National Environmental Research Program

MARINE BIODIVERSITY hub

Theme 1: National Monitoring Evaluation and Reporting

NERP Theme 1 team and collaborators

Canberra, 22nd August 2012

Presentation summary

- Theme 1 objectives and milestones for 2012
- Progress to date
  - Project 1: Collation and analysis of existing data sets
  - Project 2: Analysis of approaches for monitoring biodiversity
- Spin-offs and ancillary products
- Issues and solutions so far

Theme 1: Summary

Theme vision

This theme will contribute towards two blue-prints:

1. a sustained national environmental monitoring strategy designed to evaluate marine ecosystem health, and:
2. a sustained monitoring strategy to help manage the Commonwealth Marine Reserve Network, focussing on the Southeast Marine Region.

- Theme divided into 2 projects
  - Project 1: Collation and analysis of existing data sets, NERP: $1,194,184, Non-NERP/In-Kind: $1,582,952
  - Project 2: Analysis of approaches for monitoring biodiversity in Commonwealth waters, NERP: $1,744,224, Non-NERP/In-Kind: $2,345,935

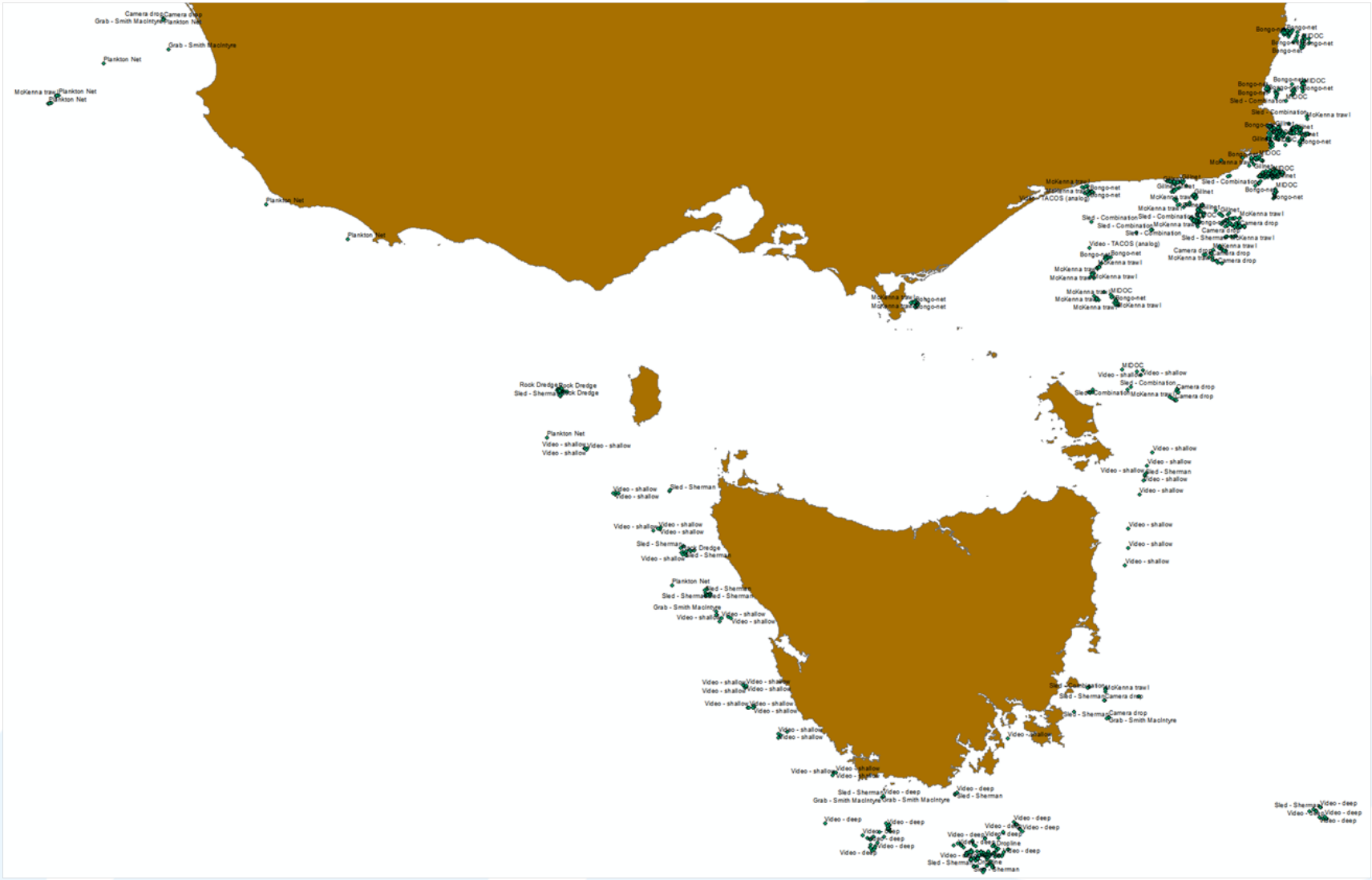
Theme 1: Milestones (AWP 2012)

Project	Milestone	Due date	Status
1 & 2	Meeting with SEWPaC to finalise science plans	31/03/12	Not started
2	Flinders CMR: Survey design (and power analysis)	30/06/12	Completed
2	Solitary islands: Survey design (and power analysis)	30/08/12	Completed
2	Flinders CMR: Field work	31/11/12	Completed
2	Solitary islands: Field work	31/11/12	Completed
1	Catalogue of existing data sources and their relevance to KEFs and/or CMRs in the south east marine planning region	31/11/12	On-going
1	Development and where possible application of new and existing statistical models for multivariate trend and change point detection	31/11/12	On-going
1 & 2	Annual report write up and draft presentation to SEWPaC	31/11/12	On-going
1	Identification and prioritisation of key data gaps for a sustained national marine environmental monitoring strategy and SE CMR network management strategy	31/03/14	On-going
2	Houtman-Abrolhos islands: Survey design (and power analysis)	30/04/13	Not started
2	Houtman Abrolhos islands: Field work	31/11/13	Not started
1	Data analysis and provision in format suitable for SoE 2016 contingent of extant data sources	31/08/14	On-going
1 & 2	Final annual report	31/11/14	Not started

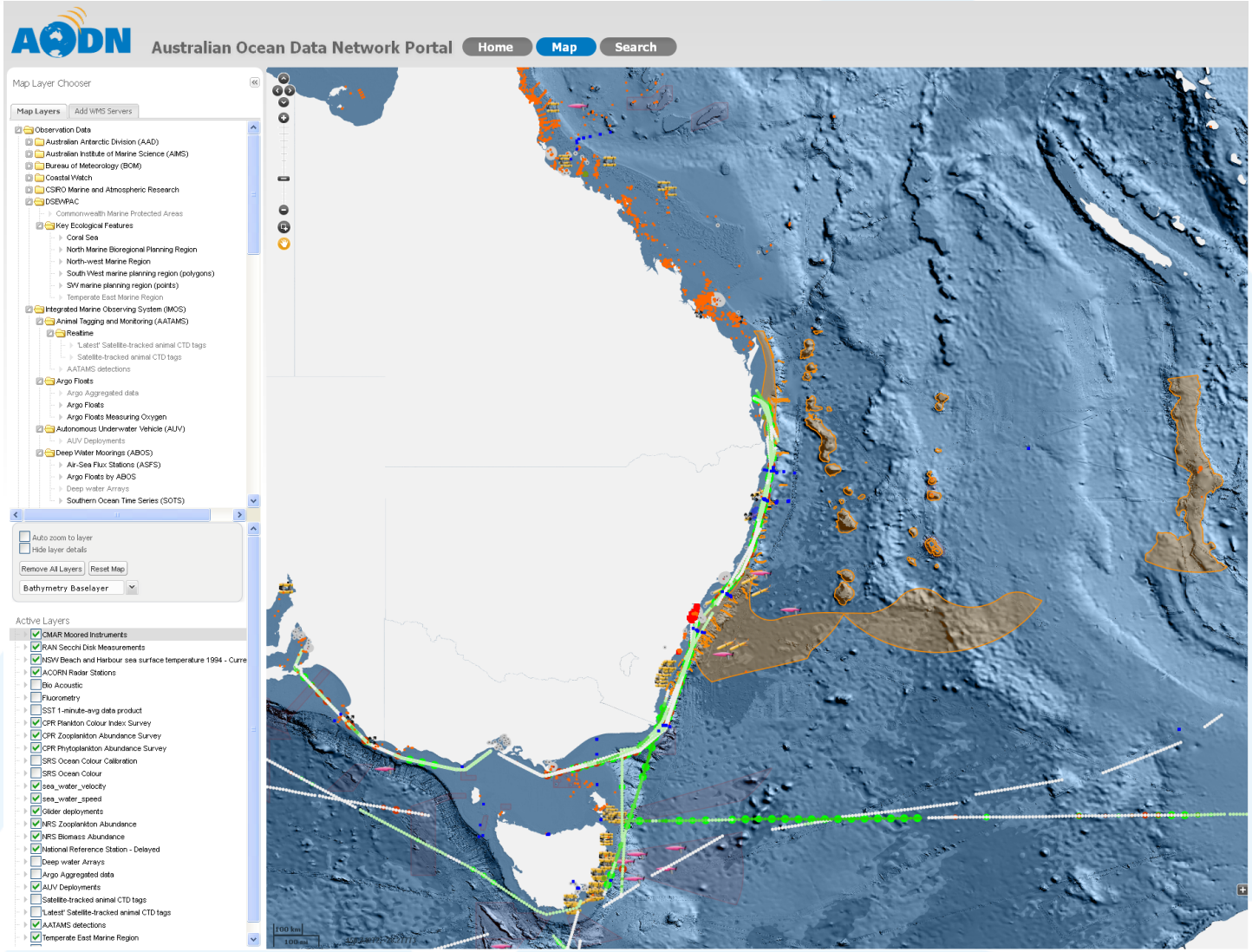
Project 1: Data catalogue

- Project 1 aims *inter alia* to source and analyse data sets to invalidate KEF predictions and identify gaps for CMR management
- Data discovery and accessibility a major stumbling point
  - 100's - 1000's data sets currently not visible
  - each new project spends considerable resources 'discovering' data
- Solution lies with IMOS/AODN
  - encouraging greater participation particularly for biological data
  - working on simple meta-data template (with Theme 2)
  - KEF and CMR shape files on AODN portal helps identify overlap

