



Marine Bioprospecting in ABNJ

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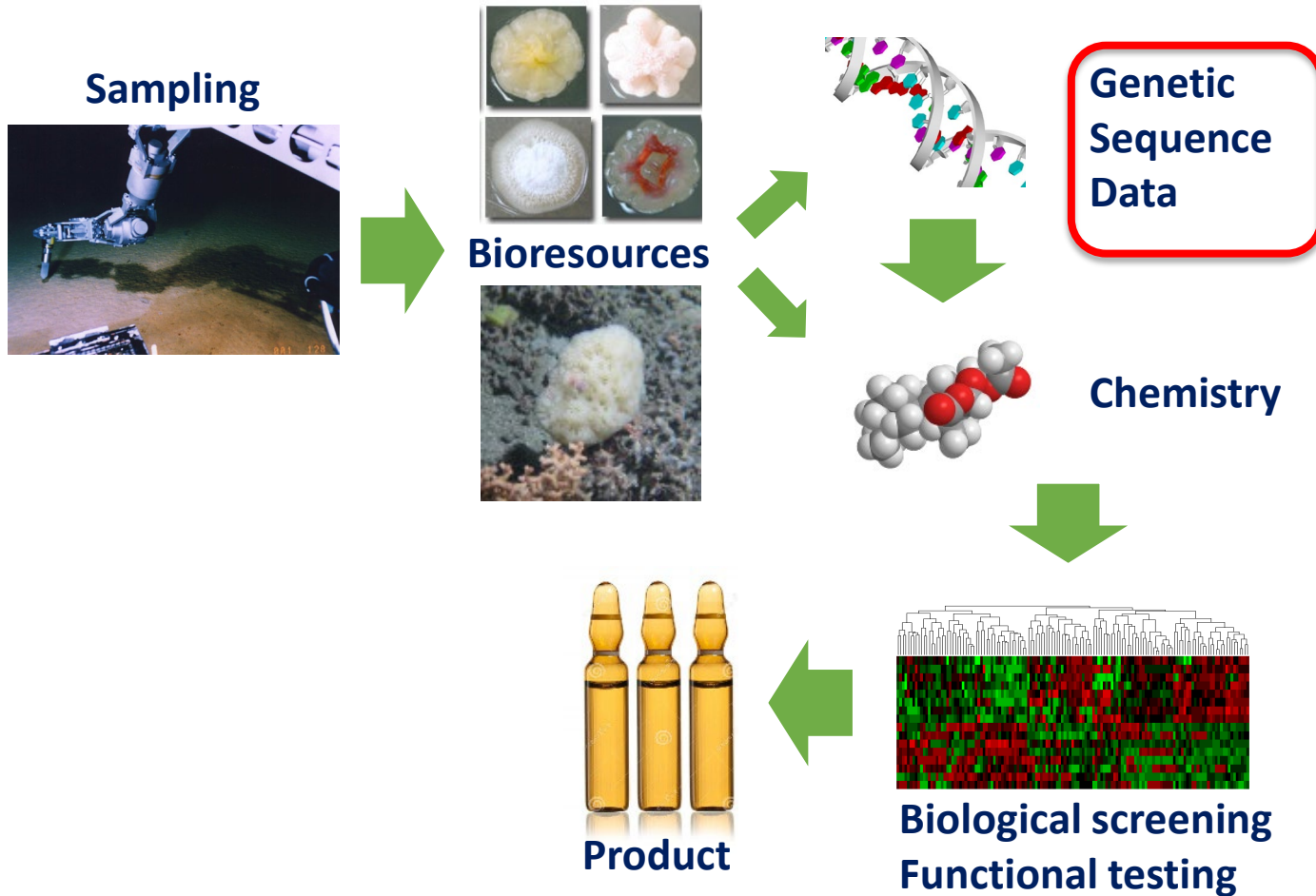
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The Process of Marine Bioprospecting



