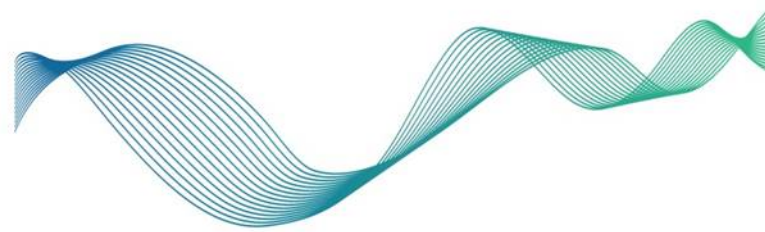


MarineBiotech



Unlocking the potential of marine biotechnology

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Technical University of Denmark



Marine Biotechnology ERA-NET (ERA-MBT) is funded under the European Commission's Seventh Framework Programme. Grant Agreement Number 604814
December 2013 - November 2017

The Earth

- **72 % of the surface is water**
- **> 90 % of the biosphere is water**
- **So why is this planet called EARTH?**

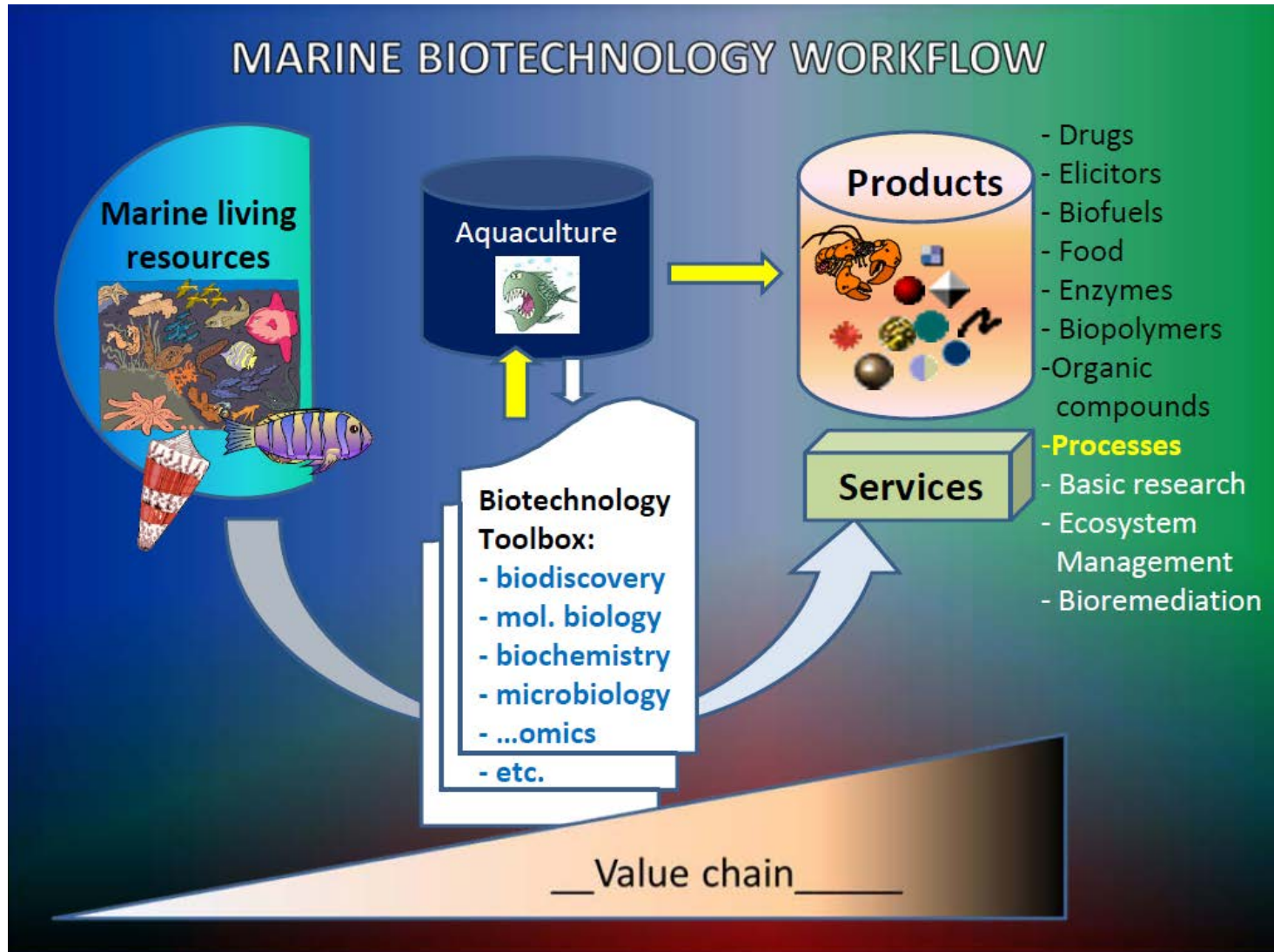


What is Marine Biotechnology?

... the use of marine bioresources as the target or source of biotechnology applications



