AZTI

MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

www.azti.es

2025

AZTI REPORT. THE ANSWER LIES IN SCIENCE

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FOREWORD

INTRODUCTION BY THE PRESIDENT

Amaia Barredo Martín,
Minister of Food, Rural Development, Agriculture and Fisheries of the Basque Government

The Basque Country, a benchmark territory in the food value chain: from sea to plate

The Basque Country is entering a decisive decade for the future of its food system. Global challenges—climate change, shifting consumption patterns, pressure on natural resources, and the need to ensure food security—call upon us as a society and as a country. In this context, the response lies in strengthening a holistic vision in which food is understood as a system that connects territory, economy, culture, and wellbeing. Within this response, **AZTI occupies a central and irreplaceable role.**

The Basque food value chain, from sea and land to the table, holds undeniable strategic importance. It is an ecosystem that not only generates wealth and employment, but also structures the territory, preserves our landscapes, drives innovation, and projects the identity of the Basque Country worldwide. Each of its links—primary production, processing, distribution, gastronomy, and consumption—is essential to advancing towards a more sustainable, balanced, and competitive model. Across all these links, AZTI's science is present, **generating knowledge that is transformed into real solutions for industry, public administrations, and society.**

This connection between scientific knowledge and the food value chain is neither accidental nor recent. It has been built over more than four decades, project by project, result by result. The sustainable management of fisheries in the Bay of Biscay and across the world's oceans, the development of cutting-edge technologies for the processing industry, research in personalised nutrition, innovation in new foods, sustainable packaging, and the understanding of consumer behaviour—all form part of a body of scientific knowledge that spans the entire value chain from end to end.

AZTI's impact is structured around a coherent and verifiable model: it generates new, high-quality knowledge—with nearly 2,000 indexed scientific publications; it delivers differential value to more than 200 clients through the transfer of innovation to the business sector, as demonstrated by spin-offs such as **Itsasbalfegó, Lipiwell, and Datafish;** it contributes to protecting the natural environment and human health with solutions ranging from assessing the environmental status of our seas to precision nutrition; and it fosters the development of the Basque Country and the society of the future by promoting **STEAM vocations,** ocean literacy, gender equality in science, and flagship events such as

Amaia Barredo. President of AZTI.

INTRODUCTION BY THE PRESIDENT

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Food4Future, MarTech, and **World Maritime Week**, which attract international talent and investment to our region.

PEGA 2030: a country-level commitment

With this same holistic ambition, the **Basque Gastronomy and Food Strategic Plan 2030** (PEGA) was launched. It is a shared roadmap that sets the course for the Basque food system in the coming years, grounded in public-private collaboration, long-term vision, and the involvement of all stakeholders in the agri-food ecosystem. Its objective is clear: to consolidate a more competitive, sustainable, and cohesive sector, capable of generating wellbeing and opportunities for society as a whole, with an expected mobilisation of nearly €2.6 billion in public-private investment.

This comprehensive approach requires strengthening the link between knowledge and decision-making. In this regard, AZTI has played a fundamental role in the development of PEGA. As a leading scientific and technological centre, it has **contributed rigour, evidence, and strategic vision to public policies,** ensuring that decisions are knowledge-based and oriented towards outcomes with real impact on both the sector and society. AZTI has not only led the design of the plan; in many ways, it is the guarantee that its objectives are achievable.

PEGA and AZTI also share a common understanding of science: science in service of the common good. AZTI's capacity to work in networks—with more than 280 professionals, 69% of whom hold PhDs, and a strong presence in major European and international scientific committees—positions it as a key actor in driving the transition towards a more sustainable and resilient food model. A model capable of addressing present challenges without compromising future opportunities.

International recognition as a country-level endorsement

The 2025 Annual Report presented here stands as evidence of top-tier scientific activity. Achievements in sustainable fisheries management, climate change, personalised nutrition, food safety, circular economy, and new protein sources are not isolated results; they are the expression of a coherent and sustained strategy that transforms knowledge into tangible value for Basque society, its companies, and its people.

The international recognition achieved this year reinforces this perspective. The presidency of the Scientific, Technical and Economic Committee for Fisheries of the European Union, the **Odum Award**—granted for the first time to a non-American scientist—the distinction as a **Lighthouse Living Lab** within the European **FutureFoodS network,** the Extraordinary Award of the Basque Academy of Gastronomy, and the J**ACUMAR Award** for Research in Aquaculture are not only honours for AZTI's research team. They confirm that the Basque Country, through its science, holds a significant position in shaping Europe's future and addressing major global challenges.

As a government, **our responsibility is to support and facilitate this transformation.** Promoting generational turnover, supporting the primary sector, fostering innovation, advancing sustainability, and strengthening the value chain as a whole are non-negotiable priorities. Above all, this must be done through collaboration, active listening, and the construction of a shared vision with all stakeholders in the food system.

Because in the Basque Country, food is far more than an economic activity: it is an expression of identity, a driver of social cohesion, and an opportunity to build a more sustainable, healthy, and prosperous future. This is the commitment shared by the Basque Government and AZTI. And this is the path we are building together.

LETTER FROM AZTI'S CEO

Rogelio Pozo

Science in Times of Uncertainty: AZTI as an Agent of Sustainable Transformation

A challenging global context.

In 2025, uncertainty driven by geopolitical tensions and conflicts has led to a reassessment of investment priorities in science and technology. Research funding is being scrutinised more rigorously, and technology centres must demonstrate impact, focus and efficiency in every project they undertake.

Innovation and business more closely connected than ever.

The current economic climate is placing increasing pressure on companies to improve profitability and optimise internal processes. Today, our clients expect innovation to be closely linked to business outcomes, with priority given to projects whose impact is clear, scalable and close to market.

At AZTI, we have fully embraced this message. We have intensified our efforts to align R&D with the real needs of our clients, delivering scientific solutions strongly oriented towards results. Now more than ever, innovation means generating tangible and measurable value.

Our research is conceived and developed with a clear objective: solving concrete challenges and strengthening the competitiveness of those who place their trust in our work.

Artificial intelligence as a driver of science.

The rapid acceleration of artificial intelligence — particularly generative AI — has been another transformative factor in 2025. New AI tools are multiplying scientific productivity, enabling us to generate, manage and analyse volumes of data that were previously unimaginable. They are also transforming the way we collaborate and transfer knowledge.

At AZTI, we have embraced this technological revolution. Rather than seeing it as a threat, we have integrated AI into our internal processes and accelerated digital transformation at every level, strengthening digital infrastructures and capabilities while incorporating artificial intelligence across our activities.

A firm purpose and the AZTI 2030 strategy.

In this context, AZTI's mission takes on its full meaning. Our purpose remains clear: to promote a healthy, sustainable and fair society through science. Every step we take is guided by this commitment.

Dr. Rogelio Pozo. CEO at AZTI.

LETTER FROM AZTI'S CEO

Rogelio Pozo

The roadmap defined in the AZTI 2030 Strategic Reflection continues to prove fully relevant, even amid today's uncertainty. The major drivers of change — climate transition, digitalisation, sustainability and demographic challenges — remain decisive forces shaping our future.

For this reason, AZTI has strengthened its **smart specialisation,** reviewing its technology plan and maintaining close dialogue with the market to understand the evolving needs of our clients. This strategy leads us to focus on high-impact projects, build strategic public–private partnerships and concentrate efforts where science can deliver the greatest value.

In short, we remain firmly committed to our 2030 vision while adapting with agility to a challenging environment, convinced that science and purpose-driven innovation can deliver real solutions even in uncertain times.

2025 achievements: science with real impact.

In 2025, AZTI achieved significant progress. Activity increased by 3.5%, reaching more than €24 million in revenue, with improved gross margins and a positive financial result, strengthening the organisation's financial foundations. This stability has enabled us to continue investing in state-of-the-art equipment (€3.1 million during the year) while maintaining a stable team of nearly **300 professionals** fully dedicated to research.

AZTI has also consolidated its position as an **international scientific reference.** Our presence in global forums and networks has continued to grow. In 2025, three AZTI researchers were appointed members of the European Union's main fisheries scientific committee (STECF), one of them being appointed president. In addition, the European Commission recognised AZTI as a Lighthouse Living Lab for our innovative contribution to European food systems.

This international projection goes hand in hand with internal scientific excellence. In 2025 we published more than **130 indexed scientific papers** — over 75% in Q1 journals — surpassing 8,000 accumulated citations.

These figures demonstrate the quality and relevance of our research. More importantly, they reflect our ability to transform knowledge into concrete solutions.

Science generating value for society and industry.

In 2025, AZTI's science translated directly into value for society and the productive sector. We helped transform knowledge into new businesses and qualified employment, supporting initiatives such as the consolidation of **Lipiwell** — a spin-off specialised in precision nutrition — and the growth of **Datafish,** a company focused on advanced real-time fisheries data analysis.

We also acted as catalysts for opportunities in the Basque Country by co-organising leading international events such as *Food4Future – Expo FoodTech* and *MarTech,* which brought thousands of experts to the region and generated significant local economic impact.

Together with regional stakeholders, we launched the *Oarsoaldea Urdina* initiative, which is consolidating a blue economy hub in Pasaia by connecting the needs of the maritime sector with cutting-edge technological solutions.

We also participated in pioneering projects — from the pilot phase of **Itsasbalfegó**, aimed at bluefin tuna farming off the Basque coast, to new digital platforms designed to improve fisheries sustainability — demonstrating how the R&D we develop generates economic, social and environmental value for our environment.

LETTER FROM AZTI'S CEO

Rogelio Pozo

PEGA 2030: from science to policy and market impact.

A particularly significant strategic milestone in 2025 was AZTI's contribution to the **Basque Gastronomy and Food Strategic Plan 2030 (PEGA).** Led by the Basque Government, this plan represents the essential roadmap for the future of the Basque food value chain, with an expected mobilisation of approximately **€2.6 billion in public–private investment.** Thanks to our expertise and deep knowledge of the sector, AZTI collaborated closely in the design and prioritisation of the plan's strategic lines of action, ensuring that our scientific and innovation capabilities translate into concrete policies, investments and projects.

This achievement exemplifies **AZTI's role as a strategic partner** to both the Basque Government and the business community. Our science supports public decision-making and industry development, guiding investments towards a more competitive, sustainable and internationally recognised gastronomy and food system.

People, partnerships and the future.

I would like to conclude by recognising those who make these achievements possible. First and foremost, the **people of AZTI** — the true pillar of our success. Their commitment, talent and capacity for adaptation have been exemplary. Throughout the year we strengthened internal communication, continuous training and shared leadership. As a result, we now have a more cohesive, motivated and future-oriented team.I would like to sincerely thank every member of AZTI for their dedication and effort. Their passion for science and commitment explain the milestones we have achieved.

I would also like to extend my gratitude to the companies, institutions and partner organisations that collaborate with AZTI. The achievements of 2025 are largely the result of these alliances and the mutual trust we have built together. Once again, we have seen that **real impact is created through collaboration.** By working closely with public administrations, academia and industry, we multiply the reach and effectiveness of our scientific solutions.

Looking ahead to the immediate future, we remain **cautiously optimistic.** We are aware that global uncertainty will continue in 2026, but the results achieved in 2025 demonstrate the strength and potential of AZTI. Each completed initiative and every recognition received reaffirm the relevance of our mission and lay the foundations for approaching the future with renewed ambition.

On behalf of the entire AZTI team, thank you for your continued support and trust. **The answer lies in science.** Together, we will continue transforming knowledge into value to build a more sustainable, healthy and prosperous future.

> By building on science, innovation and collaboration, we will **continue generating transformative impact in society.**

1

ABOUT AZTI

SCIENCE WITH A PURPOSE. INNOVATION WITH IMPACT.

At AZTI, we turn knowledge into solutions that improve people's lives and the planet's sustainability—**now and in the future**. We are an international science and technology centre **specialising in the marine environment and food.**

Our mission is to **create and transfer knowledge** through R&D&I projects that address major global challenges—climate change, sustainable food systems, the protection of marine ecosystems and human health. We do this **in close partnership with businesses and institutions,** because only by working together can we tackle challenges of this scale.

We approach every initiative with a **transformational mindset,** seeking high-impact solutions that deliver tangible value in the short term while laying the foundations for a sustainable future.

