

Challenges and responsibilities of the Italian National Biodiversity Future Center (NBFC) to protect, conserve, restore and valorize biodiversity for today's and future generations

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Istituto per le
Risorse Biologiche
e le Biotecnologie
Marine @CNR

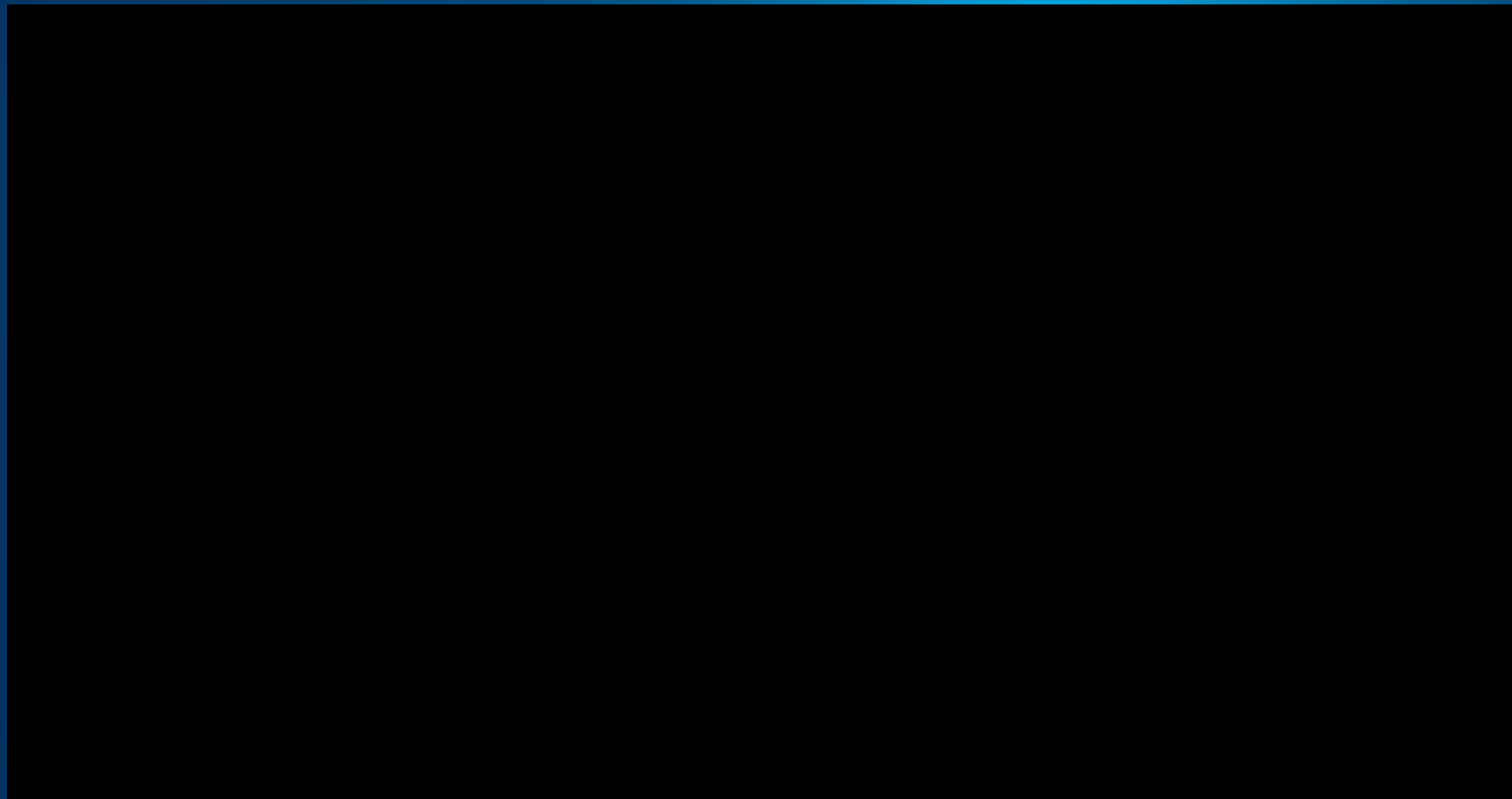
&

National Biodiversity
Future Center of Italy

APANAC 2023 Conference
29th September, 2023



The National Research Council of Italy





The National Research Council of Italy

CNR in figures

The largest public research institution in Italy, the only one under the Research Ministry performing multidisciplinary activities

CNR's mission is to perform research in its own Institutes, to promote innovation and competitiveness of the national industrial system, to promote the internationalization of the national research system, to provide technologies and solutions to emerging public and private needs, to advice Government and other public bodies, and to contribute to the qualification of human resources



È il **primo** ente di ricerca per numero di ricercatori

8503

52% Uomini **48%** Donne

Il CNR conta su un patrimonio di risorse umane di circa 8.500 persone, di cui oltre **5559** impegnati in **ricerca** e attività di **supporto alla ricerca**



7 Dipartimenti

- Scienze fisiche e tecnologie della materia
- Scienze del Sistema Terra e Tecnologie per l'Ambiente
- Scienze Biomediche
- Ingegneria - ICT e Tecnologie per l'Energia e i Trasporti
- Scienze Umane e Sociali Patrimonio Culturale
- Scienze Chimiche e Tecnologie dei Materiali
- Scienze Bio-Agroalimentari

70%

Ricercatori

88



Istituti di ricerca

228



Sedi e laboratori sul territorio

30



Unità di Ricerca presso terzi

3

Basi di ricerca permanenti ai Poli

330



Famiglie di brevetti

50



Imprese e Spin off

51



Accordi bilaterali con 37 paesi



Il CNR si rivolge alla **società** attraverso numerose iniziative aperte al grande pubblico quali **mostre scientifiche interattive**, **exhibits** presso i principali **science center** italiani e stranieri, conferenze ed eventi di divulgazione. Tra le mostre più recenti "Aqua: il futuro è nell'oceano" e "Artico. Viaggio interattivo al Polo Nord" illustrano temi di ricerca strategici per l'Ente. Le 90 edizioni realizzate hanno registrato oltre

900.000 visitatori



Una particolare attenzione è rivolta al mondo della **scuola** a cui sono dedicati progetti divulgativi, laboratori e kit didattici, incontri, corsi di aggiornamento per docenti. Su tutto il territorio nazionale, inoltre sono attivi **progetti PCTO**.



Tra i primati dell'Ente, anche quello del primo nome a dominio registrato in Italia: **cnuce.cnr.it**, registrato a Pisa nel 1987. Da allora, il CNR gestisce e mantiene le attività dei domini: it attraverso **Registro.it**, Unagrafe dei nomi a dominio italiano



Bilancio totale* **1.049.546.767**

37%

Entrate esterne

*Fonte: Rapporto tecnico-Il CNR. La Rete Scientifica. Data aggiornata al 31/12/2021.