The potential



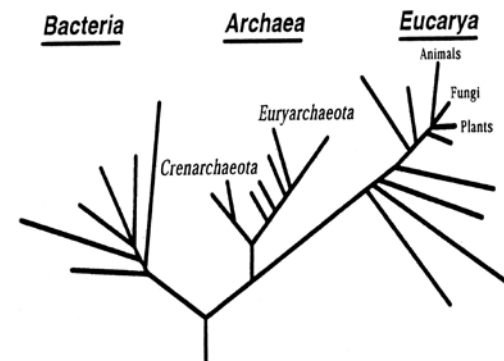
Position Paper 15

Marine Biotechnology: A New Vision and Strategy for Europe

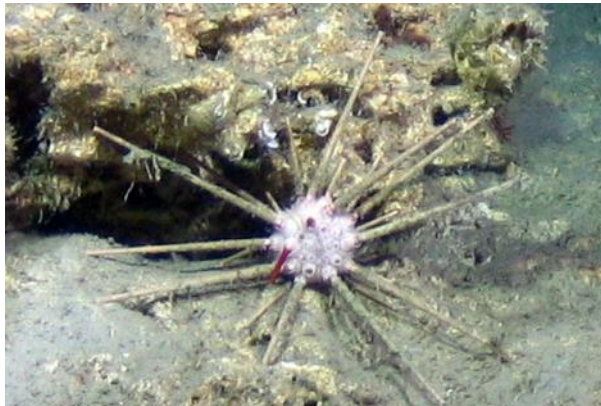
September 2010



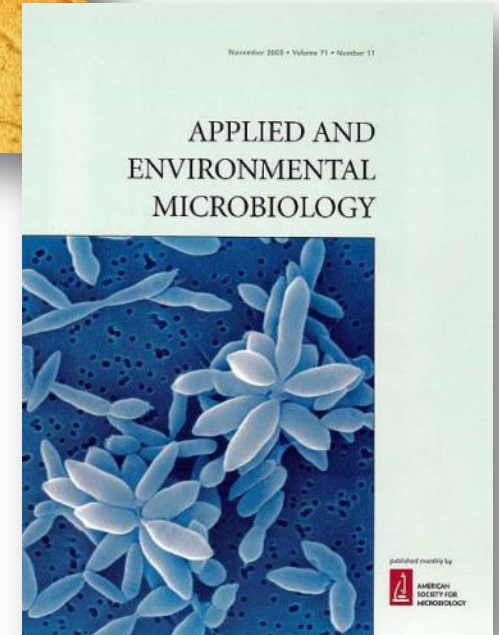
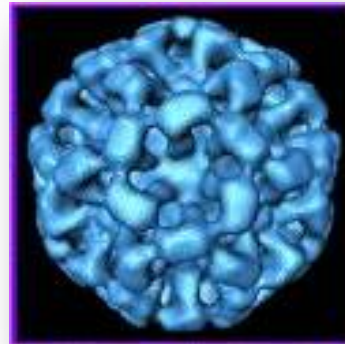
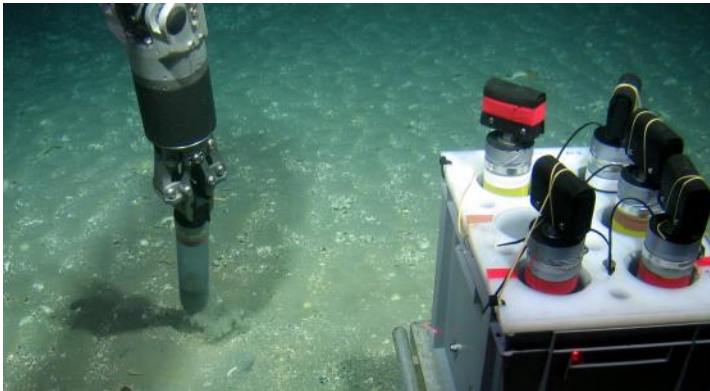
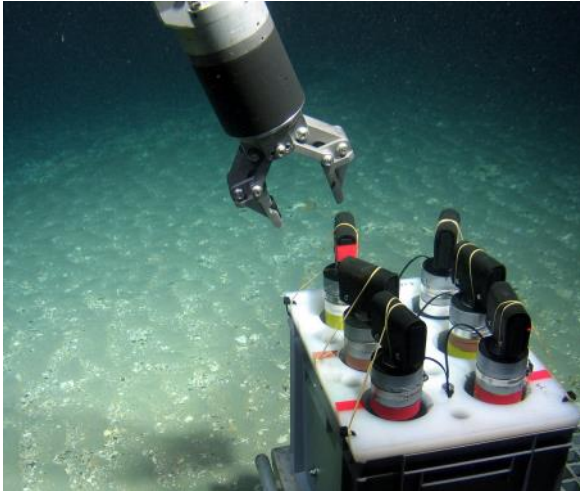
