How can SIDS diversify the use of ocean and coastal resources through bio-prospecting of marine genetic resources and beyond, in a sustainable manner?

Prof. Alan Deidun (alan.deidun@um.edu.mt)

Director, International Ocean Institute Malta training centre

Ocean Governance Ambassador for Malta

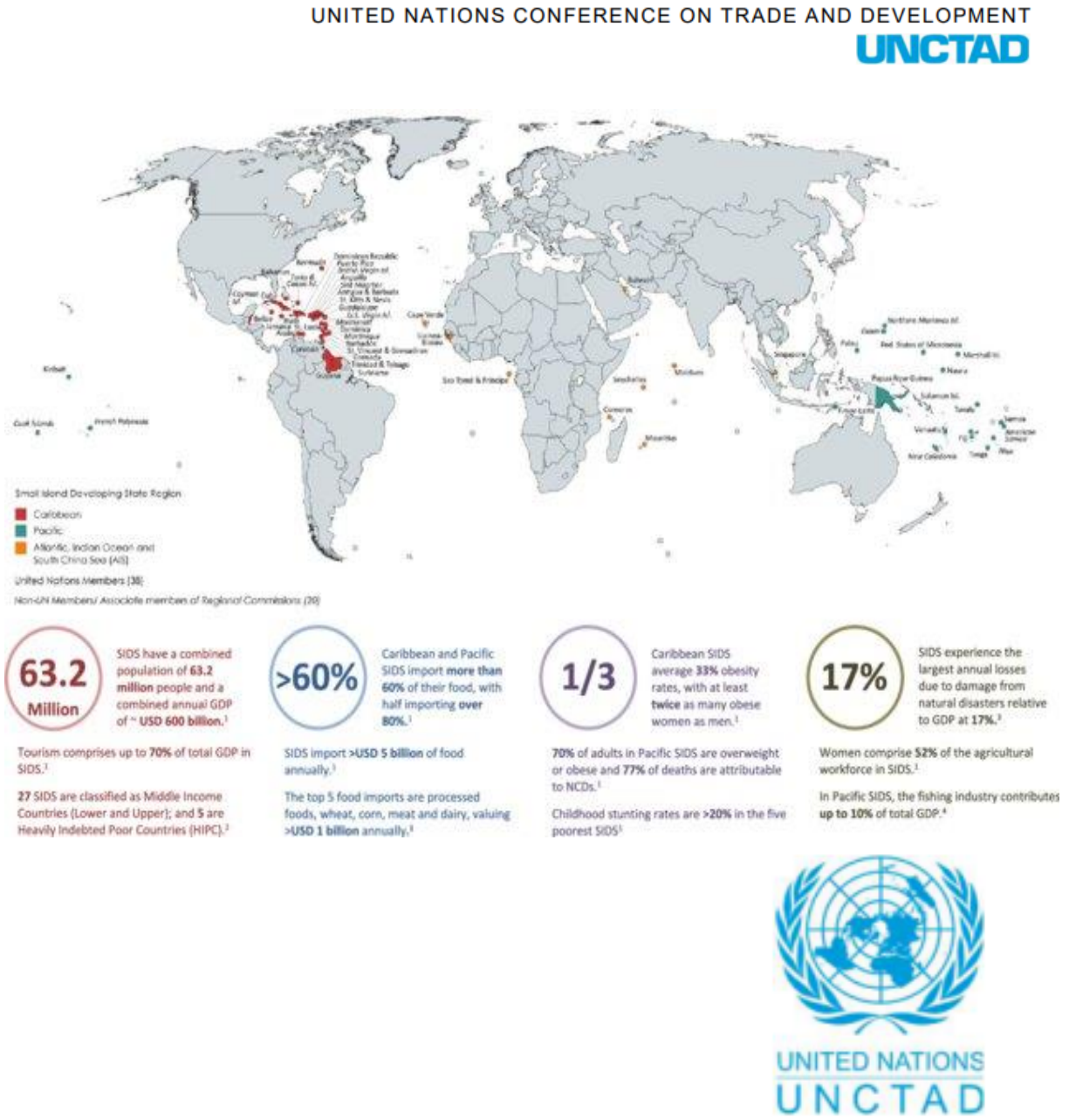
UNCTAD side event:

Sustainably harnessing the potential of marine bioprospecting for socioeconomic development in Small Island Developing States (SIDS)

7 April 2022

Malta has already established itself as a centre of training to assist SIDS with capacity-building in several, different areas. The University of Malta and its affiliated entities have a long-standing experience through the **IMO-International Maritime Law Institute, the International Ocean Institute** and other niche entities. Furthermore, since 2018, Malta hosts the **Commonwealth Small States Centre of Excellence** that has developed capacity-building solutions specifically for SIDS. Affiliated directly with, and supported by, the Ministry for Foreign and European Affairs, the Centre is extending the scope of the process of capacity-building to include areas associated with the UN Sustainable Development Goals as well as other policy documents for SIDS such as the **SAMOA Pathway, the Addis Ababa Action Agenda and the Mauritius Strategy for Implementation.**

It is noteworthy that in January 2020, Malta was appointed Co-Chair of the UN's Steering Committee on Partnerships for Small Island Developing States. Through this appointment Malta shall steer, over a two-year period, this UN process that supports SIDS in the implementation of the SAMOA Pathway and the Sustainable Development Goals.