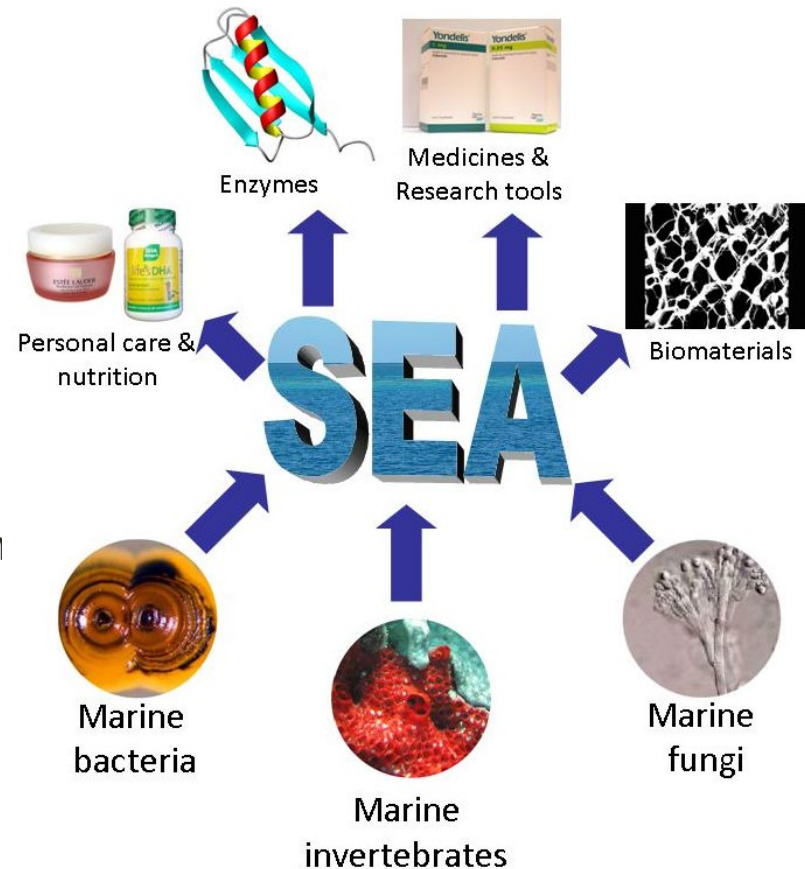
Benefits of Marine Bioprospecting

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



Non-Pharma Marine Derived Products on the Market



Vent Polymerase – for DNA amplification

Origin: Vent bacterium (Naples, Italy)

Production: Recombinant

Owner: New England Biolabs

Fuelzyme™-LF

THE NEXT-GENERATION, HIGH-PERFORMANCE
ALPHA-AMYLASE FOR MASH LIQUEFACTION

Fuelzyme – Enzyme used in biodiesel production

Origin: Deep sea bacterium (location unknown)

Production: Recombinant

Owner: Verenium (BASF)



Cosmetic screening infra-red rays

Origin: Vent bacterium (location unknown)

Production: Bacterial culture

Owner: Sederma (Croda)



Anti biofilm agents

Origin: Red seaweed

Production: Chemical Synthesis

Owner: Unilever

Marine Derived Pharmaceutical Products on the Market



Soft tissue carcinoma



Ecteinascidia turbinata



Chronic pain (analgesic)



Conus magus



Breast cancer



Halichondria okadai



Ara-C
(cytarabine)
treatment of leukemia



Ara-A (vidarabine)
antiviral



Tethya crypta



Hodgkin's Lymphoma



Dolabella auricularia



lowering very high
triglyceride levels



Purified
fish oil

Challenge 1 – Definitions

MGRs and Bioprospecting

Marine Genetic Resources: Term has no meaning to biologists and is not defined in UNCLOS but is taken to mean the Nagoya Equivalent:

“Marine genetic material” means any material of plant, animal, microbial or other origin, **found in the marine environment**, containing functional units of heredity ;

“Marine genetic resources” means **marine** genetic material of actual or potential value”

Placement of ‘Marine’ contested

Bioprospecting (Oxford English Dictionary): “the search for plant and animal species from which medicinal drugs and other commercially valuable compounds can be obtained.”