<http://www.esf.org/publications/marine-sciences.html>



Life below the surface



Life below the surface – water and sediment

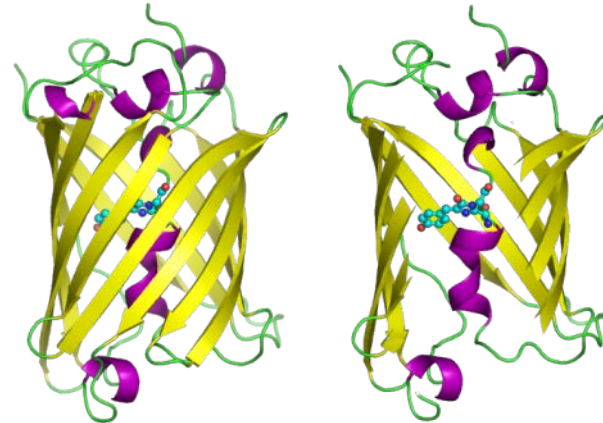


Less than 1% of marine bacteria can be cultured ➡ metagenomics

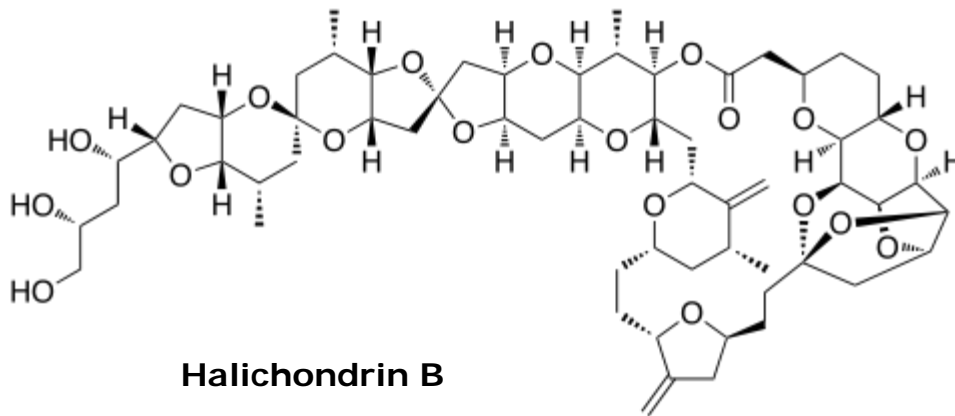
Extraction of valuable biochemical components

