



GO-SEE

**GLOBAL OCEAN
SYSTEMS ECOLOGY & EVOLUTION**

GO SEE - GLOBAL OCEAN SYSTEMS ECOLOGY & EVOLUTION - is a 10-year initiative building upon Tara Oceans know-how, data and knowledge to understand, for the first time, the structure and dynamics of a planetary ecosystem and integrate it into models of Earth's biogeochemical cycles and climate.

“UNDERSTANDING AN ENTIRE GLOBAL ECOSYSTEM”

Human societies have spent billions to discover the properties of the infinitely small (atoms and cells) and the infinitely large (stars and the universe). From these explorations we have improved lifestyles, learnt how to fight disease, and how to generate energy.

The largest continuous ecosystem on Earth is the ocean. Life most probably started there around 4 billion years ago, from where it underwent a long complexification process from the tiniest and simplest viruses and microbes to larger and sophisticated unicellular protists and multicellular organisms. This complexification process is the origin of today's extraordinary biodiversity, it has generated the oxygen we breathe and our fossil fuel reserves, while absorbing CO₂ and other noxious gases from the atmosphere to make our planet a comfortable home for humanity. It's time to give it our attention.

TARA OCEANS STANDARDIZED DATA COLLECTION FROM OCEAN ECOSYSTEMS

In 2008 the Tara Oceans (TO) consortium decided to systematically sample the largest ecosystem on Earth, marine plankton, during two circum-global navigations on board the research schooner Tara. Thousands of samples were collected, covering the whole size range of life from bacteria to small animals and including viruses, for automated imaging and DNA sequencing analyses. From them we have generated the largest sequence datasets from any biome on Earth, that have now become a foundational resource and have already led to transformative advances in biology, ecology, evolution, genomics, and oceanography.

Tara Oceans pioneered a standardized process to collect, store, and analyse samples and data from planktonic ecosystems. The data collected is very heterogeneous - including physico-chemical measurements, genomics, images of plankton - and is also immense, requiring a new database structure. Independent initiatives are now adding more data, expanding further the possibilities to explore ocean life. The database developed by Tara Oceans represents the largest genome-based global scale open access resource from marine ecosystems.

KEY FIGURES FOR TARA OCEANS AND GO-SEE

- 3 YEARS** circumnavigation – **140,000 KM**
- 22** laboratories and more than **500** scientists involved
- 35 000** samples
- >160,000** plankton taxa, most unknown
- >150 MILLION** genes identified
- >250 BILLION** DNA sequence reads in terabytes
- >6 MILLION** images of individual organisms
- >10 PUBLICATIONS** in Science and Nature
- HUNDREDS** of contextualized environmental parameters

PLANKTON

Marine plankton constitute the largest biome on Earth. In every litre of seawater there are between 10 and 100 billion life forms, including viruses, prokaryotes (bacteria and archaea), single celled eukaryotes (protists), and small animals. During the history of life on our planet, plankton were responsible for generating atmospheric oxygen long before terrestrial plants appeared, and today they still perform half of planetary photosynthesis. Plankton are a key component of global carbon cycling and climate, notably through the 'biological carbon pump' by which atmospheric CO₂ is transformed into organic carbon and eventually transferred to the ocean floor where it can be sequestered for millennia. Plankton are the primary food for fish and shellfish, and hold an enormous but largely untapped source of unique organisms and bioactive compounds relevant for bio-industries and the blue economy.





THE FUTURE HABITABILITY OF OUR PLANET DEPENDS ON PLANKTON ECOSYSTEMS

Understanding the fundamental properties of plankton ecosystems (structure, dynamics, evolution), and how life originated, complexifies, and evolves at the ecosystem level, is arguably the greatest scientific challenge of the next decades. It is essential to predict the future of our biosphere and to learn how to live in synergy with our Earth system.

AIMS AND AMBITIONS OF GO-SEE

Tara Oceans has generated a treasure trove of data to address the nature of the mechanisms at work in evolution that led to the incredible genetic diversity of life on Earth. GO-SEE will use these resources and combine them with the latest technologies in the biological sciences together with artificial intelligence and machine learning to improve our understanding of the structure and dynamics of a planetary ecosystem and integrate it into models of Earth's biogeochemical cycle. By generating a comprehensive multi-disciplinary model of an entire ecosystem, GO-SEE will unveil for the first time the basic ecological and evolutionary principles underlying the functioning of a global living system on planet Earth.

— The first comprehensive and multi-disciplinary model of an entire ecosystem, enabling the integration of biological data in climate and Earth system models

GO-SEE aims to integrate quantitative data representing the entire breadth and depth of plankton biocomplexity into models of the ocean and Earth systems, in order to improve their precision and efficiency. Down the line, the scientists aim to help develop the next generation of climate models, to inform decision-makers and the public.

— A multi-disciplinary network to empower and bring interested parties together, towards a more sustainable governance for the oceans

GO-SEE aims to continue the philosophy pioneered by the Tara Oceans project to involve scientists, students, the public, and decision-makers, to form a global consensus on the need and means to support the marine environment.

— Critical assessments of biodiversity in the ocean
Researchers are witnessing profound changes in ocean biodiversity, with migrations and species losses caused by temperature changes, oxygen loss, acidification. GO-SEE will contribute to a future multidisciplinary observation of ocean biodiversity, as asked in the United Nations SDGs and the G7 Ocean agenda, amongst others.

— More accurate prediction tools for fish stocks
Current models for fisheries are changing with new technology and the need for a more holistic view on ocean ecosystems. GO-SEE will boost the integration of data from ocean microbiomes and plankton networks into current models.

SOCIO POLITICAL OBJECTIVES

GO-SEE will provide decision-makers with crucial information for infrastructure and business management in the current context of climatic and environmental uncertainties.

INTERNATIONAL COOPERATION AND CAPACITY BUILDING

In a logic of cooperation, the [Tara Expeditions Foundation](#) and the Fonds Français pour l'Environnement Mondial (FFEM) are supporting capacity-building and research in developing countries. We aim to develop international cooperation in sciences related to ocean ecosystems, and to support greater consideration of marine ecosystems in the existing ocean policy forums.

SCIENCE AND EDUCATION

The GO-SEE program and the Tara Foundation are ideal partners for educational infrastructures, providing them with turnkey activities on scientific and interdisciplinary topics for all age groups. By staying as close as possible to the real data collecting by the scientists, pupils also get a unique first-hand experience of how « real scientists » work !



ORGANISATION / CREDITS

The GOSEE program is developed and coordinated by the CNRS 'Fédération de Recherche' Tara Oceans, together with the Tara Oceans consortium, led by EMBL, and the Tara Expeditions Foundation contact@taraexpedition.org

