

Marine Genetic Resources:

perspectives on research,
capacity building, and
benefit sharing





Deep Sea Mining and Marine Genetic Resources

Emerging classes of resources

- Access, ownership and governance
- Environmental impact

Deep Sea Minerals

- Resource scarcity
- Ocean geology

Marine Genetic Resources

- Novel drugs, cosmetics and household products
- Extreme environments
- Biodiversity

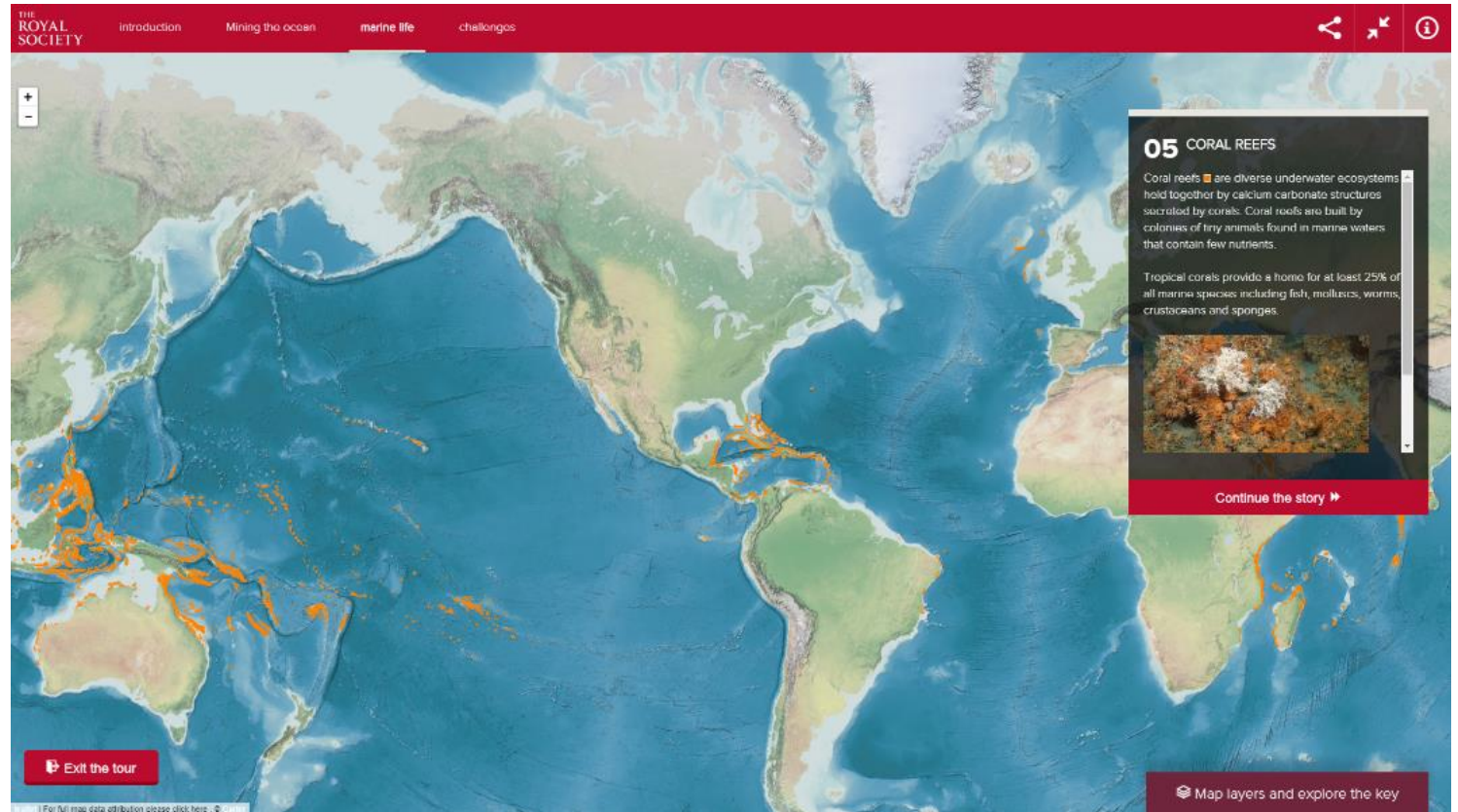
www.royalsociety.org/future-ocean-resources