For over 40 years, we have delivered science with impact, combining excellence, ethics and innovation to help **build a healthy, sustainable and cohesive society.**

KEY FIGURES

+280 People committed to science and the planet

69% of research staff hold PhDs

+200 Clients

1.952 Indexed publications

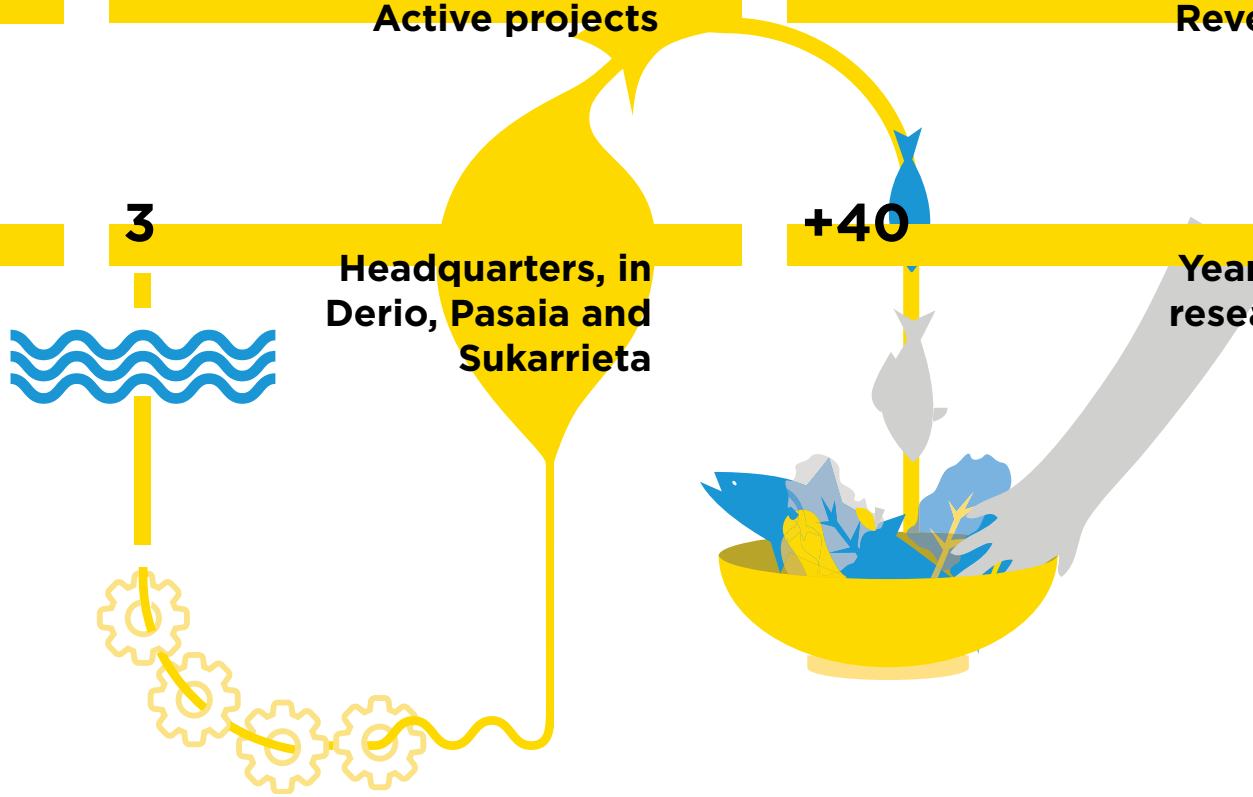
388 Active projects

+25 M€ Revenue

57% Women

3 Headquarters, in Derio, Pasaia and Sukarrieta

+40 Years of research



APPLIED SCIENCE TO RESPOND TODAY AND ANTICIPATE TOMORROW

Marine environment and climate change

We study ocean ecosystems, how they evolve and how they interact with human activities.

We develop solutions for **sustainable resource management and strategies to adapt to climate change.**

Healthy, sustainable food

We help transform the food system by developing healthier, more efficient and environmentally responsible products, technologies and business models.

Digital transformation and industrial innovation

We use data, artificial intelligence and advanced analytics to improve processes, anticipate scenarios and accelerate the transition to more sustainable and competitive industries.

ALLIANCES TO MULTIPLY IMPACT

Real impact is built through networks. At AZTI, we work with institutions, businesses, universities, public bodies and international networks to accelerate the transition towards a more sustainable, blue and healthy economy.

These alliances enable us to share knowledge, co-create technological solutions and extend the reach of our projects.

Our participation in international platforms, European networks and technology forums positions us as a **key actor in areas such as food, sustainability, the blue economy, digital innovation and biotechnology.**

These partnerships strengthen our transformational role and help our science go further.

AZTI is a private foundation and a member of the **Basque Research & Technology Alliance (BRTA).**

ALLIANCES TO MULTIPLY IMPACT

TECHNOLOGY PLATFORMS

Algakin. Basque Algae Ecosystem

AMR. Antimicrobial Resistance Connection

Copernicus Marine Service

Food Innovation Community

European Network of the Global Ocean Observing System

European Platform for Technology and Innovation in Aquaculture

European Fisheries and Aquaculture Research Organisations

FLW: Food Loss and Waste Platform

Spanish Technology Platform

Pan-European multidisciplinary research infrastructure

Pan-European multidisciplinary research infrastructure

Spanish Life Cycle Assessment Network

Spanish Aquaculture Society

STCEF: Scientific, technical and financial support for the Common Fisheries Policy

Standing Committee on Agricultural Research

ALLIANCES TO MULTIPLY IMPACT

INTERNATIONAL PARTNERSHIPS

Flanders Marine Insitute

Innovation platform Sustainable solutions for the sea and oceans

European Coalition against Phages

Research Centre

Euskalmet. Basque Meteorological Agency

Research Centre

GLOBAL PRESENCE

Food 4 Future World Summit

ALLIANCES TO MULTIPLY IMPACT

NETWORKS AND FORUMS

ADISUR

European Association of Surimi Producers

Spanish Food Safety and Nutrition Agency

Spanish Association of Sensory Analysis Professionals

Basque Energy Cluster

Basque Food Cluster

Basque Maritime Forum

Bermeo Tuna World Capital

Bio-based Industries Consortium

Naval and Marine Technology Centre

E3S. European Society for Sensory Science

European Association of Research and Technology Organisations

European Food Safety Authority

FAGOMA. Spanish Network of Bacteriophages and Transducing Elements

Thematic network on Innovation, Research and Development applied to gastronomy

KARDALA. Vocational training school for aquaculture

ALLIANCES TO MULTIPLY IMPACT

NETWORKS AND FORUMS

Ocean Energy Systems (OES) - Environmental

PIE. Plentzia Marine Station

Spanish Network of Lactic Acid Bacteria

REEDUCAMAR, Spain's marine education resources network and inventory

Underwater Research Cultural Society

University of the Basque Country

Association of Fisheries Technologists of Western Europe

2

OUR COMMITMENT

2.
OUR COMMITMENT

Research only matters when it translates into well-being and development. That's why every advance has a purpose: **improving people's lives and protecting the planet.**

This is AZTI's **distinctive role**—turning scientific knowledge into action with transformational impact, balancing scientific excellence, sustainability and economic development.

Furthermore, we embed the **UN Sustainable Development Goals (SDGs)** across all our research areas, ensuring our work contributes directly to these global targets for a sustainable future.

2.1.
COMMITTED TO A PURPOSE: IMPROVING LIVES THROUGH SCIENCE

SDG 2 - Zero Hunger

Sustainable, safe food production _

We encourage informed, sustainable consumer habits, helping people to take decisions to reduce the environmental impact of their food.

- We develop **biotechnology products** and solutions to cut waste and boost nutritional value.
- We ensure **integrity and traceability** throughout the food chain.
- We develop tools to improve the **efficiency of agrifood production.**
- We foster **healthy, affordable nutrition** for all.

SDG 3 – Good Health and Well-Being

Healthy food, well-being and quality of life _

At AZTI we realise that food is crucial to improve quality of life and prevent illness. This is why we contribute to health and well-being through science:

- Research into personalised, **precise nutrition.**
- Developing new **functional foods** to improve health.
- Assessing the impact of diet and lifestyles on public health.

2.1.
COMMITTED TO A PURPOSE: IMPROVING LIVES THROUGH SCIENCE

SDG 12 - Responsible Production and Consumption

Circular economy and reduction of waste_

At AZTI we maximise businesses' power to innovate, by designing socially, economically and environmentally sustainable solutions to inspire society to live in a more responsible way. We foster an economic model that is more efficient and respectful of natural resources:

- We design **circular solutions** to reduce waste and exploit sub-products.
- We develop **digital tools** to make industry more sustainable.
- We encourage **energy efficiency and environmental traceability** in the food chain.
- We encourage **informed, sustainable consumer habits,** helping people to take decisions to reduce the environmental impact of their food.

SDG 13 - Climate Action

Adaptation and mitigation from marine science_

At AZTI we conduct research to find out the effects of climate change on the ocean, the coastline and marine resources, to define strategies to adapt to these effects and to establish mitigation measures, turning this major global challenge into an opportunity to be exploited.

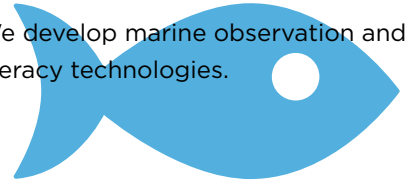
- Oceanographic modelling and early warning systems for extreme phenomena.
- Assessment of the impact of climate change on ecosystems and fisheries.
- Design of **decarbonisation** strategies and nature-based solutions.

SDG 14 - Life Below Water

Protecting the oceans and sustainable management of marine resources_

At AZTI, we work to implement initiatives that enable us to analyse the functioning of marine ecosystems, evaluate and study the environmental management of seas and coasts, and develop innovative marine technologies that contribute to better conservation of marine life. We are a European leader in marine research and ocean ecosystem conservation:

- We assess the states of the sea, biodiversity and fisheries.
- We promote **ecosystem management** and responsible fishing models.
- We develop marine observation and ocean literacy technologies.



2.2.
COMMITMENT TO EUSKADI'S ECONOMIC AND SOCIAL DEVELOPMENT

This commitment, in place since AZTI was founded in 1981, is part of AZTI's purpose and the legacy it continues to share with Basque society.

AZTI is strengthening its commitment to Euskadi's economic and social development through work that goes beyond generating and transferring knowledge. **It turns its investment in R&D into a driver of competitiveness, innovation and wellbeing across the region.** Alongside its active involvement in strategic initiatives and technology projects that energise the business base and attract investment, the centre also supports social cohesion through ocean literacy, citizen engagement and the **promotion of STEAM careers**—paying particular attention to younger generations and to gender equality in science.

Euskadi 2030 Strategic Plan for Gastronomy and Food

In 2025, AZTI strengthened its role as a strategic partner to the Basque Government's Department of Food, Rural Development, Agriculture and Fisheries in delivering the **Euskadi 2030 Strategic Plan for Gastronomy and Food.** Drawing on its sector expertise and innovation capability, the centre helped shape and prioritise the workstreams guiding the planned mobilisation of around €2.6 billion in public–private investment, aimed at boosting competitiveness, sustainability and the international standing of the Basque gastronomic and food ecosystem.

2.2.
COMMITMENT TO EUSKADI'S ECONOMIC AND SOCIAL DEVELOPMENT

Oarsoaldea Urdina: blue economy and local development

Through the Oarsoaldea Urdina initiative—developed together with the Oarsoaldea Development Agency and the Port Authority of Pasaia—AZTI is helping to build a collaborative blue-economy hub that links real needs at sea with practical technological solutions. The presentation in Pasaia of **Rekreando's portable isolation bubble for Maritime Rescue emergencies** is a good example of how this setting brings together companies, the port community, rescue services and public stakeholders.

In this way, Oarsoaldea Urdina is beginning to establish itself as an emerging reference point for maritime innovation and local economic activation, using Pasaia Bay as a testbed and strengthening the area's ecosystem through public–private collaboration.

ItsasBalfegó: bluefin tuna aquaculture as an opportunity for the Basque coast

The pilot phase of ItsasBalfegó, carried out off the coast of Getaria with AZTI's involvement, validated a bluefin tuna fattening model using two large submersible cages designed to withstand the harsh conditions of the Bay of Biscay under real operating conditions. The project **tested hydrodynamic and environmental solutions, traceable feeding systems and responsible handling protocols, opening the door to a new, high value-added aquaculture activity.**

A full roll-out could create dozens of direct and indirect jobs linked to capture, transport, processing and marketing, supporting economic diversification along the Basque coast and the sustainable use of Basque bluefin tuna quotas.

2.2. COMMITMENT TO EUSKADI'S ECONOMIC AND SOCIAL DEVELOPMENT

NEWCOMPANIES

Spin-offs and new technology ventures: Lipiwell and Datafish

AZTI continues to translate scientific knowledge into new business activity. In 2025, **Lipiwell was further consolidated as a spin-off specialising in precision nutrition based on biomarkers and multi-omics analysis,** bringing more than a decade of personalised nutrition research to market.

Datafish, meanwhile, continued to **grow as a company focused on advanced, real-time fisheries data analytics,** providing fleets and public administrations with digital tools to improve both the sustainability and profitability of fishing activities. Together, these initiatives illustrate AZTI's ability to create highly skilled jobs, attract investment and strengthen the Basque business fabric in both the marine and food domains.

EVENTSEUSKADI

Flagship events in Euskadi: Food4Future, World Maritime Week and MarTech

In 2025, AZTI helped raise **Euskadi's international profile** by organising and co-organising flagship events that draw talent, investment and business opportunities to the region. As **co-organiser of Food4Future – Expo FoodTech** in Bilbao, it helped bring together thousands of agrifood professionals and deliver a significant economic impact in Bizkaia, positioning the region as a hub for food innovation.

At the **World Maritime Week,** the centre contributed its scientific perspective on sustainability, decarbonisation and competitiveness in fisheries, connecting the Basque maritime industry with the latest technological advances.

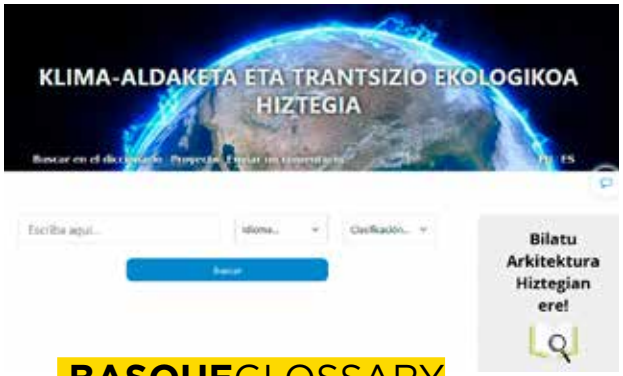
In addition, AZTI hosted the 2025 edition of **MarTech** in Pasaia—an international gathering of 130 participants from 12 countries—showcasing how marine robotics, advanced sensors, communications, AI and digital twins can support sustainable fishing, environmental monitoring and coastal climate adaptation, further consolidating Oarsoaldea as a recognised node for marine technologies applied to sustainability.

2.2.
COMMITMENT TO EUSKADI'S ECONOMIC AND SOCIAL DEVELOPMENT

SCIENCESOCIETY

Science and society: ocean literacy and citizen engagement

In 2025, AZTI continued to champion ocean literacy and scientific culture as levers for social change. By coordinating the **Basque Blue Schools Network,** taking part in networks such as **REEDUCAMAR** and **EuroGOOS,** and running its Summer School—recognised with the **MakeEUBlue Award**—the centre helps embed the ocean in the school curriculum and encourages **STEAM careers.** Initiatives such as **MarinART,** with more than 200 marine murals geolocated by citizens, and citizen science linked to projects such as **ULYSSES and GES4SEAS,** bring marine observation closer to society and encourage more responsible behaviours. These actions reinforce AZTI's role as a key bridge between science, education and social commitment.