Examples of applications:

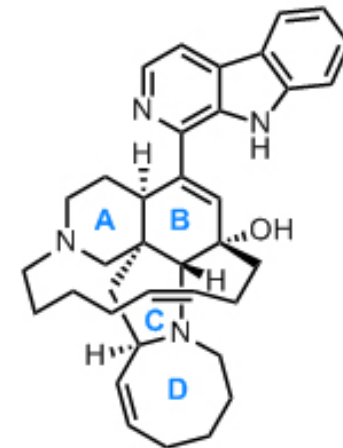
- Pigments
- Antioxidants
- Pharmaceutical use
- Nutraceutical use
- Cosmeceutical use



Green fluorescent protein



Halichondrin B



Manzamine A

Selected marine natural products in development as anticancer drugs



clinical trial	name	source	target	developed by
In Clinical Use	ectenaiscidin 743 (Yondelis)	tunicate	tubulin	PharmaMar, Rinehart
phase III	E7389 (halichondrin B inspired)*	synthetic	tubulin	Eisai
phase II	dehydrodidemnin B (Aplidine)	tunicate	ornithine decarboxylase	PharmaMar, Rinehart
phase II	soblidotin (aka TZT1027, dola-10 insp.)	synthetic	tubulin	Teikoku, Pettit
phase II	synthadotin (aka ILX651, dola-15 insp.)	synthetic	tubulin	ILEX
phase II	bryostatin 1	bryozoan	PKC	GPC Biotech, Pettit
phase II	squalamine	shark	angiogenesis	Zasloff
phase II	kahalalide F	mollusk	multiple	PharmaMar, Scheuer
phase I	PM02734 (kahalalide insp.)	synthetic	solid tumor	PharmaMar
phase I	Zalypsis (jorumycin insp.)*	synthetic	DNA	PharmaMar
phase I	E7974 (hemiasterlin insp.)*	synthetic	tubulin	Eisai
phase I	taltobulin (aka HTI286, hemiasterlin insp.)*	synthetic	tubulin	Wyeth, Andersen
phase I	salinosporamide A (aka NPI0052)	bacteria	proteasome	Nereus, Fenical
phase I	spisulosine (aka ES285)	clam	Rho	PharmaMar
phase I	KRN-7000 (agelasphin insp.)*	synthetic	NKT	Koezuka-Kirin
phase I	NPI 2358 (halimide insp.)	synthetic	tubulin	Nereus, Fenical
phase I	LBH 589 (psammaplin insp.)*	synthetic	HDAC	Novartis
Discontinued				
phase II (<2004)	dolastatin 10	sea hare	tubulin	Pettit
phase II (<1999)	didemnin B	tunicate	antineoplastic	Rinehart
phase II (<2004)	cemadotin (dola-15 insp.)	synthetic	tubulin	BASF, Pettit
phase II (<2002)	cryptophycin 52 (≈ arenastatin)*	synthetic	tubulin	Lilly, Valeriote
phase I (2004)	discodermolide*	sponge	tubulin	Novartis, HBOI
phase I (2002)	LAF 389 (bengamide insp.)*	synthetic	MetAP	Novartis, Crews
phase I (<2006)	LAQ 824 (psammaplin insp.)*	synthetic	HDAC	Novartis, Crews
phase I (<2000)	giroline (aka girodazole)*	sponge	protein synthesis	Potier

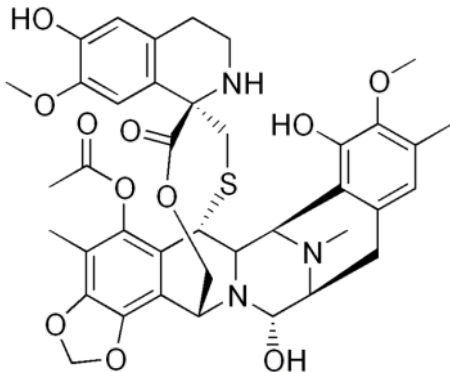
* Substances from marine sponges

The Yondelis story



© PharmaMar, S. A.