Working Group

| Chair | |
|--------------------------------|---|
| Professor Gideon Henderson FRS | University of Oxford |
| Members | |
| Professor Michael Bickle FRS | University of Cambridge |
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| Professor Rachel Mills | University of Southampton |
| Professor Thomas Mock | University of East Anglia |
| Professor Catherine Redgwell | University of Oxford |

Interactive map (launched today)

Coral Reefs



The screenshot shows an interactive map interface from The Royal Society. The top navigation bar includes the Royal Society logo and menu items: 'introduction', 'Mining the ocean', 'marine life', and 'challenges'. The map displays the world with coral reefs highlighted in orange, primarily in the tropical regions. A sidebar on the right is titled '05 CORAL REEFS' and contains the following text:

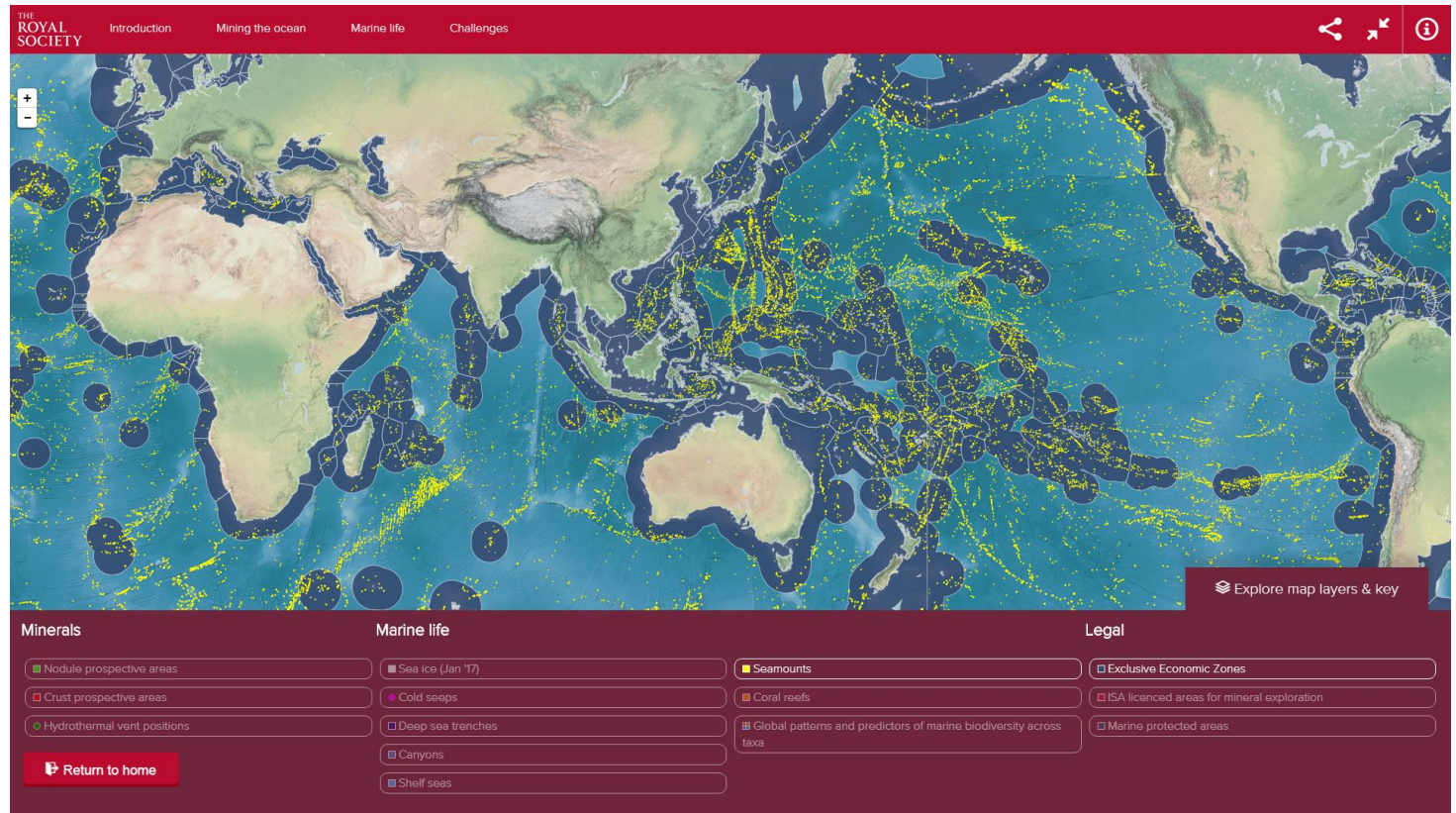
Coral reefs are diverse underwater ecosystems held together by calcium carbonate structures secreted by corals. Coral reefs are built by colonies of tiny animals found in marine waters that contain few nutrients.