Unlike seabed mining, marine genetic resources are not mined.

The MGR are used as **inspiration** to generate a product which is made by other means.

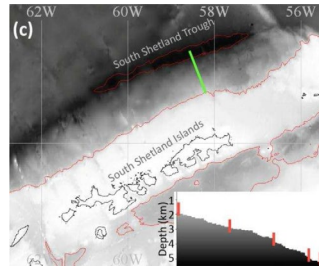
Opportunity – Providing biologically meaningful definitions

Challenge 2:

Marine Scientific Research (MSR) vs Bioprospecting

Application

- Cruise plan



Award

- Feasibility
- Checks



After Cruise

- Cruise report

VESSEL	CRUISE DATE	SAMPLING GEAR	DIVE #	SAMPLE NUMBER	LATITUDE	LONGITUDE	DEPTH	SAMPLE TYPE	DESTINATION	
Scotia	18/07/2015	Van Veen Grab	3	0915_VV_3B	57.968247N	15.546397W	1156.4	SED SubSamp	JASPARS	
Scotia	09155	18/07/2015	Van Veen Grab	3	0915_VV_3B	57.968247N	15.546397W	1156.4	SED SubSamp	JASPARS
Scotia	09155	18/07/2015	Van Veen Grab	5	0915_VV_5A	57.966204N	15.536247W	1203.8	SED SubSamp	JASPARS
Scotia	09155	18/07/2015	Van Veen Grab	5	0915_VV_5B	57.966204N	15.536247W	1203.8	SED SubSamp	JASPARS
Scotia	09155	19/07/2015	Batted Lander	1	0915_BL_1E1	57.953318N	15.550793W		Amphipods	PIERTNEY
Scotia	09155	19/07/2015	Batted Lander	1	0915_BL_1E1	57.953318N	15.550793W		Amphipods	PIERTNEY
Scotia	09155	19/07/2015	Megacore	1	0915_MC_1_3A	57.95067N	15.550255W		SED SubSamp	JASPARS
Scotia	09155	19/07/2015	Megacore	1	0915_MC_1_3B	57.95067N	15.550255W		SED SubSamp	JASPARS
Scotia	09155	19/07/2015	Megacore	2	0915_MC_2_6A	57.955577N	15.550248W		Bacterial Mat	JASPARS
Scotia	09155	19/07/2015	Megacore	2	0915_MC_2_6B	57.955577N	15.550248W		Bacterial Mat	JASPARS
Scotia	09155	19/07/2015	Megacore	2	0915_MC_2_6C	57.955577N	15.550248W		Bacterial Mat	JASPARS
Scotia	09155	19/07/2015	Megacore	2	0915_MC_2_6D	57.955577N	15.550248W		Bacterial Mat	JASPARS
Scotia	09155	19/07/2015	Megacore	2	0915_MC_2_6E	57.955577N	15.550248W		Bacterial Mat	JASPARS

MSR

- Most cruises are for basic research
- Freedom of MSR
- File cruise report to funder

How Might Bioprospecting be Accommodated?

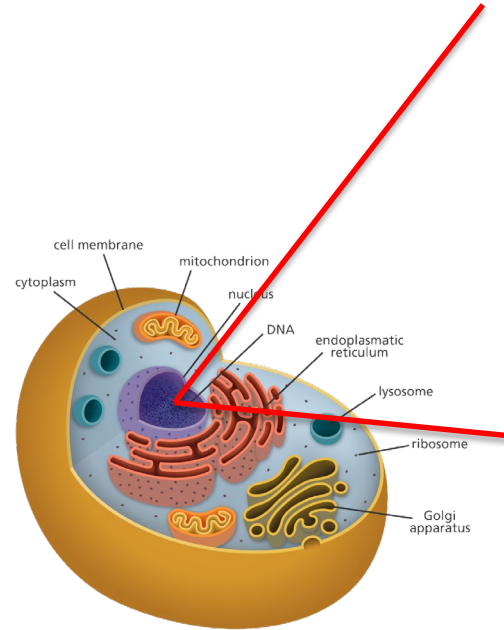
- Require updates on cruise report to alert to change of use
- Notify when commercialisation occurs

