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Lab Matters

TREC: A two-year mission to study human impact on Europe's seas and coastal regions

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Europe's life science laboratory EMBL is leading the TREC project: the first pan-European and cross-disciplinary effort to examine life in its natural context at unprecedented scales



TREC – Traversing European Coastlines – is a pan-European expedition to study coastal ecosystems and their response to the environment, on scales from molecules to communities.

Credit: Creative Team/EMBL, Arthur Larie/Fondation Tara Océan, Eva Klose

Our seas and coasts represent key ecosystems that host an extremely rich diversity of life and play critical roles in the stability and sustainability of wider ecosystems. However, anthropogenic interferences such as pollution, farming, and building construction, as well as the impact of climate change, are leading to accelerated loss of species' genetic diversity and destruction of functional ecosystems.

To minimise the future impact of such external factors on coastal biodiversity, we must understand the molecular and cellular basis of how organisms interact in ecosystems and react to external pressures in the context of their natural habitats.

TREC – Traversing European Coastlines – is a pan-European expedition to study coastal ecosystems and their response to the environment, on scales from molecules to communities. It is the first continent-wide project of its type and combines the rich expertise and infrastructure of Europe's life sciences laboratory EMBL, the Tara Ocean Foundation, the Tara OceanS Consortium, the European Marine Biology Resource Centre, and numerous European partners.

Led by EMBL, and with a focus on coastal habitats, with their rich species diversity as well as the pollution and changing climate they are exposed to, TREC aims to initiate a new era of coastal ecosystems exploration. It will combine the scientific expertise of many partners as well as existing knowledge of local ecosystems and processes, with EMBL's latest technology developments and expertise in examining life at the smallest scales.

“Our ocean and soils still hide a myriad of unanswered – but important – questions,” said EMBL Director General Edith Heard. “TREC will change that. Because of the scientific and technological advances that were made in recent years, we now have the tools and knowledge needed to document, examine, and probe coastal ecosystems at the molecular level, on land and by sea, in real time, with many partners from different nations. This is a wonderful example of science without frontiers that EMBL is so important for.”

TREC will examine the biodiversity and molecular adaptability of life at the molecular scale at 120 coastal sampling sites across 46 regions in 22 European countries during 2023 and 2024.

Scientists will collect soil, sediment, aerosol and water samples, as well as selected model organisms and numerous environmental data. Their work will cover different scales of life – from viruses and bacteria to algae, plants and animals – on land, in river estuaries, and at sea.

They will study the molecular basis of species' interactions, the role of organisms in their habitats, and how organisms respond to and at the same time influence their environment. In addition, the researchers will collect information on factors such as the presence of pollutants, antibiotics, pesticides, or hormones, as well as temperature, salinity, and oxygen levels.

“Marine biologists, ecologists, and environmentalists have studied water and soil habitats for centuries. With the technologies that molecular biologists have to hand today, we are able to study these ecosystems at unprecedented detail,” said Professor Peer Bork, Director of EMBL Heidelberg and coordinator of the TREC project. “At the same time, the pan-European nature of this project means that samples will be taken in a standardised fashion. This will make it possible to compare and probe data across Europe instead of a regional or national system in a way that was not previously possible.”

European partnerships

TREC builds on the resources, infrastructure, knowledge, and expertise provided by EMBL, including new EMBL Mobile Laboratories able to travel to

Through TREC, EMBL will bring some of the most advanced technologies available to life scientists into the field. Biological samples can be fragile; as soon as water or soil is removed from its natural environment, the organisms and ecosystems within them begin to change. By bringing advanced laboratory tools to the field, scientists can address entirely new questions.

Engaging communities with science

Improving coastal health will require not only scientific knowledge but changes to the way societies interact with and use our seas, oceans, and coastal regions. This is why EMBL, the Tara Ocean Foundation, and many local partners will also offer different public engagement and school education activities along the TREC route and beyond.

Citizens will be able to experience first hand the power of molecular biology in tackling human and planetary health challenges. They will be able to hear from scientists or explore science themselves to understand the connections between land and sea, humans and the planet. Teachers and educators will be able to access training and resources to engage and inspire the next generation of scientists.

EMBL acknowledges the generous support of many institutions, donors and sponsors, in particular the Manfred Lautenschläger-Foundation, Eppendorf SE, Carl Zeiss Microscopy, and Friends of EMBL in helping make TREC possible.

Die europäischen Küsten sind reich an biologischer Vielfalt und stellen gleichzeitig wichtige Standorte für Industrie, Kultur und Kulturerbe dar. Vierzig Prozent der europäischen Bevölkerung leben in einer Küstenregion, und viele europäische Gesellschaften wurden und werden durch ihre Beziehungen zum Meer geprägt.

Unsere Meere und Küsten stellen wichtige Ökosysteme dar, die eine außerordentlich reiche Vielfalt an Leben beherbergen und eine entscheidende Rolle für die Stabilität und Nachhaltigkeit dieser Ökosysteme spielen. Anthropogene Eingriffe wie Umweltverschmutzung, Landwirtschaft und Bauwesen sowie die Auswirkungen des Klimawandels führen jedoch zu einem beschleunigten Verlust der genetischen Artenvielfalt und zur Zerstörung funktionaler Ökosysteme.

Um die künftigen Auswirkungen externer Faktoren auf die biologische Vielfalt in Küstengebieten zu minimieren, müssen wir die molekularen und zellulären Grundlagen davon verstehen, wie Organismen in Ökosystemen miteinander interagieren und wie sie reagieren, wenn externe Belastungen auf ihre

Instrumente und Kenntnisse, um Küstenökosysteme auf molekularer Ebene zu dokumentieren, zu untersuchen und zu erforschen, an Land und auf See, in Echtzeit, und mit vielen Partnern aus verschiedenen Ländern. Dies ist ein wunderbares Beispiel für Wissenschaft ohne Grenzen, für die das EMBL so bedeutend ist.”