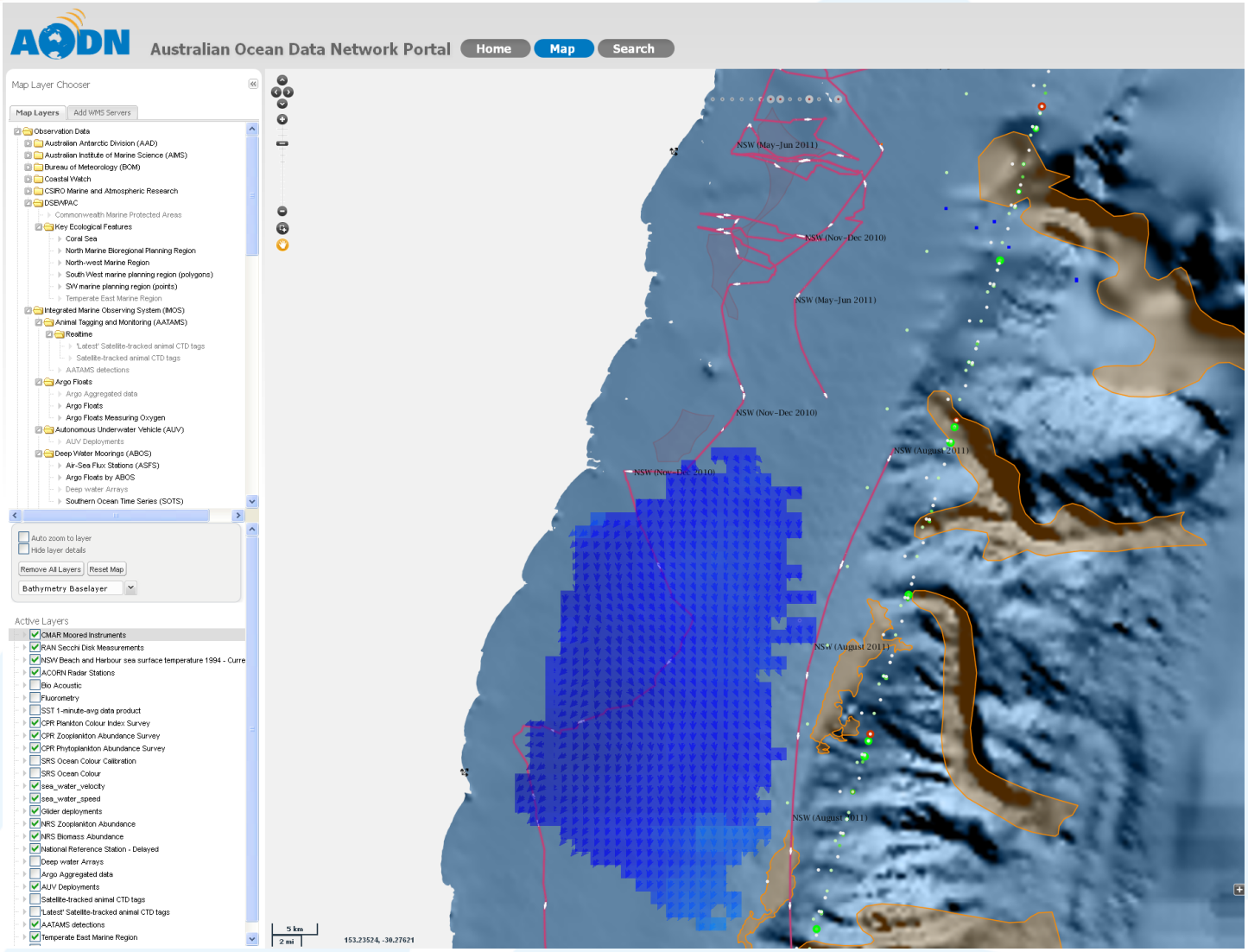
SE Data sets


Camera drop
Grab - Smith MacIntyre
Plankton Net
McKenna trawl
Bongo-net
MIDOC
Sled - Combination
Video - TACOS (analog)
Rock Dredge
Sled - Sherman
Video - shallow
Video - deep

Project 1: Eastern Australia data



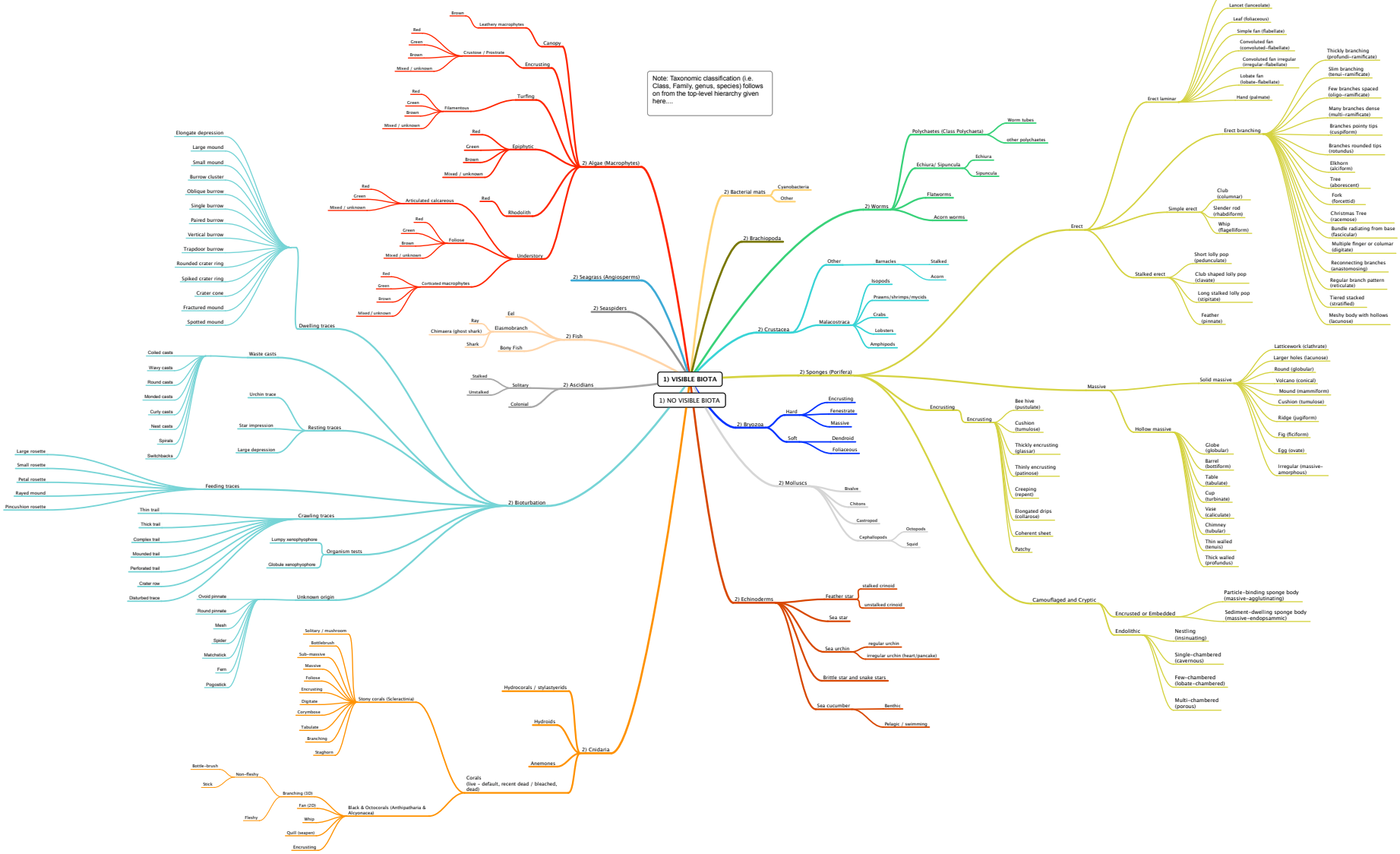
Project 1: Solitary Islands data



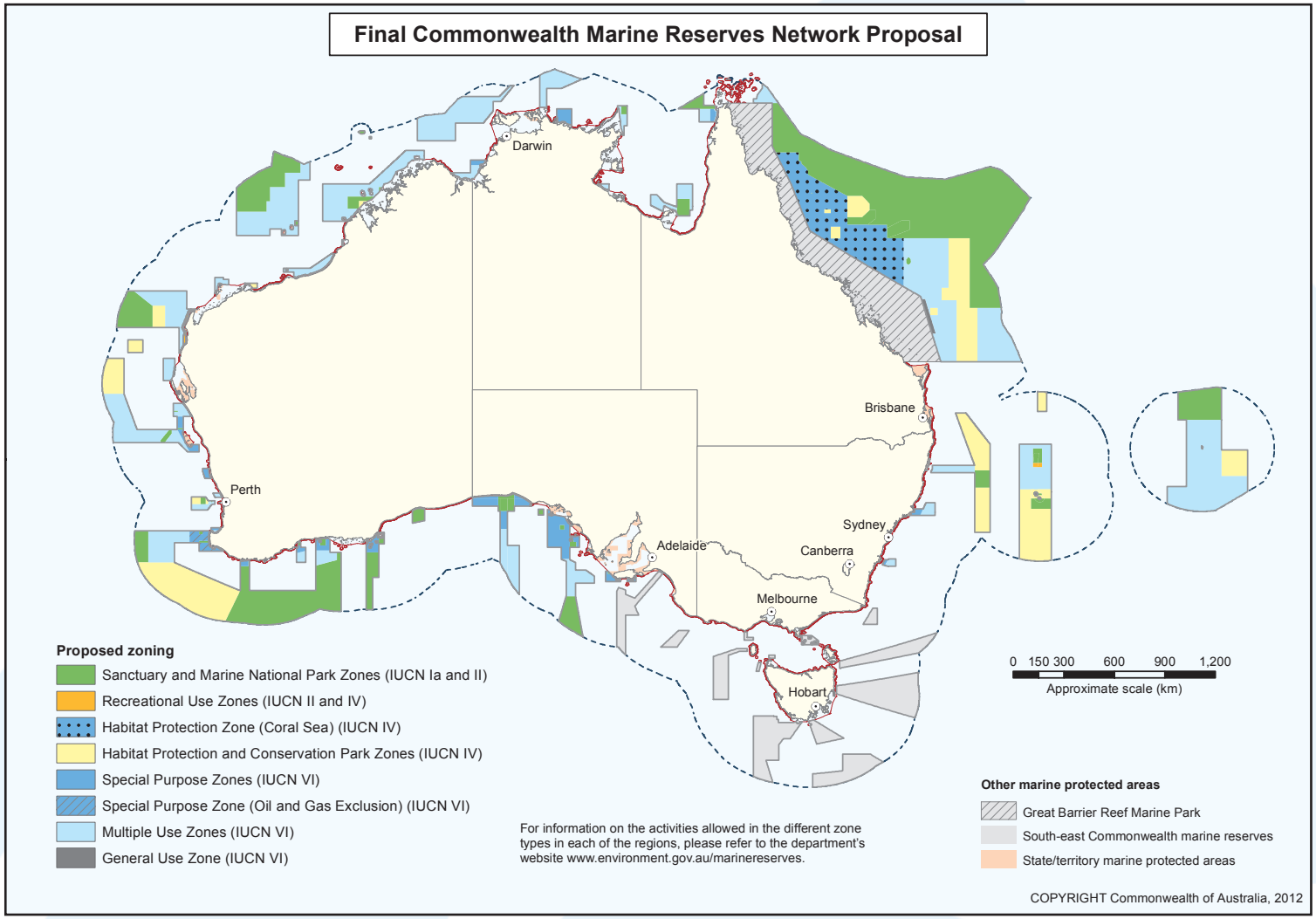
Project 1: Methods catalogue

- Methods catalogue
  - How to identify trends and change points in time series
  - Many methods with different sensitivity to number of observations and distributional assumptions
- Quick taxonomy of methods
  - EDA - comparison of plots, ordination analysis
  - Non-parametric tests - at least 8 tests in the literature
  - Parametric models - GLMs, GLMMs, MAR(1), SEMs, $\cdots$
  - State space models - linear and non-linear
  - Statistical process control

