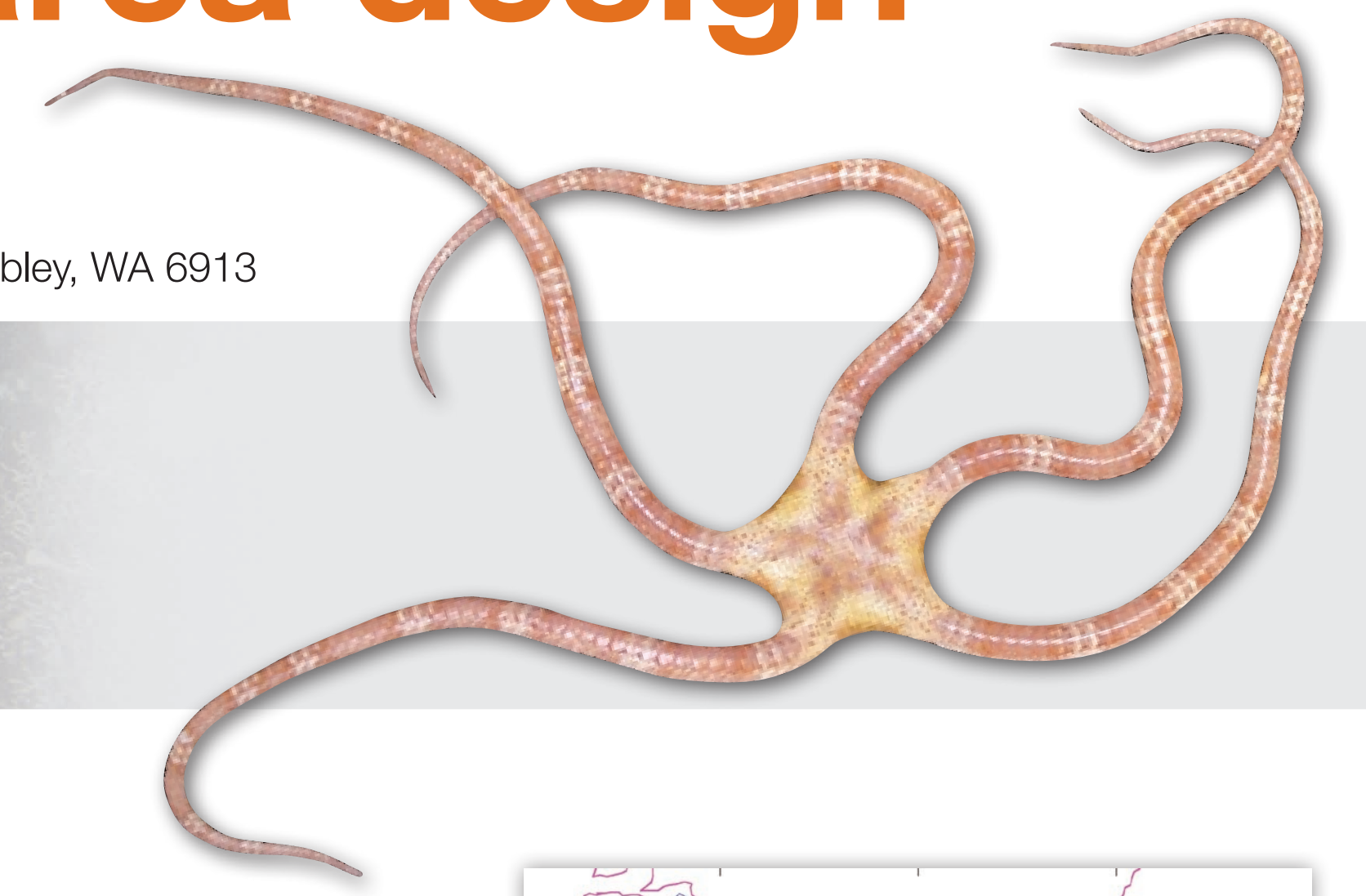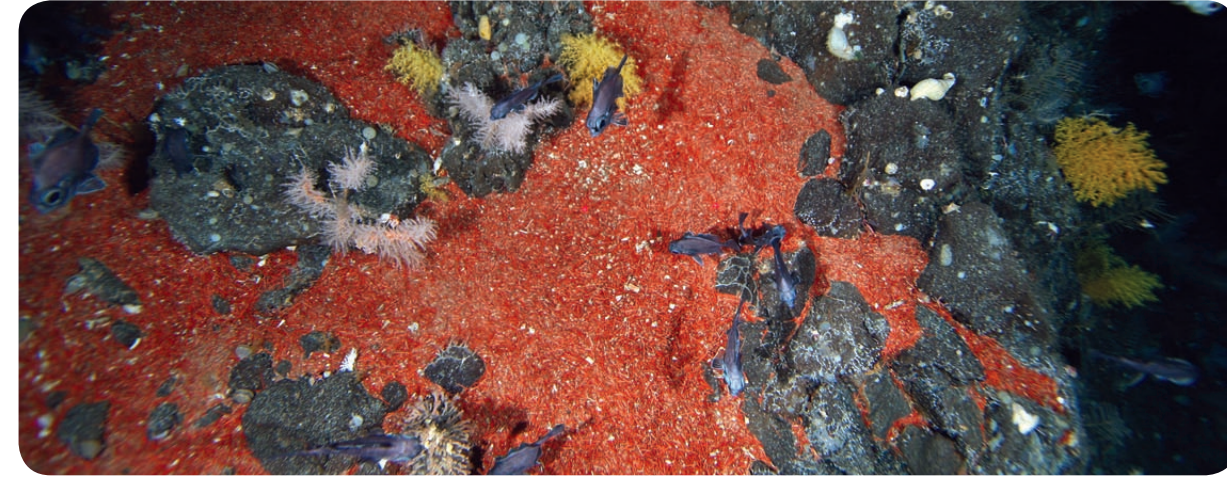# CERF

