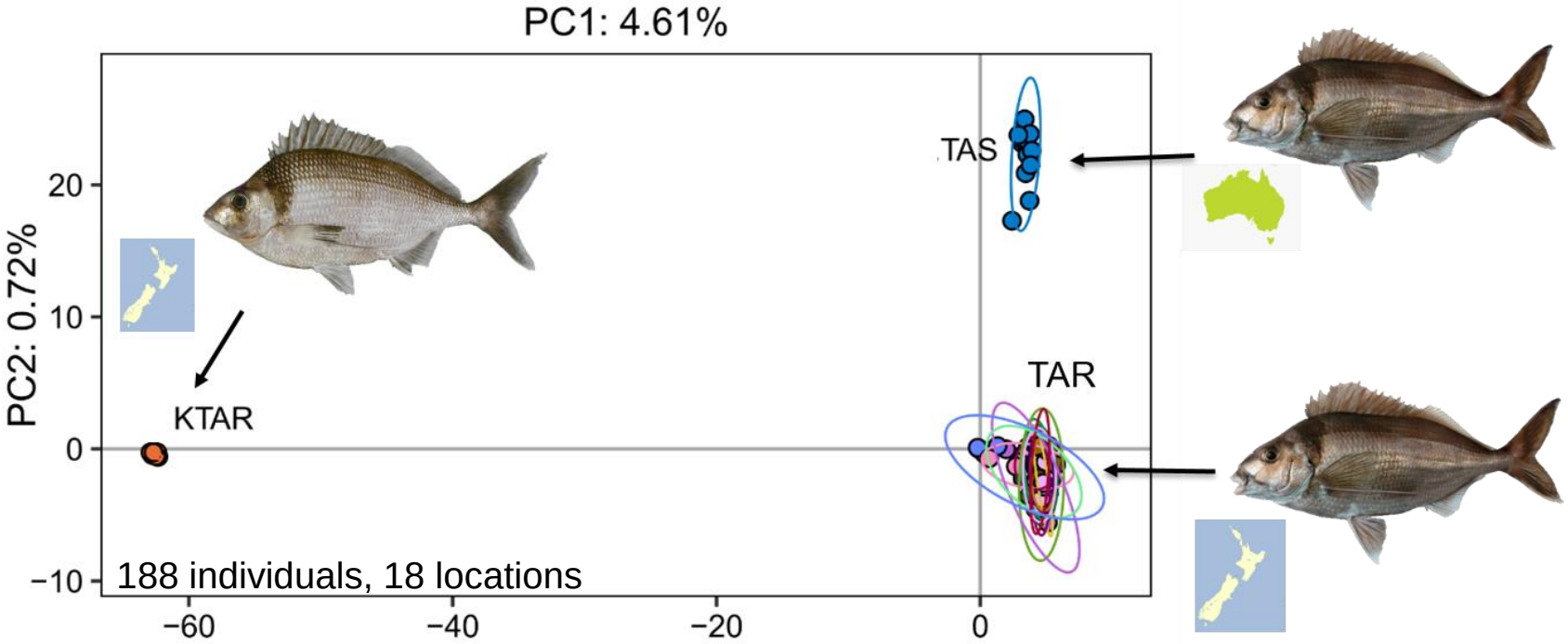
Tarakihi (*Nemadactylus macropterus*)

King tarakihi (*Nemadactylus* n.sp.)



Can genetics be used to differentiate the species?

84,144 fixed differences between King tarakihi from NZ vs. tarakihi from NZ and AU

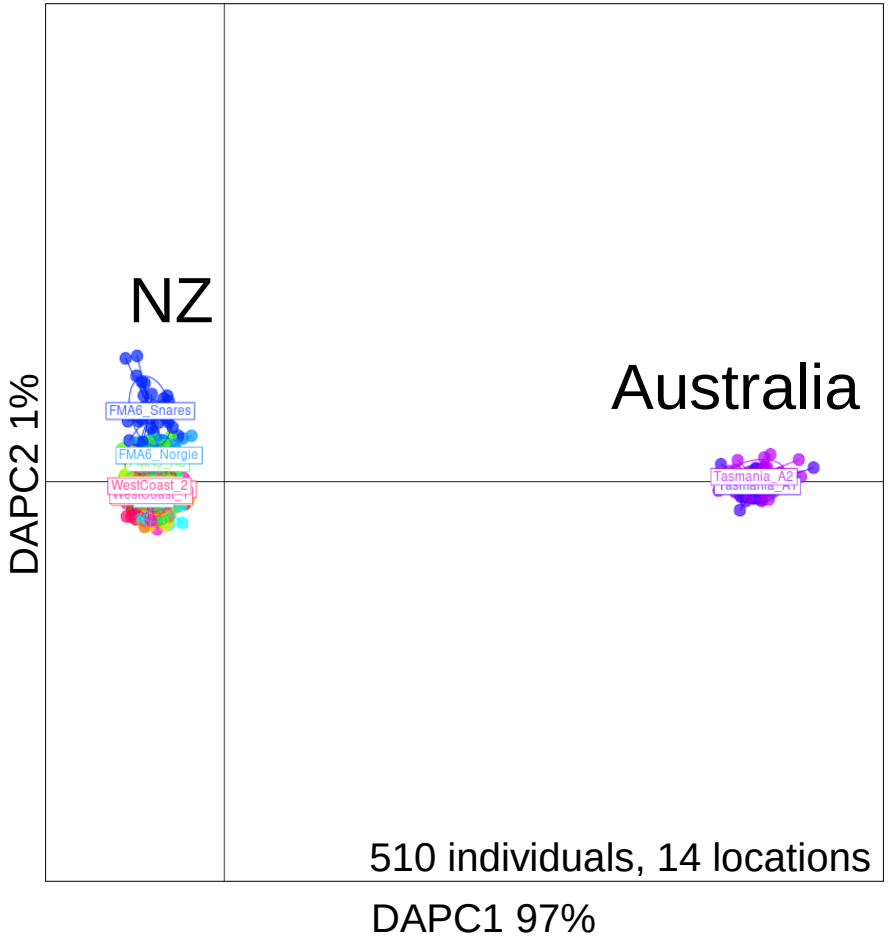


Stock structure

- Currently managed as two stocks: one eastern and one western stock
- Is this correct?
- 12 sampling sites around NZ, and 2 in Tasmania, 510 individuals