Nom	Application	Origine	Profondeur (en m)	Niveau d'étude
Discodermolide	Cancer	Éponge *Discodemia* sp.	140 Bahamas	Phase I
E 7389	Cancer	Éponge *Lissodendoryx* sp.	100 Nouvelle-Zélande	Phase I
Dictyostatin-1	Cancer	Éponge Ordre *Lithistida*	440 Jamaïque	Préclinique
Sarcodictyn et dérivés	Cancer	Corail *Sarcodictyon roseum*	Méditerranée	Préclinique
Salinosporamide A	Cancer	**Actinomycète** *Salinospora* salin	> 1 000 Pacifique	Préclinique
Topsentin	Cancer, Alzheimer	Éponge *Spongospo-rites ruetzleri*	300-600 Bahamas	Préclinique
Implants orthopédiques	Greffe osseuse	Corail	> 1 000 Pacifique	Préclinique

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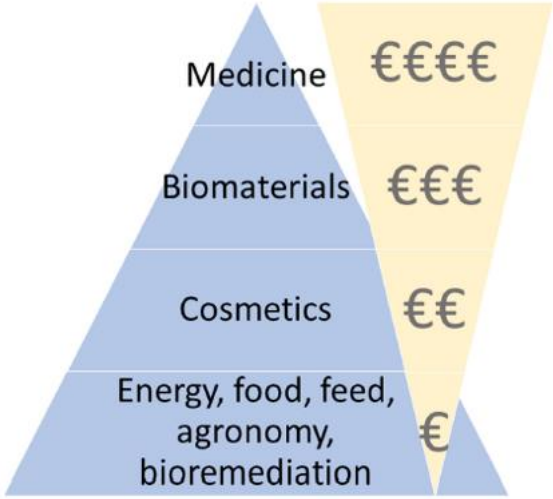
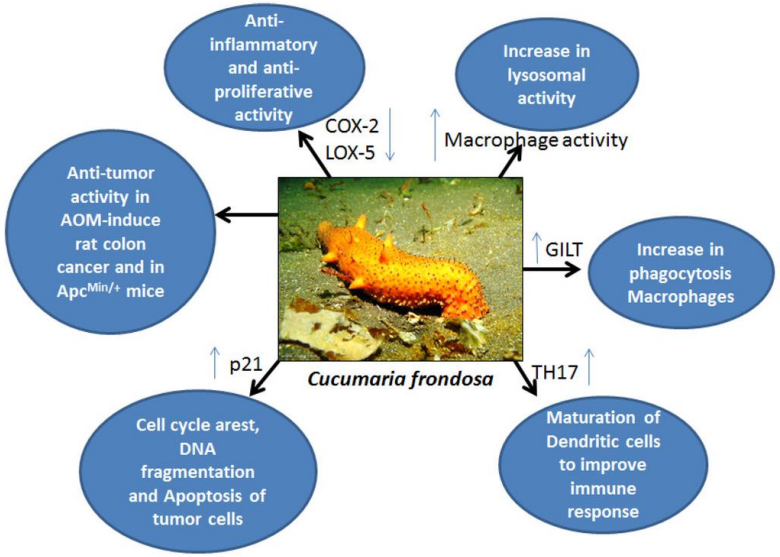


Jean Guézennec, Ba



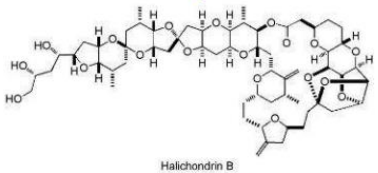
WIPO
WORLD INTELLECTUAL PROPERTY ORGANIZATION

- Nearly 13,000 genetic sequences from marine species (**Marine Genetic Resources – MGRs**) have been patented to date.
- Registering patents is not cheap or easy, and many of these patents will likely end up being a 'loss'. Companies are often looking for the next aspirin or the like that will represent a ground-breaking advance for the biotech industry, and be a goldmine of sorts for the patent holder.
- Marine genetic information is particularly valuable as many creatures found at the bottom of the world's oceans have evolved to cope with extreme environments, such as hydrothermal vents. Adaptation to extremes of pressure, acidity, heat and absence of light have given these deep-sea creatures genetic codes that are often vastly different to organisms found on land.
- These can be ripe for commercial applications. BASF for example, was able to successfully isolate of genes from marine microbes responsible for OMEGA 3 oil (PUFA) production.

Case study: Halaven

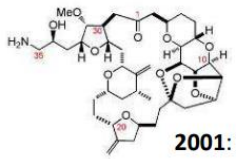
Bioprospecting

Pre 1986: Screening
Isolation & Structure



Halichondrin B

1996: Synthesis



E7389 Eribulin

2001: Derivative synthesis

Laboratory tests
and clinical trials
2010: approval by
US FDA)

Current sales
Ca US$ 350 M pa

(Usual Royalty
Rates are 1-3%)

Source:

www.abdn.ac.uk/bbnj
m.jaspars@abdn.ac.uk

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

DICTYOLONE 500 Follow us on

Dietary preparation, helps to maintain the support tissues: the bones, cartilage and skin

A traditional foodstuff recognized by the CEN of the European Union, the patented extract of the alga ***Padina pavonica*** **(EPP)** has two essential effects within our bodies:

- it restores the synthesis of collagens and glycoaminoglycans, substances that form elastic meshes and retain water and minerals in the skin, and the tissues of the bone and cartilage.
- by preserving the function of the bone cells, it restores calcium binding, which declines with age.