LA RICERCA VENUTA DAL FUTURO

Nel **2023**, il CNR **celebra 100 anni** dalla sua istituzione: era infatti il **1923** quando, presso la sede dell'Accademia Nazionale dei Lincei, sotto la presidenza di **Vito Volterra**, il Consiglio Nazionale delle Ricerche nasceva come "ente morale" con il compito di svolgere attività di formazione, promozione e coordinamento della ricerca in tutti i settori scientifici e tecnologici

A cura di: CNR - Unità Comunicazione
Ultima modifica 20 gennaio 2023



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3 interacting Institutes within the



Cumulatively, a community made by >450 staff of marine scientists, technicians, technologists

The Institute for Biological Resources and Marine Biotechnologies promotes and carries out fundamental and applied research to study marine organisms and ecosystems and their evolution, also in relation to global change and human impact



IRBIM CNR is a leading Research Center in Italy for the study of marine life, ecosystems, biodiversity and marine bio-resources



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Biodiversity holds an enormous value for us!!

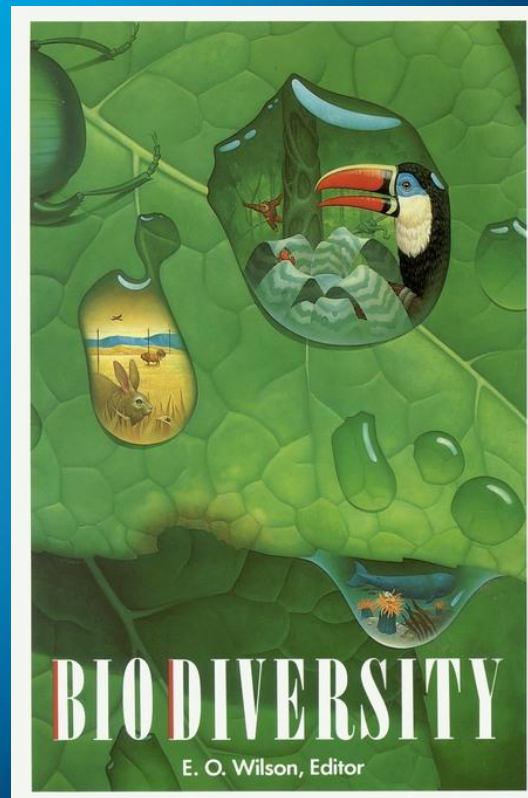
CHAPTER 1

THE CURRENT STATE OF BIOLOGICAL DIVERSITY

E.O.WILSON

Frank B. Baird, Jr. Professor of Science, Harvard University, Museum of Comparative Zoology, Cambridge, Massachusetts

Biological diversity must be treated more seriously as a global resource, to be indexed, used, and above all, preserved. Three circumstances conspire to give this matter an unprecedented urgency. First, exploding human populations are degrading the environment at an accelerating rate, especially in tropical countries. Second, science is discovering new uses for biological diversity in ways that can relieve both human suffering and environmental destruction. Third, much of the diversity is being irreversibly lost through extinction caused by the destruction of natural habitats, again especially in the tropics. Overall, we are locked into a race. We must hurry to acquire the knowledge on which a wise policy of conservation and development can be based for centuries to come.



Biodiversity in danger

Beyond any doubt, the human-driven sixth mass extinction is more severe than previously assessed and is rapidly accelerating. The current generic extinction rates are 35 times higher than expected background rates prevailing in the last million years under the absence of human impacts.

The genera lost in the last five centuries would have taken some 18,000 y to vanish in the absence of human beings.

Such mutilation of the tree of life and the resulting loss of ecosystem services provided by biodiversity to humanity is a serious threat to the stability of civilization. Immediate political, economic, and social efforts of an unprecedented scale are essential if we are to prevent these extinctions and their societal impacts

Mutilation of the tree of life via mass extinction of animal genera

Gerardo Ceballos^{1,2,3,4} and Paul R. Ehrlich^{5,6}

Contributed by Gerardo Ceballos; received May 2, 2023; accepted July 31, 2023; reviewed by Gregory P. Asner and David Tilman

Mass extinctions during the past 500 million y rapidly removed branches from the phylogenetic tree of life and required millions of years for evolution to generate functional replacements for the extinct (EX) organisms. Here we show, by examining 5,400 vertebrate genera (excluding fishes) comprising 34,600 species, that 73 genera became EX since 1500 AD. Beyond any doubt, the human-driven sixth mass extinction is more severe than previously assessed and is rapidly accelerating. The current generic extinction rates are 35 times higher than expected background rates prevailing in the last million years under the absence of human impacts. The genera lost in the last five centuries would have taken some 18,000 y to vanish in the absence of human beings.

Significance

We are in the sixth mass extinction event. Unlike the previous five, this one is caused by the overgrowth of a single species, *Homo sapiens*. Although the episode is often viewed as an

Table 1. Vertebrate generic extinctions since 1500

Taxonomic Level	Vertebrates				
	Total	Mammalia	Aves	Reptilia	Amphibia
Orders	41	14	23	2	2
Extinct orders	2	0	2	0	0
Extinct families	10	6	4	0	0
Total extinct genera	73	21	44	3	5
Monospecific extinct genera	55	15	33	2	5
Extinct polytypic genera	18	6	11	1	0

Number of taxa at different hierarchical taxonomic levels containing the extinct genera since 1500. Extinct genera include the Extinct (EX), Extinct in the Wild (EW), Possibly Extinct (PE) categories of IUCN (24). For example, the 73 extinct genera belong to 41 orders, of which two are extinct. The highest number of extinct genera belongs to Aves and the lowest to Reptilia.

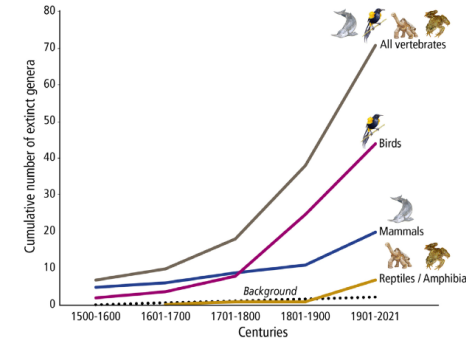


Fig. 2. Number of generic extinctions per century among in different classes of vertebrates. The low number of reptiles and amphibia, which underestimate the magnitude of extinction pattern, is probably the result of the lack of information in earlier centuries, where very few species had been described. The dotted line represent the background extinction rate.