NZ locations cluster

» Indicates NZ hoki genetically mix-one stock

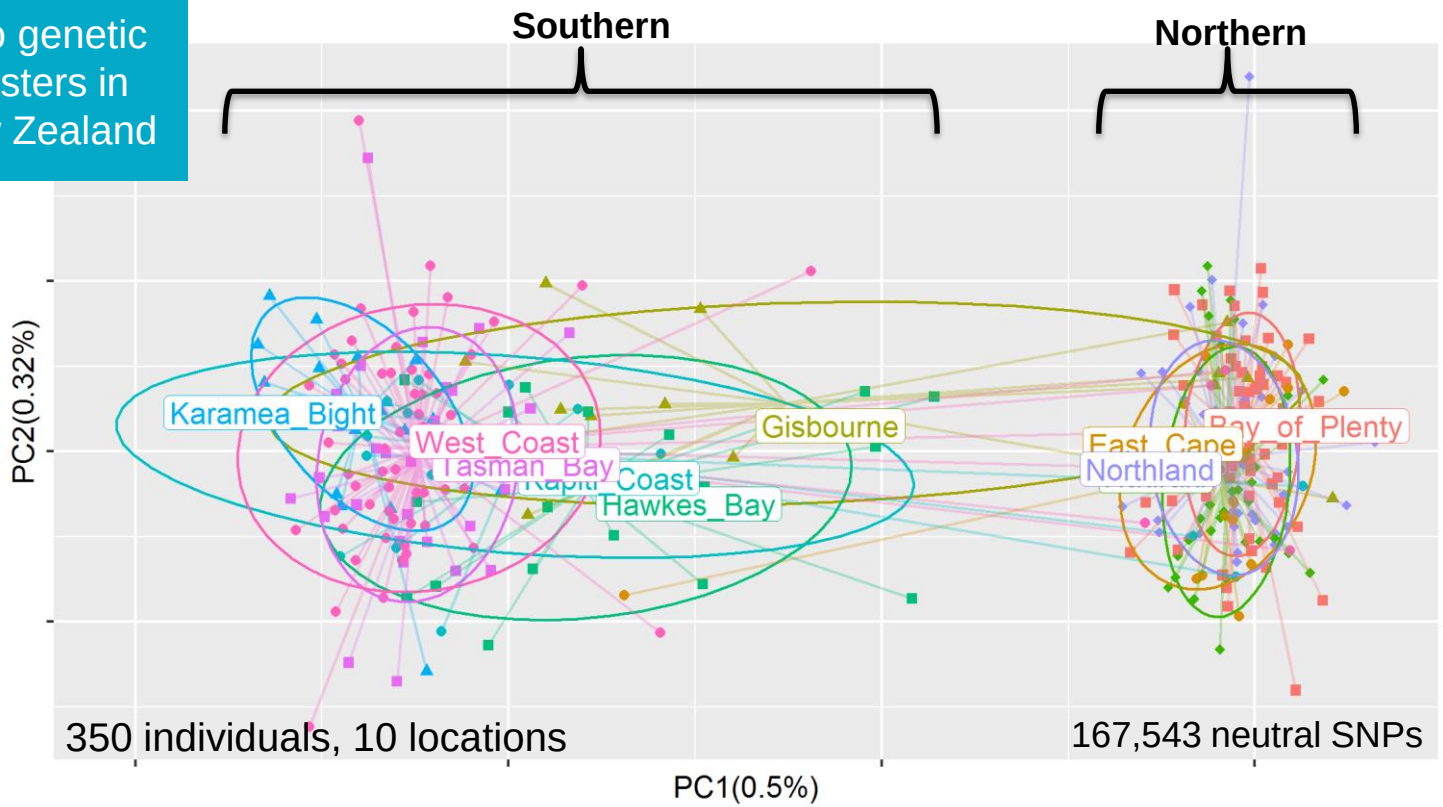


Traceability

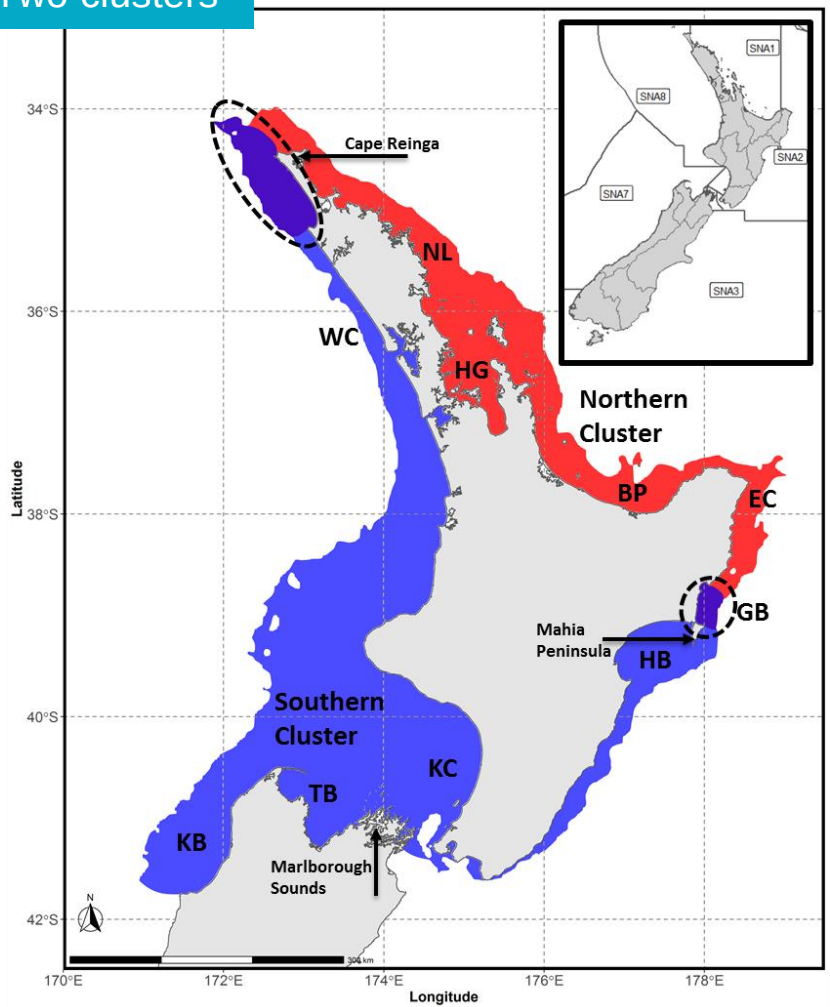
- Some species are less mobile, e.g. compared to hoki
- This can cause a reduction in genetic exchange
- Over time, this leads to genetic structuring, and limited exchange between these areas
- 10 sampling sites, 350 individuals

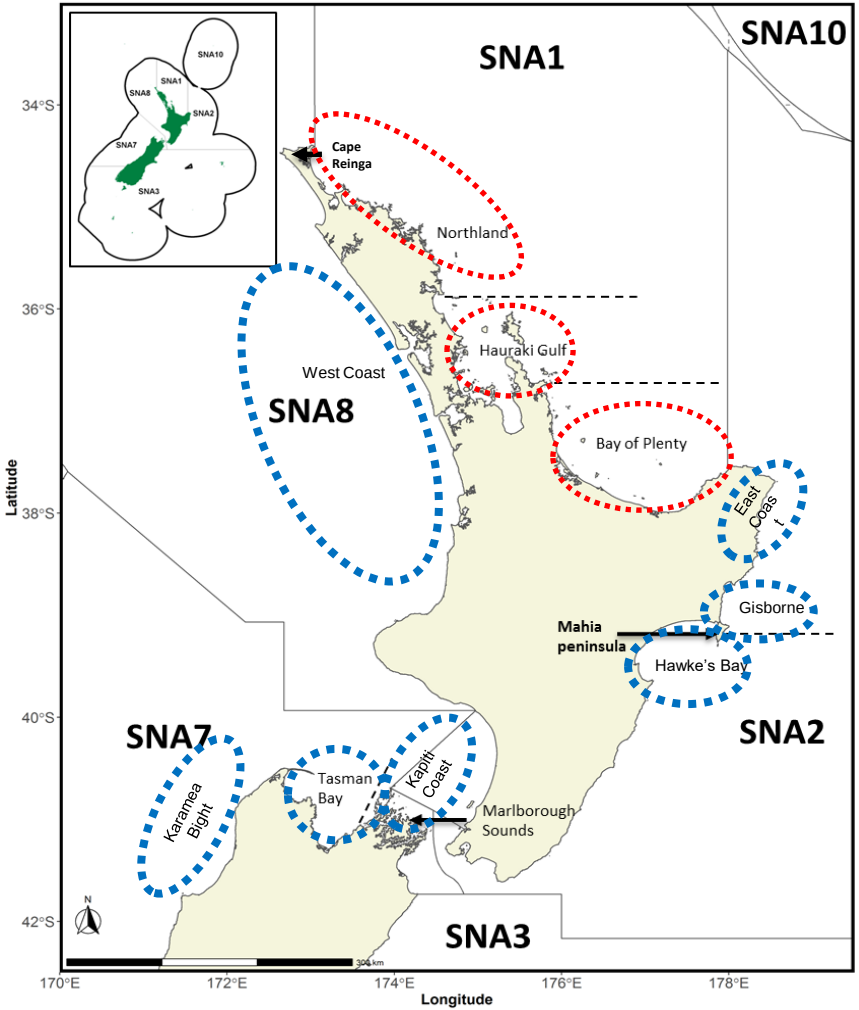
DNA reveals sub-structure within New Zealand