It has two target organs, both of which are mesenchymatous tissues: the skin and bone.

- The ***skin*** needs collagens, support fibers, and glycoaminoglycans for their plastic and water retention properties. Calcium plays a primordial role: it ensures that the calcium channels work properly and allows intra - and extra cellular exchanges to occur.
- Our ***bones*** consist of a framework that is made up mainly of collagen proteins

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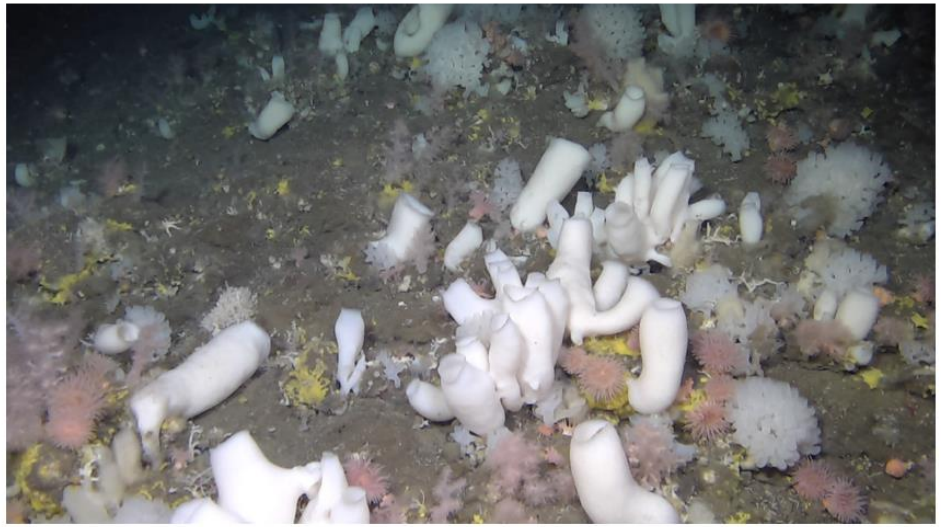
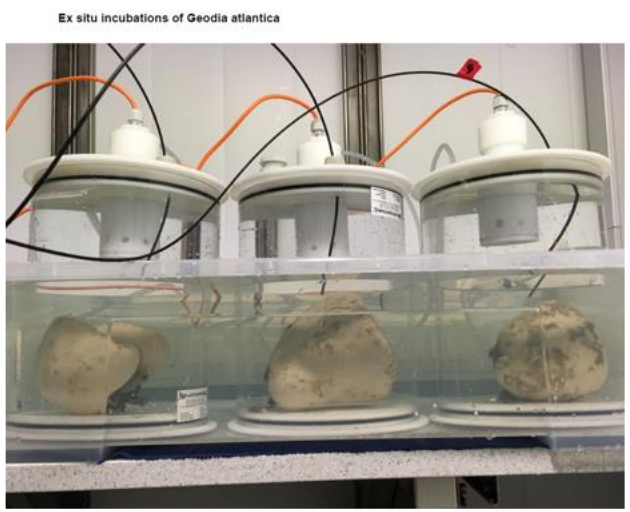


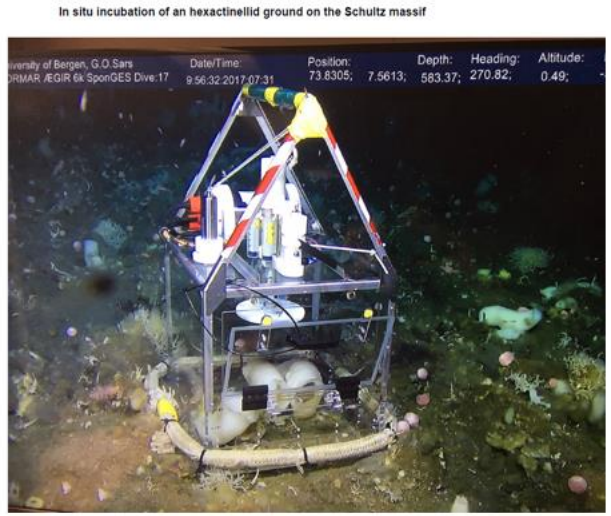
Glass sponges exploited at depths of 600m in the Atlantic – SPONGES project (www.deepseasponges.org)

Figure 5.1. Bioceramics obtained after sponge calcination.

Figure 5.2. SEM image of sterrasters (1) and dichotriaenes (2) in biosilica from *Geodia barretti*.

The relevance of silica and silicate biomaterials for biomedical application is associated with the potential to promote the deposition of new calcium phosphates, mimicking the mineralization process observed during bone formation.