Biodiversity crisis also in our seas and oceans

RESEARCH

EXTINCTION

Avoiding ocean mass extinction from climate warming

Justin L. Penn^{1,2,*} and Curtis Deutsch^{1,2,*}

Global warming threatens marine biota with losses of unknown severity. Here, we quantify global and local extinction risks in the ocean across a range of climate futures on the basis of the ecophysiological limits of diverse animal species and calibration against the fossil record. With accelerating greenhouse gas emissions, species losses from warming and oxygen depletion alone become comparable to current direct human impacts within a century and culminate in a mass extinction rivaling those in Earth's past. Polar species are at highest risk of extinction, but local biological richness declines more in the tropics. Reversing greenhouse gas emissions trends would diminish extinction risks by more than 70%, preserving marine biodiversity accumulated over the past ~50 million years of evolutionary history.

Human activities are altering the global climate, physically transforming habitats, and overexploiting ecosystems of land and sea (1, 2). As a result, rates of species extinction have risen above

lating the severity and drivers of a "sixth mass extinction" (3, 18).

Here, we project global and local extinction risks for marine animals (as a percentage of species lost) on the basis of habitat loss from

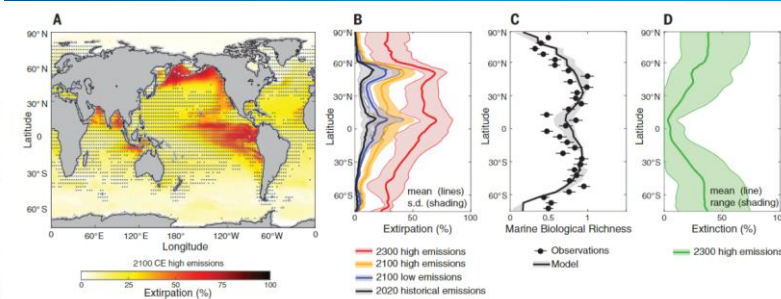


Fig. 2. Spatial variation in species losses and marine biological richness.

(A) By 2100, regions of strong extirpations overlap past productive fisheries (blue points), where catch rates exceed the global median from 1950 to 2014 (36). (B to D) Patterns of extinction risk (B), marine biological richness (C), and global extinction risk [(D); averaged across colonization scenarios] are shown versus latitude. Observed biological richness (number of species) estimated using rarefaction (31) is reproduced by the trait-based habitat model applied to climatological distributions of temperature and O_2 (37, 38) across a range of maximum summation depths [(C) line is 500 m; shading is 0 and 5000 m; (19)]. Richness is normalized to the maximum observation. Extirpation and global extinction risks are averaged from 0 to 500 m, across Earth system models, and across longitude in (B) and (D).

Human activities are altering the global climate, physically transforming habitats, and overexploiting ecosystems of land and sea. As a result, rates of species extinction have risen above natural background levels

Documented extinctions are largely confined to land, where industrial human impacts began earlier and remain more pervasive despite rapid growth in commercial fishing, marine pollution and transport

The projected impact of accelerating climate change on marine biota is profound, driving extinction risk higher and marine biological richness lower than has been seen in Earth's history for the past tens of millions of years



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RESEARCH

MARINE CONSERVATION

At-risk marine biodiversity faces extensive, expanding, and intensifying human impacts

Casey C. O'Hara^{1,*,} Melanie Frazier^{2,} Benjamin S. Halpern^{1,2}

Human activities and climate change threaten marine biodiversity worldwide, though sensitivity to stressors varies considerably by species and taxonomic group. Mapping the spatial distribution of 14 anthropogenic stressors from 2003 to 2013 onto the ranges of 1271 at-risk marine species sensitive to them, we found that, on average, species faced potential impacts across 57% of their ranges; this footprint expanded over time, and that the impacts intensified across 37% of their ranges. Fishing activity dominated the footprint of impacts in national waters, climate stressors drove the expansion and intensification of impacts. Mitigating impacts on at-risk biodiversity is critical to supporting resilient marine ecosystems, and identifying the co-occurrence of impacts across multiple taxonomic groups highlights opportunities to amplify the benefits of conservation management.

The impact on the world's oceans of human activities, including fishing (1), land-based development and runoff (2), and ship strikes (3), coupled with the accelerating effects of climate change (4), are

sensitivity to 14 anthropogenic stressors. We then intersected species range maps with relevant maps of annual stressor intensity from 2003 to 2013 to determine the extent of potential impacts [as in (17); hereafter simply "impacts"]

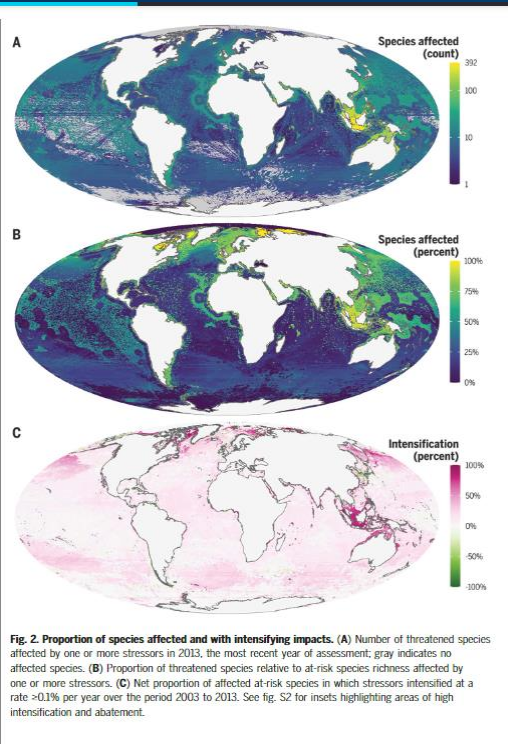


Fig. 2. Proportion of species affected and with intensifying impacts. (A) Number of threatened species affected by one or more stressors in 2013, the most recent year of assessment; gray indicates no affected species. (B) Proportion of threatened species relative to at-risk species richness affected by one or more stressors. (C) Net proportion of affected at-risk species in which stressors intensified at a rate >0.1% per year over the period 2003 to 2013. See Fig. S2 for insets highlighting areas of high intensification and abatement.

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At-risks marine species especially threatened!

Human impacts on at-risk species are changing over time. From 2003 to 2013, impacts were intensifying

Mapping the spatial distribution of 14 anthropogenic stressors from 2003 to 2013 onto the ranges of 1271 at-risk marine species sensitive to them, the authors found that, on average, species faced potential impacts across 57% of their ranges, that this footprint expanded over time, and that the impacts intensified across 37% of their ranges

And.... we are losing biodiversity, even before having fully described it!