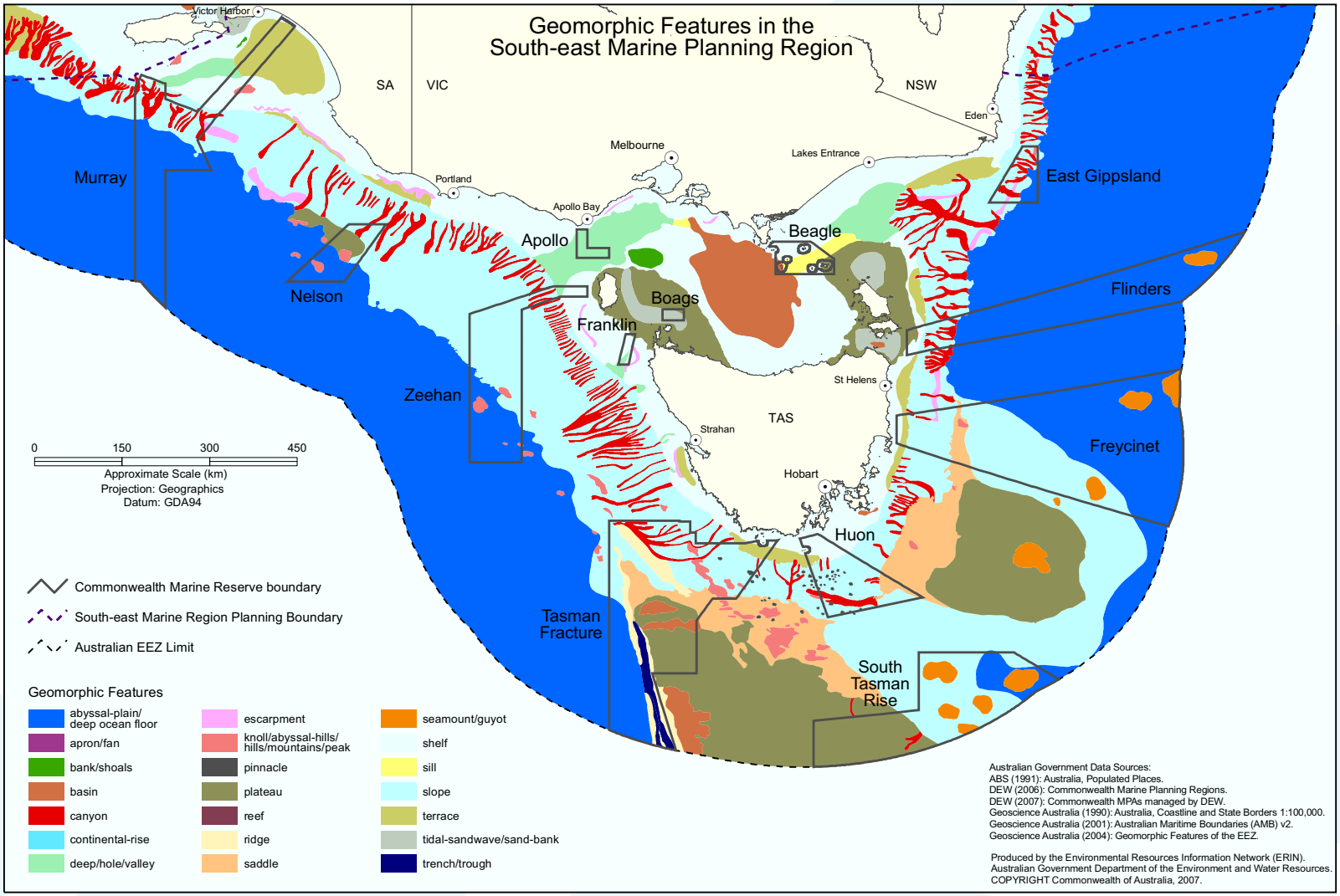
Project 1: CATAMI standard



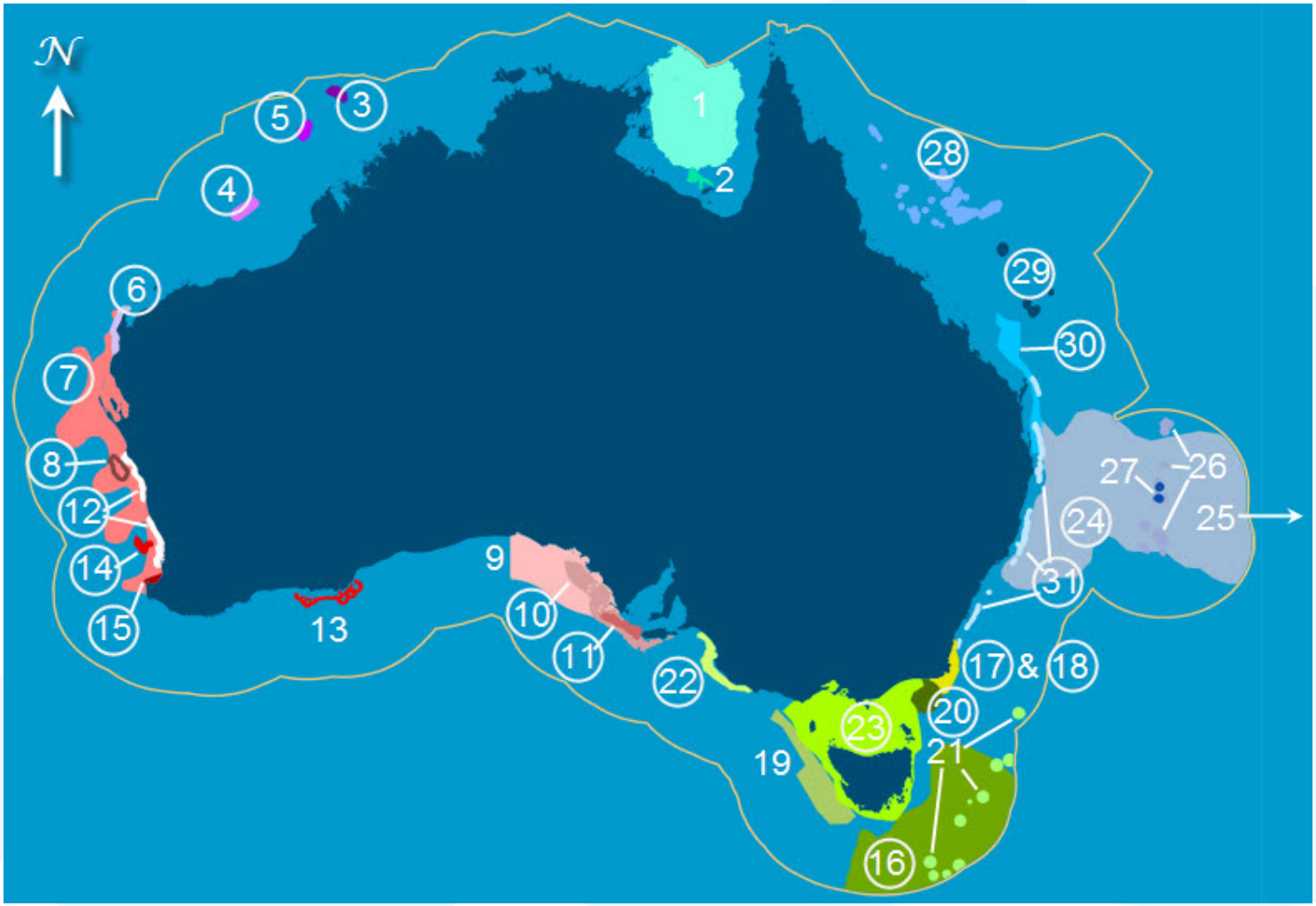
Project 2: Proposed CMR estate



Project 2: SE CMR estate



Project 2: National KEFs



Project 2: MER frameworks

US NPS MONITORING FRAMEWORK

- DEFINE GOALS
- Project 1: COMPILE EXISTING DATA
- DEVELOP CONCEPTUAL MODELS
- SELECT AND PRIORTISE INDICATORS
- Project 2 pilot studies: DEVELOP SAMPLING DESIGN
- Project 2 pilot studies: DEVELOP MONITORING PROTOCOLS
- IMOS/ AODN/ CATAMI/ Project 1: MANAGE DATA, ANALYSE AND REPORT

CSIRO INDICATOR FRAMEWORK

INPUTS	PROCESS	OUTPUTS
MARINE BIOREGIONAL PROFILES	IDENTIFY ECOLOGICAL SYSYEM DRIVERS	
MARINE BIOREGIONAL PROFILES	IDENTIFY KEFs AND THREATS	
GIS DATA LAYERS	MAP KEFs AND THREATS	SoE REPORTING
EXPERT AND STAKEHOLDER WORKSHOPS	CONCEPTUAL MODELS OF KEF-THREAT INTERACTION	
QUALITATIVE MODELLING	PREDICT HOW KEF WILL RESPOND TO THREATS	
	IDENTIFY AND PRIORITIZE INDICATORS	
	MEASURE INDICATORS AND THREATS	COMPARE PREDICTIONS WITH OBSERVATIONS
	ASSESS AND REPORT	SoE REPORTING

Project 2: Monitoring

- Survey design and monitoring protocols
  - Critical components of a MER framework
  - Size of CMR estate (and paucity of data) = significant challenge
  - Many new observation platforms = challenge and opportunity

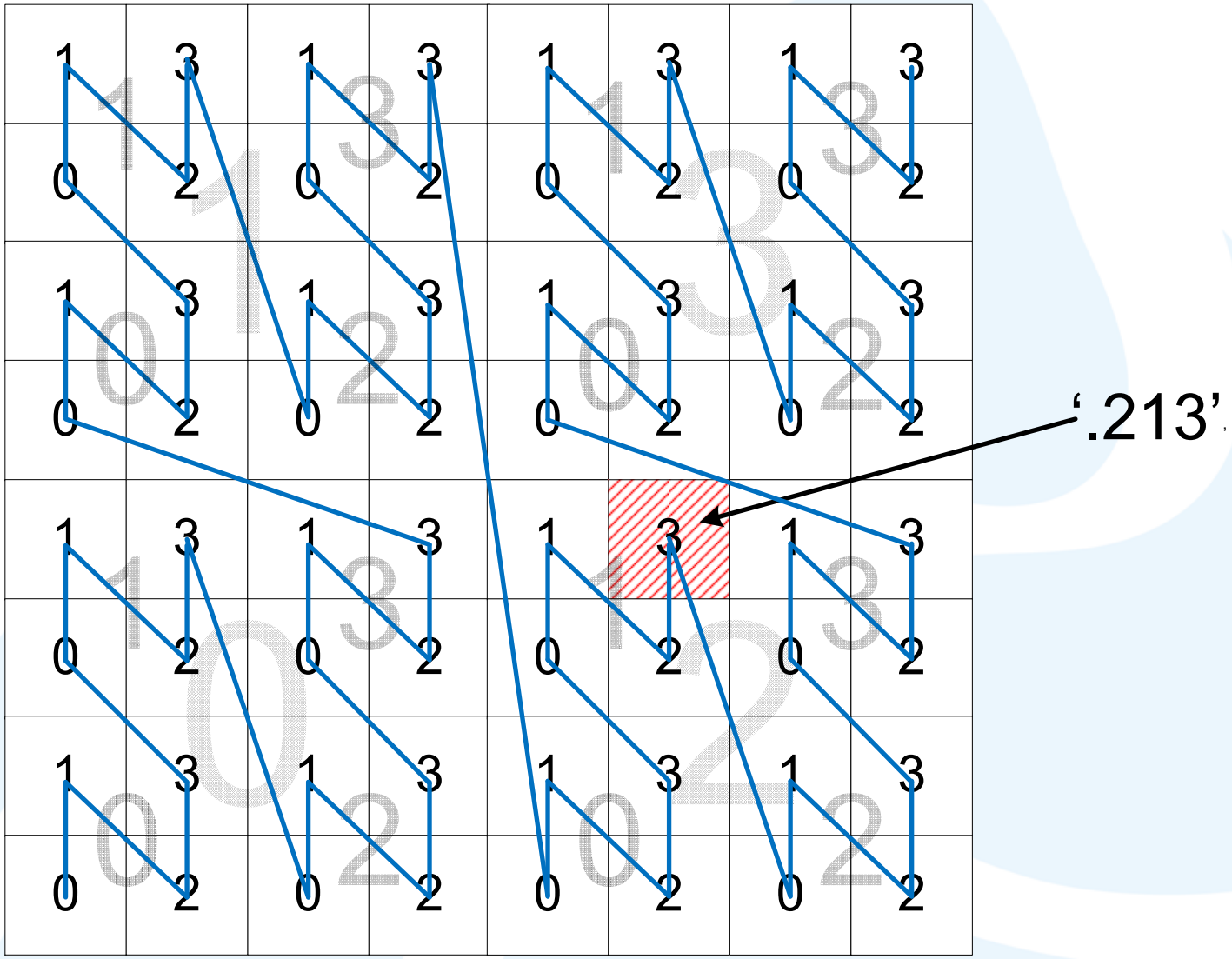
- Project 2 objectives
  - Survey design and power
  - Cost and logistical feasibility
  - Pilot studies: Flinders CMR, Solitary Islands, Houtman-Abrolhos Islands

