Monitoring and predicting change to NSW kelp forests

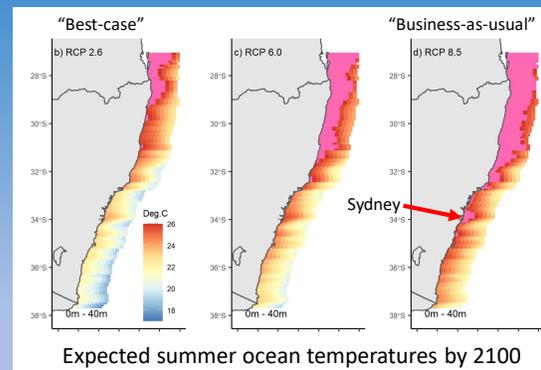Dr Tom Davis & Dr Melinda Coleman, Fisheries Research, NSW Department of Primary Industries

This project is funded by the NSW Marine Estate Management Strategy. Working to achieve a healthy coast and sea, managed for the greatest wellbeing of the community now and into the future.

1

Monitoring – why bother?

Climate-induced ocean warming is causing poleward retractions of kelp in NSW

- Ocean temperatures >~26°C exceed kelp tolerance
- Kelp losses are currently occurring on northern NSW reefs
- Preventing kelp loss will protect the ecological, economic and social values we derive from kelp forests

"Best-case"   "Business-as-usual"

b) RCP 2.6   c) RCP 6.0   d) RCP 8.5

Sydney

Deg.C
26
24
22
20
18

0m - 40m

Expected summer ocean temperatures by 2100

2

Monitoring – why bother?

Kelp forests underpin NSW's temperate marine ecosystems

- Abalone, crayfish, sea urchins + many fish species rely on kelp forests for food and shelter

Kelp provides important economic, social, cultural and ecological services

- The value of kelp to NSW is estimated at ~$1M per km of coastline per year
- Potentially losing 275km of kelp forests by 2100 = $275M/y!
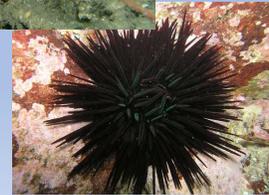
3

Monitoring – what is DPI doing?

DPI is - collecting data on the current distribution of kelp in NSW

We need to know;

- how much kelp we have and where it is
- where and when kelp losses are occurring
- the effects that losses have on ecosystems
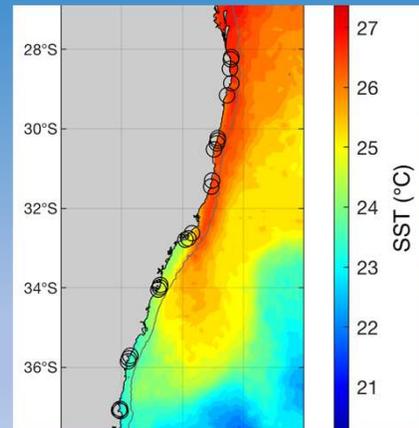- methods to reduce or prevent losses

4

Monitoring – what is DPI doing?

Baseline data collected at 22 sites along the NSW coast

Data collected in 2019, 2020 and 2021

Data collected from Tweed Heads to Eden

- Kelp distribution and density
- Urchin densities
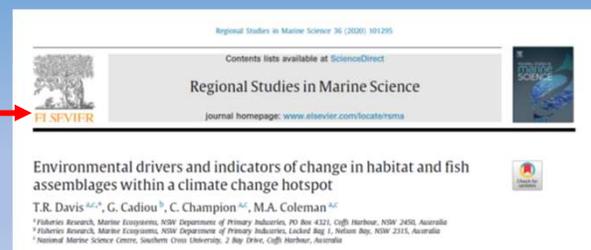- Fish assemblage data
- Water temperature

5

Monitoring – going forward

Ongoing monitoring under the NSW Marine Estate Management Strategy

Monitoring data has been used to develop climate change indicators for monitoring the condition of NSW rocky reefs;

- Kelp cover
- Coral cover
- Urchin densities
- Fish average thermal niche

These indicators will be used to detect and track climate change impacts in NSW

Regional Studies in Marine Science 36 (2020) 101295

Contents lists available at ScienceDirect

Regional Studies in Marine Science

journal homepage: www.elsevier.com/locate/rsma

Environmental drivers and indicators of change in habitat and fish assemblages within a climate change hotspot

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6

Predicting change – climate change impacts

Kelp on NSW reefs is being impacted by;