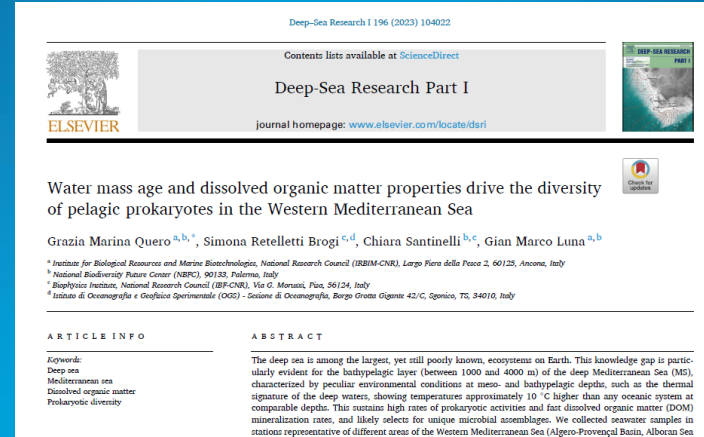
OPEN ACCESS Freely available online

Review

Deep-Sea Biodiversity in the Mediterranean Sea: The Known, the Unknown, and the Unknowable

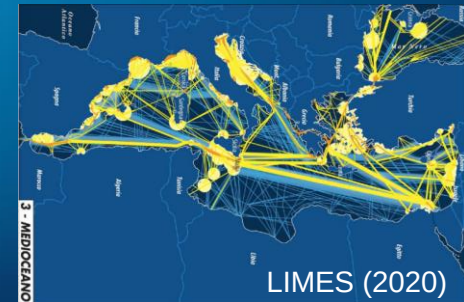
Roberto Danovaro^{1*}, Joan Batista Company², Cinzia Corinaldesi¹, Gianfranco D'Onghia³, Bella Galil⁴, Cristina Gambi¹, Andrew J. Gooday⁵, Nikolaos Lampadariou⁶, Gian Marco Luna¹, Caterina Morigi⁷, Karine Olu⁸, Paraskevi Polymenakou⁶, Eva Ramirez-Llodra², Anna Sabbatini¹, Francesc Sardà², Myriam Sibuet⁹, Anastasios Tselepidis¹⁰

1Dipartimento Scienze del Mare, Università Politecnica delle Marche, Ancona, Italy, **2**Institut de Ciències del Mar, Consejo Superior de Investigaciones Científicas, Barcelona, Spain, **3**Department of Animal and Environmental Biology, University of Bari, Bari, Italy, **4**National Institute of Oceanography, Israel Oceanographic and Limnological Research, Haifa, Israel, **5**National Oceanography Centre, Southampton, United Kingdom, **6**Hellenic Center for Marine Research, Crete, Greece, **7**Stratigraphy Department, Geological Survey of Denmark and Greenland, Copenhagen, Denmark, **8**Département Etude des Écosystèmes Profonds, Ifremer Centre de Brest, Plouzané, France, **9**Institut Océanographique, Paris, France, **10**Department of Maritime Studies, University of Piraeus, Piraeus, Greece

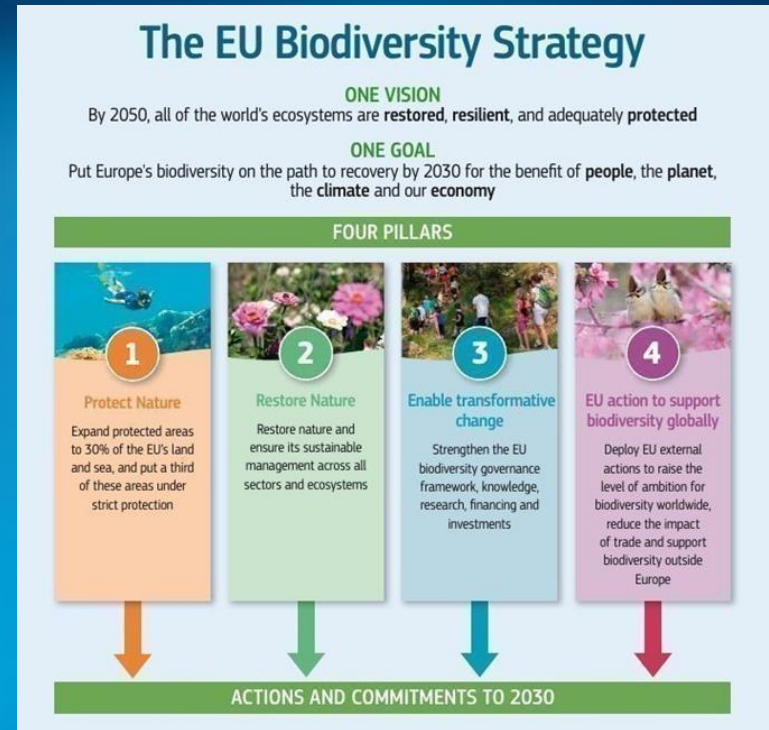


The Mediterranean Sea is >1% of global ocean but hosts 7.5% of biological diversity

The deep-sea is our last frontier



So, we need multiple, well coordinated goals and holistic actions, and set ambitious goals for biodiversity and sustainability!



A comprehensive, ambitious and long-term plan to protect nature and reverse the degradation of ecosystems. The strategy aims to put Europe's biodiversity on a path to recovery by 2030, and contains specific actions and commitments.

Within this context, the Italian National Biodiversity Future Center is born last year!

The overarching objectives of the NBFC, a unique (and unprecedented for Italy) cross-disciplinary and innovative Center, are:

- 1) **Assessing, monitoring, preserving and restoring** marine, terrestrial and urban biodiversity across selected national model ecosystems
 - 2) **Valorizing biodiversity to make it a central element for sustainable development**, through an Open Innovation approach to encourage entrepreneurial projects that enhance the science developed by the NBFC researchers, technology transfer paths and initiatives favoring the progress of Key Enabling Technologies
- (Francesca D'Esposito's talk yesterday)

A very large initiative partnering 49 Research Institutes, Universities and Companies for a total funding of 320 MEuro in three years



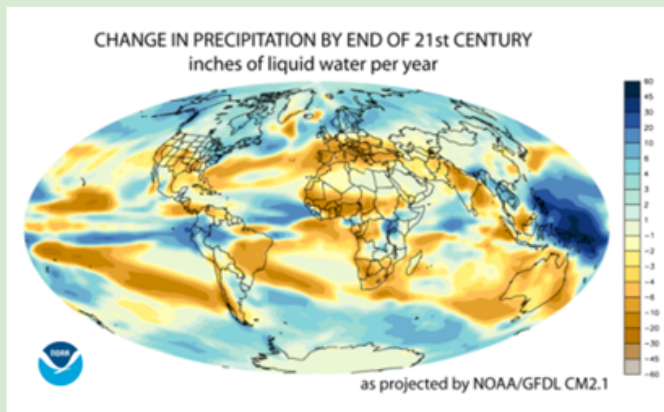
VISION: Why is Italy unique?