Glass sponges exploited at depths of 600m in the Atlantic – SPONGES project (www.deepseasponges.org)

+ extraction of a new class of C-13 biomolecules useful for cholesterol mitigation (similar function to sterols found in Benecol, etc)

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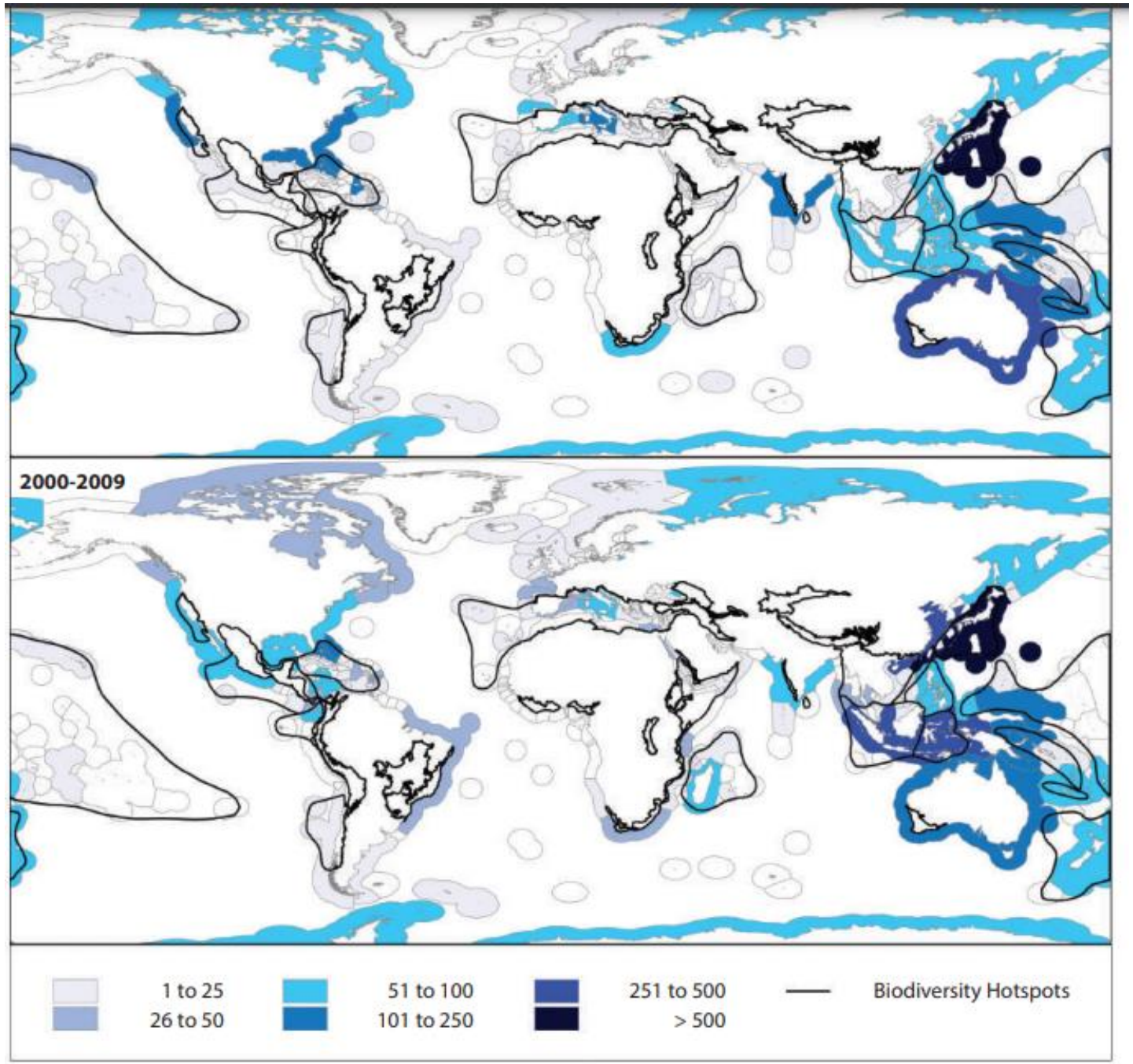

Number of new natural products from marine invertebrates for world Economic Exclusive Zones during the 1990s and 2000s. Boundaries of biodiversity hotspots are also presented.

Source: Leal and others, 2012.