Two genetic clusters in New Zealand



Two clusters





Genomic insights

DNA

Ecosystem

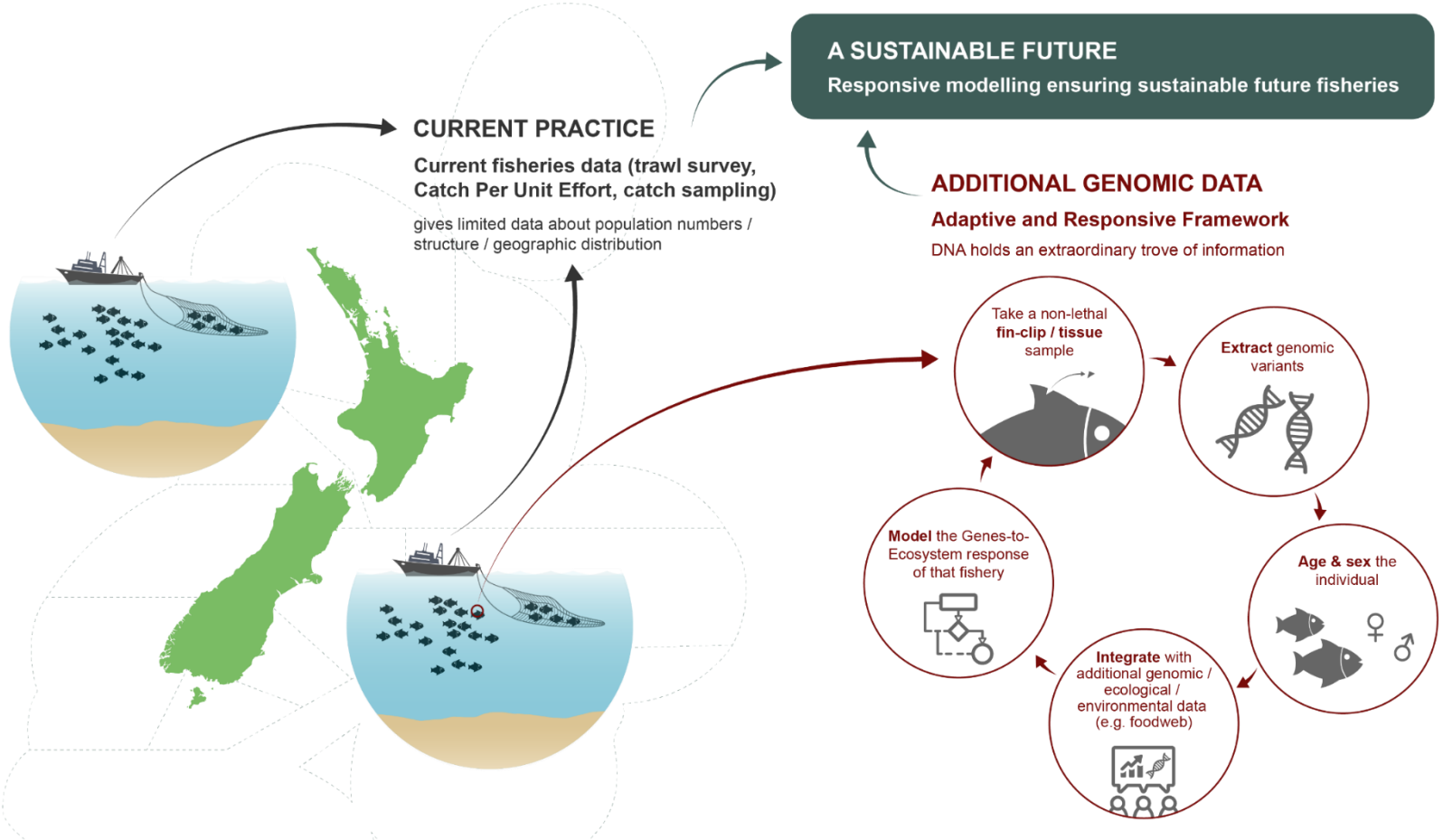
Species

Food webs

Stock structure

Traceability

What could a future look like?



Acknowledgements

- David Chagné – hoki (PFR)
- Emily Koot – hoki (PFR)
- Tom Oosting – snapper (VUW)
- Yvan Papa – tarakihi (VUW)
- Peter Ritchie (VUW)
- Genomics Aotearoa
- Te Ohu Kaimoana
- Deepwater Group
- Fishing 2040 Panel
- Aotearoa Circle
- Many more…

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World-class science for a better future.

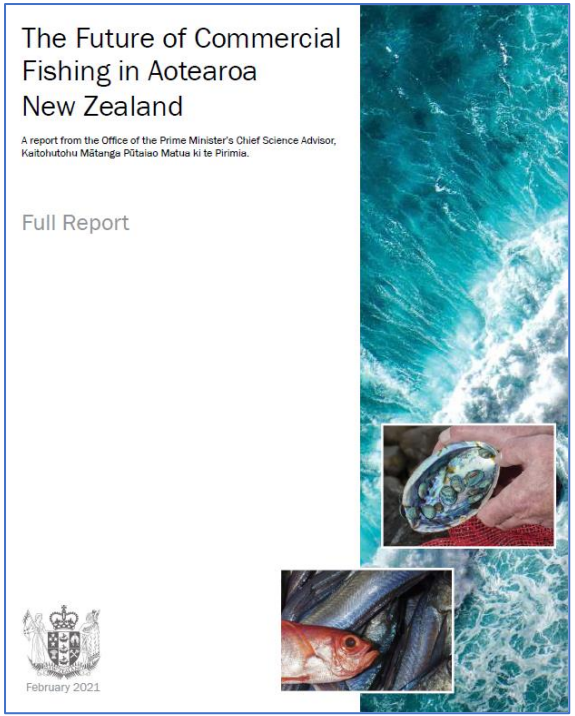
- Healthy eco-systems
- Prosperous blue economy
- Thriving people and communities

Science and technology for sustainable fisheries and a healthy ocean

Chris Cornelisen

CAWTHRON

11 May 2022



- Strengthened leadership
- Oceans Strategy
- Te ao Māori – connected worldview
- Refined set of regulatory tools
- Data platform that enables decision making
- Ecosystem approach to fisheries management
- Maximise research and innovation

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Why do we fish?

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Why do we fish?

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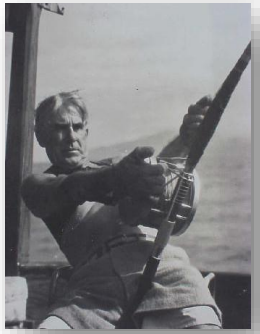
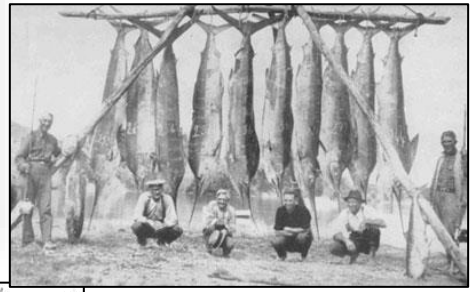
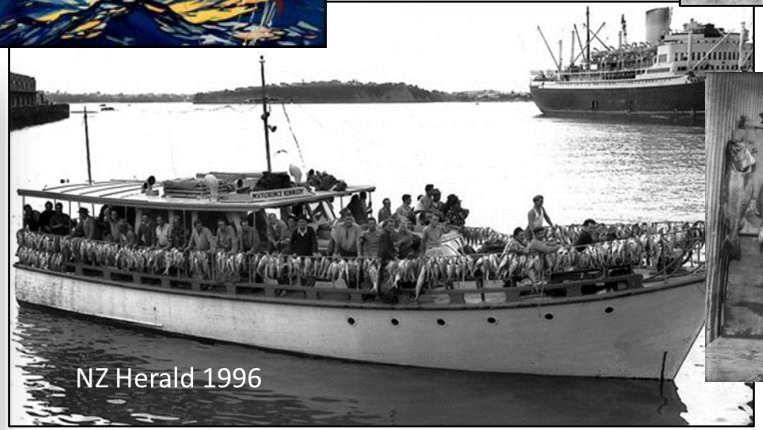
Why do we fish?





NZ Geo



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Why do we fish?