Opportunity – Global cruise data available in consistent format

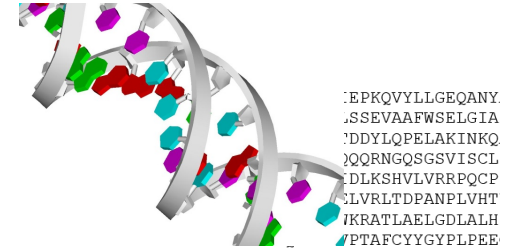
Challenge 3: Lack of a Basic Understanding of Biology



Marine biological resource



Cells (one or more)

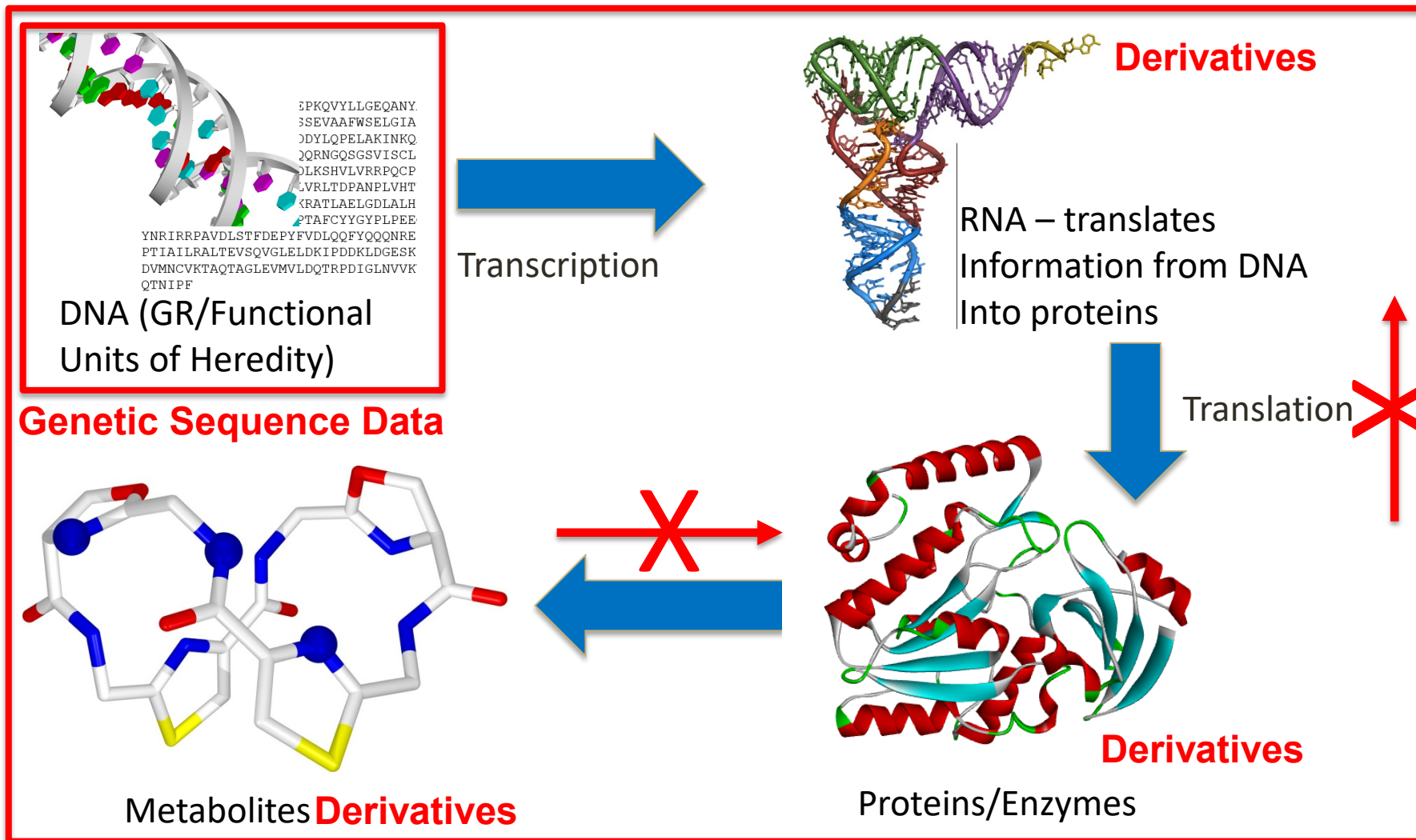


DNA (GR/Functional
Units of Heredity)

**Opportunity –
Providing workable policy instruments consistent with biological principles**

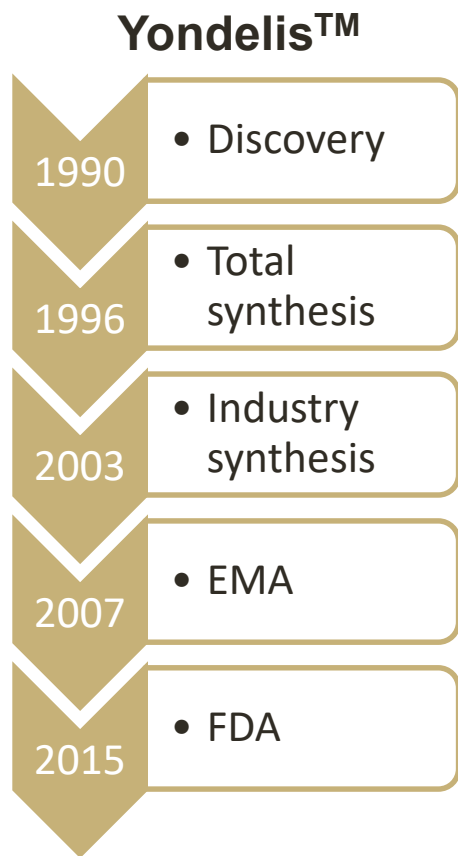
Challenge 4: What are Derivatives?