Tropical corals provide a home for at least 25% of all marine species including fish, molluscs, worms, crustaceans and sponges.

Below the text is a small image of coral reefs and a red button labeled 'Continue the story'. At the bottom of the sidebar is a link 'Map layers and explore the key'. In the bottom left corner of the map area, there is a red button labeled 'Exit the tour' and a small text link: 'For all map data attribution please click here'.

Interactive map (launched today)

Seamounts and EEZs



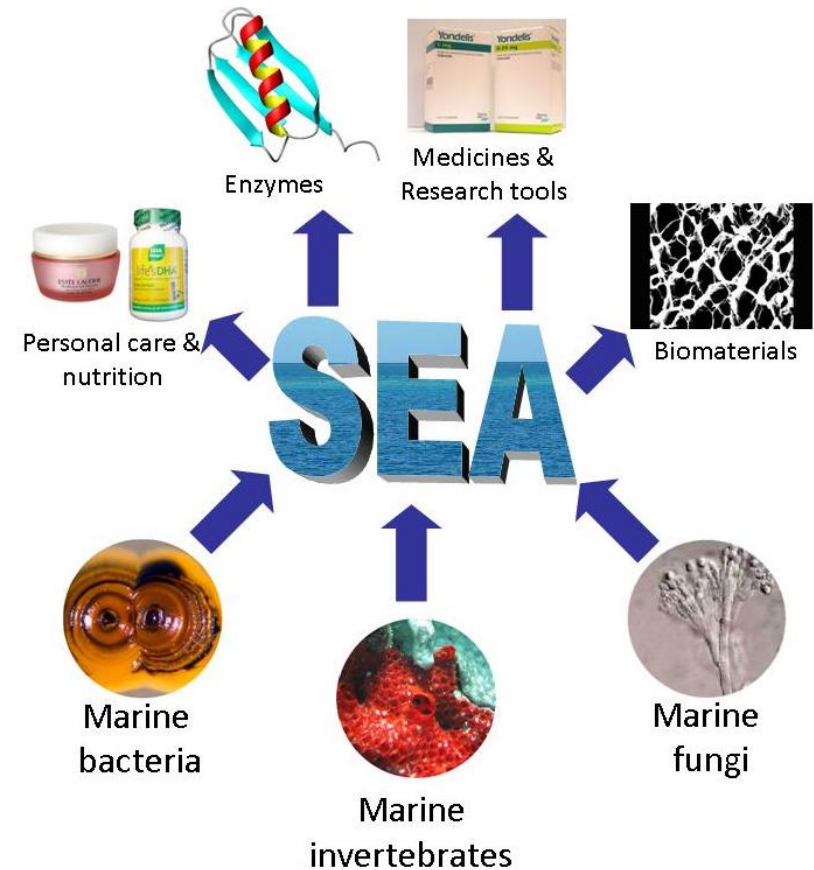
Benefits of Bioprospecting

Offers advantage over comparable terrestrial resource:

- Superior performance
- Better economics

Unprecedented activity in particular application:

- Enzymes: new reactivity/new biotransformation
- Small molecules: novel chemical structures & new mechanism of action
- Materials: new properties



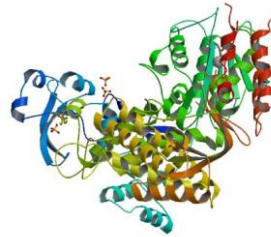
Pharmaceutical Products



Yondelis
Cancer treatment
Origin: Seasquirt
Location: Caribbean Mangroves
Production: Semisynthesis
Owner: PharmaMar



Prialt
Intractable pain
Origin: Cone snail
Location: Philippines
Production: Recombinant
Owner: Neurex/Elan



Vent Polymerase
DNA amplification
Origin: Vent bacterium
Location: Naples, Italy
Production: Recombinant
Owner: New England Biolabs



Fuelzyme
Enzyme used in biodiesel production
Origin: Deep sea bacterium
Location: Unknown)
Production: Recombinant
Owner: Verenium (BASF)