Crayfish

Snapper

Scallops

MARTIN DE RUYTER/STUFF

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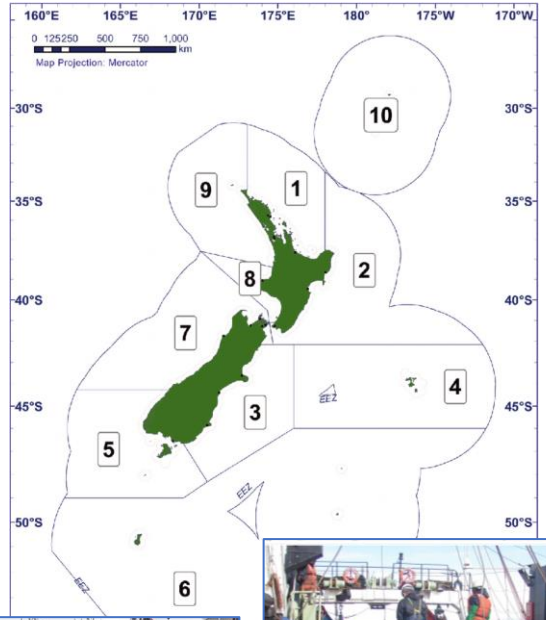
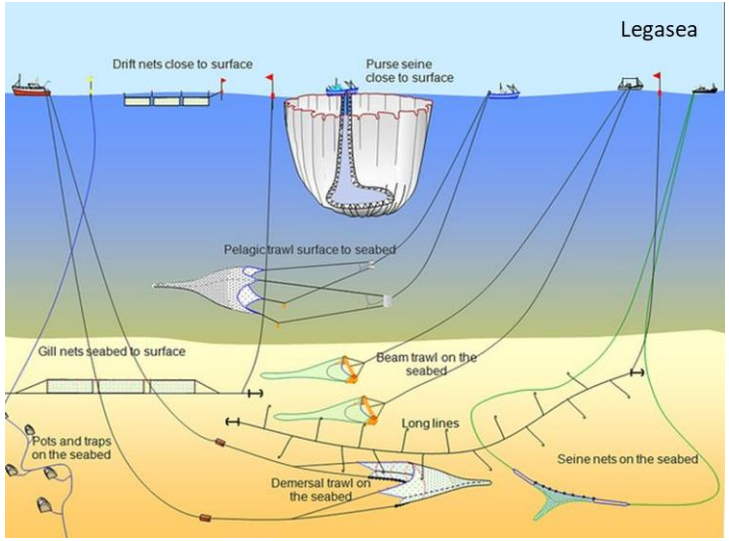


Māori Fisheries Settlement (Natl Library)



MPI

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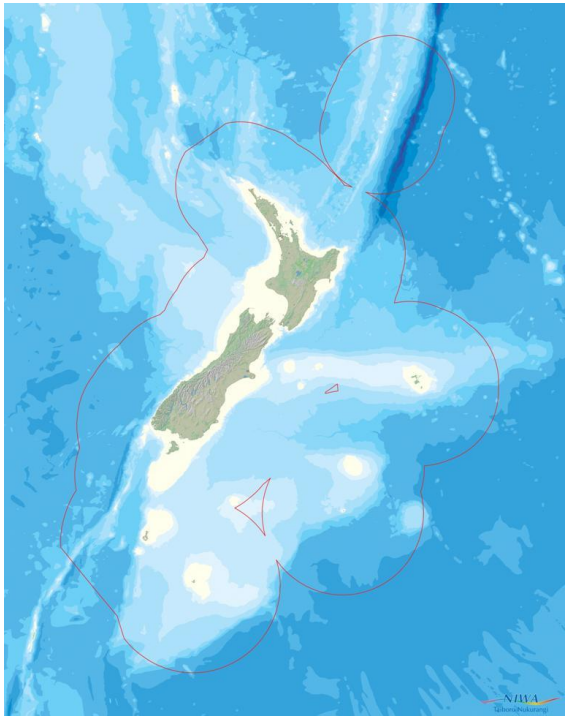
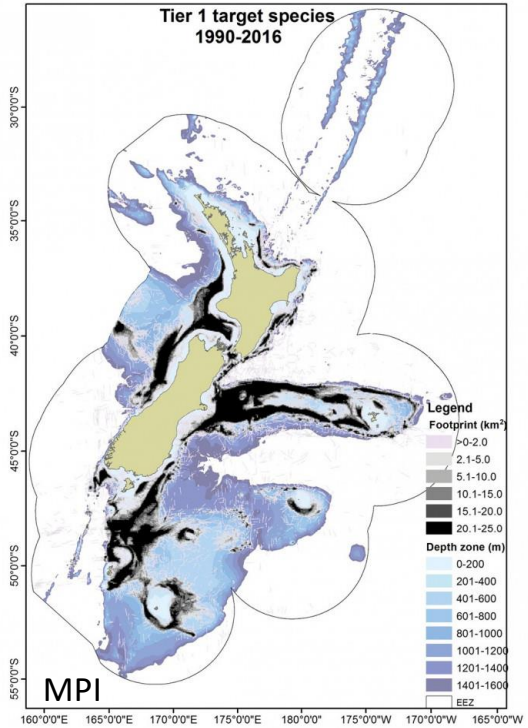
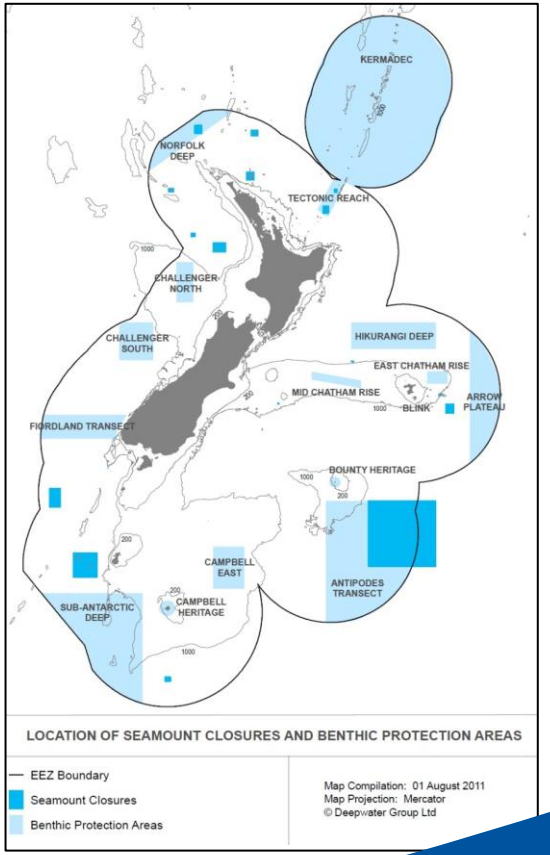



Tier 1 target species
1990-2016
30°0'0"S
35°0'0"S
40°0'0"S
45°0'0"S
50°0'0"S
55°0'0"S
160°0'0"E
165°0'0"E
170°0'0"E
175°0'0"E
180°0'0"
175°0'0"W
170°0'0"W
165°0'0"W
Legend
Footprint (km²)
>0-2.0
2.1-5.0
5.1-10.0
10.1-15.0
15.1-20.0
20.1-25.0
Depth zone (m)
0-200
201-400
401-600
601-800
801-1000
1001-1200
1201-1400
1401-1600
EEZ
MPI


KERMADEC
NORFOLK DEEP
TECTONIC REACH
CHALLENGER NORTH
CHALLENGER SOUTH
HIKURANGI DEEP
EAST CHATHAM RISE
MID CHATHAM RISE
BLINK
ARROW PLATEAU
FIORDLAND TRANSECT
BOUNTY HERITAGE
CAMPBELL EAST
ANTIPODES TRANSECT
SUB-ANTARCTIC DEEP
CAMPBELL HERITAGE
LOCATION OF SEAMOUNT CLOSURES AND BENTHIC PROTECTION AREAS
EEZ Boundary
Seamount Closures
Benthic Protection Areas
Map Compilation: 01 August 2011
Map Projection: Mercator
© Deepwater Group Ltd