Italy hotspot in the Mediterranean

- Italy is probably the country in Europe with the highest rate of **biodiversity**, a huge number of **endemisms** and with unique richness of very different **habitats** including coastal, island, mountain, aquatic biotopes
- One of the places in Europe where the effects of **climate change** will be stronger

- **130 Ecosystems**
- **60000 animal species**
- **10000 vascular plants**
- **7.5% of the world marine biodiversity**
- **12 Mil Ha forests with 45% ranked at high biodiversity**

The 6th Mass Extinction
A number of them within
the IUCN Red List



NBFC is further strengthening international leadership in **Biodiversity**

Key topics **and key outputs** of NBFC



- Monitoring and mapping Biodiversity and Ecosystem functions
- Adaptation and mitigation of climate change
- Alien species
- Restoration of degraded ecosystems with NBS
- Increasing protected areas
- Genetic characterization of endemic and endangered species
- Assessing and maximizing ecosystem services
- Launching and testing new biomolecules
- Mitigating emerging pollutants
- Biodiversity oriented planning of land, sea and urban areas
- Recycling of biodiversity waste

Reducing the loss of Biodiversity

Increasing contribution of ecosystems to Carbon Neutrality

at least 40 alien species studied

at least 20 NBS tested

up to 30% protected sea and land area (from the actual 22%)

between 50 and 100 species sequenced

at least 30 new models and protocols released

at least 1000 biomolecules investigated and tested

- Sustainable aquaculture
- Reducing fisheries impact

- Fighting Forest Fires

- Urban greening
- Biodiversity for Human Health

- Valorizing Nursery Chain

Key topics and **key outputs** of NBFC₁ GATEWAY

Digitizing museum collections

at least 5 Million samples digitized

Educating a new generation of scientists

at least 700 new scientists formed and 3000 papers published

Engaging citizens and innovators

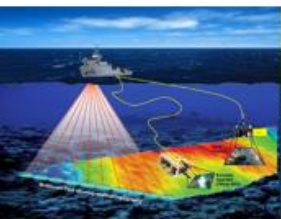
at least 1000000 citizens and 500 innovators involved

Exploiting the value of biodiversity

finalizing a “certified index” of biodiversity

10 Million € call launched for protected areas

20 Million € call for SME launched soon



From state-of-the-art labs to the OPEN LABS in field study areas

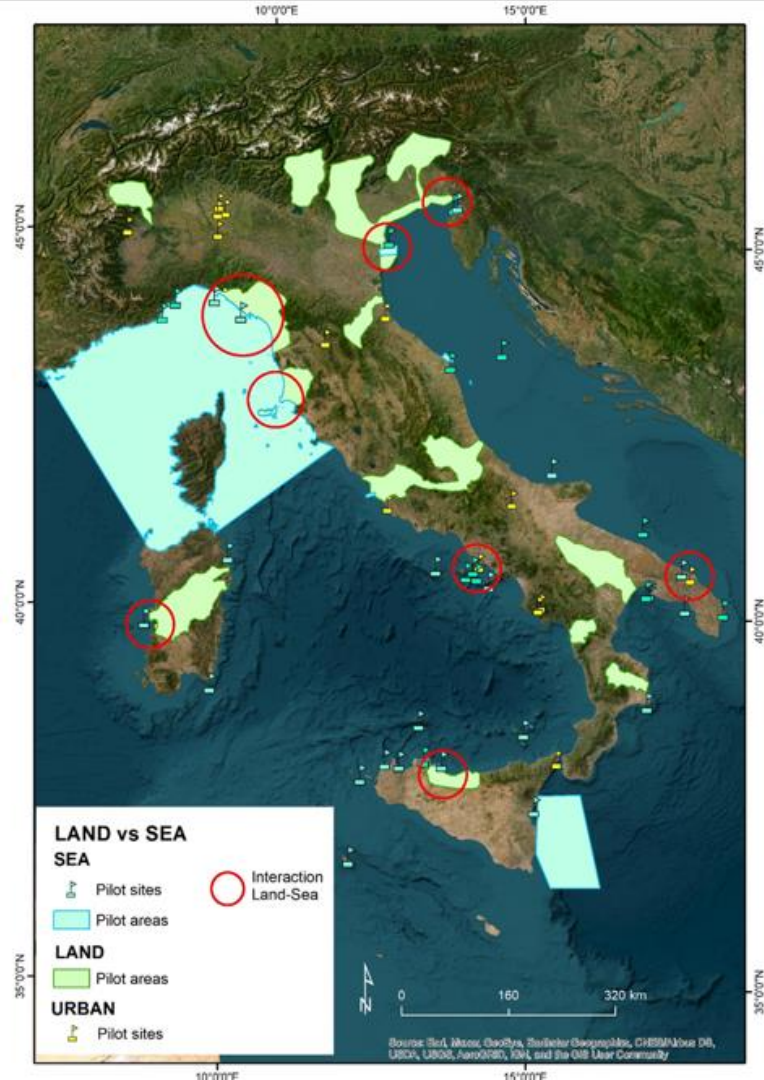


about 130.000 km²

> 30 sites 10% SEA

12 Broad Sites 16% LAND

10 Cities (40 sites)



ACTION 1: promote green and blue jobs



The number of green and blue jobs will rise over time, as will the percentage of employment in these sectors

- In 2022 over 3.1 million green/blue jobs in Italy
- Growth forecast 2.2/2.4 x year by 2025
- Green/blue jobs are more sought after by young people, are more stable and at least 45% of job positions are located in the center and south



Blue and green jobs intercepted by NBFC spokes:

Environmental technician
Environmental scientist
Environmental consultant



7 spokes

Biodiversity manager
Farm manager
Climate change scientist
Water quality scientist