In Silico Data



Opportunity – Providing consistency between Nagoya/BBNJ and SynBio

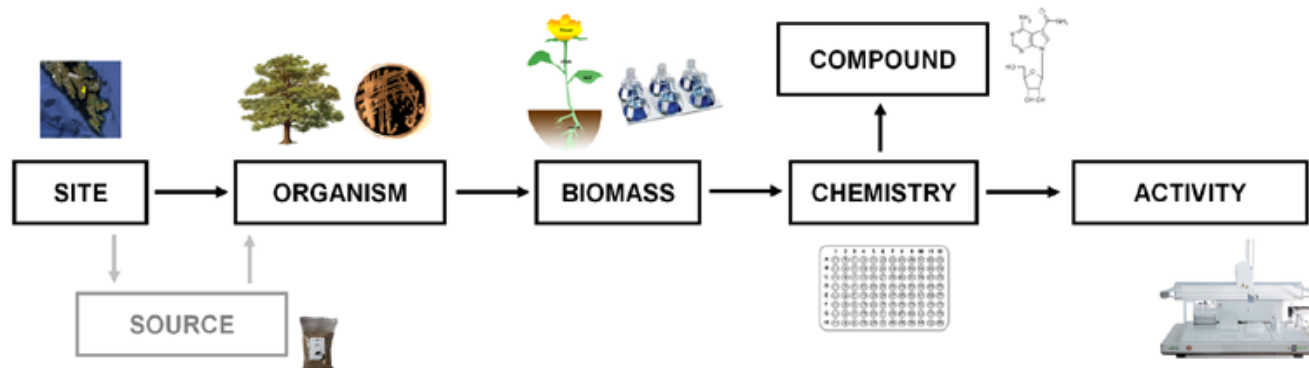
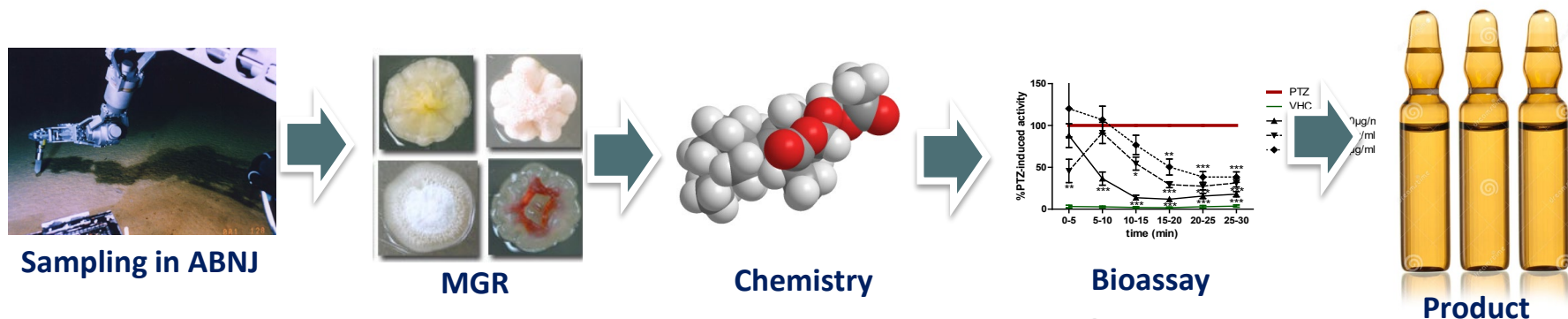
Challenge 5: Appreciation of the Biodiscovery Timeline and Actual Potential for Monetary Benefits



- Cost in 2014 to bring drug to market US\$2,558 M* - >70% Clinical trials
- Typical industry royalties on natural products developed into drugs is 1-3%
- Halaven (Eisai), derived from a Japanese sponge makes US\$200 M per year – in principle yielding US\$ 2-6 M pa.
- Currently 7 approved marine drugs – total royalties would be US\$ 10-50 M.
- Blockbuster drug (> US\$ 1 Bn pa income) would yield US\$10-30 M pa
- Currently 7 approved marine drugs come from ~28,000 discovered marine compounds (1 in 4000 chance) – none are ‘blockbusters’
- All examples were discovered pre-CBD – not clear if actual royalties are being paid
- Other markets – nutraceuticals/cosmeceuticals, lower risk, quicker to market, lower investment and lower returns.

*Tufts Study http://csdd.tufts.edu/news/complete_story/cost_study_press_event_webcast

Challenge 6: Monitoring Sample and Data Flows



OpenNAPIS™
Functional Design

White Point Systems, Inc.
20100626

Opportunity: Track & trace sample from origin to exploitation

BUT: needs improved data infrastructure

OR: Can a light-touch alternative to track and trace be envisioned?