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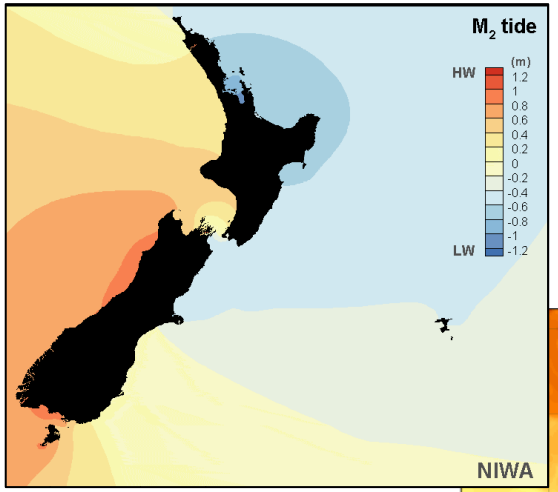
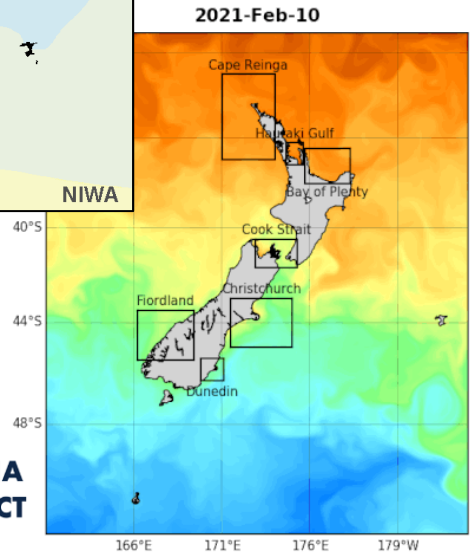
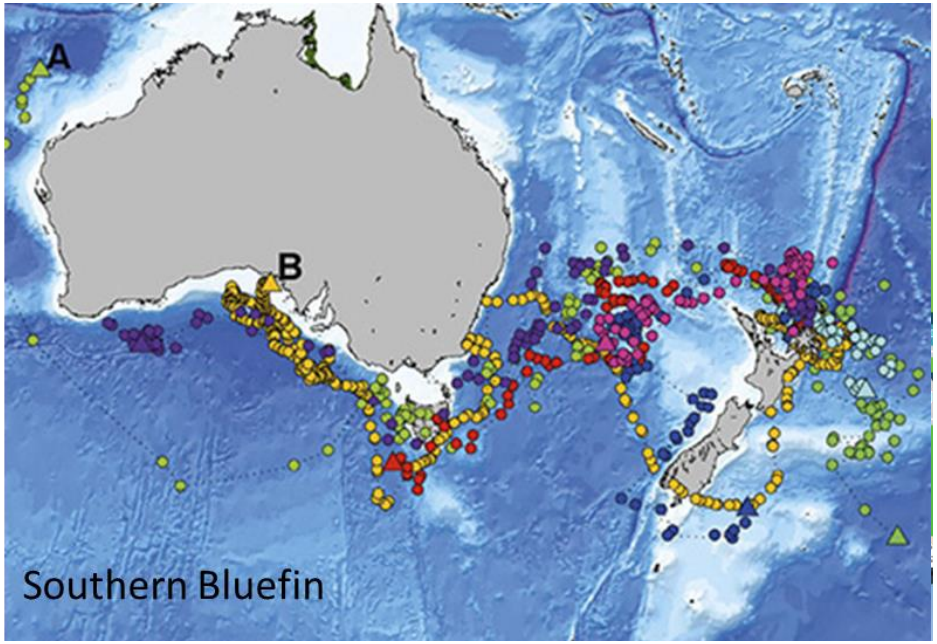


NIWA
Taihoro Nukurangi



MOANA PROJECT



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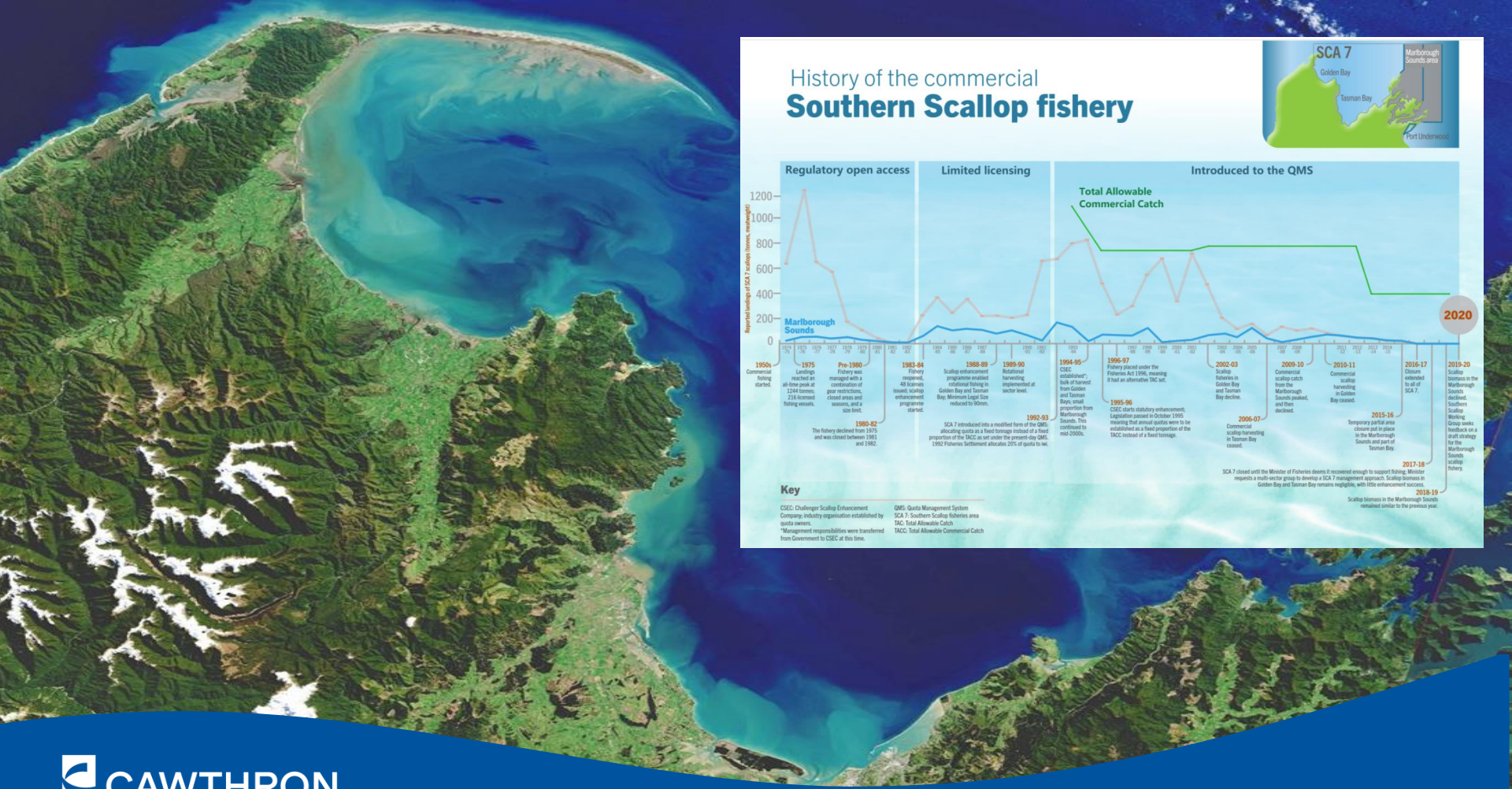
History of the commercial
Southern Scallop fishery
SCA 7
Golden Bay
Tasman Bay
Marlborough Sounds area
Port Underwood
Regulatory open access
Limited licensing
Introduced to the QMS
Total Allowable Commercial Catch
Marlborough Sounds
Reported landings of SCA 7 scallops (tonne, meat weight)
1200
1000
800
600
400
200
0
2020
1950s
Commercial fishing started.
1975
Landings reached an all-time peak at 1244 tonnes; 216 licensed fishing vessels.
Pre-1980
Fishery was managed with a combination of gear restrictions, closed areas and seasons, and a size limit.
1980-82
The fishery declined from 1975 and was closed between 1981 and 1982.
1983-84
Fishery reopened, 48 licenses issued; scallop enhancement programme started.
1988-89
Scallop enhancement programme enabled rotational fishing in Golden Bay and Tasman Bay; Minimum Legal Size reduced to 90mm.
1989-90
Rotational harvesting implemented at sector level.
1992-93
SCA 7 introduced into a modified form of the QMS: allocating quota as a fixed tonnage instead of a fixed proportion of the TACC as set under the present-day QMS. 1992 Fisheries Settlement allocates 20% of quota to iwi.
1994-95
CSEC established*; bulk of harvest from Golden and Tasman Bays; small proportion from Marlborough Sounds. This continued to mid-2000s.
1995-96
CSEC starts statutory enhancement; Legislation passed in October 1995 meaning that annual quotas were to be established as a fixed proportion of the TACC instead of a fixed tonnage.
1996-97
Fishery placed under the Fisheries Act 1996, meaning it had an alternative TAC set.
2002-03
Scallop fisheries in Golden Bay and Tasman Bay decline.
2006-07
Commercial scallop harvesting in Tasman Bay ceased.
2009-10
Commercial scallop catch from the Marlborough Sounds peaked, and then declined.
2010-11
Commercial scallop harvesting in Golden Bay ceased.
2015-16
Temporary partial area closure put in place in the Marlborough Sounds and part of Tasman Bay.
2016-17
Closure extended to all of SCA 7.
2017-18
SCA 7 closed until the Minister of Fisheries deems it recovered enough to support fishing. Minister requests a multi-sector group to develop a SCA 7 management approach. Scallop biomass in Golden Bay and Tasman Bay remains negligible, with little enhancement success.
2018-19
Scallop biomass in the Marlborough Sounds remained similar to the previous year.
2019-20
Scallop biomass in the Marlborough Sounds declined. Southern Scallop Working Group seeks feedback on a draft strategy for the Marlborough Sounds scallop fishery.
Key
CSEC: Challenger Scallop Enhancement Company: industry organisation established by quota owners.
*Management responsibilities were transferred from Government to CSEC at this time.
QMS: Quota Management System
SCA 7: Southern Scallop fisheries area
TAC: Total Allowable Catch
TACC: Total Allowable Commercial Catch