BASQUEGLOSSARY

Basque Glossary on Climate Change and the Ecological Transition

Together with Kutxa Fundazioa, BC3, IHOBE, Naturklima and UZEI, AZTI contributed to the development of the first Basque-language glossary on climate change and the ecological transition: *Klima-aldaketa eta trantsizio ekologikoa Hiztegia*.

The resource brings together more than **200 terms with equivalents in Spanish, French and English, and has become a reference tool for professionals, public administrations and the media.**

Its value goes beyond language, supporting a more rigorous and accessible public conversation around the ecological transition and climate action in Euskadi.

2.2. COMMITMENT TO EUSKADI'S ECONOMIC AND SOCIAL DEVELOPMENT

ECOLOGICALRESTORATION

Carbon footprint offsetting and ecological restoration in Orio

To complement its emissions reduction measures, AZTI continued to support locally rooted climate offsetting actions. In 2025, its contribution—through Naturklima—to an ecological restoration project on a degraded tertiary dune next to Orio beach was consolidated.

The initiative aims to **offset 61 tonnes of CO_2 by planting up to 400 trees and removing invasive species across around 20,000 m^2.** It combines carbon capture with coastal habitat recovery and improved shoreline resilience, showing how corporate footprint management can translate into tangible environmental and social benefits for the region.

GENDEREQUALITY

Promoting STEAM careers and gender equality in science

In 2025, AZTI strengthened its commitment to science outreach and to promoting STEAM careers, especially among younger generations and girls. The centre joined the **Emakumeak Zientzian** initiative, becoming part of a network of organisations that raise the profile of women scientists and promote female role models in research.

Over the year, AZTI took part in science fairs, science weeks, STEAM events and guided visits to its facilities, bringing marine and food research closer to school pupils, vocational training centres, universities and the wider public. These activities were complemented by talks, workshops and partnerships with other organisations across the education and innovation ecosystem, reinforcing AZTI's role as an active contributor to scientific literacy, ocean culture and the uptake of science and technology studies in Euskadi.

3

SCIENTIFIC EXCELLENCE AND INTERNATIONAL LEADERSHIP

3.
SCIENTIFIC EXCELLENCE AND INTERNATIONAL LEADERSHIP

AZTI's scientific excellence, combined with its ability to translate research results into practical solutions, underpins an increasingly well-established international leadership role. In 2025, this combination strengthened the centre's presence on leading scientific advisory committees and forums—most notably through a **prominent role in the European Union's STECF, as well as active participation in European Parliament** settings and European Commission platforms—and reinforced its contribution to strategic challenges such as the energy transition in the fisheries sector.

AZTI's recognition as a **FutureFoodS Lighthouse Living Lab,** together with its participation in marine and food innovation networks and platforms, further positions its research team as an influential reference point in shaping European R&D&I agendas.

3.1.
A STRONG PRESENCE ON LEADING SCIENTIFIC COMMITTEES

Leadership within the Scientific, Technical and Economic Committee for Fisheries (STECF)

In 2025, three AZTI researchers were appointed as members of the European Union's Scientific, Technical and Economic Committee for Fisheries (STECF), and **Raúl Prellezo took on the role of Chai**r. This high level of representation places **AZTI among the organisations with the greatest presence** within this key body for EU fisheries management advice and further strengthens its international reputation for scientific excellence.

An expert voice in the European Parliament and European Commission platforms

AZTI researchers contributed to high-level institutional forums, including the European Parliament event **"Competitive Blue Tech for Sustainable High Seas Fisheries"**, sharing expertise in marine technologies, satellite data and artificial intelligence applied to more sustainable high-seas fisheries. AZTI also took part in hearings and platforms on fisheries, aquaculture, food safety and healthy diets, including the **EU Platform on Food Losses and Food Waste,** of which it has been a member since 2021, and fed results from projects such as GES4SEAS into the European debate on achieving Good Environmental Status of Europe's seas.

Supporting the fisheries sector's energy transition

The appointment of **Gorka Gabiña to the scientific committee on the fisheries sector's energy transition** reinforces AZTI's role in fleet decarbonisation and modernisation. Through this contribution, the centre provides expert knowledge to support fishing models that are more efficient, competitive and environmentally responsible.

A national reference point: Spain's Fisheries Science Roundtable

AZTI has played an active role in **Spain's Fisheries Science Roundtable,** consolidating its position as one of the country's leading reference centres in this field. This involvement enables the centre to provide scientific evidence and technical judgement in the design of strategies and policies relating to sustainability and fisheries management, strengthening its role as a key interlocutor in the main sector forums nationwide.

3.2.
RECOGNITION AS A “LIGHTHOUSE LIVING LAB”

Lighthouse Living Lab and European node for food innovation

The **European FutureFoodS network** has designated AZTI as a “Lighthouse Living Lab”, recognising it as a **leading testbed for transforming European food systems through open innovation.**

This distinction, together with its continued presence on technology platforms and scientific committees, consolidates the centre’s standing as an influential player in setting research and innovation agendas at European level.

3.3. PARTICIPATION IN FOOD AND MARINE INNOVATION NETWORKS AND PLATFORMS

AEPAS. Spanish Association of Sensory Analysis Professionals

- **Irene Peral Díez:** member of the Dysphagia Working Group. Product representative.
- **Esther Sanmartín Sierra:** member of the Dysphagia Working Group. Texture representative.

AER. Economic Committee for Fisheries

- **Raúl Péllezo Igarza:** president.

Scientific Advisory Committee of the Basque Council for Science, Technology and Innovation

- **Iñigo Martínez de Marañón:** advisor.

E3S. European Sensory Science Society

- **Noelia Quinta González:** member of the expert group on infant nutrition and the applied neuromarketing group.
- **Elena Santa Cruz Cádinas:** member of the infant expert group.
- **Esther Sanmartín Sierra:** member of the microstructure expert group.
- **Irene Peral Díez:** member of the food design expert group.

EARTO. European Association of Research and Technology Organisations

EIT Food

- **Sonia Riesco Granja:** member of the Consumer Observatory and responsible for identifying trends.
- **Itziar Tueros Gutiérrez:** expert in the Think&Do Tank Group – Healthy Ageing through Nutrition.
- **Ainara Cano San José:** expert in the Think&Do Tank Group – Healthy Ageing through Nutrition.

EMECS. International Centre for Environmental Management of Enclosed Coastal Seas

- **Ángel Borja Yerro:** member of the Advisory Board.

esLCA. Spanish Life Cycle Assessment Network

- **Saioa Ramos Fernández:** member and coordinator of the AGRIFOOD Working Group.

ETP. Association for Energy Transition in EU Fisheries and Aquaculture

- **Gorka Gabiña Iribar:** member of the expert advisory group.

3.3. PARTICIPATION IN FOOD AND MARINE INNOVATION NETWORKS AND PLATFORMS

EU Platform on Food Losses and Food Waste

- **Jaime Zudaire Verdejo:** member.
- **David San Martín Errea:** member.

EuroGOOS. European Global Ocean Observing System

- **Julien Mader:** member of the Executive Directors Board and Co-chair of the HF radar working group.
- **Lohitzune Solabarrieta Odriozola:** member of the HF radar working group.
- **Iván Manso Navarrete:** member of the working group on fixed platforms.
- **Anna Rubio Company:** member of the working group on coastlines and the working group on gliders.
- **Asier Nieto Iribar:** member of the working group on gliders.

Food4Life

- **Marta Rentaría Bilbao:** member (dairy sector group).
- **Mónica Gutiérrez Ruiz:** member (quality, production, packaging and sustainability groups).

- **Jaime Zudaire Verdejo:** member (quality, production, packaging and sustainability groups).
- **Itziar Tueros Gutiérrez:** member (food and health group).
- **Sara Arranz Martínez: member** (food and health group).
- **Elena Santa Cruz Cádinas:** member (consumer group).

FSBI. Society for Fish Biology and Fisheries

- **Naiara Rodríguez Ezpeleta:** board member.

Fundación Conama

- **David San Martín Errea:** member of working groups on water, circular economy, waste and blue economy.
- **Bruno Inarra Chastagnol:** member of the Working Groups on water, circular economy, waste and blue economy.
- **Mónica Gutiérrez Ruiz:** member of the Working Groups on water, circular economy, waste and blue economy.

Gadea Science Foundation

- **Ángel Borja Yerro:** member of the Advisory Board.

3.3. PARTICIPATION IN FOOD AND MARINE INNOVATION NETWORKS AND PLATFORMS

FVON. Fishing vessel ocean observing network

- **Ainhoa Caballero Reyes:** committee member.

G3ECA. Spanish Group of Experts on Blue Carbon Ecosystems

- **Mireia Valle Tobar:** representative for the Basque Country.
- **Guillem Chust Peters:** miembro.
- **Jose Mikel Garmendia Etxandi:** member.
- **Javier Franco San Sebastián:** member.

HCMR. Hellenic Centre for Marine Research – Institute of Oceanography

- **Ángel Borja Yerro:** Advisory Board member.

IATTC. Inter-American Tropical Tuna Commission

- **Gorka Merino Cabrera:** European scientific coordinator.

Ibi-ROOS. Ireland-Biscay-Iberia Regional Operational Oceanographic System

- **Anna Rubio Company:** committee member.

ICCAT. International Commission for the Conservation of Atlantic Tuna

- **Haritz Arrizabalaga de Mingo:** European scientific coordinator and chair of the Albacore Working Group**.**
- **Naiara Rodríguez Ezpeleta:** Chair of the CKMR subgroup on bluefin tuna.

- **Eider Andonegi Odriozola:** chair of the Ecosystems Subcommittee (SC-ECO)

ICES. International Council for the Exploration of the Sea

- **Dorela García Rodríguez:** Vice-Chair of the Advisory Committee (ACOM).
- **María Korta Albisu:** Co-Chair of the Working Group on Mackerel and Horse Mackerel Egg Studies (WGMEGS).
- **Arantza Murillas Maza:** Chair of the Working Group on Resilience and Marine Ecosystem Services (WGRMES).
- **Guillermo Boyra Elizagar:** Member of the Working Group on Acoustic and Egg Studies of Small Pelagic Fish (WGACEGG).
- **Jose Antonio Fernandes Salvador:** chair of the Working Group on Machine Learning in Marine Sciences (WGMLEARN).
- **Naiara Rodríguez Ezpeleta:** chair of the Working Group on the Application of Genetics in Fisheries and Aquaculture (WGAGFA).
- **Estanis Mugerza Gojenola:** chair of the Working Group on Recreational Fisheries Studies (WGRFS)
- **María Jesús Belzunce Segarra:** co-chair of the Marine Chemistry Working Group (MCWG

3.3.
PARTICIPATION IN FOOD AND MARINE INNOVATION NETWORKS AND PLATFORMS

- **Estibaliz Díaz Silvestre:** chair of the Working Group on Eels (WGEEL) (ICES/EIFAC/GFCM
- **Beatriz Sobradillo:** Co-Chair of the Working Group on Acoustic and Egg Surveys of Small Pelagic Fish in the Northeast Atlantic (WGACEGG).

IDDSI. International Dysphagia Diet Standardisation Initiative

- **Esther Sanmartín Sierra:** Member of the Expert Group.
- **Irene Peral Díez:** Member of the Expert Group

ILICO. Infrastructure de recherche littorale et côtière.

- **Anna Rubio Compañy:** member of the Scientific Council.

IOTC. Indian Ocean Tuna Commission

- **Gorka Merino Cabrera:** vice-chair and European scientific coordinator, and chair of the Tropical Tuna Working Group.

IPBES. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

- **Mireia Valle Tobar:** member of the international panel for biodiversity.

JACUMAR. National Advisory Board on Marine Crops

- **José Germán Rodríguez Patiño:** member of the mollusc group.

KOSTARISK. Cross-Border Laboratory for Coastal Risk Research

- **Julien Mader:** Co-chair
- **Iñaki de Santiago González:** Technical representative of AZTI

MARE. Marine and Environmental Sciences Centre

- **Ángel Borja Yerro:** Member of the Advisory Board

OBECLUST. European Cluster of Obesity Research Projects

- **Itziar Tueros Gutiérrez:** Member of the Steering Committee.
- **Sara Arranz Martínez:** member of the Steering Committee.

Ocean Prediction DCC

- **Roland Garnier:** committee member

Strategic Plan for Aquaculture, Euskal Akuikultura 2030

No representative.

SCAR Food Systems

- **Itziar Tueros Gutiérrez:** member.

SIBIC. Iberian Society of Ichthyology

- **Estibaliz Díaz Silvestre**

STECF. Scientific, Technical and Economic Committee for Fisheries

- **Raúl Péllez Igarza:** chair.
- **Leire Ibarriaga Contreras:** member.
- **Elsa Cuende de Francisco:** member.

SUSTAINMARE. German Marine Research Alliance

- **Ángel Borja Yerro:** member of the Scientific Council.

4

RESEARCH RESULTS

4. RESEARCH RESULTS

AZTI's research outputs reflect a sustained commitment to generating **robust knowledge** that is also practical—**helping society anticipate and respond to major challenges.**

From understanding the impacts of climate change and deploying ocean–coastal observing and modelling systems, to developing tools for the sustainable management of seas and coastlines and advancing a more resilient blue economy, the centre's scientific activity is geared towards **improving decision-making and reducing risk.**

In parallel, AZTI is accelerating the shift towards **food that is more sustainable, safe and healthy** through innovation in eco-efficiency, digitalisation and artificial intelligence, new protein sources, processing and preservation technologies, personalised nutrition, food safety and biotechnology—also drawing on consumer behaviour insights to **turn scientific evidence into deployable solutions**

4.1 CLIMATE CHANGE

We research **how marine climate change affects the ocean, ecosystems and the human activities** that depend on them.

We use **science, advanced modelling and observation systems** to develop solutions to predict their effects, reduce vulnerabilities and help to devise effective strategies for adaptation.