Project 2: GRTS

- Generalised Random Tessellation Stratified (GRTS) design
  - Core recommendation for national blueprint
  - Employed by US National Parks Service and Environmental Protection Agency (amongst others)

- Long list of advantages
  - Works for finite, linear, and areal resources
  - Spatially balanced - uncovers pattern in observations
  - Consecutive sub-sequence of the full sample retains spatial balance
  - Inclusion probability can be $\propto$ to any positive ancillary variable
  - Good variance properties under sampling constraints (e.g. site inaccessible)

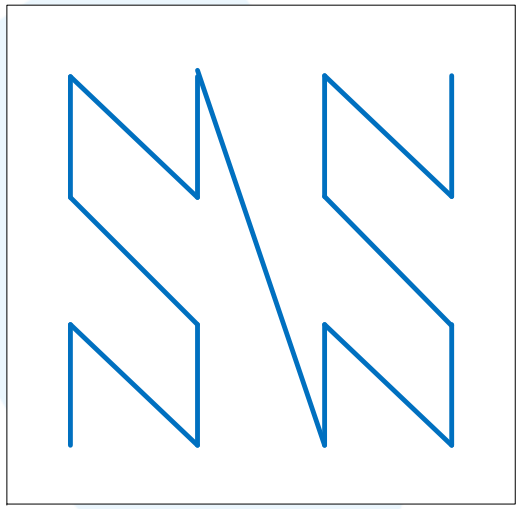
GRTS: 3L quadrant recursive partition



GRTS: 2L hierarchical random order

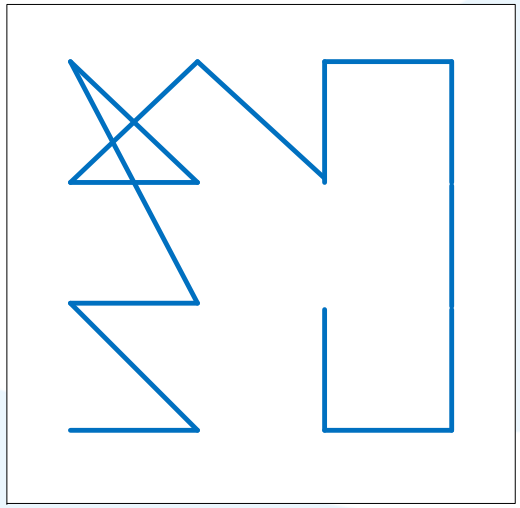
6	8	14	16
5	7	13	15
2	4	10	12
1	3	9	11

Non-random order

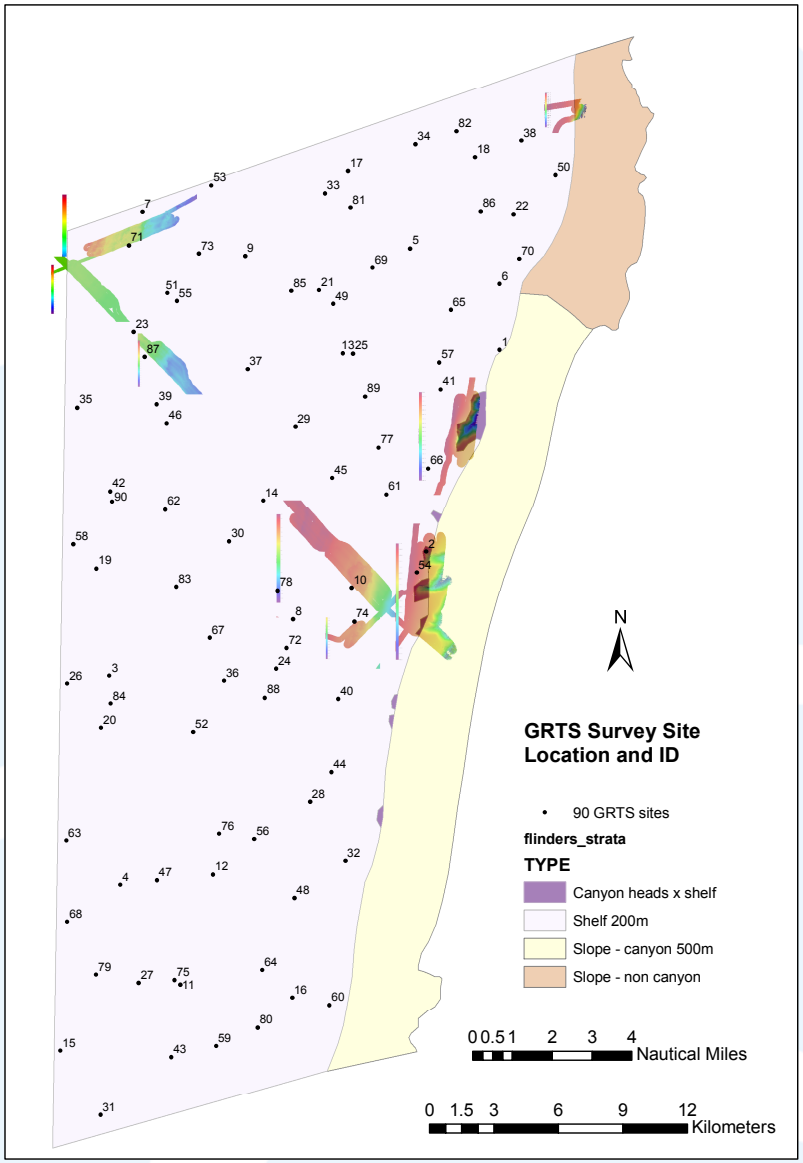


12	9	7	6
10	11	8	5
14	13	1	4
16	15	2	3

Hierarchical random order



Flinders CMR: 90 GRTS shelf sites



Flinders pilot: objectives

- Flinders CMR pilot survey objectives for slope and shelf:
  - Develop and trial GRTS design to characterise habitat
  - Deploy, retrieve and analyse data for a suite of non-destructive survey methods
  - Demonstrate applicability and constraints relative to SEWPaC objectives

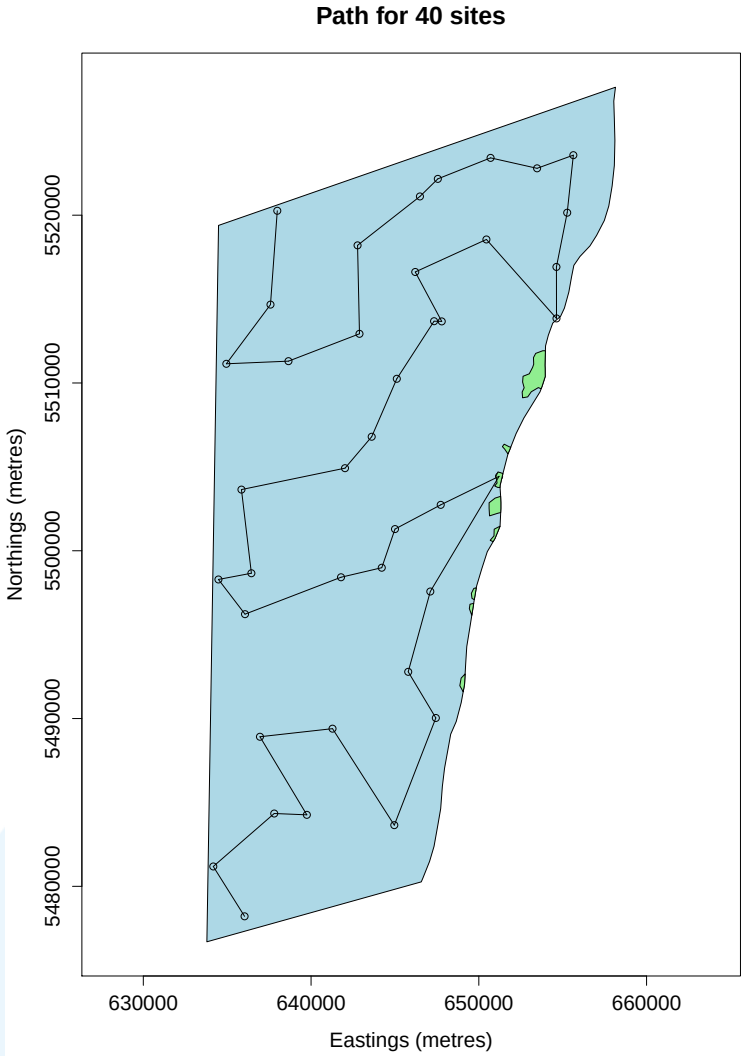
- Conservation values objectives for the CMR
  - Yet to be fully operationalized (Theme 2)
  - Have begun with:
    1. low productivity, highly impacted species
    2. commercially important fish species
    3. invertebrate mega-benthos