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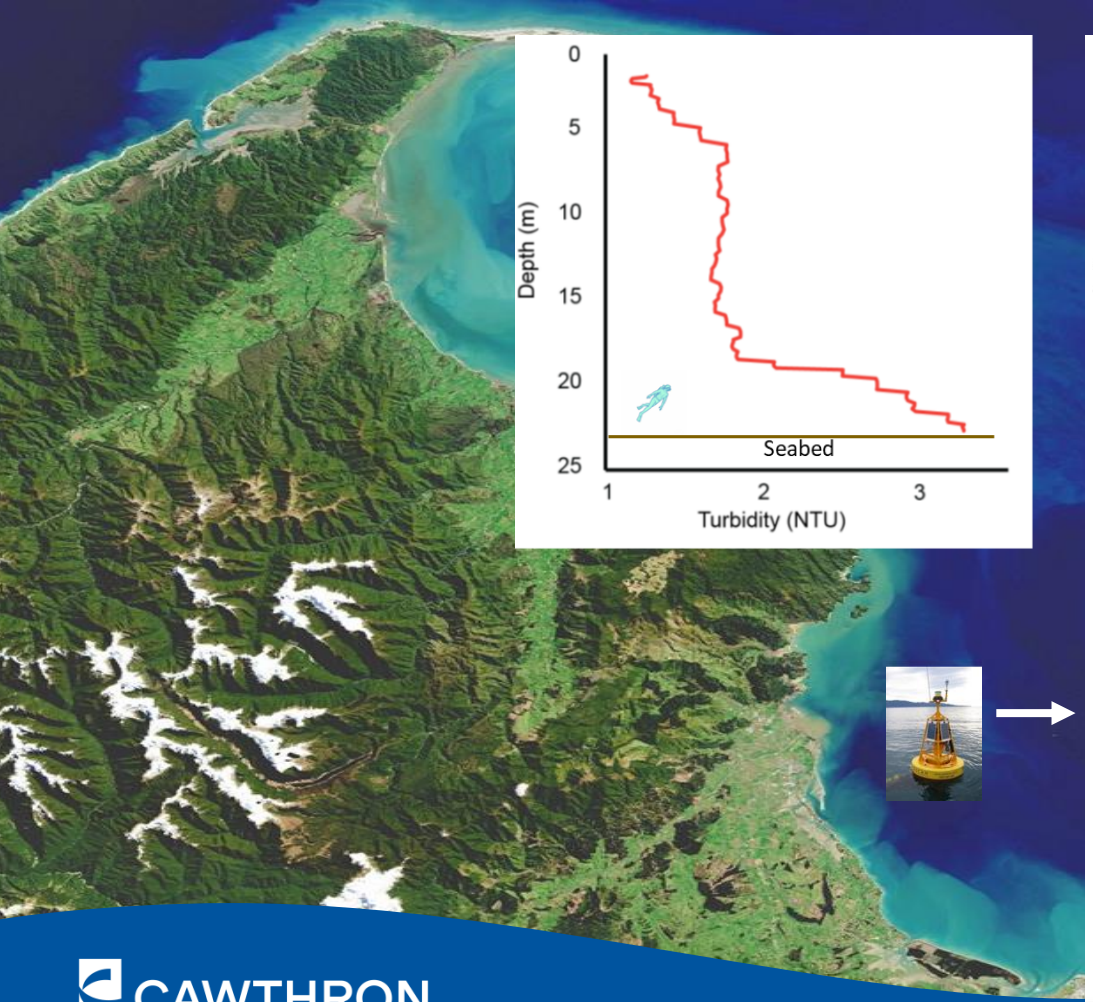
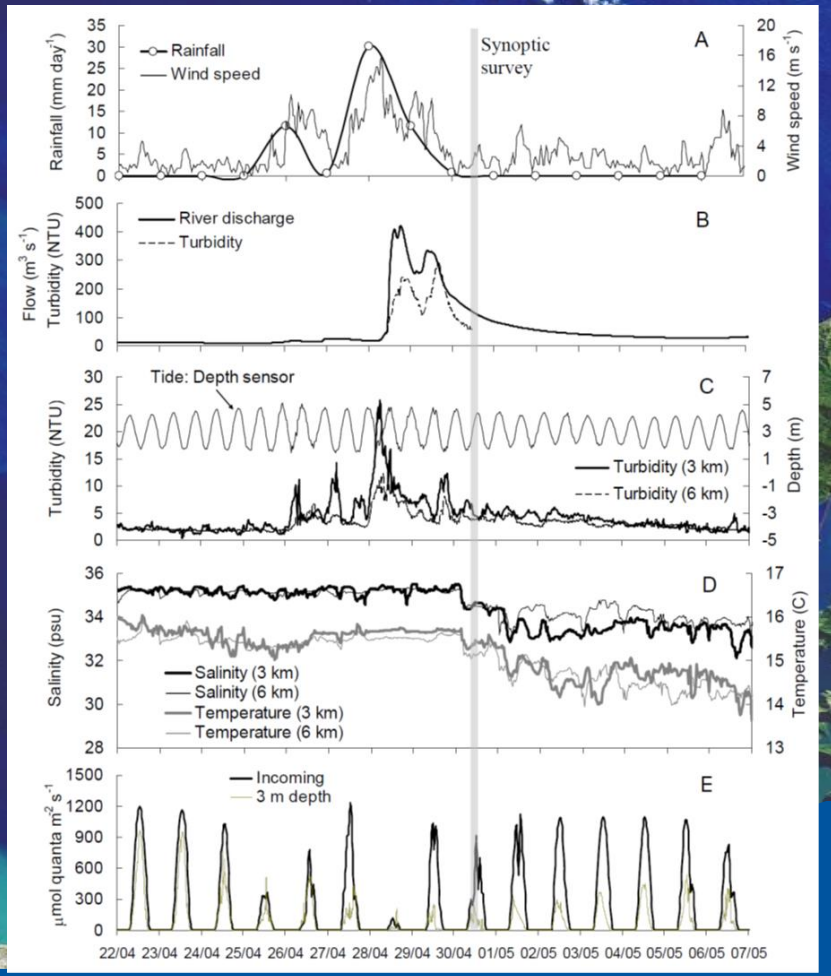

Depth (m)
0
5
10
15
20
25
Seabed
1
2
3
Turbidity (NTU)