5 spokes

Environmental health and safety officer



4 spokes

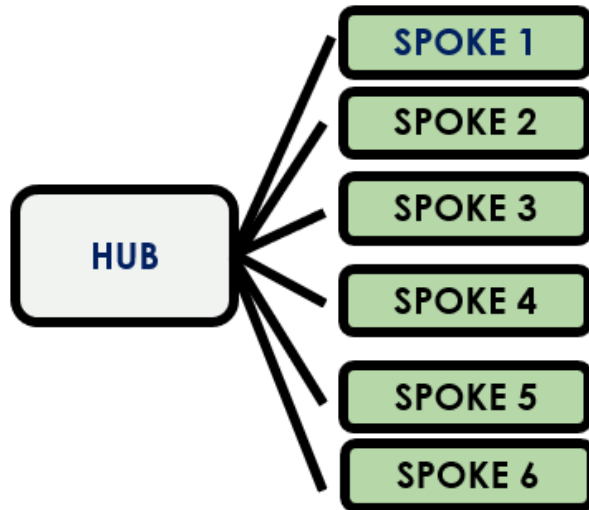
Forestry manager / forester
Recycling worker
Urban grower / urban farmer
Marine biologist



3 spokes

ACTION 2: connecting with national supply chains

MARKETS AND SUPPLY CHAINS



Sea Ecotourism and sustainable use of marine resources

Marine aquaculture, sustainable fishing, Marine biotechnology (i.e. biosensors and sampling tools)

Land Ecotourism, Environment conservation and biodiversity protection, Freshwater management, citizen science

Nature Based Solutions, Environmental certifications, Climate change adaptation

Nursery and forestry chain, Urban planning and Green architecture

Nutraceutical, **Pharmaceutical**, **Food** and **Cosmetics** supply chain. Industrial biotechnology

ACTION 3: training

SPOKE 7



RRI: multi-stakeholder training and participation

- for the success of conservation, restoration, monitoring and evaluation actions
- element of inclusion



DIVERSITY AS A VALUE: empowerment classes and activities

Strengthening the individual's potential without losing their individuality



RESPECT DIVERSITY

Identify personal strengths and aptitudes and provide young people with the tools they need to achieve their goals

NBFC - ACCESSIBILITY

DATA, TECHNOLOGIES, PEOPLE

**Natural
Collections
Digitization**



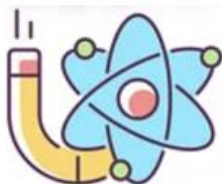
5 million samples



4000 samples

**Molecular
Biodiversity**

**Bioresources
(chemicals,
metabolites)**



8000 natural compounds



covering 100% territory

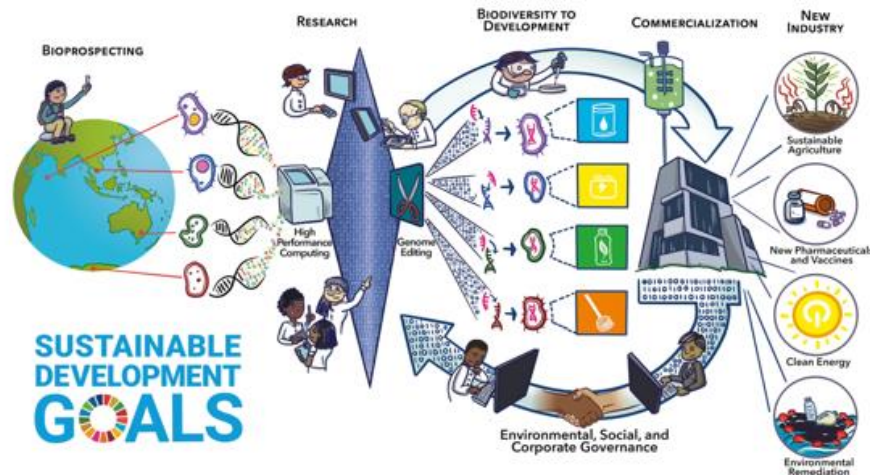
**Territorial
Biodiversity
Monitoring
platform**

NBFC - OPEN INNOVATION

Open Innovation – Research Translation and Applied Knowledge Exchange in Practice through cooperation among University, Research centers and Industry

SPOKE 8

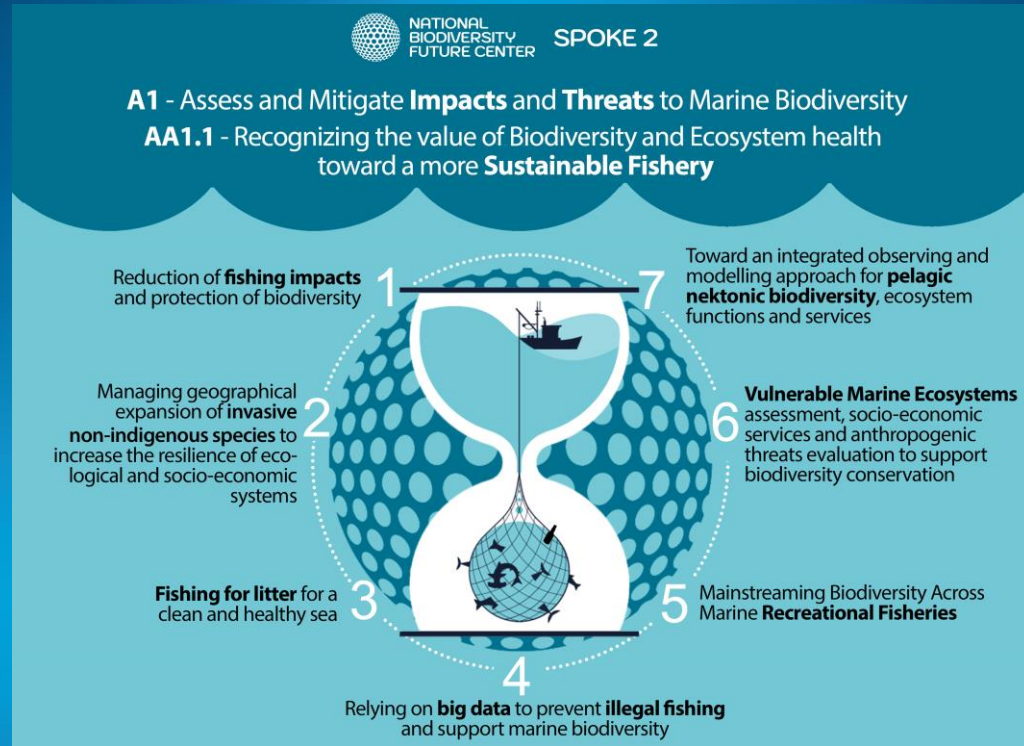
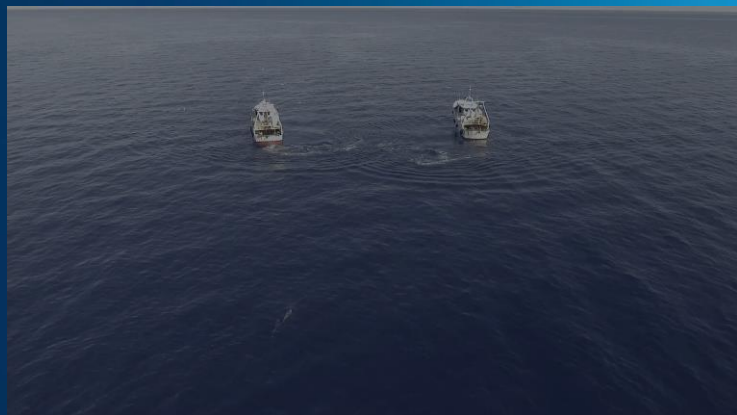
- ACCELERATOR GRANTS
- CONNECT AND DEVELOP GRANTS
- TRANSLATIONAL SUPPORT AND TECH TRANSFER
- UPSKILLING