Modelling connectivity among Commonwealth Marine Protected Areas in south east Australia:

Tools for resilient protected area design

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the challenge

Understanding how widely marine organisms disperse and the spatial scale of connectivity within and among populations, species and ecosystems is critical to effective science-based spatial management of marine biodiversity.

How well do current marine reserve design efforts account for the spatial component of population and community diversity?

The spatial extent of a population or ecological community has direct bearing on several key aspects of reserve design, namely **how big they should be** (to ensure adequate representation and viability of the organism) and **how close together should they be** (to ensure adequate opportunity for dispersal between reserves to prevent the effects of isolation including loss of viability and evolutionary divergence).

Habitat destruction by fishing

Tasmanian seamounts

> One goal of the MPA network is protection of the extensive seamount habitats south of Tasmania, heavily impacted by orange roughy fishing.

our approach

Recent development of physical oceanographic tools aided by advances in satellite and in situ observation technologies and computer analysis has potential to provide unprecedented inferences about biological dispersal and connectivity.

Here we use 3D oceanographic modelling and particle-tracking techniques (using the BlueLINK Reanalysis (BRAN) model, developed by CSIRO for the Australian Navy) to examine patterns of biological connectivity among Commonwealth Marine Protected Areas (MPAs) in southeast Australia.
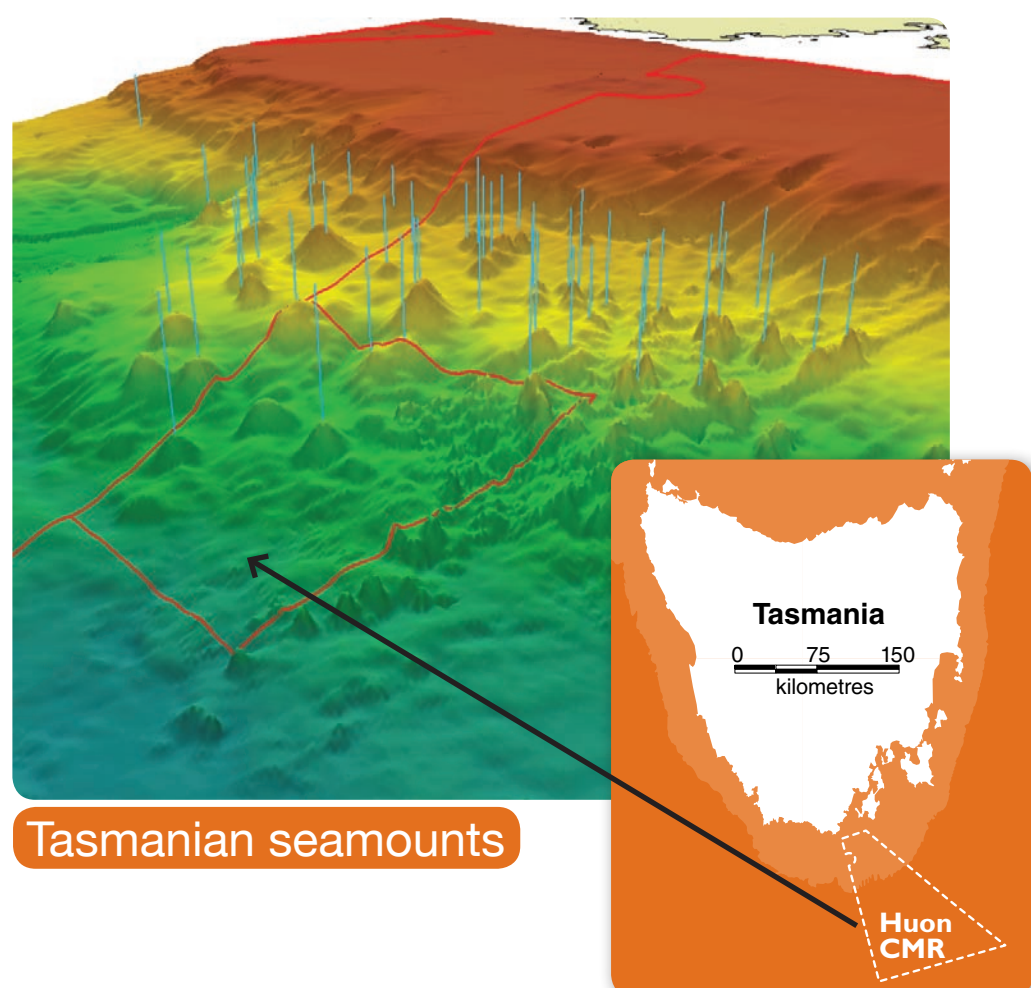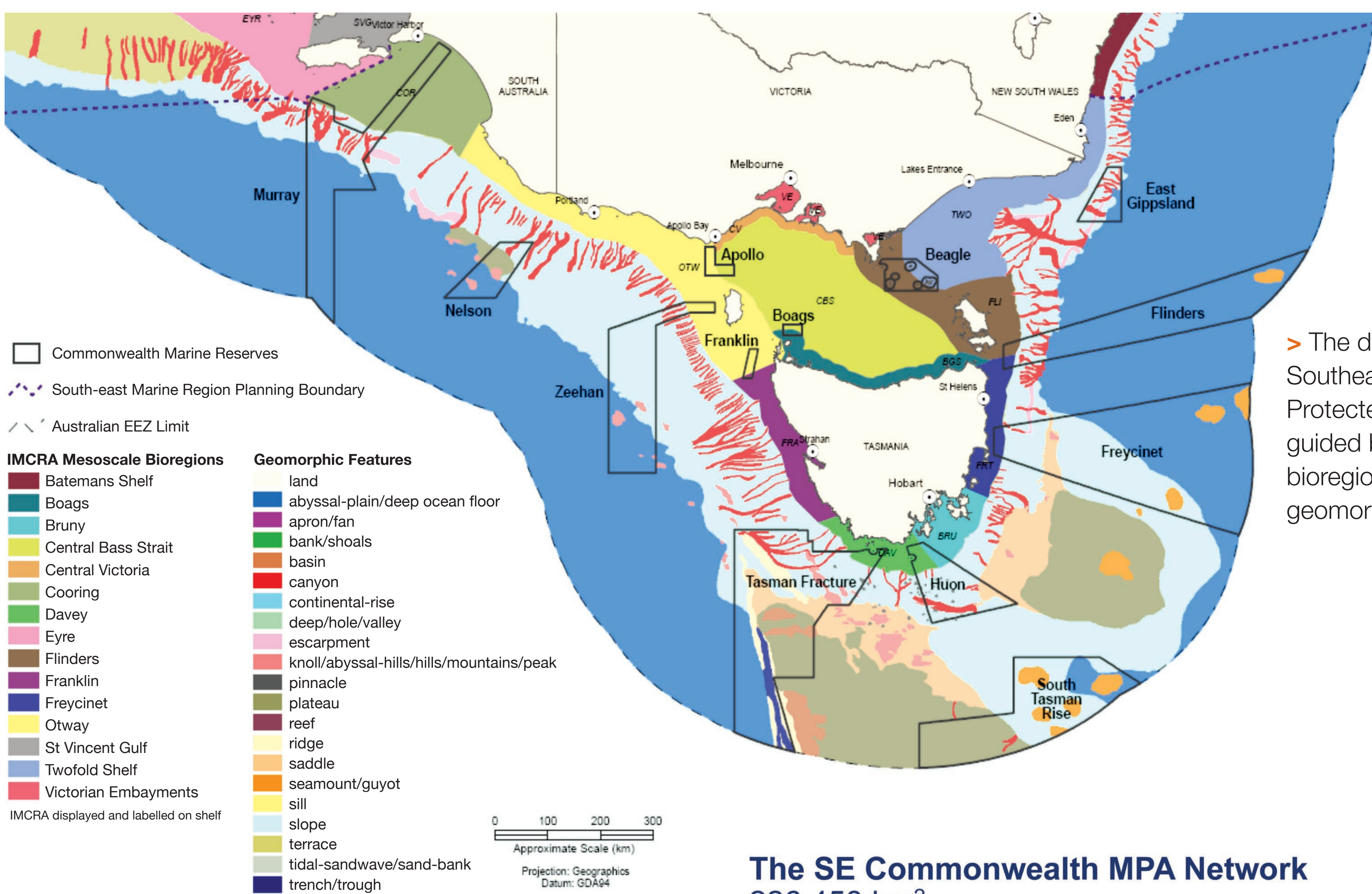
This approach allows us to model marine larval dispersal in three dimensions under the influence of the hydrodynamic processes dominating oceanic and coastal waters around Australia.