Rainfall (mm day-1)
Wind speed (m s-1)
Rainfall
Wind speed
Synoptic survey
A
Flow (m3 s-1)
Turbidity (NTU)
River discharge
Turbidity
B
Tide: Depth sensor
C
Turbidity (3 km)
Turbidity (6 km)
Depth (m)
Salinity (psu)
Temperature (C)
D
Salinity (3 km)
Salinity (6 km)
Temperature (3 km)
Temperature (6 km)
µmol quanta m-2 s-1
Incoming
3 m depth
E
22/04 23/04 24/04 25/04 26/04 27/04 28/04 29/04 30/04 01/05 02/05 03/05 04/05 05/05 06/05 07/05

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National Science Challenges | SUSTAINABLE SEAS | Ko ngā moana whakauka


National Science Challenges

RESEARCH ROUND-UP

Fisheries: Tools, resources and research

SUSTAINABLE SEAS

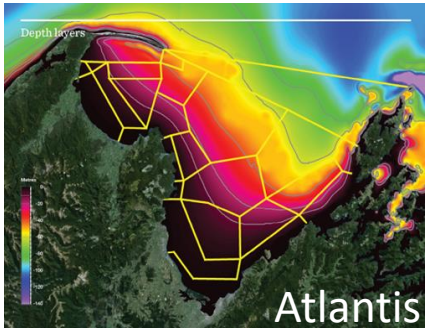
Ko ngā moana whakauka

Summary

The long-term economic use of our marine resources is dependent on healthy marine ecosystems. Fisheries (commercial, customary, and recreational) are significant marine resources for Aotearoa New Zealand. To ensure fishing remains a sustainable way of life for future generations, the Government has made progressing towards ecosystem-based fisheries management approaches a priority. Together with our Māori partners and stakeholders we are developing knowledge, tools and resources to support this.

This is a catalogue of our tools, resources and research projects that support an EBM approach to fisheries – some are available now to use or develop further, others are currently in development.

June 2021



Understanding fisheries within ecosystems

Exploring disturbance and recovery under different scenarios

Participatory processes for decision making

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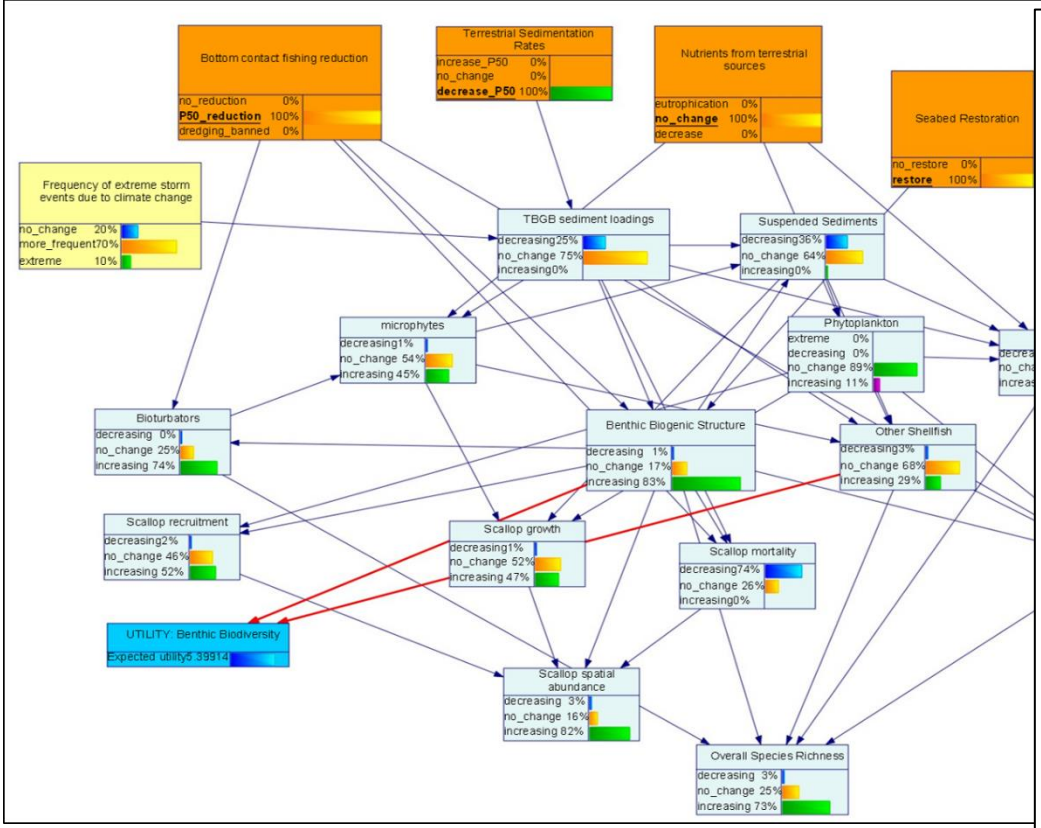

DECISIONS SUMMARY	SCALLOP COMMERCIAL FISHERY PROFITABILITY	FINFISH FISHERY PROFITABILITY	RECREATIONAL SCALLOP MEAN SIZE AND ACCESSIBILITY	BENTHIC BIODIVERSITY	ECOSYSTEM HEALTH
⌄ ⌄ = ⌃⌃	3.01	2.54	7.87	5.40	6.33
⌃⌃ ⌄ = ⌃⌃	-0.59	0.16	8.81	5.63	6.63
⌃⌃ ⌄ ⌄ ⌃⌃	-0.78	-0.02	8.44	4.95	6.31
⌃⌃ ⌄ ⌄ =	-1.64	-0.65	6.71	3.20	4.55
⌃⌃ = ⌄ =	-1.89	-1.03	6.22	1.99	3.50
= ⌄ ⌄ =	-0.38	-0.18	-1.98	-0.53	-0.65

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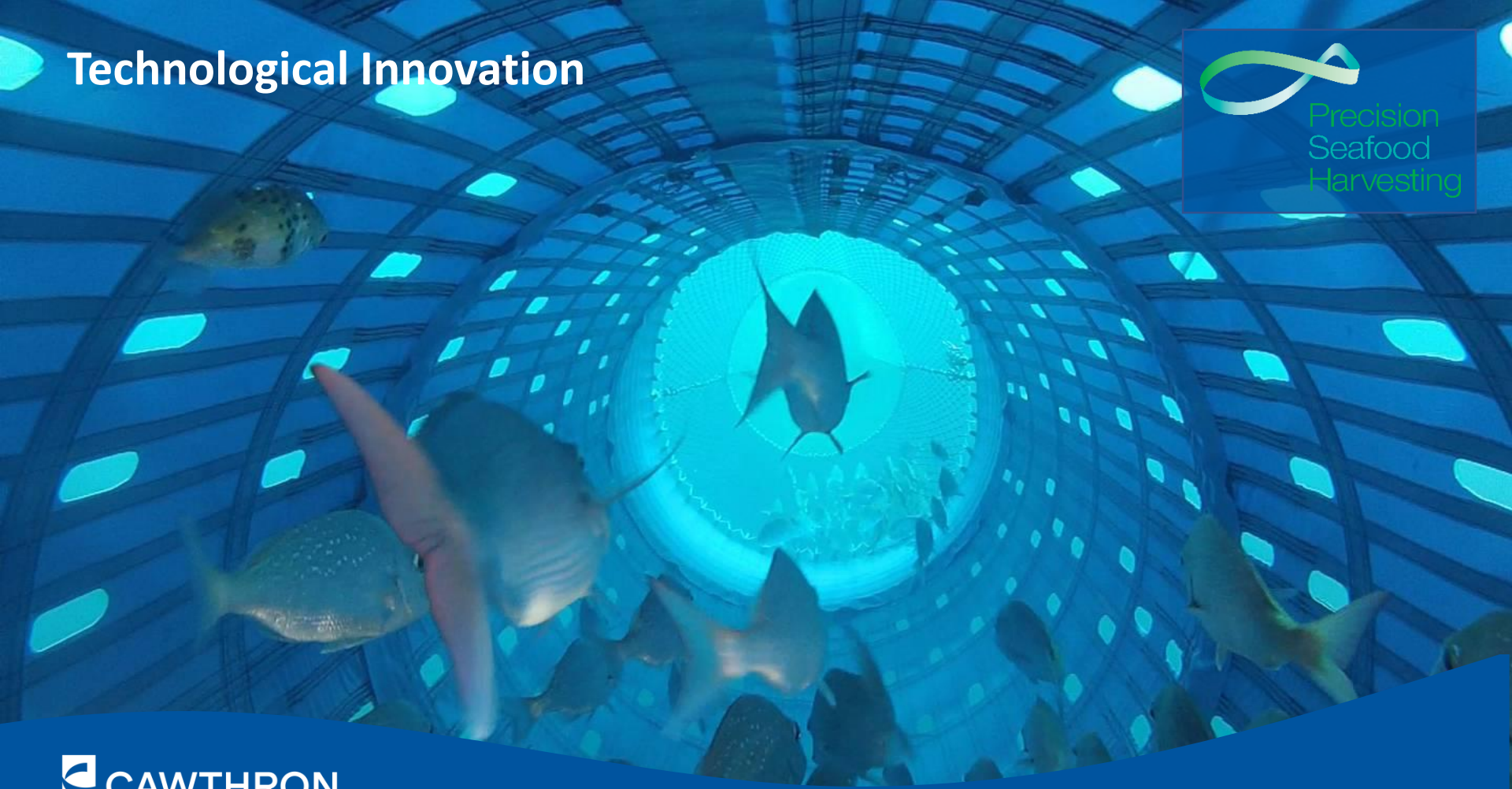
Technological Innovation