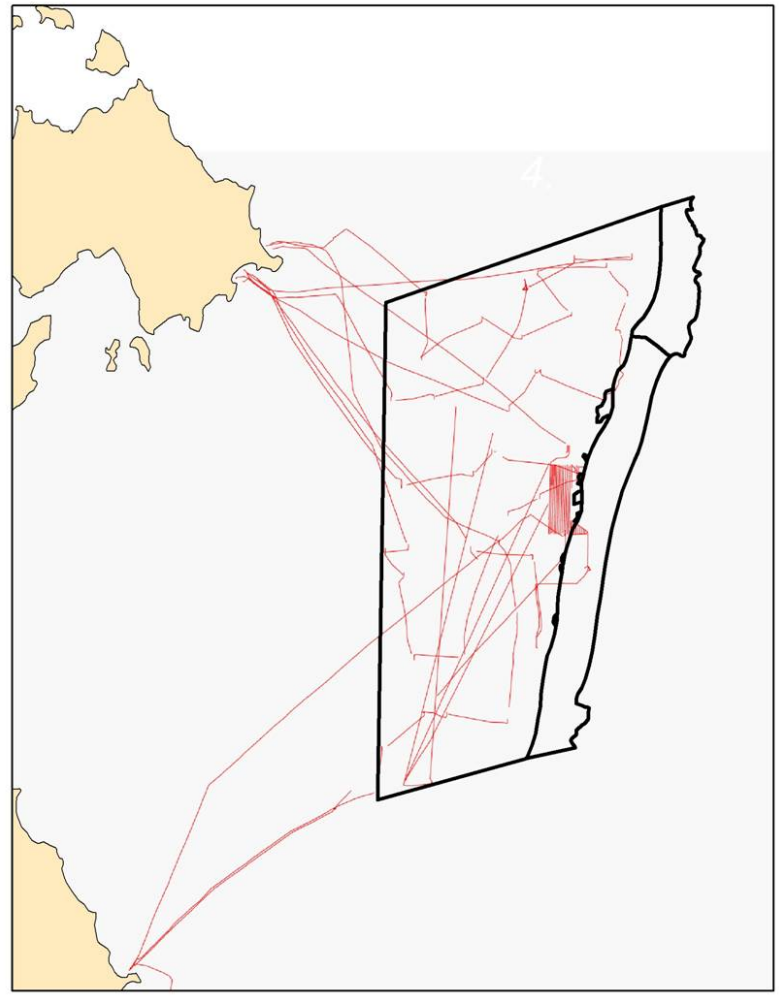
Flinders pilot: Survey equipment

Flinders pilot: Phase 1 outcomes

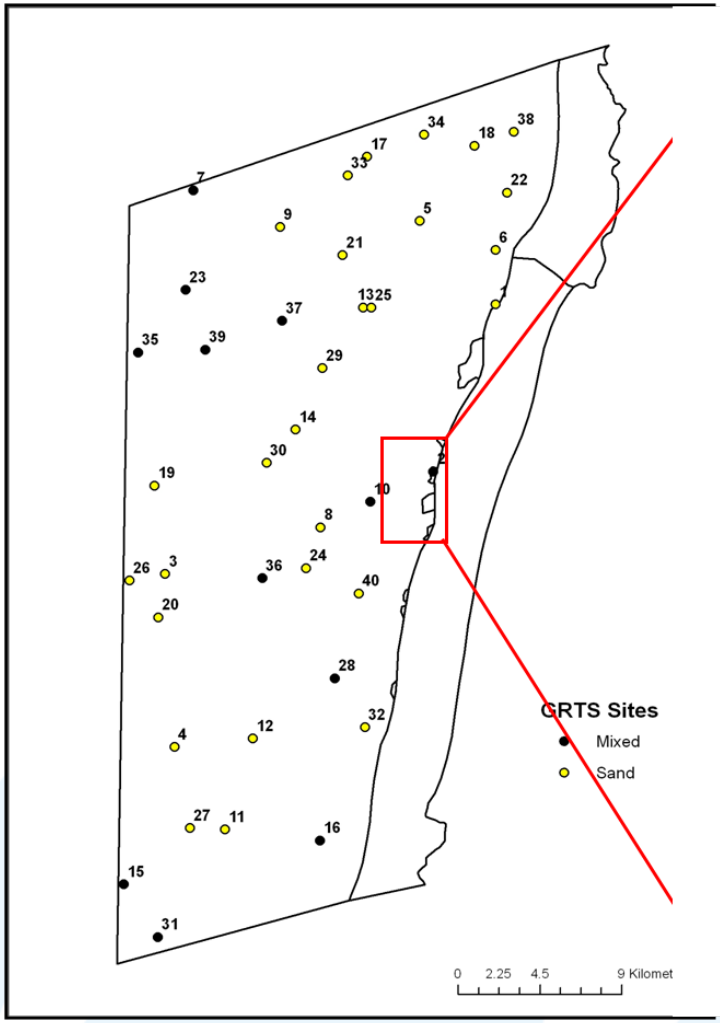
- Phase 1 outcomes:
  - 40 drop camera samples to GRTS design
  - Swath map between GRTS sample locations
  - Continuous swath map of $\sim$ 30kms^2
  - Sediment grab at 31 stations
- Constraints relate to:
  - Significant transit distances
  - Vessel unable to work through the night
  - Objectives and conceptual models