4.1.1 OBSERVATION AND IMPACT

We systematically observe the marine and coastal environment and monitor key variables to support adaptive planning.

Scientific evidence to anticipate acidification impacts along the Basque coast

In 2025, AZTI strengthened the evidence that the Bay of Biscay is undergoing acidification, based on a study drawing on more than 21,700 pH measurements collected between 2002 and 2022. The analysis shows **decreases of between 0.022 and 0.041 pH units per decade down to 100 metres depth.** The time series—maintained by the URA network and analysed within the **Gipuzkoa Marine Climate Change Observatory** promoted by **Naturklima**—indicates rates slightly above the global average and a broadly consistent pattern along the whole coastline. This information is essential for planning mitigation and adaptation measures to protect sensitive habitats, activities such as aquaculture, and the resilience of the coast in the face of climate change.

Evidence to help Mediterranean fisheries adapt to sea warming

Together with ICM-CSIC, AZTI analysed 20 years of catch and revenue data from the Catalan coast and showed that warming in the **Mediterranean is altering the composition of fisheries:** warm-water species are increasing while cold-water species are declining, with uneven impacts depending on fleets and species. The study, published in **Global Change Biology,** combines ecological and economic information to identify more vulnerable fleets, adaptation opportunities and "double-risk" species (climate plus fishing pressure). These findings—consistent with AZTI's earlier work on tropicalisation and the loss of cold-water species in European seas—provide a concrete scientific basis for adjusting Mediterranean fisheries management while safeguarding both the marine environment and local economies.

4.1.2 ADAPTATION

We develop tools, models and systems to help regions and sectors to adapt: coastal infrastructures, marine spatial planning and early warning systems.

Adapting the Basque coastline to climate change through URBAN KLIMA 2050

Within the **URBAN KLIMA 2050** project, which implements the **Basque Climate Change Strategy KLIMA 2050,** AZTI leads the actions linked to adapting the coastal strip to risks such as sea-level rise, increased wave energy and more intense storms.

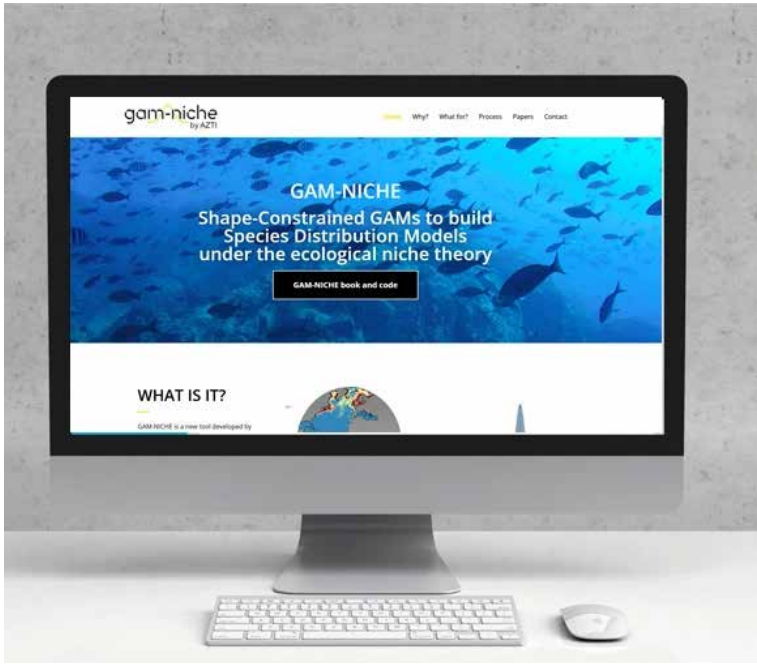
In Zarautz, it coordinates an **urban-coast adaptation pilot** that includes new risk-prevention tools: installing cameras at strategic points to monitor wave and beach dynamics; improving and integrating weather and storm forecasting systems; and providing technical support for the planned adaptation interventions on the seafront boardwalk and beach, in collaboration with the Town Council.

AZTI also contributes to the **strategic assessment of the condition of Basque ports and their climate vulnerability,** evaluating flood risk and the performance of existing defences under future scenarios. In natural coastal areas, it takes part in the **integrated restoration of Laga beach and the Oka basin—estuary, beaches and cliffs—**to strengthen resilience. In addition, it is driving a marine–coastal climate change hub by defining key indicators, analysing historical time series and developing— for the first time—high-resolution flood-risk models for the entire Basque coastline under different climate scenarios.

More than 100 researchers trained through GAM-NICHE courses

In the context of the European Horizon **Mission Atlantic** project, the new **GAM-NICHE tool** (https://gam-niche.azti.es/)—designed to build Species Distribution Models based on ecological niche theory—has been widely disseminated through training delivered at the ICES ASC conference (Lithuania), the University of Barcelona (Master's in "Adaptation and Extinction in the Anthropocene"), online (The International Biogeography Society), a research stay by Julia Petroski (University of São Paulo), and a summer school (Brazil).

GAM-NICHE is **a GitHub tutorial in R, with an application focused on marine fish.** The tool can be used across multiple contexts, including species conservation, habitat restoration, and the management and assessment of climate change impacts.



4.1.3 MITIGATION

We propose solutions to reduce the impacts of climate change on the marine environment: decarbonising the fishing fleet, restoring ecosystems and encouraging responsible production and consumption.

Offsetting AZTI's carbon footprint through coastal ecosystem restoration in Orio

As part of its action plan to minimise its carbon footprint, AZTI has complemented reduction measures with climate offsetting actions that generate local environmental value. In 2023, the centre provided funding to Naturklima to **offset 61 tonnes of CO_2**, supporting a woodland planting project next to Orio beach over an area of around 20,000 m².

The intervention is located on a tertiary dune where previous vegetation has failed to establish, and includes planting up to 400 trees and removing invasive species. In this way, emissions offsetting translates into increased carbon capture, the recovery of a degraded coastal habitat and improved shoreline resilience, with benefits for biodiversity and for the surrounding community.

Blue carbon for climate action: Euskadi as a meeting point for carbon sequestration initiatives

In 2025, AZTI strengthened its role in blue carbon ecosystem research by hosting the annual meeting of the European **C-BLUES** project in the Urdaibai Reserve, **focused on seagrass meadows, salt marshes, macroalgae and mangroves.** Around 40 specialists from different countries met to help close knowledge gaps on these ecosystems, improve estimates of their carbon sequestration capacity, and support their inclusion in national greenhouse gas inventories and climate policies.

The initiative aims to increase the weight of blue carbon ecosystems in European and international climate action, aligning science, coastal management and Paris Agreement commitments. At the COP30, held last November in Belém, Brazil, the ocean and blue carbon were included for the first time in national contributions and in the negotiations.

4.2 OPERATIONAL OCEANOGRAPHY

We develop **ocean/coastal observation and modelling systems** to provide high-resolution data and forecasts for risk anticipation, improved maritime safety and support for sustainable coastal resource management.

Thanks to our unique infrastructure in the Basque Country and our participation in European networks, we offer data, **data products and operational solutions** to challenges such as climate change adaptation, emergency management, energy transition and the digitisation of the maritime sector.

4.2.1.
REAL-TIME OBSERVATION AND MONITORING

We operate the Basque Country's ocean/meteorological network, including advanced videometry systems, deep-sea buoys, coastal stations, tide gauges, HF radars and autonomous vehicles. Real-time data feed web platforms like EuskOOS (locally) and Copernicus (globally) of key importance in emergencies, port safety and coastal management.

Autonomous underwater vehicles to strengthen observation along the Basque coast

As part of the **BIGFIS** project, with support from the Provincial Council of Gipuzkoa, AZTI has added two autonomous underwater gliders to the Basque coast observing network. Equipped with advanced sensors, these vehicles can monitor down to 1,000 metres depth and cover more than 1,000 km, measuring physical and biogeochemical parameters such as temperature, salinity, oxygen, turbidity, chlorophyll and nitrates, and even detecting schools of pelagic fish.

Their integration with systems such as **OBSERVAMAR** and **EuskOOS** improves understanding of how ocean circulation influences the cycles that sustain phytoplankton and the marine food web, providing crucial 3D information to track the fingerprint of climate change and to support better-informed management of the environment and the activities that depend on it.

4.2.1.
REAL-TIME OBSERVATION AND MONITORING

Computer vision technology to track marine litter in near real time

The **ULYSSES** project aims to improve the health of the Basque coastline and the oceans by generating **knowledge on how litter is transported and accumulates** from rivers to the Bay of Biscay. Within this framework, AZTI has installed two cameras on the Bizkaia Bridge to deploy a computer vision system that monitors marine litter leaving the estuary and heading out to sea. This infrastructure generates **continuous data on the quantity and types of floating waste,** providing an operational tool to track these flows in near real time and to support the design of more effective upstream prevention measures and coastal clean-up actions.

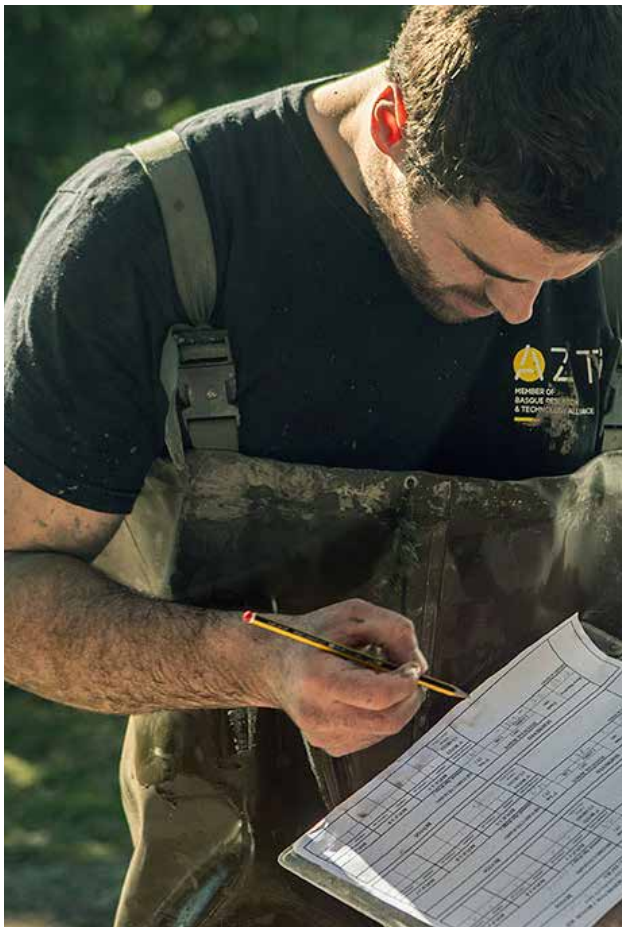
4.3
ENVIRONMENTAL MANAGEMENT OF SEAS AND COASTS - BLUE ECONOMY

We offer **solutions for marine spatial planning and the sustainable management of ecosystem goods and services,** partnering with the port industry, the offshore sector and public administrations in the transition towards a more resilient and sustainable blue economy.

We develop tools, indicators and methodologies to assess the **ecological and environmental state of coastal and estuarine areas,** within the framework of the Water Framework Directive and the Marine Strategy Framework Directive.

We provide support to the sector – industry, administration and companies – in **Environmental Impact Assessment (EIA)** procedures.

4.3.1
ASSESSING THE STATE OF HEALTH OF THE MARINE ENVIRONMENT



We research the ecological state of coastal and estuarine areas, developing methods for assessing their ecological and environmental state under the Water Framework Directive and the Marine Strategy Framework Directive (MSFD).

Europe fails its marine health check: scientists call for greater ambition and better governance

A pioneering study from the European **GES4SEAS** project, coordinated by AZTI and published in Conservation Letters, concludes that EU seas are still far from achieving the Good Environmental Status set out in the Marine Strategy Framework Directive. Using an integrated assessment of the 11 environmental descriptors (biodiversity, fisheries, marine litter, underwater noise, etc.), the research shows that human pressures—overfishing, pollution, invasive species and climate change—continue to act cumulatively, without a sufficiently effective or coordinated response.

The work identifies disparities between basins: while the Baltic and North Sea are making progress thanks to frameworks such as **HELCOM and OSPAR**, areas such as the eastern Mediterranean and the Alboran Sea still face major data gaps and intense pressures. The western Mediterranean, which includes much of Spain's coastline, also shows one of the poorest ecological status indices.

The research team calls for stronger marine governance, improved data quality and coverage, and more ambitious, science-based measures—highlighting that the health of Europe's seas is critical for sustainable fisheries, blue jobs and climate regulation.

4.3.1
ASSESSING THE STATE OF HEALTH OF THE MARINE ENVIRONMENT

Environmental DNA to diagnose estuary health

Through the **MicroMon project,** AZTI is using environmental DNA (eDNA) to **turn estuarine microorganisms into "natural sensors" of ecological status.** Using small sediment samples, the team reconstructs the composition and ecological networks of bacteria and archaea, generating rapid, accurate and more cost-effective indicators than traditional methods for assessing the impacts of pollutants and climate change.

By comparing data from estuaries across five continents, MicroMon shows that **microbial communities exposed to similar conditions respond in comparable ways—opening the door to global ecological quality standards** and providing public administrations with a powerful tool to manage and conserve estuaries that filter pollutants, serve as nursery grounds and help mitigate climate change.

In addition, molecular tools are being developed in projects such as the **Quality Network** (for URA) and the European projects **GES4SEAS** and **OBAMA-NEXT** to assess the status of macroinvertebrates (gAMBI and M-gAMBI) and fish (gAFI).

Using AI to make large-scale monitoring data accessible for better marine management

AZTI and URA published a study in **Frontiers in Ocean Sustainability** that, for the first time, used a platform created by the publisher to make massive datasets available to researchers and managers.

An AI extracts the metadata and makes the information easy to access. The work drew on 30 years of monitoring data from the Basque coast and estuaries.