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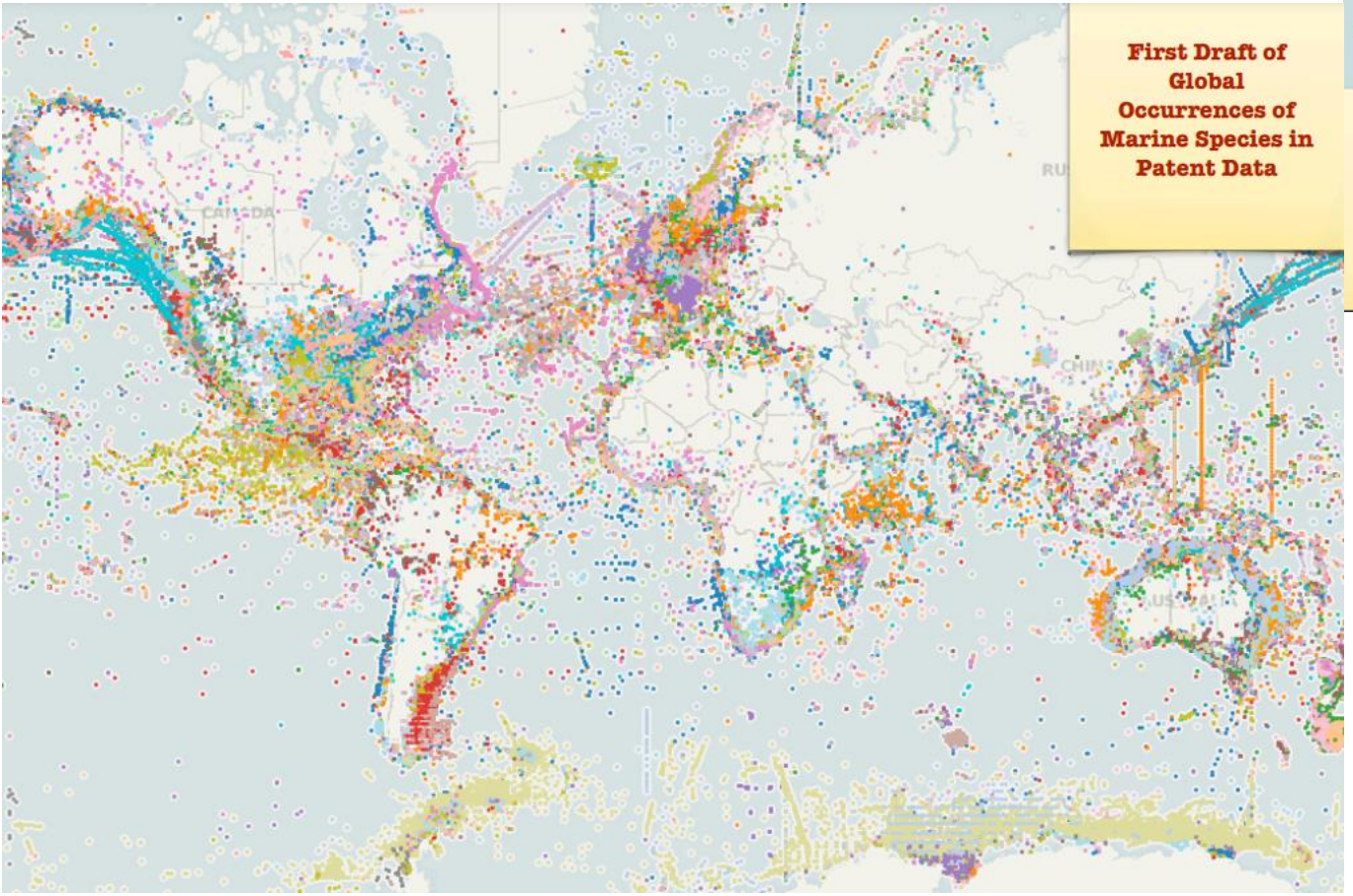
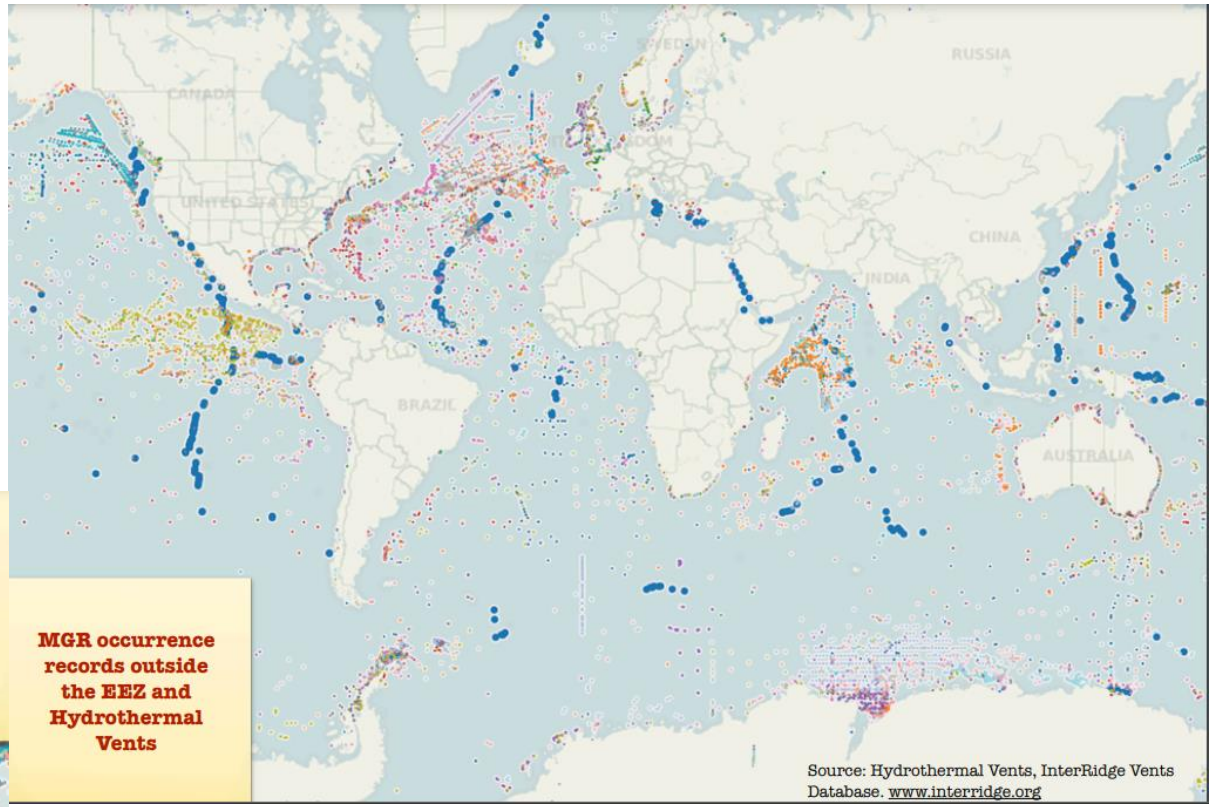