Non-Pharmaceutical Products

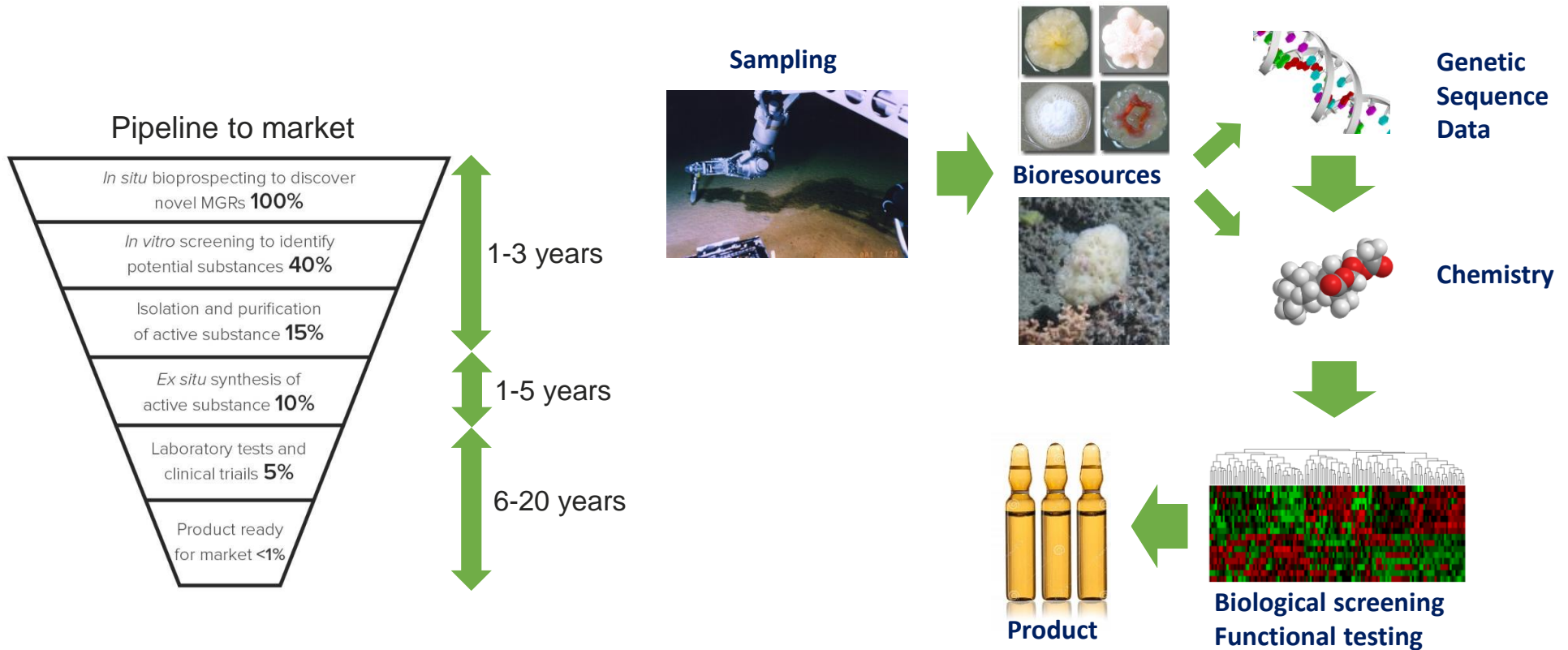


Venuceane
Cosmetic screening infra-red rays
Origin: Vent bacterium
Location: Unknown
Production: Fermentation
Owner: Sederma (Croda)



Brominated Furanones
Anti biofilm agents
Origin: Red seaweed
Location: Australia
Production: Synthesis
Owner: Unilever

The Process of Marine Bioprospecting



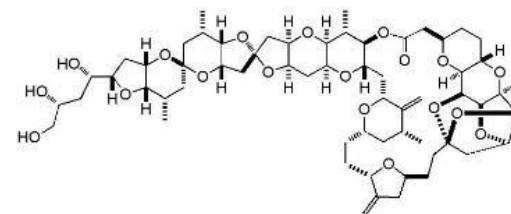
Case study: Halaven



Bioprospecting



Pre 1986: Screening
Isolation & Structure

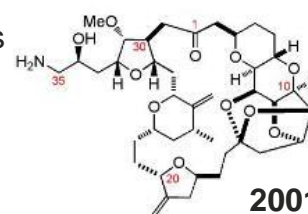


Halichondrin B

1996: Synthesis

Laboratory tests
and clinical trials

2010: approval
by US FDA



2001: Derivative synthesis

E7389 Eribulin

Current sales
c. US\$ 350 M pa

(Usual Royalty
Rates are 1-3%)