Basque maritime heritage in support of marine science and decarbonisation

AZTI and Albaola signed an agreement to **turn historic vessels**—such as the replica of the whaler San Juan and the traditional fishing boat Ozentziyo—**into platforms for research, education and experimentation in marine sustainability.** The partnership will enable scientific projects in the North Atlantic, support solutions to decarbonise waterborne mobility in Pasaia Bay, and bring oceanography and the sustainable management of marine resources closer to citizens through educational activities—combining historical memory with innovation.

4.3.2.
ASSESSMENT OF ECOSYSTEM GOODS AND SERVICES

We assess ecosystem services and the benefits they provide to society in terms of provisioning (food, raw materials), regulating services (climate change, nutrient transfer), and cultural services (leisure and recreation in natural environments, the existence value of emblematic species, and cultural values associated with artisanal activities).

Ecosystem-based management of the marine environment in the Basque Country to deliver the EU Marine Strategy

AZTI advises the Basque Government's Directorate for Natural Heritage and Climate Change Adaptation on implementing an ecosystem-based approach in the Basque Country's marine environment, within the third cycle of the Marine Strategy Framework Directive. The work focuses on updating the environmental status diagnosis, assessing ecological indicators, and defining reference conditions and quality objectives for biodiversity, seabed integrity and ecosystem services.

The project integrates data and models to assess Good Environmental Status under climate change scenarios; develops tools to characterise habitats and species spatially and prioritise measures in marine protected areas and Natura 2000 sites; and identifies pressures, risks and knowledge gaps. Using an approach that combines biological, physico-chemical and socio-economic indicators, AZTI provides a solid technical basis for the Basque Country to move towards adaptive marine management aligned with European standards and the EU Biodiversity Strategy.

4.3.2.
ASSESSMENT OF ECOSYSTEM GOODS AND SERVICES

Links between nature, health and wellbeing

Within the **RESONATE** project we are scientifically assessing the links between nature, health and wellbeing. Studies are being developed to explore how nature-based therapies—such as social prescribing and "green and blue prescriptions"—can improve physical and mental health, reduce stress and strengthen biopsychosocial resilience.

The research includes collecting and analysing data linked to **therapies delivered to people at risk of cardiovascular disease in urban, rural and coastal settings,** to demonstrate the benefits of these interventions across different contexts.

In addition, the work seeks to generate causal evidence linking participation in these therapies with more sustainable behaviours, enabling these solutions to be embedded in public policy and health strategies, helping to **reduce the burden of non-communicable diseases and the costs associated with mental health in Europe.**

4.3.3.
IMPACT AND ENVIRONMENTAL VIGILANCE IN THE MARINE ENVIRONMENT

As part of the Environmental Impact Assessment (EIA) process, we draw up Environmental Impact Studies (EIS) and associated Environmental Monitoring Plans (EMP) for both plans and programmes – in the context of Strategic Environmental Assessment (SEA) – and for projects in the marine environment.

Research and technology to reduce marine litter

The **Sumideros** project deepens understanding of the abundance and types of seabed and surface litter and microplastics both within and beyond the usual fishing grounds of Basque coastal trawlers.

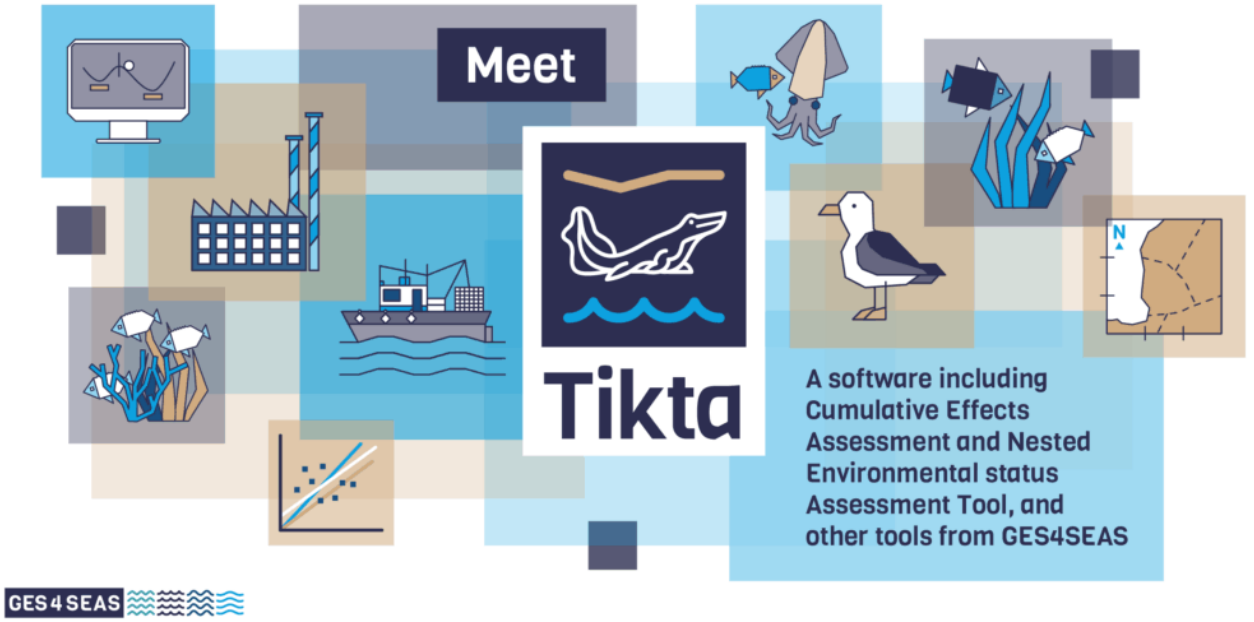
A scientific campaign is carried out aboard a vessel to collect data used to produce distribution maps, identify habitats likely to accumulate litter, analyse the fish communities associated with these sinks, and prepare datasets for **EMODnet and the Marine Strategy Framework Directive.**

4.3.3.
IMPACT AND ENVIRONMENTAL VIGILANCE IN THE MARINE ENVIRONMENT

EasySat Indicators: satellite data in support of environmental indicators

Within **GES4SEAS,** AZTI developed EasySat Indicators, an R Shiny web application that enables non-expert users to calculate environmental indicators from time-series satellite datasets in NetCDF-CF format. The tool offers pixel-level analysis to generate indicator maps and statistics for specific locations (stations, polygons, etc.), calculating metrics such as mean, minima, maxima, number of observations, standard deviation, median, 90th percentile and the Mann–Kendall tau trend.

Outputs can be downloaded as GeoTIFF and CSV files, ready for use in Excel, GIS and other tools such as **“Tikta”**, making it easier to assess the ecological status of marine waters under the Water Framework Directive and the Marine Strategy Framework Directive.



4.3.4
MARINE SPATIAL MANAGEMENT AND PLANNING

We generate knowledge and tools for sustainable, efficient management of human activities.

More ecosystem-based marine spatial planning thanks to MarinePlan

Within the European **MarinePlan project**, the EB-MSP Assessment Tool (**https://aztidata.es/EB-MSP/**) was developed: a web app that helps managers and public decision-makers review, in a structured way, whether their marine spatial plans genuinely apply ecosystem-based management principles.

The tool translates broad concepts into an **"intelligent checklist"** of concrete actions for each phase of the planning process, integrating ecological, social, economic and governance dimensions.

Its application to the assessment of 12 national plans across Europe has shown it meets a real need for operational tools co-developed by managers and experts, providing a **robust basis for aligning marine planning with biodiversity conservation goals,** the sustainability of maritime sectors and climate change adaptation.

Cumulative impacts of offshore wind on birds in the Bay of Biscay

Within the **OSPAR** Convention framework, AZTI contributed to the development and testing of a cumulative impact assessment (CIA) framework that enables an integrated analysis of the effects of offshore wind and other human activities on seabirds. As a proof of concept, the approach was applied to OSPAR Region IV (the Bay of Biscay and the Iberian coast), a critical area for threatened species such as the Balearic shearwater, which is highly exposed to the roll-out of offshore wind projects and to pressures such as shipping, fishing and coastal infrastructure.

This work helped **adapt and operationalise the CIA framework for scenarios involving renewables development and other activities,** identifying cumulative risks and the most vulnerable species, and providing a methodological basis that OSPAR will use to guide mitigation measures and help ensure that the deployment of marine renewable energy aligns with conservation objectives for birds and biodiversity in the North-East Atlantic.

4.3.4
MARINE SPATIAL MANAGEMENT AND PLANNING

Tools and knowledge to enable the sustainable deployment of marine renewable energy

Since 2004, AZTI has supported the development of marine renewable energy (wave, offshore wind and floating solar) by providing environmental monitoring, operational oceanography and spatial planning tools that enable public administrations and companies to decide where and how to install projects while minimising risks to the marine environment.

Drawing on monitoring plans for wave energy converters in real operating conditions and tools such as **WEC-ERA,** **WIND-ERA** and **VAPEM**, the centre assesses pressures and impacts, identifies suitable areas from a technical, economic and environmental perspective, and applies risk-based approaches to project consenting.

In collaboration with infrastructures such as BiMEP and through projects including **WESE**, **SafeWAVE** and EKIOCEAN, AZTI has become a key partner in ensuring that marine renewables deployment progresses in line with EU decarbonisation objectives, remains compatible with other sea uses, and is socially acceptable.

Sustainable floating photovoltaic plants to make better use of marine space

Within the **EKIOCEAN project**, led by BCAM together with CLÚSTER ENERGÍA, AZTI, TECNALIA and the UPV/EHU, new sustainable solutions for floating photovoltaic plants in marine environments were investigated.

The work developed innovative concepts for floating structures, concretes and bio-based coatings with antifouling properties; analysed failure modes and operation and maintenance strategies; and generated tools to assess environmental impacts and identify optimal locations for future floating PV plants. These results facilitate the deployment of floating solar as part of the energy transition, reducing pressure on land and harnessing the potential of marine space.

4.4.
EFFICIENT, SUSTAINABLE FISHERIES AND AQUACULTURE

We strive to assure sustainable fisheries and aquaculture that are efficient and resilient in the face of today's environmental, technological and socio-economic challenges.

At AZTI we work on **scientific and technological solutions** to allow the conservation of marine resources, optimise extractive and activities and aquaculture and reinforce the competitiveness of the sector within the blue economy.

With an all-embracing approach based on science, digitalisation and applied innovation, we support fleets, businesses and authorities in their transition towards **more sustainable, decarbonised and profitable production models.**

4.4.1. SUSTAINABLE FISHERY MANAGEMENT

We provide scientific know-how and advanced tools to assess the state of resources, improve fishery management and reduce the impact of their activity on marine biodiversity. We promote governance based on data, transparency and economic, social and environmental sustainability in the sector.

MANAGEMENT OF KEY SPECIES IN THE CANTABRIAN SEA AND THE ATLANTIC

Sustainable anchovy management with less uncertainty: JUVENA 2025

In 2025, the combined **JUVENA and BIOMAN** surveys strengthened the scientific evidence that administrations and the fishing sector need to manage one of the Bay of Biscay's key resources sustainably. JUVENA 2025, led by AZTI, estimated a juvenile anchovy biomass of 544,781 tonnes in the Bay of Biscay—more than double the average for the last two decades and well above the 255,344 tonnes recorded in 2024. The survey confirms high abundance and very favourable oceanographic conditions for the survival of juveniles spawned in spring; the average size of 6.3 cm, below the time-series mean, is typical of years with high spawning survival.

These results are complemented by those of BIOMAN, which in May estimated high adult biomass and strong egg production, offering an almost complete picture of the species' life cycle. The combined JUVENA+BIOMAN series, together with fleet catches, is discussed and validated within ICES' WGACEGG and fed into the indices used to calculate the 2026 TAC, giving greater certainty to the fleet and industry and supporting more adaptive anchovy management.

Stronger scientific foundations for sustainable management of mackerel and Atlantic horse mackerel

In 2025, AZTI strengthened the scientific basis for the sustainable management of mackerel and western horse mackerel by taking part in the **MEGS 2025 triennial** survey aboard the Ángeles Alvariño scientific research vessel, where spawning stock

4.4.1. SUSTAINABLE FISHERY MANAGEMENT

biomass was estimated using the egg production method. The data obtained are incorporated into the ICES MEGS/WGWIDE working groups and, through the **National fisheries data collection** programme co-funded by the European Maritime, Fisheries and Aquaculture Fund (EMFAF), feed into the quota recommendations submitted to the European Commission—particularly critical in a context of mackerel overfishing and biomass close to the threshold that triggers specific management measures.

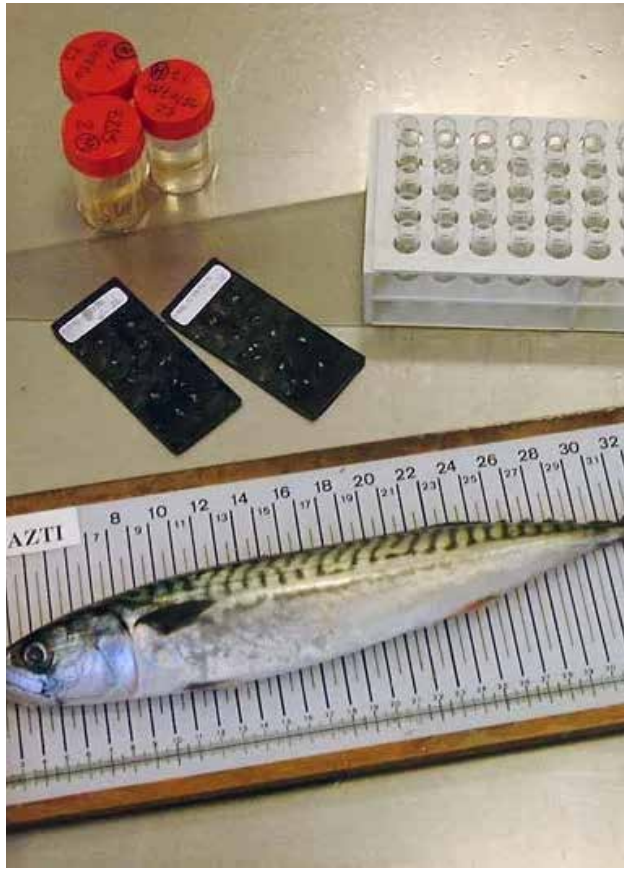
In addition, the impact that the scientific catch advice for this species for 2026 would have on the different fleets in the Basque Country has been assessed. This impact is particularly significant for the **purse-seine and trawl fleets.** By contrast, small-scale fleets will be affected to a greater or lesser extent depending on their ability to catch the species, as in recent years they have faced considerable difficulties accessing the stock with their gear.