Precision Seafood Harvesting

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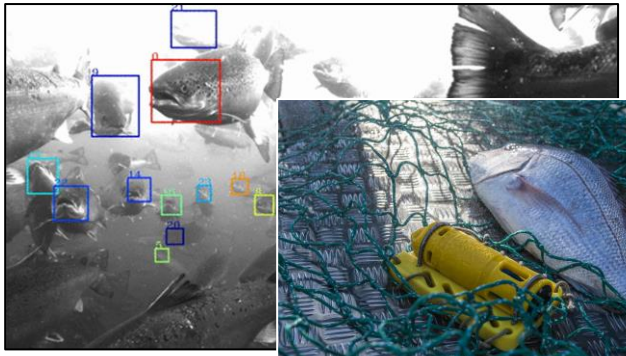
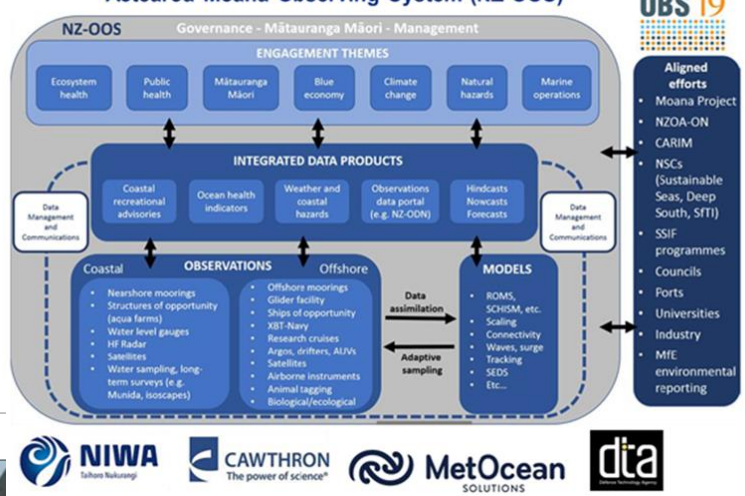
INVESTIGATING MĀTAURANGA MĀORI APPROACHES TO ENHANCING THE ENVIRONMENTAL PERFORMANCE OF COMMERCIAL NZ FISHERIES



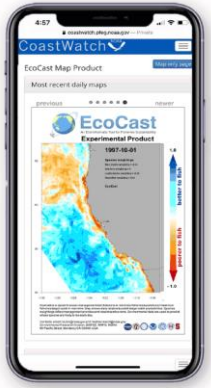
ZEBRATECH

NIWA

SNAPIT



NIWA CAWTHRON The power of science MetOcean SOLUTIONS dta



WHOI

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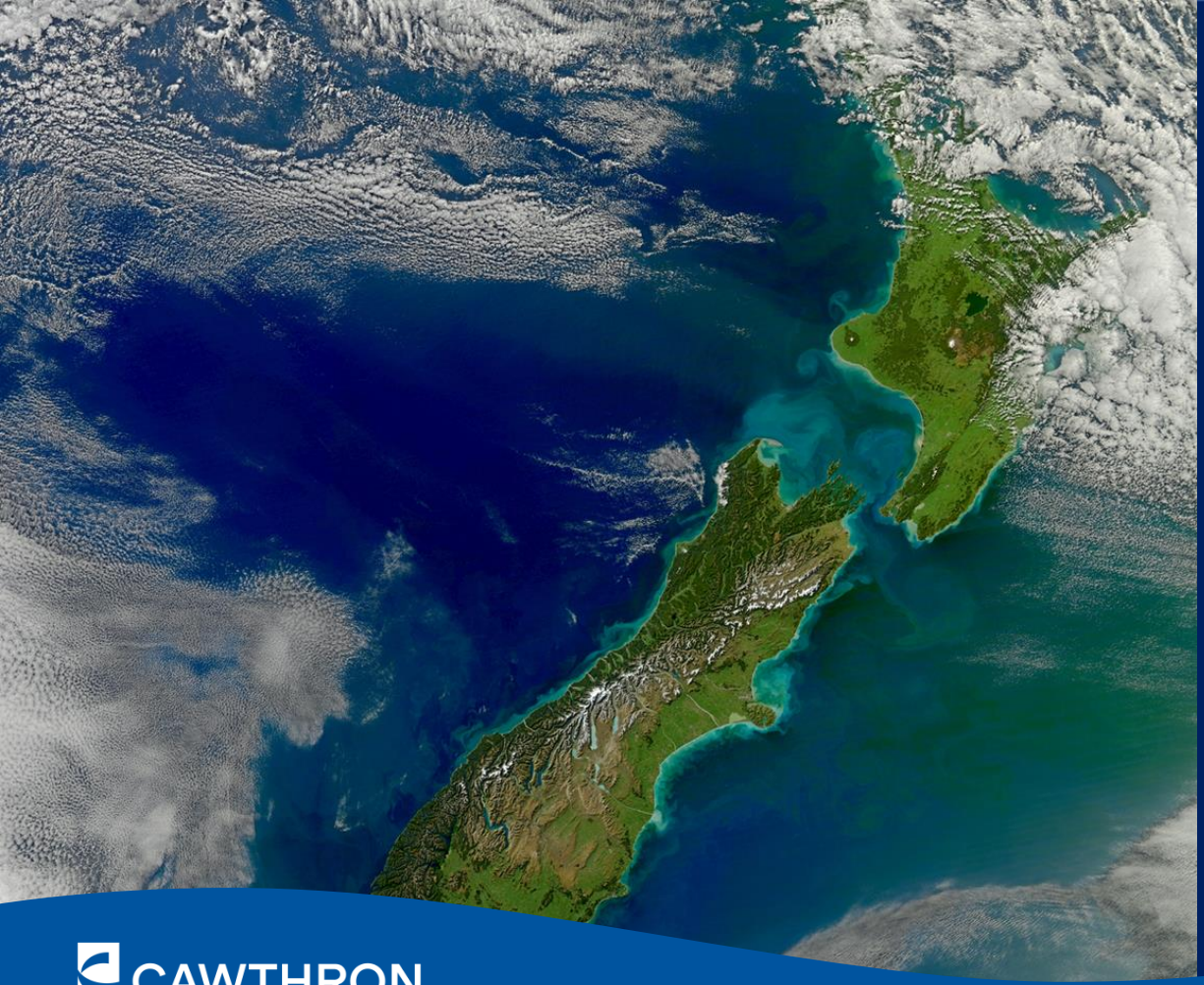

Thank you

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Ko te kōunga o te pūtaiao te auahatanga ki te ao anamata.

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Kia ora, thanks for attending!

Speaker's Science Forum

Aotearoa New Zealand

Questions welcome.

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Te Pōkai Tara
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