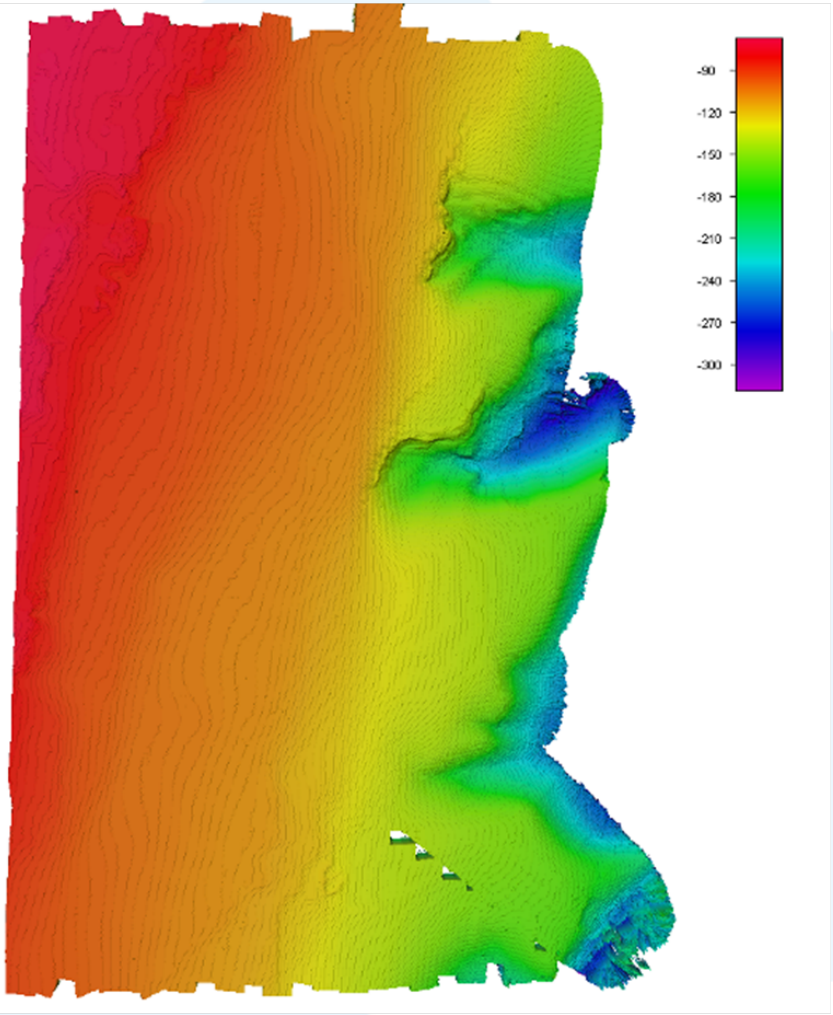
Flinders pilot: Phase 1 outcomes



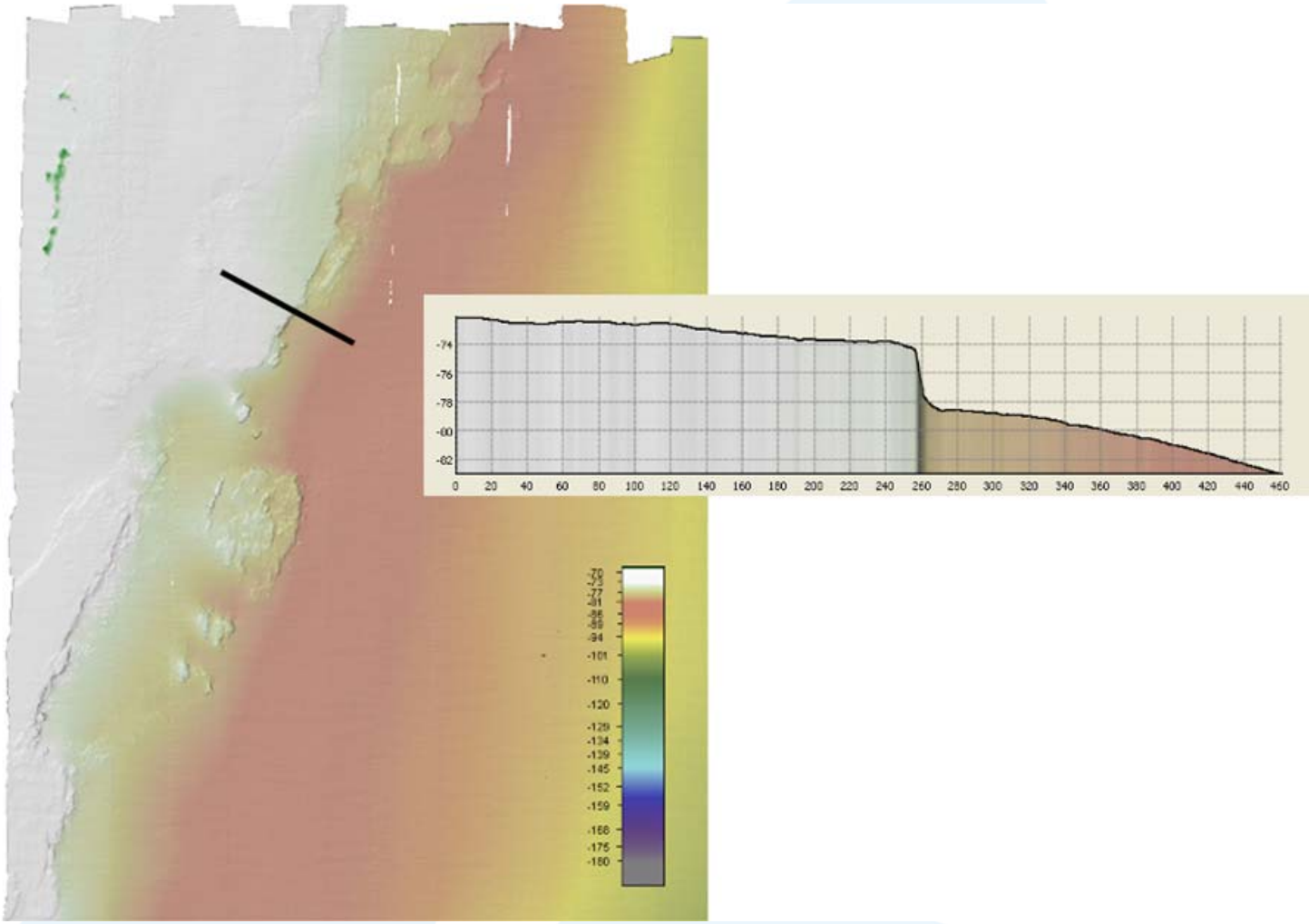


Flinders pilot: Phase 1 outcomes





Flinders pilot: Phase 1 outcomes

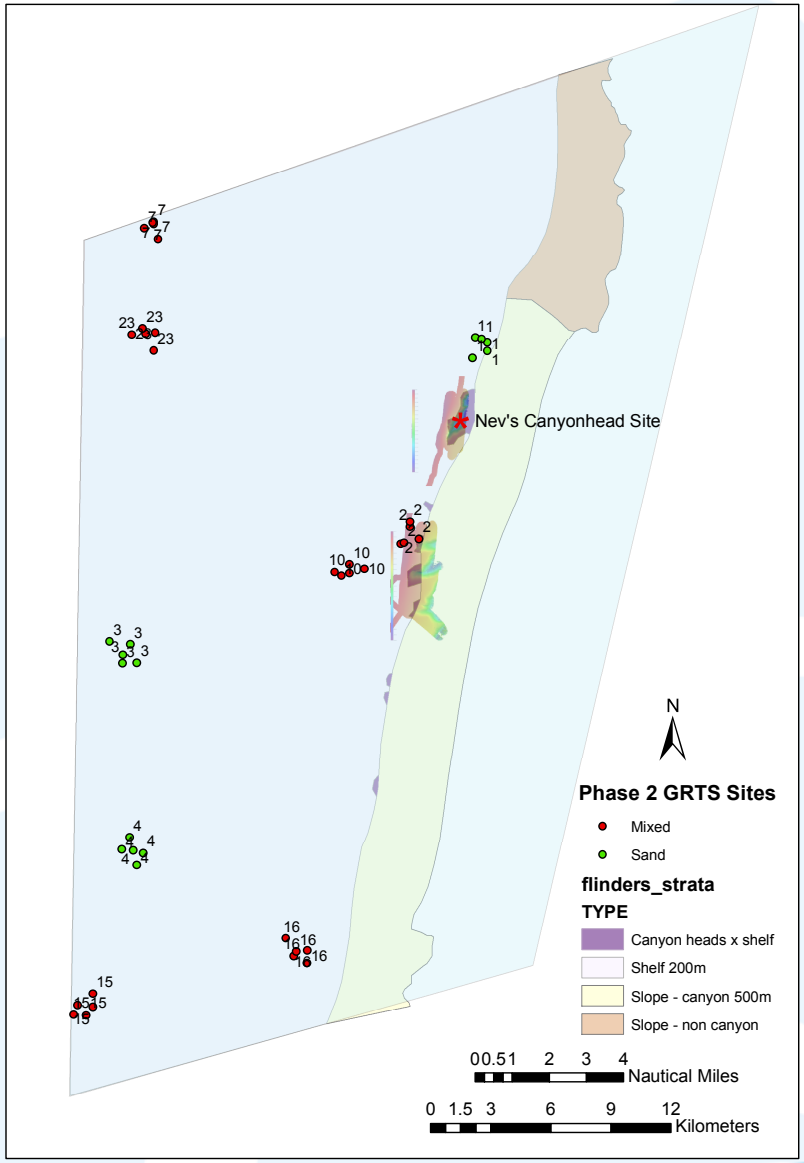


Flinders pilot: Drop camera @ 35

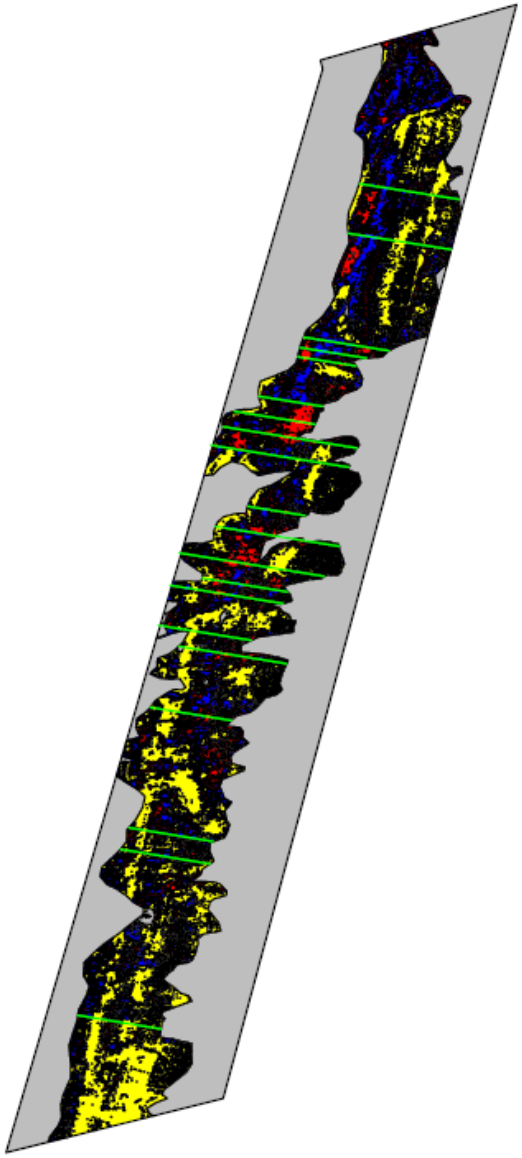
Flinders pilot: Phase 2 summary

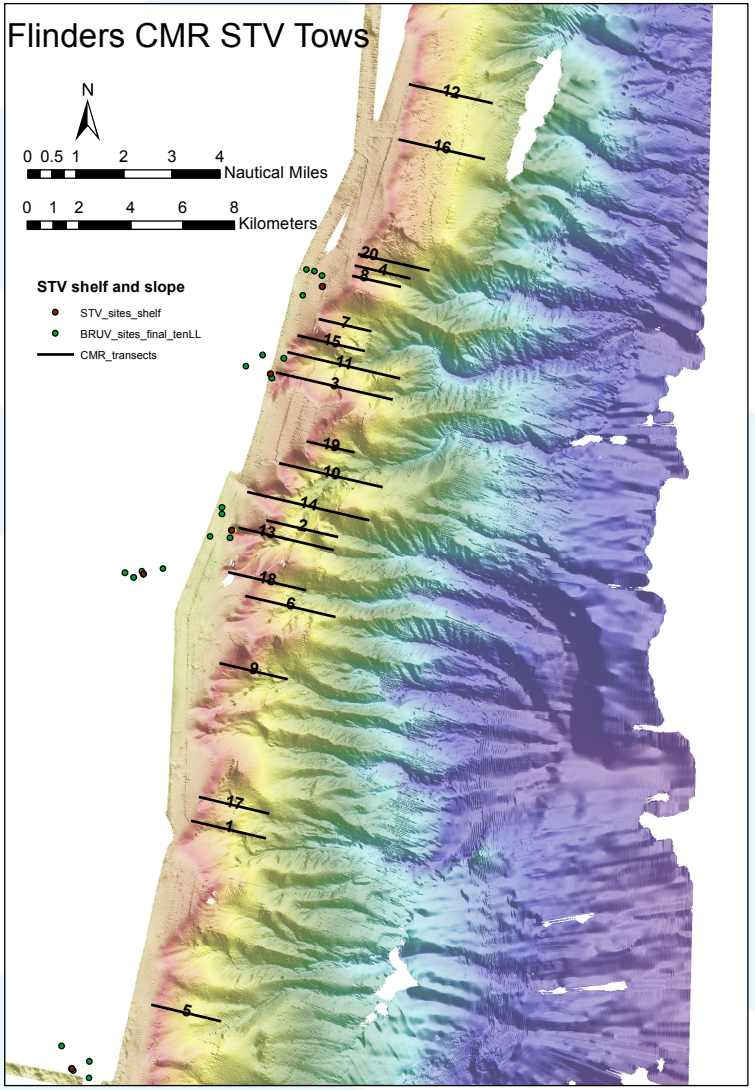
- Phase 2 outcomes (CMR):
  - Shallow water BRUVs (sets of 5) and STV tows (sets of 2) at 13 shelf and canyon head sites
  - Deep water BRUVs at two slope sites
  - STV slope transects at 8 GRTS-based start points
- Phase 2 outcomes (CBC and CC):
  - Deep water BRUVs at two slope sites
  - STV slope transects at 4 GRTS-based start points
  - STV slope transects at 2 selected points