This work will aid the design of MPAs that are adequate and representative, but also resilient in the face of the natural variation displayed by hydrodynamic dispersal processes and it provides.

We may also be able to explore the potential impacts of climate change-induced shifts in connectivity on species range shifts and altered dispersal dynamics.

general findings

> There is higher connectivity among eastern MPAs due to East Australia Current.

> Dispersal is inversely proportional to transport depth.

> Depth can also determine direction of connectivity.

> Larval duration is very important.

> Substantial larval retention occurs within MPAs

> The seasonal variability is stronger than interannual variability.

Effect of larval duration
- 14days/100days
- 500-1500m release depth

Effect of season
- summer/winter
- 500-1500m release depth
- 50 day larval duration

Interannual variation
- high / low EAC years
- 500-1500m release depth
- 14day larval duration

Effect of dispersal depth
- surface / 500m
- 500-1500m release depth
- 14day larval duration

Dispersal in deep water
- 3000-4000m
- summer / winter
- 14day larval duration

> The design of the Southeast Marine Protected Areas was guided by data on bioregionalisation and geomorphology.

Commonwealth Marine Reserves

South-east Marine Region Planning Boundary

Australian EEZ Limit

IMCRA Mesoscale Bioregions
- Batemans Shelf
- Boags
- Bruny
- Central Bass Strait
- Central Victoria
- Cooring
- Davey
- Eyre
- Flinders
- Franklin
- Freycinet
- Otway
- St Vincent Gulf
- Twofold Shelf
- Victorian Embayments

IMCRA displayed and labelled on shelf

Geomorphic Features
- land
- abyssal-plain/deep ocean floor
- apron/fan
- bank/shoals
- basin
- canyon
- continental-rise
- deep/hole/valley
- escarpment
- knoll/abyssal-hills/hills/mountains/peak
- pinnacle
- plateau
- reef
- ridge
- saddle
- seamount/guyot
- sill
- slope
- terrace
- tidal-sandwave/sand-bank
- trench/trough

Approximate Scale (km)
0   100   200   300
Projection: Geographics
Datum: GDA94

The SE Commonwealth MPA Network
226,458 km²
19.6% of south east EEZ
30% by area of world MPAs now in Australia

MARINE BIODIVERSITY RESEARCH
Prediction and Management of Australia's Marine Biodiversity

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