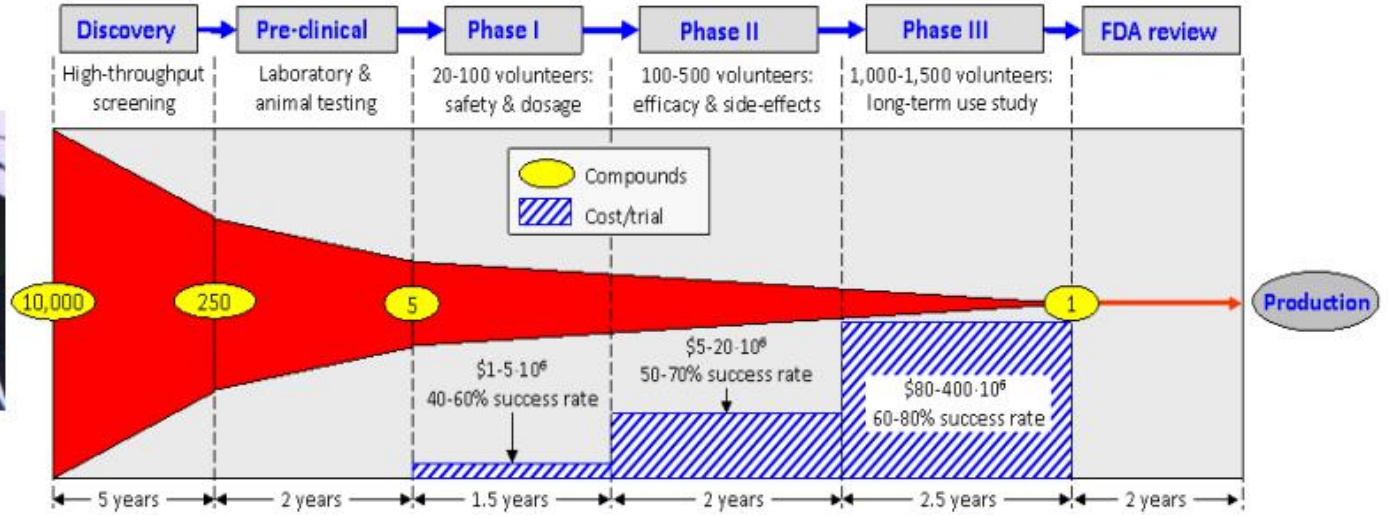
Source:

Paul Oldham, Stephen Hall & Colin Barnes

United Nations University & One World Analytics

The Biodiscovery Timeline

Sampling in ABNJ



Universities

Large companies

Universities and SME's

Scientific knowledge & data

Commercial

'Potential' value

Actual value

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Thomas Vanagt

Sometimes, Blue Economy opportunities land on our lap…….

In the summer of 2018, an almost incomprehensibly large mass of stringy brown seaweed appeared in the Atlantic Ocean. It stretched from one coast to the other, from the shores of West Africa to the Gulf of Mexico. Spanning 8,850 kilometres (5,000 miles), the seaweed bloom, known as the great Atlantic sargassum belt, was the largest ever recorded. Researchers analysing satellite images of the bloom estimated its mass to be more than 20 million tonnes – heavier than 200 fully loaded aircraft carriers.

Sargassum in the Florida Keys

- Sargassum blooms harm coastal biodiversity, fisheries and the tourism industry in the Caribbean and Mexico. Barbados declared a national emergency in June 2018 after its shorelines were engulfed by sargassum;
- In parts of Mexico and the Caribbean, locals are taking the matter into their own hands and finding innovative ways to turn the environmental disaster on their coastlines into a sustainable economic opportunity;
- Some are turning sargassum into materials from paper to building materials. In Playa del Carmen, for example – one of Mexico's most popular tourist destinations – a community group is tackling the sargassum invasion by turning it into soap.

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- The Biomaya Initiative, an organisation established to deal with the sargassum glut, hires local residents to collect the foul-smelling seaweed from the beaches, and then cleans it to remove metals and plastics. Then women living in nearby villages, that date back to the Maya period, mix the processed sargassum with glycerin and honey to make soap which they sell for $2 (£1.50) a bar to hotels, hospitals and shops in the area;

- "As a community we decided to do this to protect the planet and take care of our beaches," says Gonzalo Balderas, founder of Biomaya Initiative. In the past three years, tourist numbers have plummeted due to sargassum in Playa del Carmen, Balderas says. "It's supposed to be a dream beach."