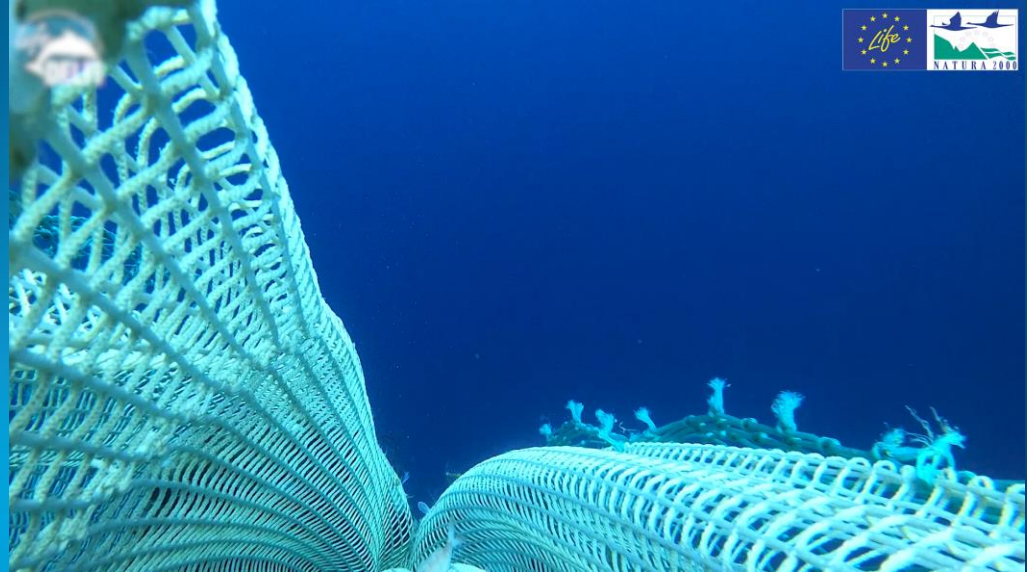
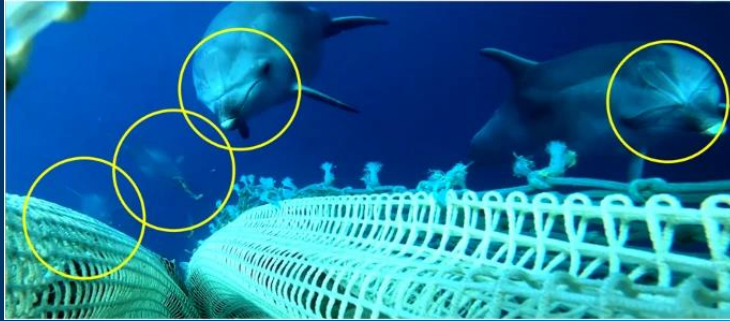


FROM: Vuong, P et al., (2022). The little things that matter: how bioprospecting microbial biodiversity can build towards the realization of United Nations Sustainable Development Goals. *npj Biodiversity*, 1(1), 4.

A few examples of science performed in NBFC

Research for a more sustainable and biodiversity-friendly fishery





www.nature.com/scientificdata

scientific data

OPEN

Check for updates

DATA DESCRIPTOR

A WAV file dataset of bottlenose dolphin whistles, clicks, and pulse sounds during trawling interactions

Francesco Di Nardo¹, Rocco De Marco², Alessandro Lucchetti^{2,3} & David Scaradozzi¹

Globally, interactions between fishing activities and dolphins are cause for concern due to their negative effects on both mammals and fishermen. The recording of acoustic emissions could aid in detecting the presence of dolphins in close proximity to fishing gear, elucidating their behavior, and guiding potential management measures designed to limit this harmful phenomenon. This data descriptor presents a dataset of acoustic recordings (WAV files) collected during interactions between common bottlenose dolphins (*Tursiops truncatus*) and fishing activities in the Adriatic Sea. This dataset is distinguished by the high complexity of its repertoire, which includes various different typologies of dolphin emission. Specifically, a group of free-ranging dolphins was found to emit frequency-modulated whistles.

The signal digital files and corresponding features make this dataset suitable for studying dolphin behavior in order to gain a deeper understanding of their communication and interaction with fishing gear (trawl).

A few examples of science performed
in NBFC

Fishery and alien invasive species

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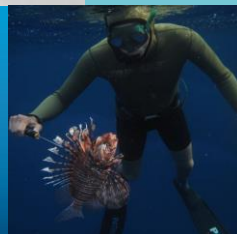
Italy

● This article is more than 1 month old

Invasive blue crabs threaten economy of whole regions of Italy, official say

Crustacean native to Americas is devastating shellfish production

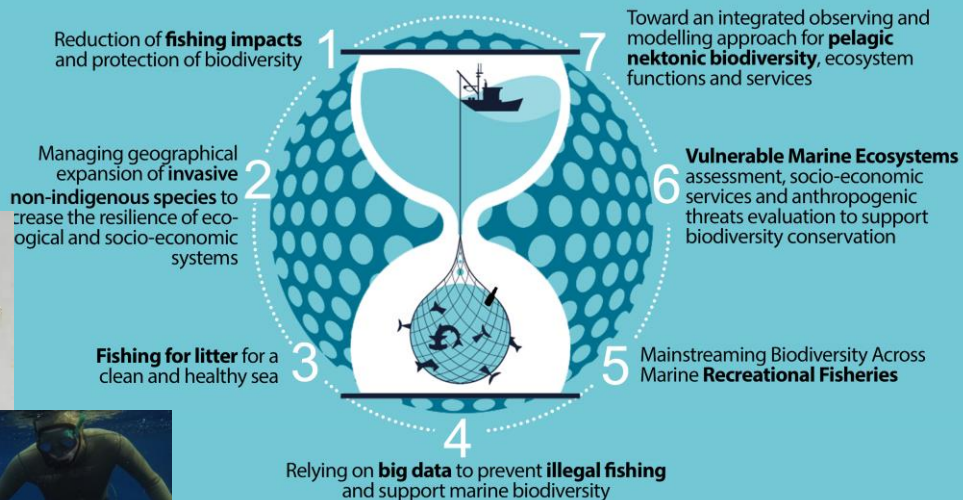
Adaptive management of marine NIS
Strategies for using them as a commercial resource