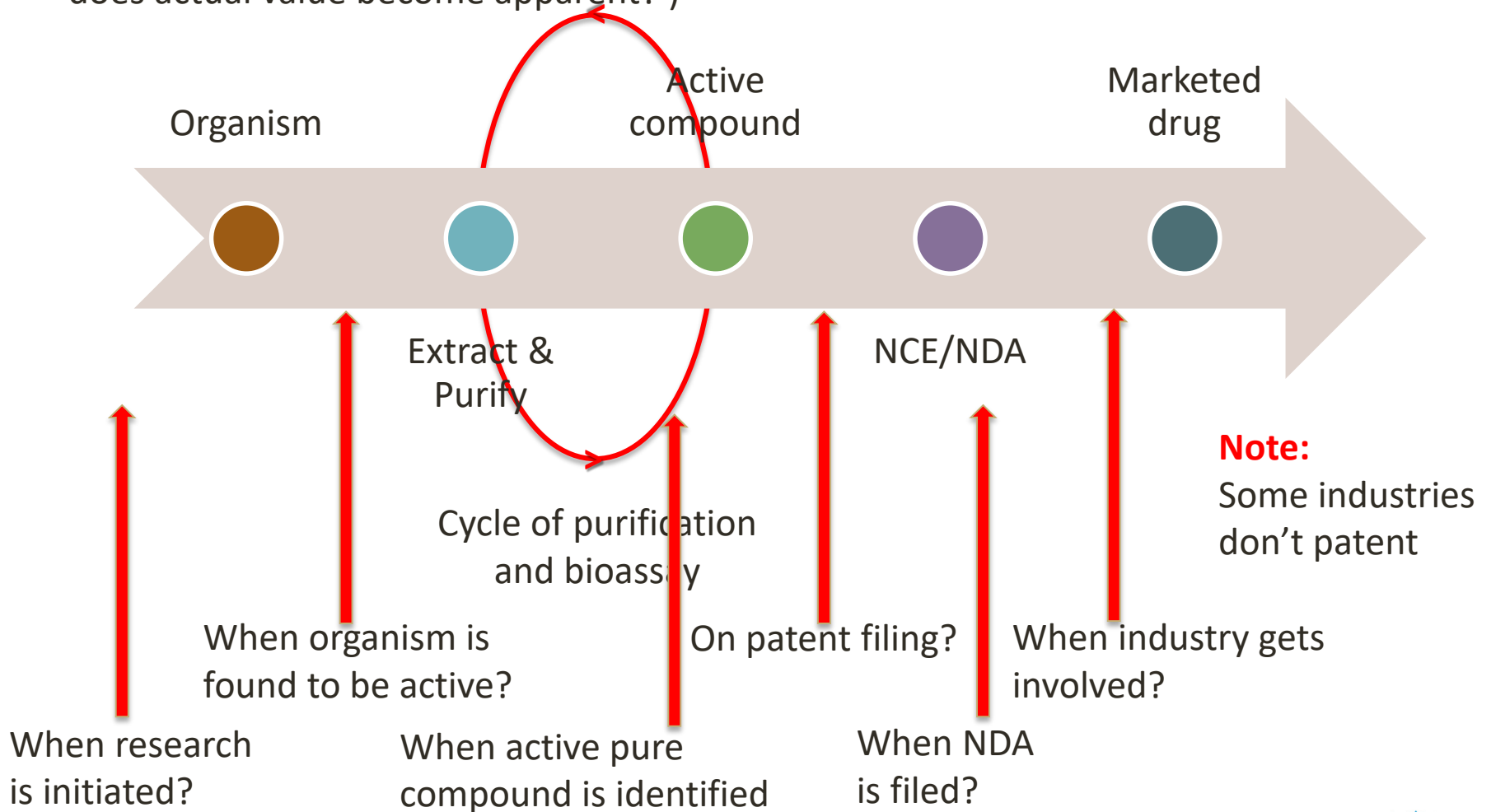
Challenge 7: Types of Data Included

Categories of information	Explanation	Types of data
Data only	Raw data (e.g. genetic sequence data)	<ul style="list-style-type: none"> • Metadata associated with the samples • Initial taxonomic analysis of the samples • Genetic sequence data (DNA) • Transcriptome data (RNA of the genes that are functional at that time) • Automatic gene/transcriptome function annotations • Protein sequence data (DNA/RNA data automatically translated to give amino acid sequence)
Data and analysis	Genetic sequence data which has been annotated with putative gene functions using an algorithm	<ul style="list-style-type: none"> • Initial taxonomic analysis of the samples (DNA methods?) • Automatic gene/transcriptome automatic function annotations • Protein sequence data (DNA/RNA data automatically translated to give amino acid sequence) • <i>Protein structure data (Embargo)</i> • <i>Metabolite data (mainly commercial databases)</i>
Data, analysis and interpretation	Critical evaluation of the data and its analysis conducted by an expert	<ul style="list-style-type: none"> • Full taxonomic analysis of the samples • Manual gene/transcriptome function annotations • <i>Protein structure data (Embargo)</i> • <i>Metabolite data (mainly commercial databases)</i>

Challenge 8:

When Does Commercial Research Begin?