Drying paper made from Sargassum seaweed

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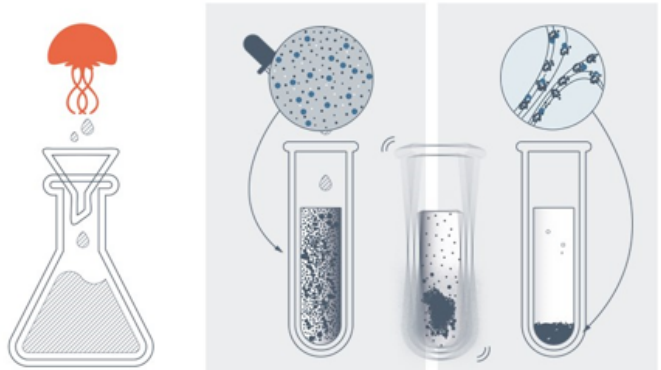
Bioprospecting can be closer to home……

Mucus from jellyfish are **trapping nanoparticles**



Mucus from jellyfish

a) Aqueous phase **contaminated with nanoparticles** (QDs, gold NPs)

b) **Nanoparticles Trapped** in the mucus: Descontaminated supernatant

[Patwa et al., Scientific Rep. 2015]

GoJelly project deliverables – jellyfish mucus used to trap MPs, as a fertiliser additive and even as fish feed biomass

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Bioprospecting can be closer to home……

Portunus segnis **– blue swimmer crab – a highly invasive species which could morph from an environmental management challenge into an opportunity**

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Bioprospecting can be closer to home……

Contribution to the circular economy

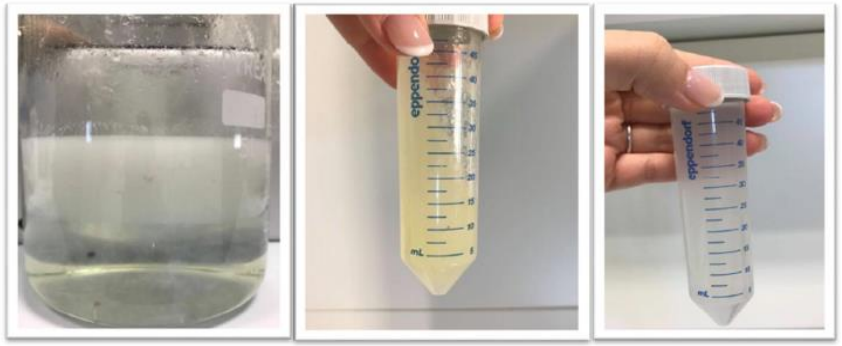
- **Circular economy** = an economic system aimed at eliminating waste and the continual use of resources.
- 3000-5000 tons of bluefin tuna offal is legally dumped within the edge of Maltese territorial waters each year
- BYTHOS project (http://www.bythos.eu/) has extracted collagen and OMEGA-3 oils from such fish waste (cosmetic industry, nutritional supplement)

YouTube clip =
https://www.youtube.com/watch?v=nmm8_rfNsoc

Table 1. Table of the Principal Literature Reviewed Categorised According to the Types of Fish Species Studied and their % Collagen Yield Attained.

Fish Source	Yield /%	Reference
Skin		
Black Drum	2.30	Ogawa et al., 2004
Sheepshead Seabream	2.60	Ogawa et al., 2004
Rohu	4.13	Hema et al. 2013
Mrigala	4.70	Mahboob, 2015
Dog Shark	8.96	Hema et al. 2013
Bigeye Snapper	10.94	Kittiphattanabawon et al., 2005
Spanish mackerel	13.68	Li et al., 2013
Albacore Tuna*	13.97	Hema et al. 2013
Channel catfish	24.00	Liu et al., 2007
Surf smelt	24.00	Nagai et al., 2010
Grass Carp	25.50	Wang et al., 2014
Yellow Fin Tuna*	27.10	Woo et al., 2008
Amur Sturgeon	37.42	Wang et al., 2014
Carp	41.30	Duan et al., 2009
Rohu	46.13	Pal et al., 2015
Chub Mackerel	49.89	Nagai and Suzuki, 2000
Bullhead Shark	50.10	Nagai and Suzuki, 2000
Japanese Sea Bass	51.40	Nagai and Suzuki, 2000
Catla	63.40	Pal et al., 2015
Spanish mackerel	13.68	Li et al., 2013
Bone		
Bigeye snapper	1.59	Kittiphattanabawon et al., 2005
Carp	1.06	Duan et al., 2009
Grass Carp	0.70	Wang et al., 2014
Spanish mackerel	12.54	Li et al., 2013
Japanese Sea Bass	40.70	Nagai and Suzuki, 2000
Skipjack Tuna*	42.30	Nagai and Suzuki, 2000
Yellow Seabream	40.10	Nagai and Suzuki, 2000
Scales		
Carp	1.35	Duan et al., 2009
Mrigala	3.20	Mahboob, 2015
Catla	3.90	Mahboob, 2015
Grass Carp	16.70	Wang et al. 2014
Red Seabream	37.50	Nagai et al., 2004
Japanese Sea Bass	41.00	Nagai et al., 2004

Figure 2. Image of starting raw material. *Left*: fish parts as obtained from source, *Middle*: Bone prior to pre-treatment. *Right: Skin prior to pre-treatment.*



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The way forward….