 **NATIONAL
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FUTURE CENTER** **SPOKE 2**

A1 - Assess and Mitigate Impacts and Threats to Marine Biodiversity

AA1.1 - Recognizing the value of Biodiversity and Ecosystem health toward a more Sustainable Fishery



Ecological Restoration

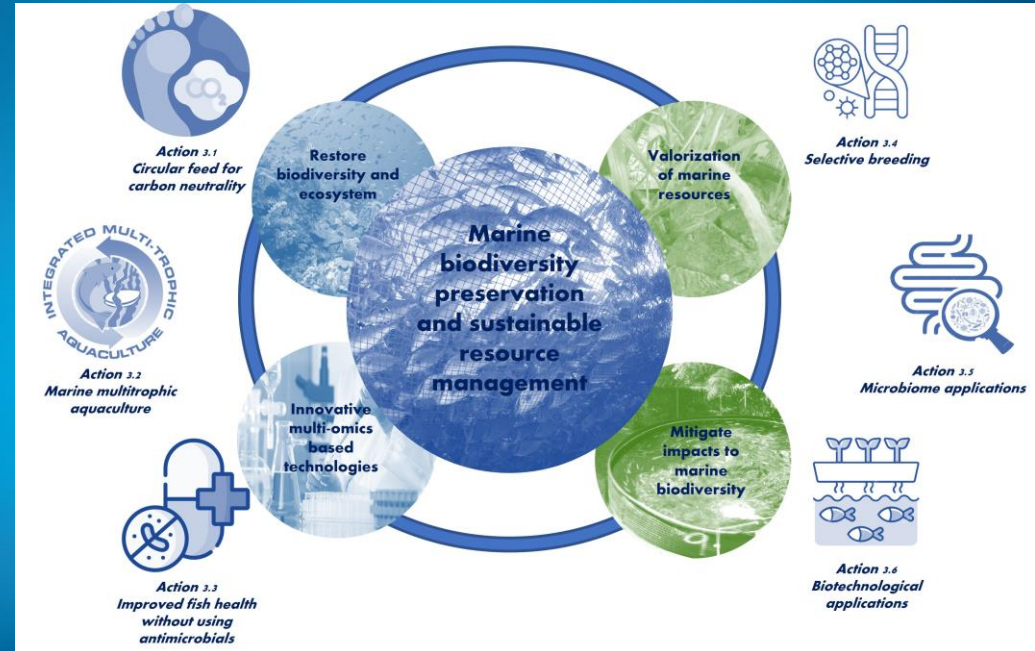


Harmonization
by networking



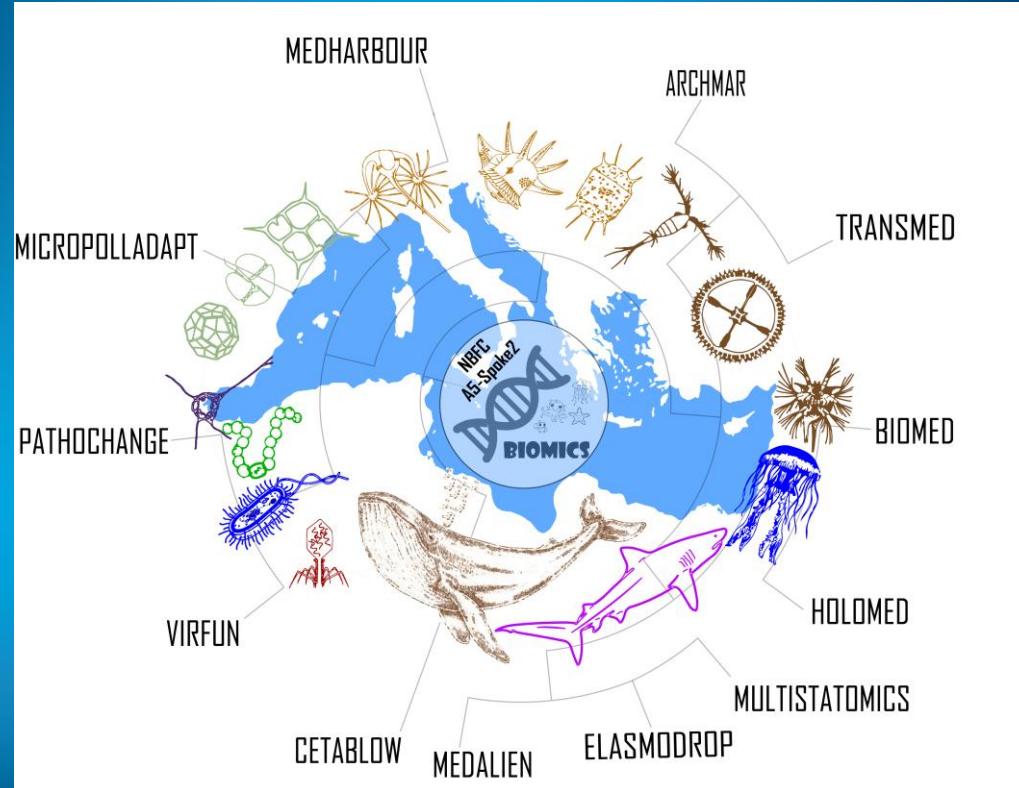
A few examples of science performed
in NBFC

One Health Aquaculture



A few examples of science performed in NBFC

Developing an omics marine observatory (eDNA)
Genomics of tropical invasive fishes in a warming Mediterranean Sea
Large scale metagenomic analysis of the Atlantic/Mediterranean Sea
Retrospective multi-omics analysis of archived marine samples
Impact of climate change on marine pathogen emergence
eDNA monitoring of mediterranean elasmobranchs
Metapangenomic of Marine Pathogens



CETABLOW

Metagenomic analysis of exhaled breath condensate of Cetaceans

(Action leader: M. Rosso)

✓ Sampling tests

- 8 finwhales (*Balaenoptera physalus*) have been successfully sampled during at sea surveys carried out in the period Jan 2023 – May 2023



- Blow sampling (example, whale ID03)



- Photogrammetry shots (example, whale ID02)



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Gracias por la atención – Thank you for your attention
Muy feliz de cooperar – Very happy to cooperate with you

Gian Marco Luna
Director

gianmarco.luna@cnr.it

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