Flinders pilot: Phase 2 shelf sites



Flinders pilot: Phase 2 slope transects

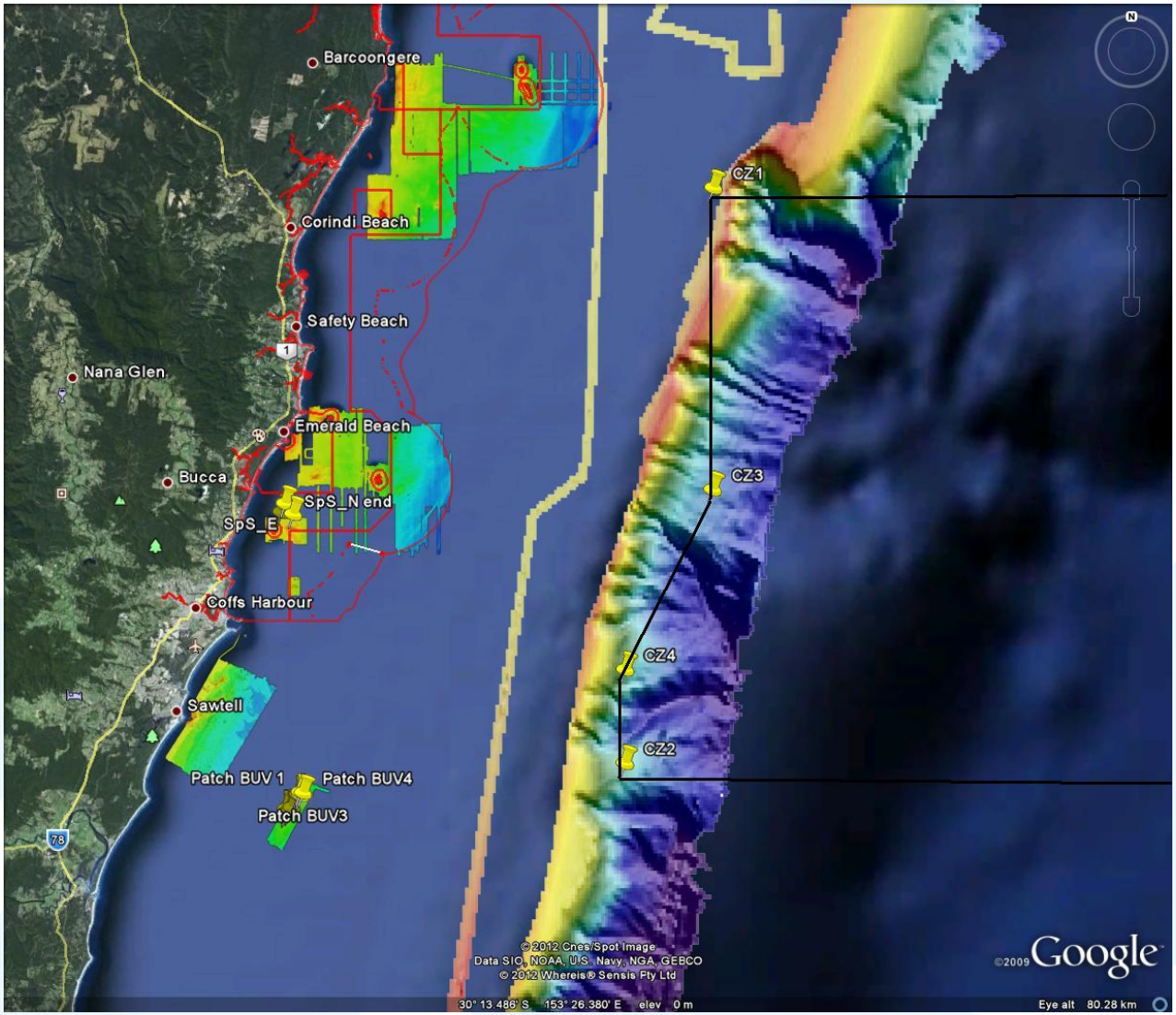




Flinders pilot: BRUV @ 23

Flinders pilot: BRUV @ 10

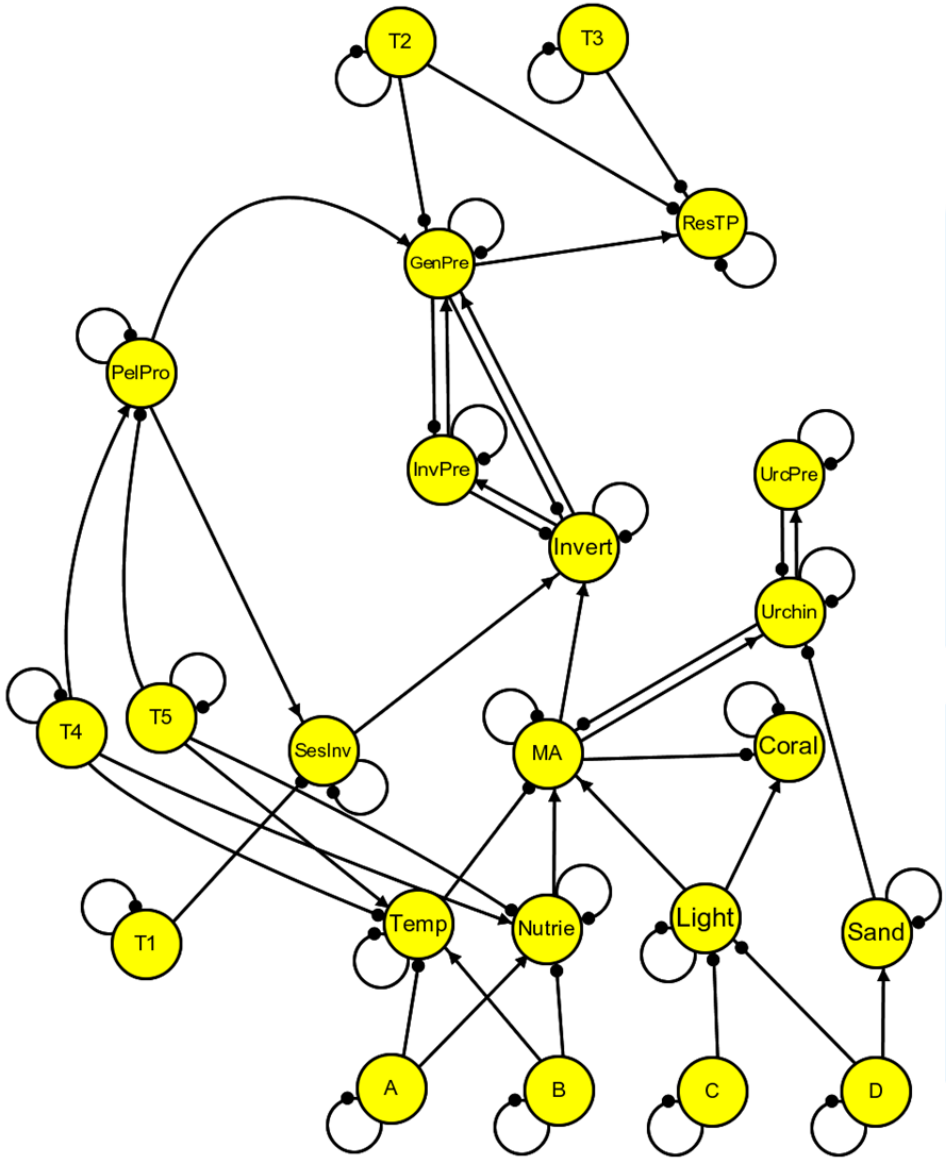
SI pilot: Context



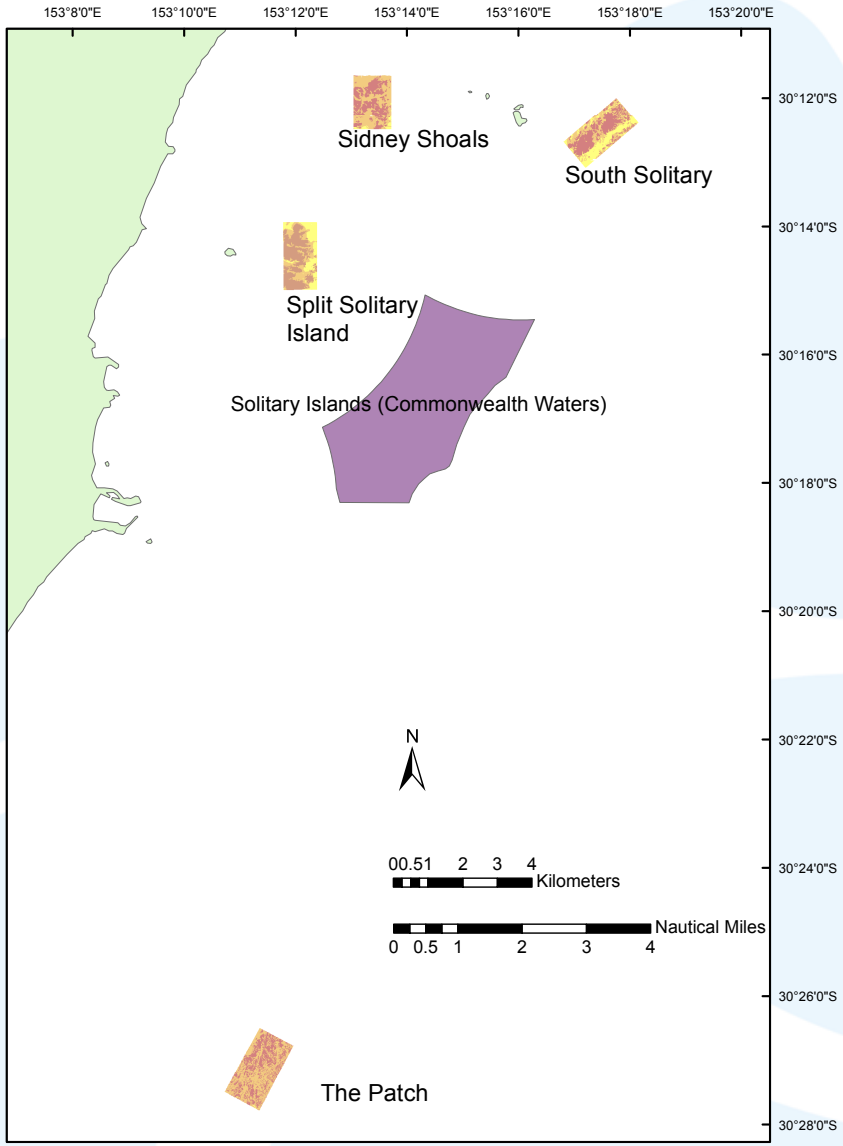
SI pilot: Objectives

- Objectives of Solitary islands pilot
  - deploy, retrieve and analyse data from a suite of non-destructive survey methods in the KEF
  - compare AUV and STV deployment - ”dense-broad grid” v GRTS
  - autocorrelation with BRUVs
  - demonstrate applicability and constraints relative to KEF objectives
- Qualitative model predictions
  - well developed conceptual models for four habitat types
  - methods to invalidate KEF model predictions