Where is the transition from basic research to research with commercial intent? (when does actual value become apparent?)



Benefit Sharing

- Must be multilateral compared to bilateral for Nagoya Protocol
- Benefits may include:
 - Scientific exchanges/training
 - Technology transfer
 - Capacity building (infrastructure)
 - Enhanced reputation
 - Increased number/quality of scientific publications
 - Biodiversity conservation
 - Valuable regional resources developed (knowledge, samples, data)
 - Upfront/milestone payments & royalties

Mare Geneticum & the Obligatory Prior Electronic Notification (OPEN) System



BRILL
NIJHOFF

THE INTERNATIONAL JOURNAL OF
MARINE AND COASTAL LAW 33 (2018) 1–31



brill.com/estu

Mare Geneticum: Balancing Governance of Marine Genetic Resources in International Waters

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Mare Geneticum Provides Building Blocks Based on Scientific Good Practice

Obligatory Prior Electronic Notification (OPEN)



If IA requires monetary BS: royalties to be paid on commercialisation at % fixed by sector



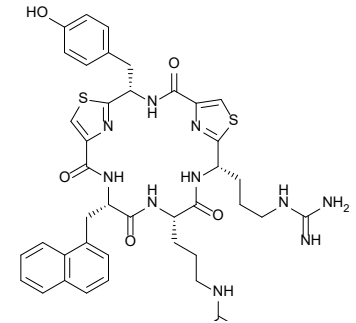
Update OPEN Exclusivity Period



Extend Exclusivity Period For a fee

Update OPEN

Update OPEN



LGEQANY.
WSELGIA
LAKINKQ
BSVISCL
VRRPQCP
ANPLVHT
LCEAIERYSGIFQGDPEWKRAFLAELGDLALH
AIDWTFVWSLTEQKHKYVPTAFICYGYPLPEE
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PTIALLRALTEVSQVGLLELDKIPDDKLDGESK
DVMNCVKTAQTAGLEVMLVDQTRPDIGLNVVK
QTNIPF

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 September 2007 (13.09.2007)

(10) International Publication Number
WO 2007/103739 A2



Share Samples and Raw Data



Access

Benefit Sharing

Benefits to Scientists of the OPEN System

- Benefits to scientists by standardising data and providing central resource (OPEN):
 - Open access to raw data and samples
 - OPEN standardises data management, taxonomy and species identification
 - OPEN enhances international research coordination and cooperation

Issues for the Marine Scientific Research Community

- **Provide reliable scientific and other evidence to ensure marine scientific research on marine genetic resources is not impeded.**
- Definitions (e.g. Marine Genetic Resources)
- Highlighting and agreeing on elements of good practice.
- Reporting and notification procedures: how will it be monitored/enforced and by whom?
- Traceability becomes an issue as benefits may take a long time to be realised. Who will trace this?
- How can we manage expectations for financial returns?
- Can we make sure an implementing agreement is flexible enough to cope with scientific progress?
- **Light touch regulation which does not impose high bureaucratic burden is preferable.**

The School of Natural and Computing Sciences

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Marine Genetic Resources in the UN BBNJ Process

<https://www.abdn.ac.uk/bbnj/>

IGC2

28 March
2019

Side Event
Conference Room 12
1.15-2.30

Mare Geneticum and an
EcoSystem Approach:
Power, Openness and Sharing

- ACCESS AND BENEFIT SHARING
- MANAGEMENT TOOLS
- ENVIRONMENTAL IMPACT ASSESSMENTS
- TECHNOLOGY TRANSFER
- CROSS CUTTING