A single Northeast Atlantic mackerel stock for simpler, more coherent management

AZTI led an unprecedented genomic study of Atlantic mackerel showing that, in the Northeast Atlantic, **there are no genetically distinct spawning components, but rather a single connected population.**

The work, published in **Open Research Europe,** also confirms that mackerel found around Iceland and Greenland belong to this same population, rather than the Northwest Atlantic one.

These findings have led ICES to **treat Northeast Atlantic mackerel as a single management unit,** simplifying scientific advice and avoiding unnecessary analyses by spawning component.



4.4.1. SUSTAINABLE FISHERY MANAGEMENT

Science to improve the management of tropical tunas

AZTI has advanced new approaches to managing tropical tunas in the Atlantic and Indian Oceans. The team carried out the assessments for **bigeye tuna** (Atlantic, 2025) and **yellowfin tuna** (Indian Ocean, 2024), both of which are key to the Basque fleet.

These assessments—recognised internationally for their robustness—have supported management measures that are better aligned with the current status and productivity of both species.

Beyond strengthening fisheries sustainability, AZTI's innovative methods are built on **advanced monitoring technologies and population modelling.**

This approach delivers more accurate data on tuna dynamics and enables management strategies to be adjusted to environmental and fishing-driven changes. In this way, it helps safeguard the future of species that are fundamental to marine ecosystem balance, while also supporting the **economic viability of the fishing industry**—particularly for the Basque fleet, which depends heavily on these resources.

In parallel, AZTI is developing a management procedure for Atlantic tropical tunas (bigeye, yellowfin and skipjack), assessed under **Management Strategy Evaluation (MSE) standards.** ICCAT is expected to adopt this procedure to ensure adaptive and stable exploitation of these resources in the coming years.

This procedure aims to secure the long-term sustainability of tuna stocks in the region by implementing dynamic strategies that respond to environmental and fisheries changes. Assessment under MSE standards **makes it possible to consider a range of scenarios and risks,** ensuring that scientific recommendations align with both conservation and profitability objectives. Adoption by ICCAT would also foster international cooperation and strengthen fisheries governance, contributing to the preservation of marine ecosystems and the economic wellbeing of fishing-dependent communities.

4.4.1. SUSTAINABLE FISHERY MANAGEMENT

Record tagging of albacore confirms strong fidelity to the Bay of Biscay

In 2025, a record was set for albacore tagging in the Bay of Biscay—both in the number of fish fitted with electronic tags and in recaptures—thanks to an ICCAT-funded campaign carried out in collaboration with the live-bait and trolling fleets. These **devices track tuna movements through time and space,** significantly improving knowledge of the distribution and migratory patterns of this key resource for *arrantzales.* The results confirm **strong fidelity of albacore to the Bay of Biscay,** providing essential information to fine-tune management strategies and reinforce the sustainability of the fishery.

Scientific monitoring of commercial and recreational fishing for more robust advice

In 2025, AZTI stepped up scientific monitoring of fishing activity through **360 port sampling events and 71 at-sea observer trip**s on vessels homeported in Euskadi. This work involved **measuring 130,650 individuals from 133 different species** and collecting detailed biological information on key species such as European hake (*Merluccius merluccius*), megrim (*Lepidorhombus spp.*), anchovy (*Engraulis*

encrasicolus), mackerel (*Scomber scombrus*) and sardine (*Sardina pilchardus*). During surveys at sea, incidental catches of protected species were also recorded, providing relevant data to assess their conservation status.

In **marine recreational fishing, 426 activity-count surveys and 579 interviews were carried out at 19 coastal sites,** covering the three main modalities (shore-based, boat-based and spearfishing). This information helps characterise effort and catches in marine recreational fisheries and supports a more complete picture of their impact on marine resources.

Both the sampling and the data collection protocols for commercial and recreational fishing are developed in close collaboration with other scientific institutes and are validated within ICES working groups and regional expert forums, ensuring methodological harmonisation and high-quality information.

Data are cleaned and analysed in line with international standards and integrated into European databases used for fisheries management, forming the basis of the scientific advice underpinning the Common Fisheries Policy and supporting the sustainability of marine resources.

In addition, AZTI contributed to a European study on **small-scale fisheries** showing that, despite accounting for the largest number of vessels and days at sea, the scientific information available for this fleet remains more limited and less precise than for industrial fleets—an additional challenge for effective management.

4.4.1. SUSTAINABLE FISHERY MANAGEMENT

SPECIES AT RISK AND CONSERVATION

The European eel's extinction spiral: evidence to curb fishing and trade

In 2025, a study led by the Doñana Biological Station (CSIC), with AZTI's participation, showed that the European eel (*Anguilla anguilla*) is caught in a "market-driven extinction spiral".

While glass eel catches in Spain have fallen by around 95% since 1980, **prices have surged from under €5/kg in 1925 to close to €1,000/kg,** keeping exploitation profitable despite the species' collapse.

Published in **Conservation Letters,** the study draws on historical catch and price series and **reinforces ICES advice to halt all eel fishing and introduce a temporary moratorium on trade in eel products to prevent the species' definitive disappearance**—highlighting the importance of the data and scientific monitoring to which AZTI makes a key contribution.

Monitoring deep-water sharks to protect a vulnerable ecosystem

In 2025, AZTI strengthened knowledge of deep-sea ecosystems in the Matxitxako Canyon through the **PALPROF 2025** survey, designed to update time series on the abundance and biodiversity of sharks and other species between 500 and 2,200 metres depth.

The use of mini DST and CTD probes enabled precise monitoring of longline deployments and effective fishing time, improving the calculation of catch per unit effort. As a new element, 27 sharks from seven different species—including individuals fitted with satellite tags—were tagged in collaboration with IEO-CSIC, generating key information on their behaviour and habitat and supporting the responsible assessment of populations that are particularly sensitive to fishing pressure.

4.4.1. SUSTAINABLE FISHERY MANAGEMENT

SCIENTIFIC AND METHODOLOGICAL TOOLS FOR FISHERIES MANAGEMENT

Genomics to align management units with the biological reality of stocks

The **GIFAMAN** project has shown how genomic tools can address one of the classic weaknesses in fisheries management: management units are often defined by administrative boundaries rather than by real biological populations. Focusing on five commercially important species in the Northeast Atlantic (three demersal and two pelagic), with over 400 individuals sequenced per species, the project generated whole-genome genomic data (RAD-seq, lcWGS, WGS) to study population structure, spawning components, hybridisation, environmental adaptation and connectivity between management areas.

The results have helped settle long-running debates and have had direct impacts on stock assessment.

For **Atlantic mackerel,** the project confirms a single mixed population in the North Atlantic, with no genetic differentiation between spawning areas.

For **European hake,** high connectivity between some areas assigned to different "stocks", and low connectivity within other areas inside the same management unit, suggests that a single-stock or spatially explicit model better reflects biological reality—an approach already put forward to management bodies.

For **anglerfish,** hybridisation between white and black anglerfish has been confirmed and quantified, identifying areas with a higher proportion of non-reproductive hybrids that need to be considered in assessments.

For **European sardine,** 24 chromosomal inversions were detected, showing that structural genome variation plays a key role in genetic differentiation along the Northeast Atlantic and should be incorporated into adaptation and management studies.

Overall, **GIFAMAN has produced genomic datasets that are already being integrated into ICES assessment plans,** improving stock delineation and the accuracy of assessments, and has strengthened capacity through a doctoral thesis and by disseminating results in conferences and open-access scientific publications.

4.4.1. SUSTAINABLE FISHERY MANAGEMENT

Fisheries input–output tables for a more accurate measure of the Basque fleet's economic impact

Funded by the Basque Government through EMFAF, the **TIO project** enabled AZTI—working with HAZI and the administration itself—to develop the first pilot input–output tables in which the fisheries sector no longer appears as a single aggregated branch (CNAE 03), but is broken down into new branches that reflect its real structure.

This redesign makes it possible to analyse how changes in catches or management policies ripple through the wider economy (suppliers, services, employment and income), quantifying far more precisely the direct, indirect and induced impacts of each fleet segment on the Basque economic fabric.

These fisheries-specific input–output tables therefore become a strategic tool for designing evidence-based management and support measures for the sector.

Blue Fishing Index (BFI) to guide a fairer allocation of fishing opportunities

Within the **SOSART project**, funded by the Basque Government through EMFAF, AZTI contributed to the development of the Blue Fishing Index (BFI)—a composite indicator designed to quantify the contribution of each fleet segment to environmental, economic and social sustainability.

The BFI integrates 25 variables into 12 sub-indicators and eight indicators, organised across three dimensions, and was tested using official data from the Spanish fleet (2018–2019). The results show that a balanced weighting across dimensions produces more robust and stable outcomes.

Co-created with stakeholders, this tool offers Member States a practical, replicable framework to support progress towards a Sustainable Blue Economy, providing objective criteria for more equitable access to fishing opportunities based on each segment's real contribution to sustainability.

4.4.1. SUSTAINABLE FISHERY MANAGEMENT

Practical tools for ecosystem-based fisheries management and safer seafood consumption

As part of the European SEAwise project, **two interactive applications were developed to evaluate ecosystem-based management strategies**, alongside simulation models that integrate environmental variables, changes in stock productivity, dynamic prices, carbon footprint and socio-economic indicators. The project also contributed to the development of online courses and tutorials.

This work is complemented by risk assessments of incidental catches of 19 protected species, analyses of fishing impacts on food webs and sensitive habitats, and systematic reviews of the effects of fishing on European ecosystems—**providing managers and the sector with an operational "toolbox"** to support the implementation of ecosystem-based fisheries management in Europe.

MARINE ECOSYSTEMS AND TOP MARINE PREDATORS

Environmental DNA to better understand what large whales eat

In 2025, working with the University of the Azores, AZTI showed that it **is possible to reconstruct the diet of large cetaceans** (rorquals and sperm whales) in a non-invasive and cost-effective way **by analysing environmental and faecal DNA** in waters of the Mid-Atlantic.

The study highlights **the key role of mesopelagic fish and deep-water squid** in these food webs and validates eDNA as a robust tool for long-term monitoring of the feeding ecology of large marine predators. This provides strategic information for ecosystem management and for ensuring compatibility between cetacean conservation and fisheries that target their prey.

4.4.2. FISHERY TECHNOLOGIES

We develop technology solutions to modernise fleets, improve energy efficiency, reduce environmental impact and maximise selectiveness.

We use artificial intelligence, advanced modelling and digital tools to foster smarter, safer and more sustainable fisheries.

ENERGY TRANSITION AND FLEET DECARBONISATION

Decarbonising the fishing fleet to improve sustainability and economic efficiency

Since 2008, AZTI has been developing tailored solutions to help fishing fleets reduce their energy consumption and carbon footprint while improving profitability. Through digital monitoring, **energy audits** are carried out to define saving strategies that can deliver **reductions of 10–25% on long trips and 5–7% in coastal fleets.**

These measures are complemented by improvements to hulls, propulsion, fuels and hybrid systems, as well as innovations in fishing gears that reduce hydrodynamic drag and seabed impact. The approach **combines technology, data and close collaboration with the sector** to ensure the fleet's energy transition is technically and economically viable.

AI and digital solutions for a more efficient, decarbonised and traceable fleet

AZTI is supporting the fishing sector through a "technological revolution" that **combines tradition with data to achieve more efficient and sustainable operations.** On-board digital monitoring and machine-learning models make it possible to optimise fuel use, predict favourable fishing grounds for key species such as anchovy and tuna, and improve safety and comfort on vessels. In parallel, **on-board computer vision systems automatically identify and count catches,** strengthening traceability and control, while innovation in gear and selective devices helps reduce discards and by-catch.

These solutions are integrated with **decarbonisation strategies** (energy audits, new fuels and hybrid systems) and **circular economy approaches,** offering the sector a practical roadmap towards more profitable fishing with a lower carbon footprint.

4.4.2. FISHERY TECHNOLOGIES

INNOVATION IN FISHING GEAR AND SUSTAINABLE TRAWLING

More selective and efficient trawling to meet regulations without losing profitability

Selectivity 2025 campaign, scientifically led by AZTI on board the Emma Bardán scientific research vessel, tested new solutions under real operating conditions to help the bottom trawl fleet reduce discards and comply with the **Landing Obligation** while maintaining economic viability.

Key advances include the use of T90 and T45 turned-mesh codends, which make it easier for smaller fish to escape, and the introduction of semi-pelagic trawl doors, which reduce impacts on benthic habitats and can also save fuel.

The use of **underwater video** to observe species behaviour complements an approach that turns innovation in gear and rigging into an immediate lever for competitiveness and sustainability for the Cantabrian–Northwest fleet.

Flying doors: reducing seabed impact and fuel consumption

Working with Spain's Ministry of Agriculture, Fisheries and Food, AZTI is testing **semi-pelagic, or "flying", trawl doors** that keep the trawl net open without dragging the doors along the seabed, significantly reducing damage to benthic habitats and sediment resuspension.

Thanks to their lower hydrodynamic resistance, this technology can **reduce fuel consumption and emissions,** provided it is properly tuned using sensor systems that control door position in real time.

Although adoption requires investment and operational changes on board, trials to date position flying doors as a clear lever for moving towards more responsible and efficient trawling.