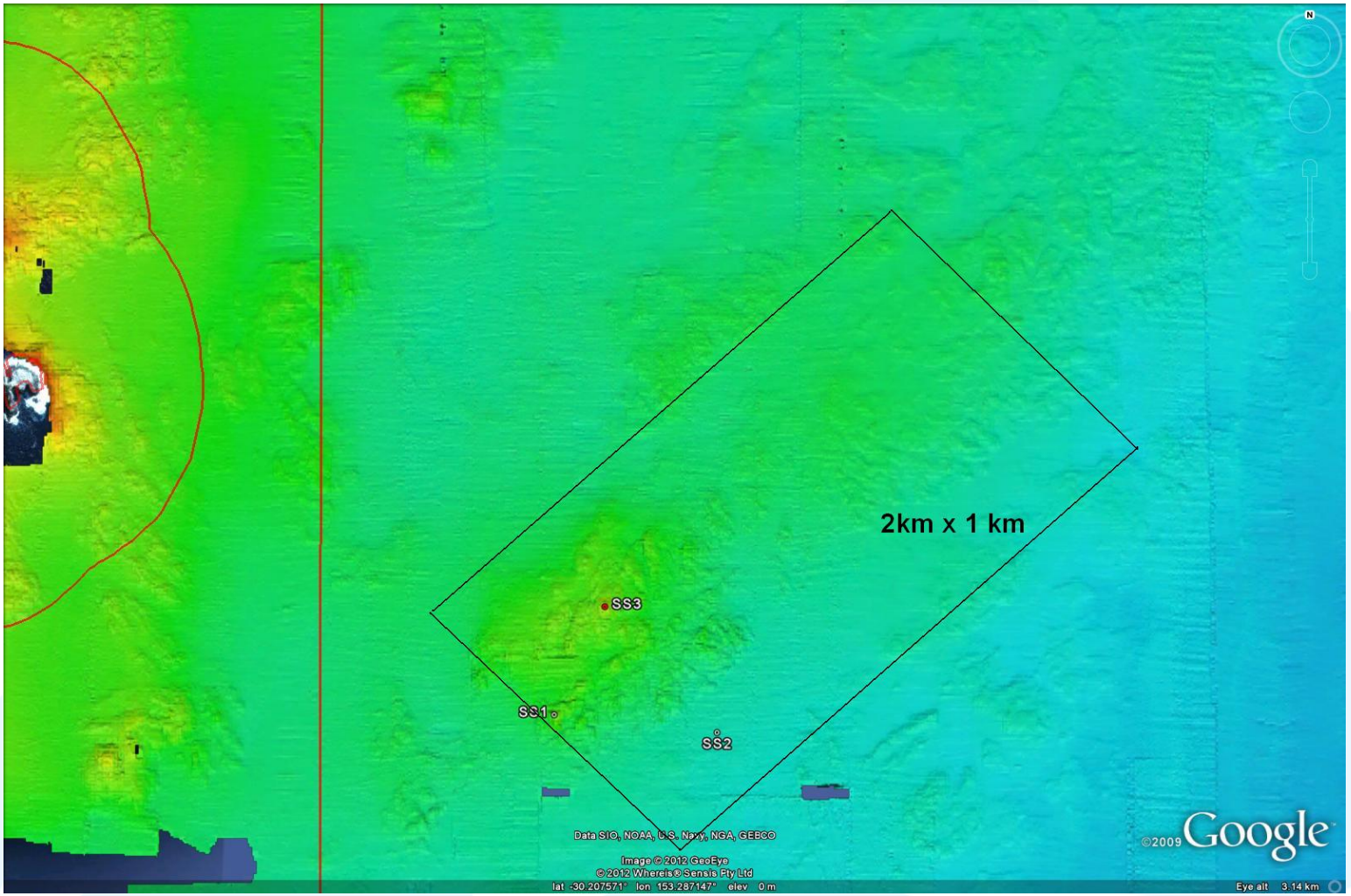
SI pilot: Conceptual model



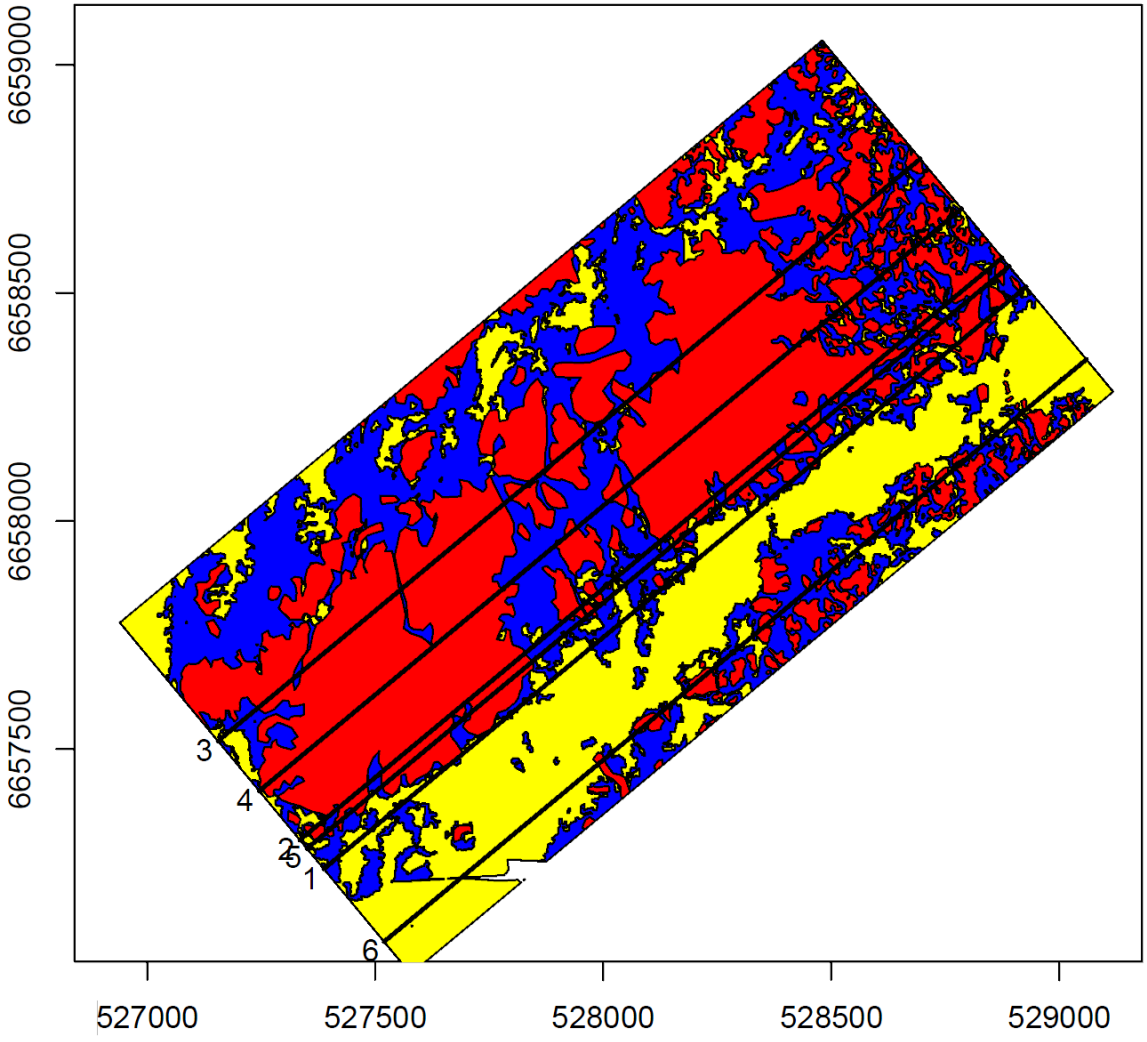
SI pilot: survey sites



South Solitary: survey frame



South Solitary: GRTS transects

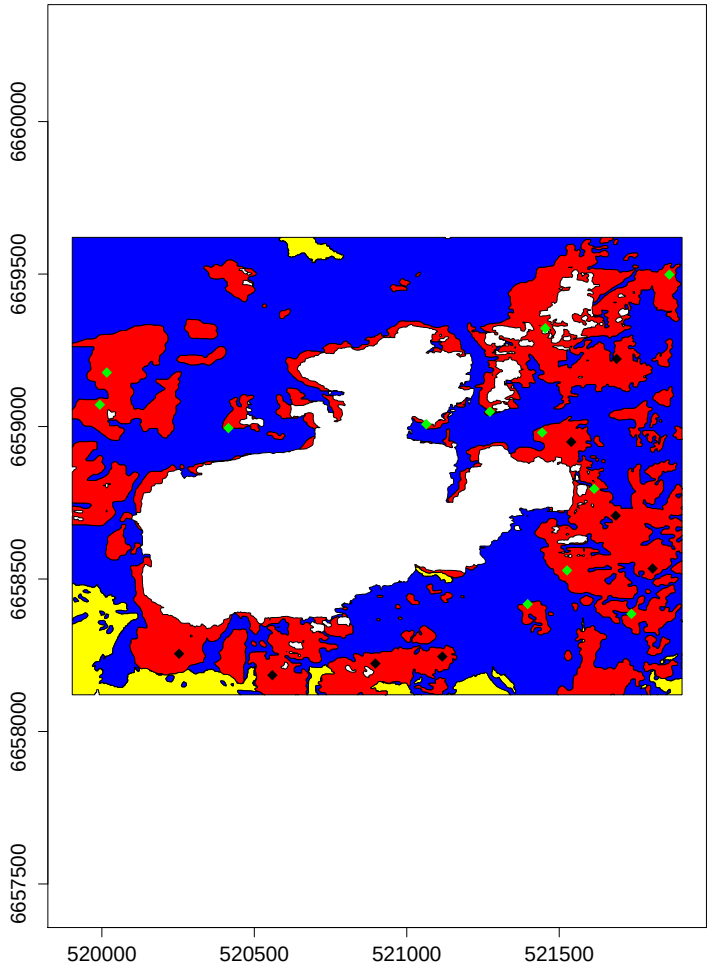


SI pilot: Outcomes

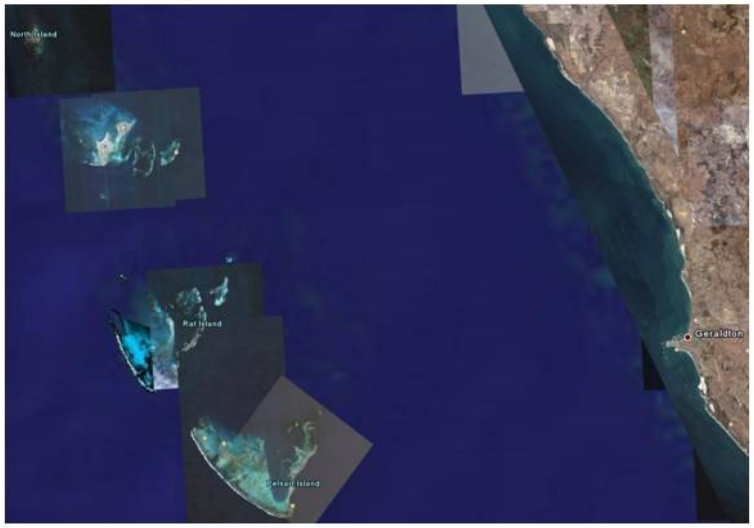
- Solitary islands pilot outcomes
  - 4 STV transects in each of 4 KEF survey locations
  - BRUVs (sets of 4) in each of the 4 KEF survey locations
  - 20 BRUVs in autocorrelation experiment
  - AUV with forward oblique looking SV this week
  - Continuous swath map of $\sim$ 30kms^2 weather delayed

- Constraints relate to
  - weather
  - precise location of BRUVs
  - mechanical failures

40 Acres: GRTS BRUV design



Houtman-Abrolhos Islands: Context



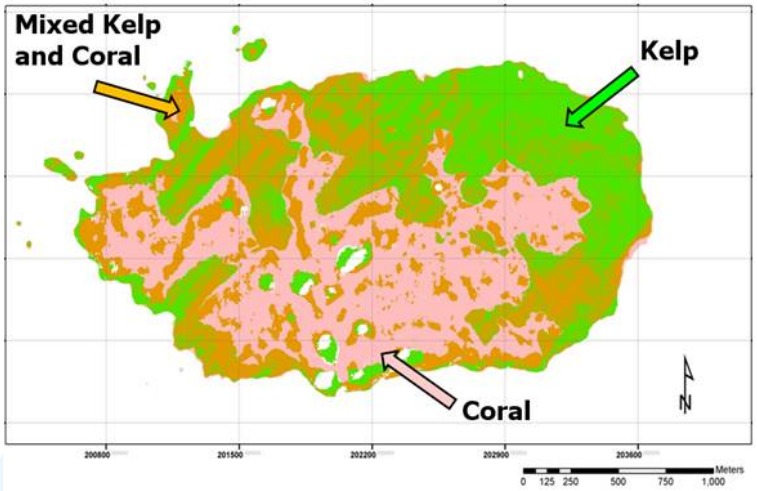
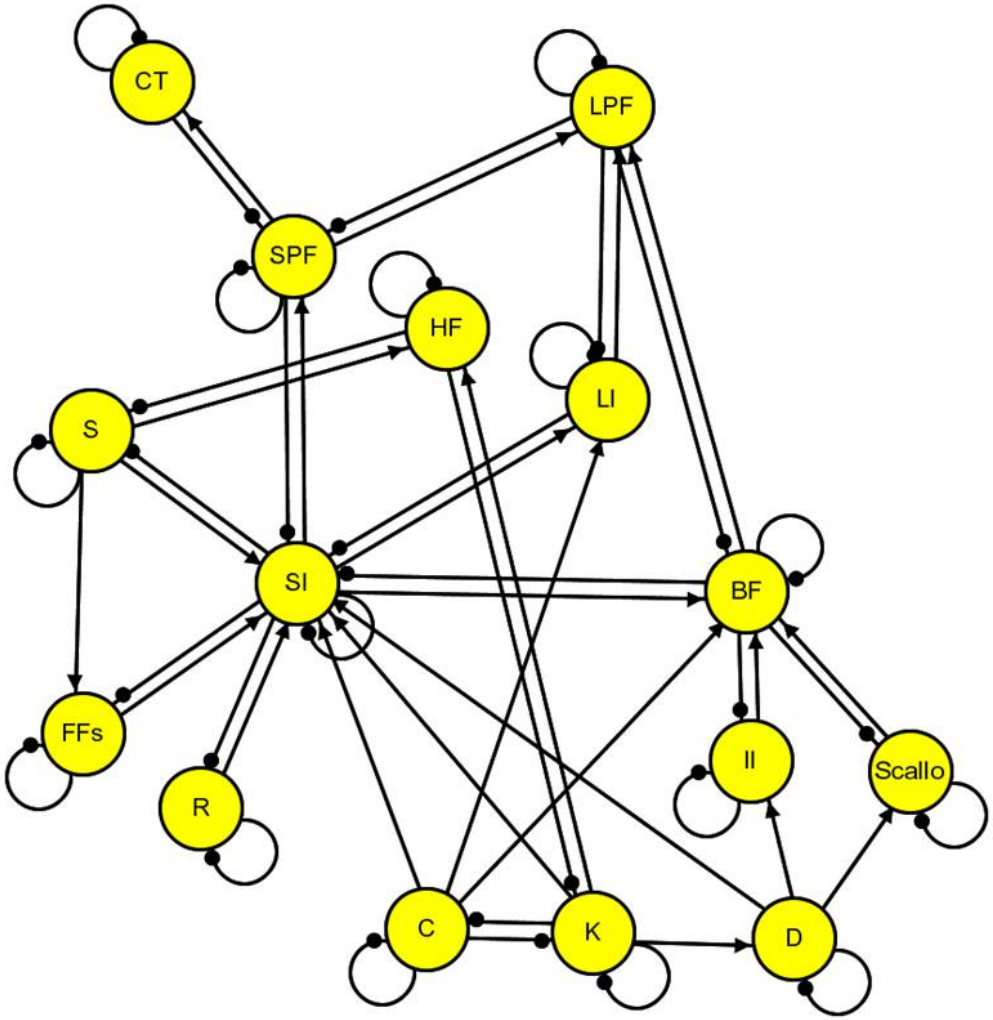


Image courtesy of Marine Futures, UWA



HA Islands: Summary

- Objectives for HA island pilot
  - Not fully determined yet
  - Western (boundary current) comparison for Solitary Islands
  - KEF conceptual model invalidation
  - leverage of existing AUV and WA fisheries monitoring

- Potential issues
  - KEF lies wholly within state waters
  - Paucity of data in commonwealth waters
  - KEF conceptual model invalidation

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