Given the extensive investment in R&D and the financial outlay that bioprospecting in deep-sea habitats and patent registration represent, SIDS can plausibly benefit from marine bioprospecting in the following manners:

(i) Through meaningful collaborations with multi-national companies with the capacity to deliver – can be achieved through an prescriptive application of ABS provisions (including monitoring of future benefits);

(ii) Through a re-investment of royalties from ABS implementation into national training and capacity-building efforts and a local patenting support fund;

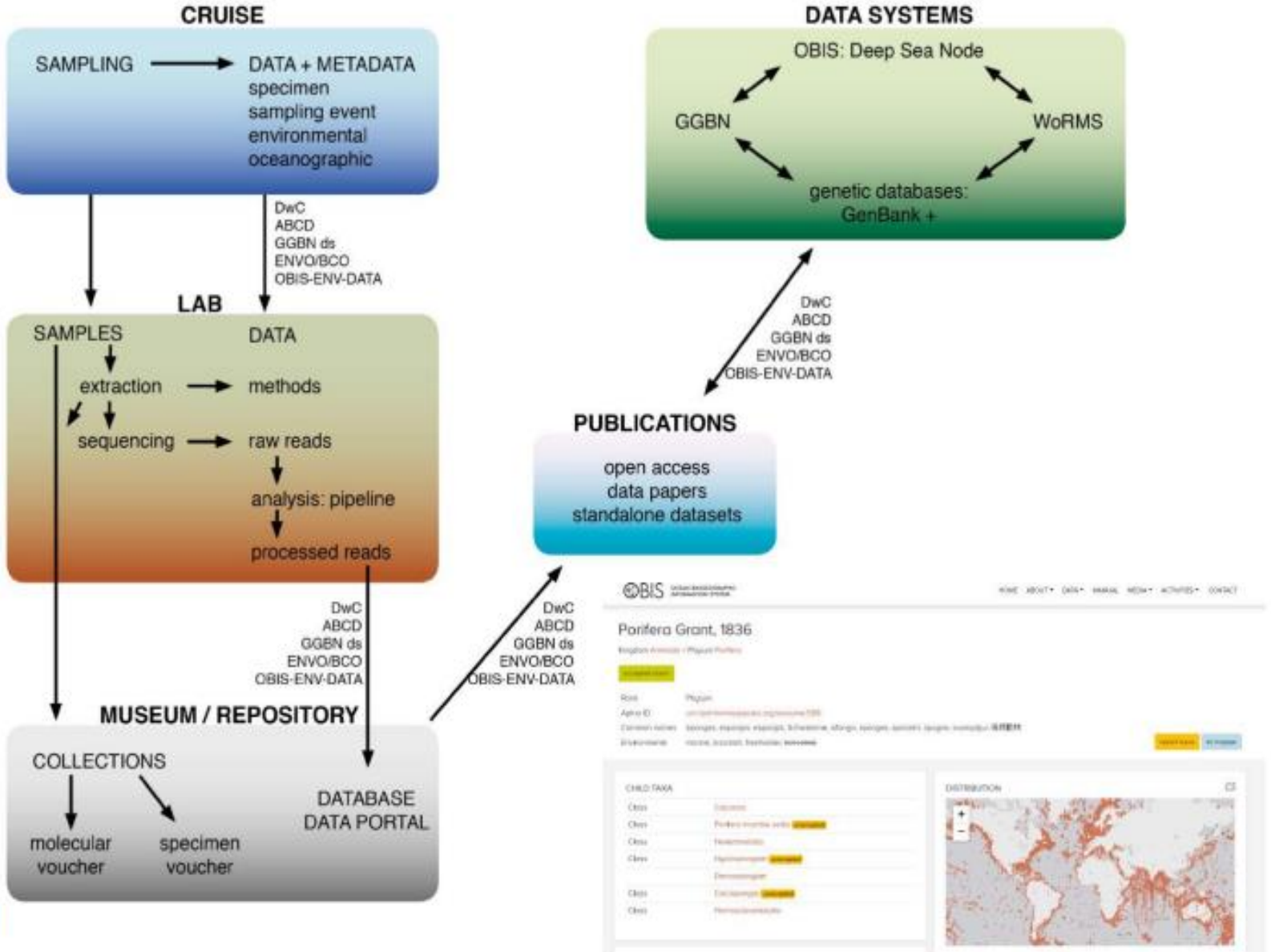
(iii) Through a simplified permit system so as to make BBNJ exploitation less attractive;

(iv) Through a greater focus on biomass currently viewed as ‘waste’ – circular economy considerations;

(v) Through proper consideration of ecosystem services provided by exploited habitats and species (e.g. climate change mitigation by mangroves)

Build on Science Good Practice

Data Must Be:
Findable
Accessible
Interoperable
Reusable



Muriel Rabone
Natural History Museum, London

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grazzi
tatan
dakujem
efcharisto
obrigada
havala
dekuji
paldies
spasibo
kiitos
obrigado
Thank You
blagodarya
tack
Merci
dekui
gracias
dzieki
multumesc
Dank u
grazie
Danke
koszi