46 Regionen in 22 europäischen Ländern

Wissenschaftler*innen stehen heute die fortschrittlichsten molekular- und zellbiologischen Technologien zur Verfügung, die es ermöglichen, die Mechanismen des Lebens auf der Erde in einem Umfang und Detaillierungsgrad zu studieren, der bisher technisch nicht möglich war. Mit Methoden von der Genomik und Metabolomik bis hin zur Bildgebung und künstlicher Intelligenz können wir große Datenmengen zu den kleinsten Mikroben bis hin zu Tieren und

Charakter dieses Projekts, dass die Proben auf standardisierte Weise genommen werden. Dadurch wird es möglich sein, Daten aus ganz Europa zu vergleichen und auf bisher nicht mögliche Weise zu untersuchen, anstatt regional oder national begrenzte System zu verwenden.“

Europäische Partnerschaften

TREC stützt sich auf die Ressourcen, Infrastruktur, Wissen und Erfahrung des EMBL, inklusive des neuen mobilen EMBL-Labors, welches entlegene Orte anfahren kann sowie ein umfangreiches Netz europäischer

Bürgerinnen und Bürger können aus erster Hand erfahren, welche Möglichkeiten die Molekularbiologie bei der Bewältigung menschlicher und planetarischer Gesundheitsprobleme bietet. Sie werden die Möglichkeit haben, von Wissenschaftler*innen zu lernen oder die Wissenschaft selbst zu erforschen, um die Verbindungen zwischen Land und Meer, dem Menschen und

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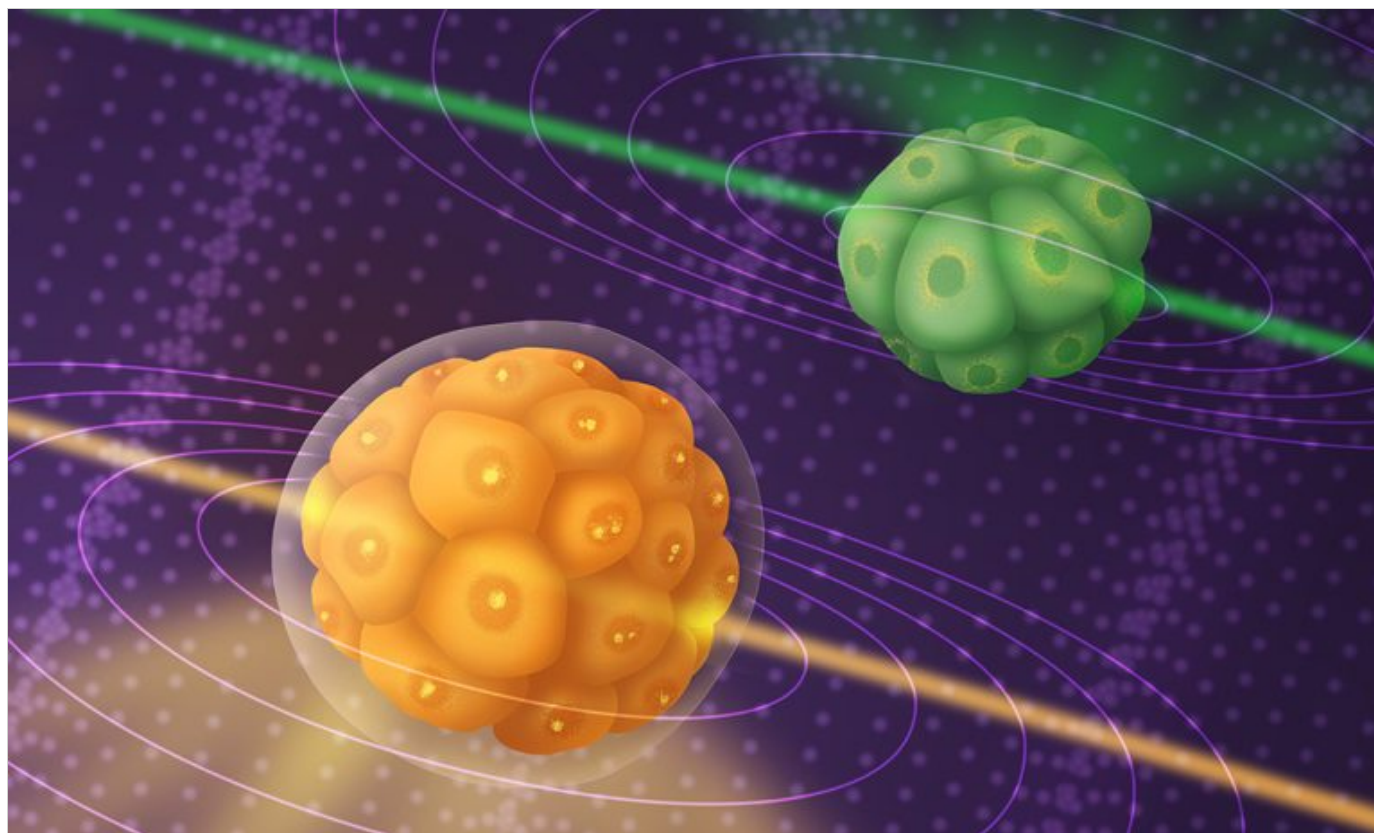
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