- Rising ocean temperatures
- Marine heat waves
- Increased storm activity
- Flooding
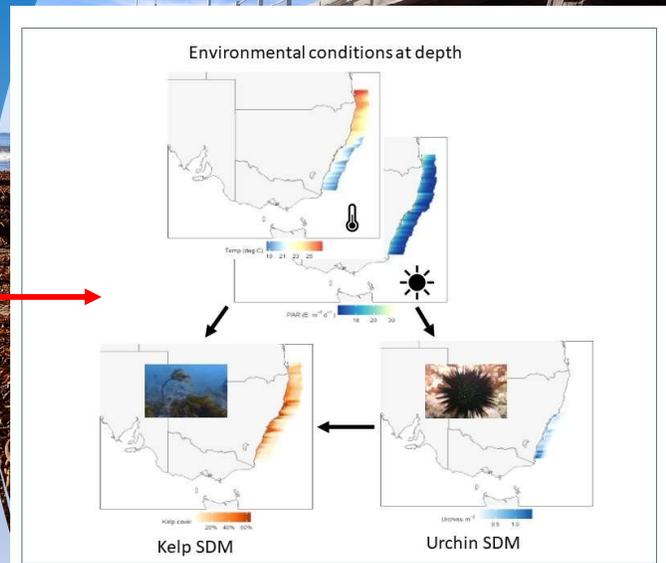- Tropicalisation (replacement of temperate by tropical species)

7

Predicting change – species distribution modelling

Computer models

- Developed to predict current and future urchin and kelp distributions
  - Temperature data -> Urchin distributions
  - Temperature, Light, Urchin data -> Kelp distributions

Environmental conditions at depth

Kelp SDM

Urchin SDM

8

Predicting change – kelp refugia

Computer models

- applied to identify future kelp refugia along the NSW coast
- greatest impacts at shallow depths where water is warmest
- Kelp can persist in cool deep offshore waters (30m+)
  - Moreton Island
  - Sydney/Wollongong

Marine Environmental Research 166 (2021) 105267

Contents lists available at ScienceDirect

Marine Environmental Research

journal homepage: http://www.elsevier.com/locate/marenvrev

Climate refugia for kelp within an ocean warming hotspot revealed by stacked species distribution modelling

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9

Predicting change – future distributions

Computer models

- applied to project future distribution under climate change scenarios
- Retractions projected by 2100
  - 0km - RCP 2.6 "Best case"
  - 275km - RCP 8.5 "Business as usual"
- Urgent climate action will reduce loss of kelp forests in NSW!

Received: 17 August 2021 | Revised: 16 November 2021 | Accepted: 26 November 2021

DOI: 10.1111/ddi.13462

RESEARCH ARTICLE

Diversity and Distributions WILEY

Ecological interactions mediate projected loss of kelp biomass under climate change

Tom R. Davis [1,2] | Curtis Champion [1,2] | Melinda A. Coleman [1,2,3]

10

## Predicting change – Good news?

- Projected losses are less severe than previous models
    - Some models predict losses along the entire NSW coast by 2100
- Losses will mainly occur in northern NSW and on shallow inshore reefs
- Understanding where losses will occur will enable assisted adaptation programs and facilitate protection of future kelp refugia
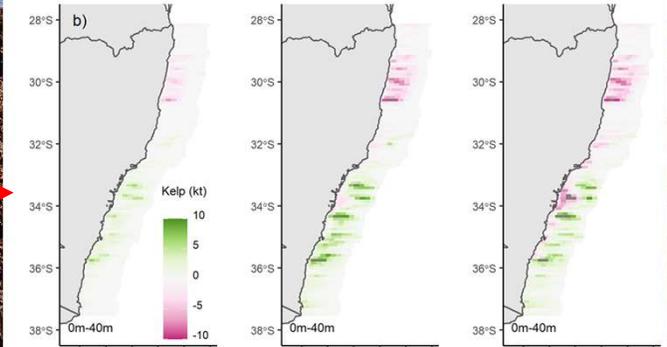
11

Predicting change – Good news?

- Losses will be offset by gains in southern NSW
- Gains in southern NSW predicted due to increased temperatures making conditions less suitable for urchins and better for kelp growth
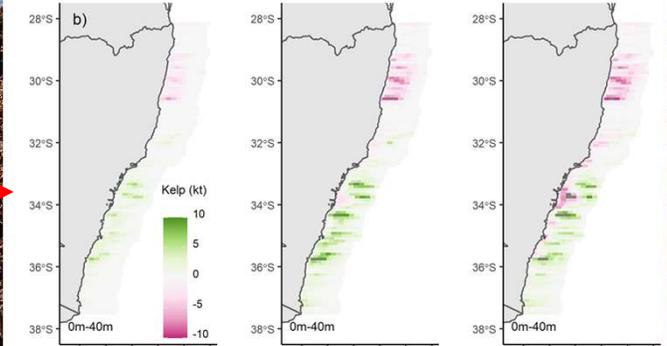
12

Summary

- NSW DPI is conducting ongoing monitoring of climate change impacts on NSW kelp forests
- We are developing ways to mitigate impacts on ecosystems and promote active adaptation to reduce kelp losses
- We are using modelling to identify key areas where kelp will persist into the future and where increased protection is warranted

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13

Conclusion

- Preventing kelp loss will protect the huge ecological, economic and social values we derive from kelp forests in Australia (~$1M/km/y)
- Urgent climate action is needed to reduce loss of kelp forests in NSW!

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14