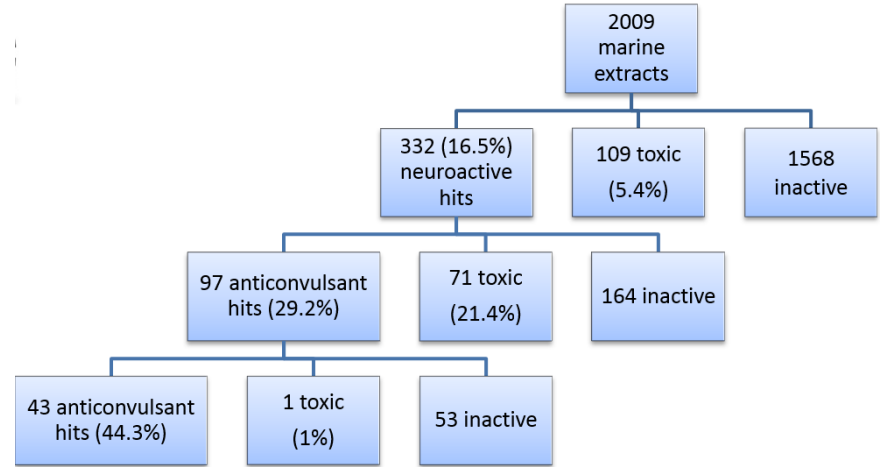


Case Study: Epilepsy



Background

- 65 million people suffer from epilepsy worldwide.
- 2.4 million are diagnosed each year.
- There are 25 anti-seizure drugs on the market.
- Current anti-seizure drugs fail to control seizures in 30% of the patients due to drug-resistance.



Overall hits = 2.1%



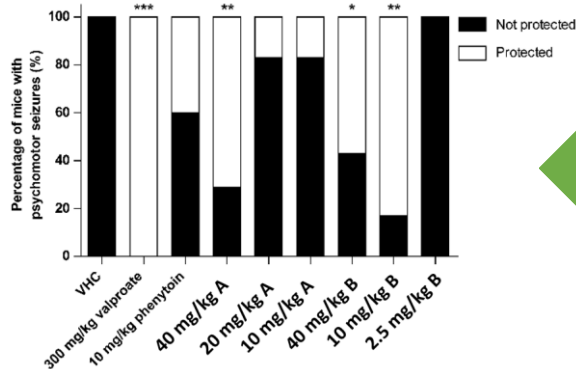
Most active 'hit' from marine fungus

Scale-up & isolation of marine fungal compound

Excellent 'drug-like' properties

Tested in 'Gold Standard' mouse 6-Hz seizure model

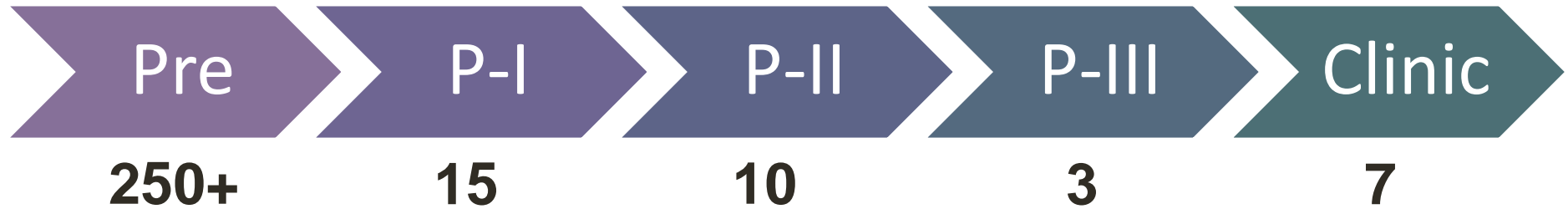
Significant protection from seizures



Further Development



Marine Pharmaceutical Pipeline



Mainly derived from shallow reef dwelling organisms

Mainly anti-cancer with a few analgesics and antivirals

Mainly start-ups at early stage with large pharma at late stage

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