4.4.2. FISHERY TECHNOLOGIES

TECHNOLOGIES FOR MORE RESPONSIBLE TUNA FISHERIES

Biodegradable and selective devices for more responsible tuna fishing

Together with industry, AZTI is driving a new generation of technological solutions **to reduce the impacts of tropical tuna fisheries on marine ecosystems.** In collaboration with Zunibal, the centre contributed to the development of the first industrialised FAD made entirely from a material that is biodegradable in the marine environment (bio-based PBS). It is lighter and more resistant than conventional devices and, if it sinks, it biodegrades without leaving harmful residues.

After more than **200 devices have been tested** in the Atlantic and Indian Oceans, this platform offers the tuna fleet a genuine alternative to reduce marine litter and respond to regulatory requirements set by Regional Fisheries Management Organisations.

In parallel, through the **SEARCULAR** project and together with ISSF and the company ECHEBASTAR, AZTI is advancing the **design and testing of EcoFADs** made from natural, sustainable materials—covering two models already used by the fleet but now fully biodegradable, as well as a new circular design known as the **Jelly-FAD.**

Trials in the Mediterranean and the Indian Ocean, alongside joint workshops with the fleet, are helping to fine-tune key aspects such as buoyancy, manoeuvrability, durability, cost and biodegradability, progressively replacing conventional components (plastic floats, weights and metal frames) with lower-impact alternatives. In addition, together with **ANABAC and OPAGAC,** AZTI has developed and tested on board **bycatch release devices** (BRDs)—ramps, stretchers, gates, hoppers and selective grids—that enable unwanted catches such as sharks and rays to be released more quickly, safely and effectively, increasing the survival of vulnerable species and improving crew safety.

Overall, these innovations are putting the tuna fleet on a clear path towards fishing that is more selective, lower in waste and aligned with international sustainability commitments.

4.4.3. AQUACULTURE

We research and develop production systems and environmental management strategies to favour aquaculture that is more efficient and cares for the marine environment. We are committed to innovation, biosafety and the circular economy to boost the competitiveness ad sustainability of the aquaculture sector.

Offshore bluefin tuna aquaculture to diversify the blue economy

ItsasBalfegó, a pioneering initiative led by Balfegó and AZTI, has completed its pilot project to rear bluefin tuna in two submersible cages located 3.7 nautical miles off the port of Getaria. A total of 75 fish, caught using purse seine gear, were held and fed under controlled conditions with frozen fish (sardine and mackerel) sourced from responsibly managed fisheries.

Oversight by ICCAT and the competent authorities, the project aims to **assess the technical, economic and environmental feasibility of a new offshore aquaculture model** that can add value to Basque bluefin tuna quotas, create jobs and supply high-quality product to Euskadi's hospitality sector.

Oceanic aquaculture on the Basque coast: a testbed rather than an industrial farm

Findings from **ACULAB** show that **the Basque coast is not the best candidate for large-scale offshore mussel farming**, due to climatic, physical and biological conditions, as well as a range of regulatory and economic barriers.

However, the same environment emerges as a strategic asset: **an ideal offshore "laboratory" for testing more sustainable materials** (such as bio-based ropes to replace fossil-plastic ones), trialling the cultivation of alternative species such as oysters and macroalgae with potential CO^2 sink capacity, and leveraging the extensive oceanographic datasets collected for climate research, marine planning and sensor validation.

4.5.
FOOD SUSTAINABILITY AND ECO-EFFICIENCY

We back technical solutions to advance towards a **more efficient, circular and resilient food industry, by making the best use of water and energy, cutting wastage and waste,** designing new packs and developing new proteins.

We are committed to **digitalisation and social sustainability as pillars** of our response to regulatory challenges, consumer demands and climate change.

4.5.1. EFFICIENT PRODUCTION

We develop and implement solutions aimed at saving and re-using water, efficient resource management and waste reduction. We optimise production processes using clean technologies and sustainable models to boost competitiveness and internal use of food resources.

New methodologies to measure and reduce environmental footprint in the food industry

In 2025, through the **Envifood** project, AZTI made progress in the practical application of innovative methodologies to reduce the environmental footprint of food processes and products.

The **EnviroScore™** system was applied to assess the environmental impact of specific product references; eco-efficiency improvement plans were defined for production lines; and digital tools such as **ENVIRODIGITAL** were integrated to assess product environmental impact and monitor environmental indicators in real time.

The pilot trials carried out in sector companies and the practical guidance produced facilitate the adoption of these criteria by industry, consolidating AZTI as a reference partner in the **transition towards more sustainable and competitive production models.**

4.5.2. FOOD SUSTAINABILITY

We provide total solutions to identify, quantify and reduce environmental and social impacts throughout the food chain.

We use advanced methodologies like life cycle analysis, carbon footprint, water footprint and ecodesign strategies, promoting transparency, trust and differentiation on the market.

Key levers to increase food production without harming the planet

AZTI produced a **report on sustainability in the food industry** analysing how to produce more food without exceeding planetary boundaries, in a sector that consumes close to 70% of the world's freshwater and generates around 24% of greenhouse gas emissions.

The report proposes a whole-system approach ranging from ecodesign and life cycle assessment, eco-efficiency and the circular economy, to empowering consumers to reduce food waste and make informed choices.

Assessing and reducing environmental footprint from farm to fork with ENVIRODIGITAL

AZTI and NEIKER signed an agreement to scale up **ENVIRODIGITAL, a Product Environmental Footprint (PEF)-based digital tool** that enables the environmental impacts of foods and processes to be measured and managed across the entire agrifood chain. The collaboration will focus on automating data capture and calculation in farming and livestock systems and extending the use of ENVIRODIGITAL among cooperatives, farms and processing companies. Through the **Enviroscore® environmental label** (A–E scale), the tool supports product comparisons, helps prioritise improvements and turns sustainability into a lever for competitiveness.

4.5.2. FOOD SUSTAINABILITY

Environmental “A” label for Artomaña Txakoli: sustainability as a competitive advantage

With AZTI’s support, the winery **Artomaña Txakolina** (Álava) achieved the highest Enviroscore rating (A) for 10 of its 11 own-brand wines, with a B rating for the remaining one, after assessing their environmental footprint using ENVIRODIGITAL. Based on the European PEF methodology, the analysis covers the full value chain—from the vineyard through to consumption and end-of-life of the bottle—and recognises practices such as the use of local grapes, lightweight bottles and optimised packaging.

“Sustainable Gastronomy” certification for more responsible food service

In collaboration with **BBK Kuna and Basque Know-How Fundazioa (BKHF),** AZTI contributed to the design of the “**Sustainable Gastronomy**” label— a certification model that integrates environmental and socio-economic criteria into the management of food service establishments.

The certification assesses eight key areas— from sustainable sourcing and waste/food waste management to efficient water and energy use, working conditions and transparent communication— and ranks venues across three sustainability levels, also providing an improvement plan. In this way, the label helps local hospitality businesses identify concrete actions to become more sustainable and respond to growing societal demand for responsible, place-based gastronomy.

4.5.3.
NEW SOURCES OF PROTEINS AND BIOPRODUCTS

We research, develop and transfer new protein sources and bioproducts made from by-products of the food industry. Using biotechnologies like microalgae and fungi, we create functional ingredients and high added-value proteins for human and animal food, fostering the circular economy and new business opportunities.

Upcycling fisheries by-products into more sustainable aquaculture feeds

Within the **ATIPECA** project, AZTI is working with companies and technology centres to **transform tuna and salmonid bones**—by-products from the fisheries industry—**into an innovative mineral ingredient** rich in highly bioavailable phosphorus and calcium for aquaculture feeds.

This approach **reduces reliance on conventional raw materials,** makes better use of existing resources and supports a more circular and efficient aquaculture model.

Grape, orange and olive by-products turned into local, sustainable feeds

Coordinated by AZTI, the European **NEWFEED** project has shown that by-products from grapes, oranges and olives can be transformed into local (KM0) ingredients for feeding ruminants and poultry, while maintaining animal health and product quality.

With 14 partners from Spain, Greece and Egypt, the consortium validated **three circular value chains that reduce waste, lower feed costs and open up new business opportunities** in Mediterranean livestock farming—strengthening the circular economy and the resilience of the agri-livestock sector.

4.5.3.
NEW SOURCES OF PROTEINS AND BIOPRODUCTS

Safe fish-viscera silage for more sustainable aquaculture feeds

AZTI's study shows that silage made from fish viscera **can be safely reused in feeds for gilthead seabream,** without increasing the allergenicity risk associated with Anisakis. No significant presence of allergens was detected in the muscle of fish fed with these diets, and the observed reactivities were attributed to cross-reactive or non-specific responses.

This method enables the **valorisation of a currently underused viscera stream,** reduces dependence on fishmeal and fish oil, and opens up a new income pathway for Basque fleets, with minimal infrastructure requirements both on board and on shore.

Marine biofertilisers: turning fish by-products into a resource for circular agriculture

Food production, climate change and waste reuse pose a growing challenge—one that the European **SEA2LAND** project addresses by recovering nutrients to produce bio-based fertilisers from fish processing and aquaculture by-products.

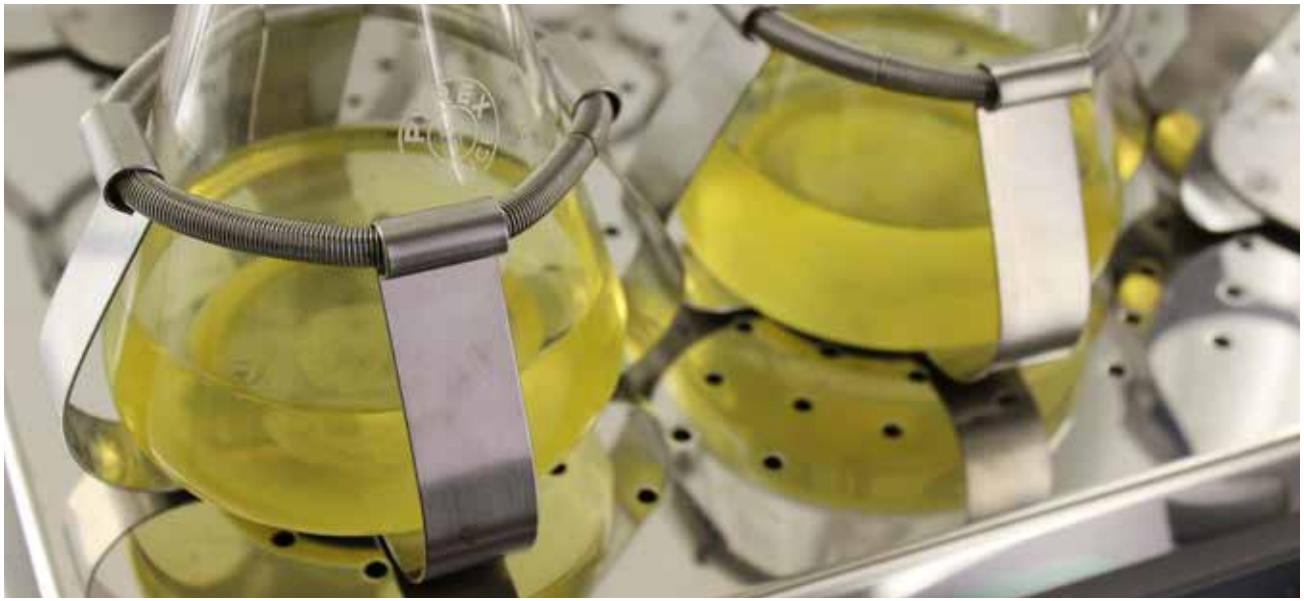
In the **Cantabrian pilot, l**ed by AZTI together with the Biscay-based company Barna, sustainable biofertilisers have been successfully developed using biotechnological processes such as **enzymatic hydrolysis and autolysis,** transforming part of the 60,000 tonnes of fish by-products generated each year into inputs suitable for fertiliser production.

The results demonstrate the **potential of these marine residues as an agricultural resource,** reducing waste, closing nutrient loops and strengthening regional production of circular fertilisers in line with more sustainable farming in Europe.

4.5.3.
NEW SOURCES OF PROTEINS AND BIOPRODUCTS

Marine biomaterials for safer, more circular organic farming

In the European **project BIO²** – Natural Solutions for Organic Farming, AZTI leads the **development of next-generation fertilisers and biomaterials from by-products of the fisheries industry,** replacing controversial inputs still permitted in organic farming (such as certain fungicides or contaminated fertilisers). Using biotechnology and green chemistry, these underutilised resources are converted into cleaner, more effective biofertilisers that improve soil health, use local raw materials and reduce agriculture's pollutant load—contributing to the objectives of the European Green Deal.



Progress in sustainable biotechnology: new microalgae- and fungi-based solutions

In 2025, through the **BIOPRO project**, AZTI consolidated new biotechnological solutions based on microalgae and fungi to valorise food by-products and advance the circular economy. Pilot-scale microalgae biomass was produced (batch and fed-batch), fermented biomass from pomace was obtained, and solid-state fermentation processes using sugar-rich effluents were optimised, generating bioactive extracts with demonstrated functionality.

These advances have already delivered scientific outputs—including a publication in an indexed journal and a presentation at an international conference—reinforcing AZTI's capacity to develop high value-added, sustainable ingredients for the food industry.

4.5.4. DIGITALISATION AND ARTIFICIAL INTELLIGENCE

We develop and implement advanced digital solutions incorporating sensor systems, real-time data analysis and artificial intelligence. We process monitoring and smart control, boosting quality, efficiency and traceability throughout the food chain, moving towards a connected, automated, data-based industry.

Foundations for end-to-end digitalisation of the fisheries value chain

Through the **DIGCAN** project, AZTI has advanced the diagnosis of digitalisation across the fisheries value chain, designing and rolling out a sector consultation model that characterises the current state at each link and identifies technology and information needs.

These preliminary results will inform the definition of a comprehensive **digital transformation plan** to improve efficiency, traceability and value added in fisheries within the blue economy and the digital economy.