A colony of the marine tunicate *Ecteinascidia turbinata*



- 1969 **Trabectedin** found to have anticancer activity
- 1984 Structure determined (Rinehart, Univ. Illinois)
- 1 ton animal \rightarrow 1 gram trabectedin
- 1996 Semi-synthetic method developed (Safracin B produced in *Ps. fluorescens*)
- 2007 EMEA authorisation for marketing trabectedin under trade name Yondelis by PharmaMar, for treatment of soft tissue sarcoma
- Mechanism: Superoxide produced resulting in DNA backbone cleavage and cell apoptosis
- Approved in 57 countries worldwide
- Sales approx. 45 million € in 2009

Cosmeceuticals

- European market > € 27.6 billion per year (COLIPA – The European Cosmetics Association, 2006)

	% of market
• Skin care products	25.7
• Hair products	23.7
• 'Toiletries'	23.4

	% production growth
• Facial serviettes	4.9
• Whitening agents	6.0
• Anti-age/anti-wrinkle cream	0.5
• Trend towards 'natural products'	



Resilience™ by Estée Lauder contains anti-inflammatory pseudopterosin



Products contain blue-green algae extracts

Biomaterials (bone and tissue)

Source organism	Biomaterial	Health application
Macro-algae	Polysaccharides, calcareous algae	Bone and tissue scaffold
Crustacean and Molluscs	Chitin, chitosan, protein-derived peptides	Tissue repair
Finfish	Protein - collagen	Tissue repair, collagen reinforced cements – bone repair
Sponges	Uses skeletal structure	Bone and tissue scaffold, tissue repair, bone grafting

Biomaterials (adhesives)

Source organism	Bioactive compounds	Health application
Molluscs Goose barnacle Mussels	Proteins Proteoglycans	Wound closure Orthopaedics Prosthetics Collection bags
Echinoderms Starfish Urchins	Proteins	Orthopaedics

Another example:

Slime eel used for new biomaterial

Source: Vancouver Aquarium (2014)

<http://www.youtube.com/watch?v=pmaal7Hf0WA>



Time to market for new products

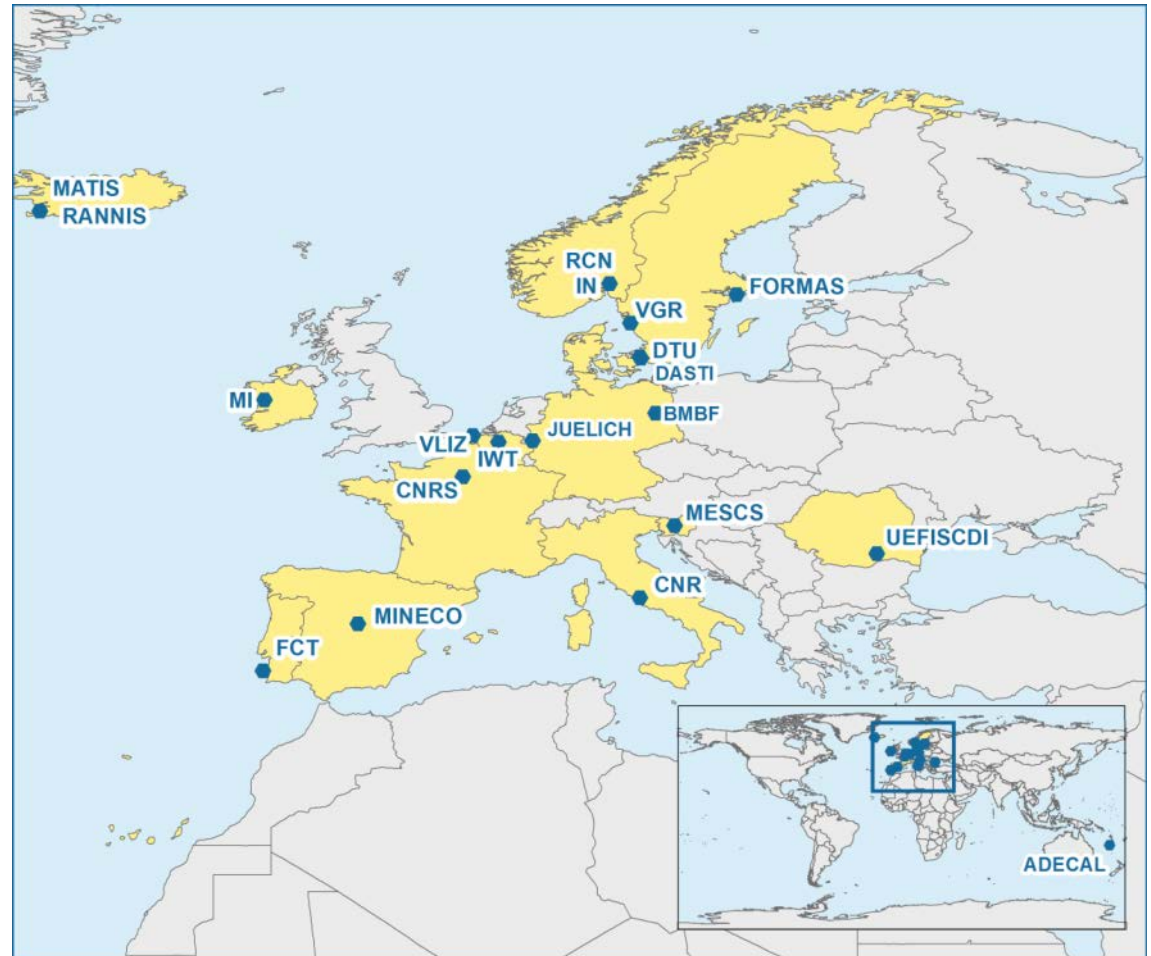
	Time to market for new products		
	1-5 years	5-10 years	10+ years
Industry sector	Food, Agriculture, Cosmetics	Chemicals, Advanced Materials, Medical Devices	Pharmaceutical, Medical Devices, Energy
Source organism	Macro and micro algae, fish processing waste, fish and shellfish	Macro and micro algae, marine invertebrates, fish processing waste, sponges, marine fungi	Macro and micro algae, marine invertebrates, sponges, marine bacteria and viruses
Compounds	<ul style="list-style-type: none"> • Pigments incl. carotenoids • Lipids/fatty acids • Proteins/peptides/amino acids • Minerals • Polysaccharides • Biopolymers • Enzymes • Secondary metabolites incl. phenolics 	<ul style="list-style-type: none"> • Pigments incl. carotenoids • Lipids/fatty acids • Proteins/peptides/amino acids • Minerals • Polysaccharides • Biopolymers • Enzymes • Secondary metabolites, incl. phenolics 	<ul style="list-style-type: none"> • Pigments incl. carotenoids • Lipids/fatty acids • Proteins/peptides/amino acids • Minerals • Polysaccharides • Biopolymers • Enzymes • Secondary metabolites incl. phenolics
Examples of Applications (current and future)	<ul style="list-style-type: none"> • Functional ingredients incl. antioxidants • Nutraceuticals • Food supplements • Human and animal nutrition • Cosmetics • Personal care • Cosmeceuticals • Horticulture growth stimulants • Fertilisers • Cleaning and detergents 	<ul style="list-style-type: none"> • Industrial adhesives • Medical adhesives • Animal health • Tissue and bone replacement • Wound dressings • Dental material • Anti-bacterial • Anti-obesity • Micro-encapsulation • Drug delivery • Bioremediation 	<ul style="list-style-type: none"> • Nano particles • Anti-cancer • Anti-inflammatory • Anti-infective • Anti-viral • Anaesthetics • Other medical therapeutics

Unlocking the potential

ERA NET MarineBiotech

- 19 partners in 14 countries
- Three calls for projects
- First call: Multistream biorefinery

www.marinebiotech.eu



Unlocking the potential

- **Make industry and public community aware of the potentials of marine biotechnology**
- **Demonstrate how marine biomass can contribute to improve European bioeconomy**
- **Change policies for exploiting marine resources – today too many restrictions**
- **Improve international agreements to ownership of the marine genepool**

Partners



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SCIENCE AND SPORT



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