Smart sensing and AI to control food quality in real time

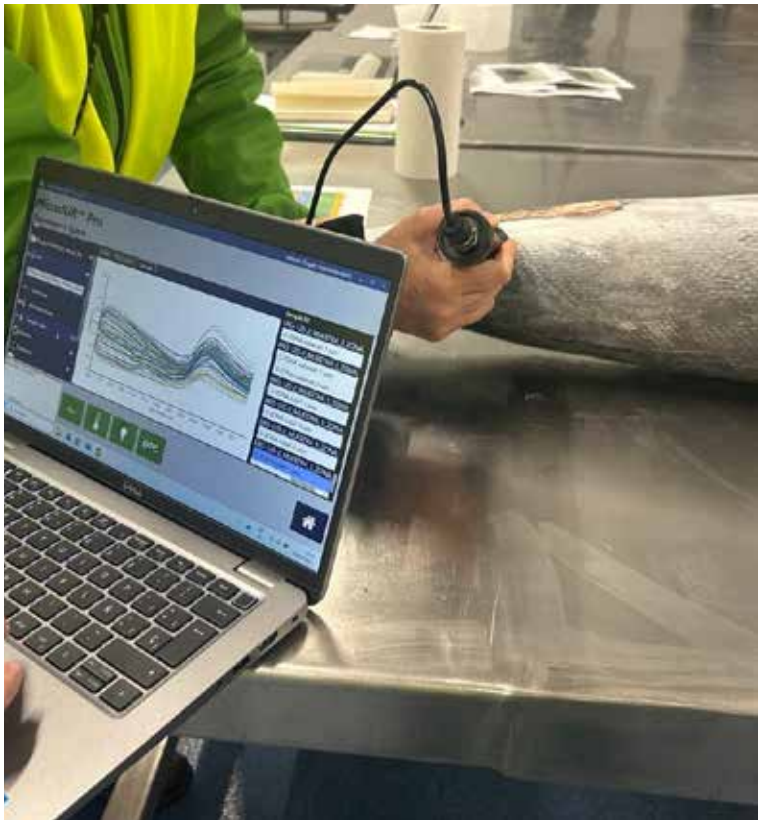
Through the **SensAIFood** project, AZTI has taken a significant step forward in smart monitoring of food quality, comparing **NIR sensors** and developing models to determine the lipid profile of products.

Integrating the **chemometrics** module into AZTI's IoT platform and connecting it directly to the NIR sensor makes it possible to assess quality in real time and automate process decisions, improving efficiency, reducing losses and strengthening the food sector's digital transformation.

IoT and predictive models for more efficient and sustainable processes

In the **EcoefIoT** project, AZTI piloted its **AZTI-IoT** platform in a processing plant, incorporating new sensors to monitor critical parameters and capture high-value operational data.

Building on this foundation, AI predictive models are being developed, alongside the preliminary design of a digital twin that will **enable production scenarios to be simulated** and resource use to be optimised—reducing environmental impacts and improving the competitiveness of food companies.



4.6
NEW FOODS AND TECHNOLOGIES

We develop and transfer solutions to create innovative, healthy and sustainable foods, incorporating advanced **formulation and processing technologies.**

We support industry in t**he design of new products, incorporating alternative ingredients and using efficient processes,** responding to consumer trends and the challenges of sustainability, health and competitiveness in the industry.

4.6.1. FORMULATION AND TRANSFORMATION

We back the development of foods adapted to specific consumer profiles (seniors, children and special needs) and formats in line with new trends: healthy snacking, finger foods, clean label, ready-to-eat products and allergen-free formulations.

We incorporate recovered ingredients and alternative proteins, assuring nutritional quality and differentiation on the market.

Alternative proteins and omics for a healthier, more sustainable industry

AZTI coordinated the **CERVERA OPTIPROT Network** of Excellence, which over two years has demonstrated the potential of plant- and microbial-based proteins, as well as proteins derived from agrifood by-products, to develop healthier, functional foods and ingredients with a lower environmental impact.

The network also advances the development of **hybrid foods,** intelligently combining animal, plant and alternative proteins, and applying omics technologies to support progress in precision nutrition.

Joint work with AINIA, ANFACO-CYTMA, EURECAT and CNTA has delivered new valorisation processes, **innovative protein products**, biomarkers to personalise diets and results transferable to industry, while also strengthening scientific talent development, the creation of spin-offs such as **LIPIWELL,** and international collaboration on the future of food.

4.6.1. FORMULATION AND TRANSFORMATION

AI and data to accelerate the shift towards more sustainable proteins

Within the European **GIANT LEAPS** project, AZTI is developing an artificial intelligence algorithm that, starting from a specific animal protein, identifies more sustainable protein alternatives by integrating nutritional composition and amino-acid profile data—and in the future will also incorporate sustainability, digestibility and safety criteria.

Embedded in a digital platform alongside IRIS Solutions and DIL, the tool will enable R&D teams, nutritionists and companies to design new protein products without relying solely on laboratory trial and error, accelerating the development of plant-based, fermented or cultivated alternatives.

Plant proteins for older adults from surplus legumes grown without chemicals

In the 3SLEKA project, AZTI and NEIKER transformed surplus chickpeas and beans grown without fertilisers or plant protection products into new flours, snacks and spreads with improved nutritional properties tailored to the needs of older people.

These solutions provide healthy, accessible plant-based alternative proteins while valorising local crops, reducing waste and strengthening the circular economy across the agrifood chain.

In addition, the joint work developed advanced methodologies to control pesticide residues and optimise product texture, ensuring foods that are safe, sustainable and appealing to senior consumers.

4.6.2. PROCESSING AND CONSERVING TECHNOLOGIES

We use advanced processing technologies such as hydrostatic high pressures (HHP), laser, expansion and coextrusion technologies to enhance sensory and health properties and shelf life, create new textures and boost the efficiency of processes.

We validate equipment, processes and solutions in pilot environments to facilitate industrial transfer.

Innovation in low-fat emulsions to develop healthier foods

In collaboration with the Universitat Politècnica de València, AZTI carried out a systematic review of more than 400 studies on low-fat emulsions applied to products such as meat, dairy, sauces, bakery goods, ice cream and vegan alternatives.

Published in Food Science & Nutrition, the analysis found that **only 6.6% of studies include rigorous sensory evaluation,** even though creaminess, texture and flavour are critical to consumer acceptance of lower-fat products.

The review highlights **the need for standardised sensory protocols** to speed up the launch of healthier formulations without sacrificing enjoyment.

4.7
PERSONALISED NUTRITION AND HEALTH

We develop innovative nutritional solutions using **biotechnology, omic science and artificial intelligence** to foster healthy food suited to each person.

We research the **link between diet and health, identify biomarkers** and validate effects through clinical studies.

In this way we provide the food and health industry with tools to design personalised products, ingredients and services to **enhance quality of life and meet new consumer demands.**

4.7.1.
THE IMPACT OF FOOD ON HUMAN HEALTH

We assess the effect of diet, food and ingredients on health through clinical studies, creating molecular profiles and identifying biomarkers, in order to draw up personalised nutritional recommendations based on scientific evidence

Precision medicine for frailty and healthy ageing

Within the **ELKARTEK BG23** study, AZTI contributed to the development of precision medicine applications aimed at **predicting frailty and supporting healthy ageing.**

The results show that adopting healthy habits in diet and physical activity is associated with greater diversity and activity of the gut microbiota and with more favourable health biomarkers.

Older participants and women in the study showed dietary patterns more closely aligned with recommendations—higher consumption of fish and vegetables and lower intake of meat—which translated into higher levels of EPA and DHA and a higher omega-3 index in red blood cells, as well as more favourable short-chain fatty acid profiles.

This knowledge helps guide personalised recommendations for healthy ageing, with an emphasis on **increasing fibre intake, reducing consumption of animal protein and processed foods, and considering supplementation with pre- and probiotic products.**

Understanding ageing and anticipating risks

In 2025, AZTI strengthened its contribution to understanding the biological and molecular processes of ageing through several strategic projects focused on early risk detection and maintaining autonomy in later life.

In **ITTHACA**, funded by the Basque Government, the centre is working on identifying ageing biomarkers and developing predictive models

4.7.1. THE IMPACT OF FOOD ON HUMAN HEALTH

and health-monitoring systems for the older population in Euskadi.

AZTI's contribution focuses on **studying gut microbiota and nutritional habits linked to dementia risk,** as well as applying **neuroscience technologies** to understand how emotions associated with food texture influence eating behaviour in older adults—exploring new biomarkers, biosensors and predictive models to support healthy, independent ageing.

The **BG25 project** pursues a comprehensive strategy to understand the biological and molecular processes of ageing; AZTI leads research on **amino acids and lipids related to inflammation, mitochondrial health and cognitive function,** generating key knowledge for the future design of personalised diets.

BG25 focuses on **new diagnostic and therapeutic approaches to age-related neurological diseases,** with AZTI's contribution centred on personalised nutrition—studying how to adapt diet, including texture, to the specific needs of older people with neurological conditions.

Personalised nutrition and prevention of diet-related chronic disease

AZTI participates in initiatives that connect scientific evidence with the prevention of non-communicable diseases linked to diet.

The European **CoDiet** project aims to develop scientific and digital tools to address current knowledge gaps on the relationship between diet and chronic disease.

The outcome will be a **tool to assess the risk of diet-induced conditions and a set of personalised nutritional recommendations** focused on prevention, transferable to clinical practice, public policy and food innovation.

4.7.2. PRECISION NUTRITION TECHNOLOGIES

We develop and apply omic and sensory technologies and AI algorithms to allow progress towards precision nutrition, incorporating molecular, clinical and lifestyle data to generate recommendations adapted to each person.

Lipiwell: AZTI's precision nutrition reaches the market

In 2025, Lipiwell was launched as a spin-off that brings AZTI's accumulated scientific and technological expertise in precision nutrition to market. The service draws on the centre's experience in **multi-omics analysis, microbiota research and lipidomics to personalise diet** according to each person's individual characteristics, offering evidence-based recommendations and professional guidance.

Lipiwell represents the culmination of more than a decade of AZTI research in personalised nutrition and is founded with a clear focus: u**nderstanding each woman's body and life stage in order to design tailored nutrition plans** that help improve health and wellbeing.

From elite sport to the wider public: "Nutrition by Athletic Club"

In 2025, Lipiwell launched "Nutrition by Athletic Club", a personalised nutrition service that **brings knowledge generated with high-performance athletes to the general public.** Based on the Lipiwell Method, the programme analyses metabolic profile and the lipid composition of red blood cell membranes to design tailored nutrition plans aligned with each person's physiology, goals and lifestyle.

The service offers different levels of commitment—from a free BASIC plan during the first months to advanced options with high-precision lipidomic analysis and in-person follow-up at San Mamés—and is supported by an **app that integrates metrics, recipes and a dynamic "Nutrition Score".**

4.7.3. INNOVATION IN FOODS FOR SPECIAL NEEDS

We design products adapted to specific groups of people (small children, seniors, people with cancer, dysphagia and allergies), assuring safety, nutritional quality and sensory acceptance, with solutions to enhance quality of life and generate value for industry.

Foods and textures tailored to the needs of older adults

AZTI's research team studies how food structure and texture shape acceptability, safety and wellbeing in older people, translating scientific knowledge into practical product solutions.

Within **ITTHACA**, the centre is applying neuroscience technologies in a longitudinal study with women aged 65 to 85 at the CITA-Alzhéimer Centre in San Sebastián. The study combines measures of acceptability, sensory perception and both conscious and unconscious emotional responses (facial expressions, skin conductance and heart rate). Preliminary findings show distinct response patterns different textures, which will underpin the design of foods that are better accepted by this population group.

ADIMENTEX is developing data-science-based tools for the design of textured products, helping to optimise and speed up the development of tailored solutions.

NUTRIAGE focuses specifically on how food structure affects sensory acceptability and swallowing safety in older consumers, generating functional food structures that are efficient, safe and appetising.

Within **BmG25**, personalised nutrition also includes adapting textures to the needs of older people with neurological conditions, reinforcing the goal of maintaining both the pleasure of eating and food safety in later life.

4.8
FOOD QUALITY AND SAFETY

We develop and transfer solutions that **ensure safety, authenticity and traceability across the entire value chain**—reducing risks, meeting regulatory requirements and strengthening competitiveness.

4.8.1. MINIMISING FOOD SAFETY RISKS

We prevent and reduce food-related risks through innovative solutions, including the biocontrol of pathogens and unwanted bacteria, rapid detection of chemical compounds and microorganisms, and shelf-life and expiration studies.

Bacteriophages against Listeria: natural biotechnology for more robust food safety

Through the **FAGOSASUN** project and its bacteriophage line of work, AZTI has validated **a natural, effective and safe biocontrol solution against** *Listeria monocytogenes*—the most relevant foodborne pathogen for public health due to its high mortality.

The technology, based on naturally occurring phages, can be applied both to processing surfaces and equipment and directly to food, acting as a complement or alternative to conventional disinfection and preservation systems.

Working with food and biotech companies, FAGOSASUN has reached Technology Readiness Level TRL 6, laying the groundwork for **future transfer and commercialisation and helping to reduce health risks** and the costs associated with outbreaks and product recalls.

4.8.1. MINIMISING FOOD SAFETY RISKS

Biotechnology to reduce antibiotics and strengthen safety in pig and poultry production

Within the **BIOTEGANIA** project, launched in 2024 and funded under the TransMISIONES call by CDTI and the State Research Agency, AZTI coordinates a group of renowned scientific and technology centres within a consortium that also includes livestock producers, biotechnology companies and firms with extensive experience in end-to-end project management.

The shared objective is to **develop biotechnological and digital solutions that improve animal health and food safety,** with a focus on the pig and poultry sectors. In collaboration with Exopol, AZTI leads the work package dedicated to developing advanced biotechnological tools for the diagnosis, prevention and efficient control of pathogens across the entire chain, from farm to fork.

Among these solutions, AZTI is the main lead for **developing rapid, on-site pathogen detection systems based on isothermal amplification,** designed to be used directly in livestock production facilities as early warning systems for critical pig and poultry pathogens such as *E. coli and Brachyspira*.

Another strategic line led by AZTI is the development of bacteriophage-based solutions targeting relevant pathogens such as *Campylobacter* and *Listeria*, also tackling the specific challenge of isolating phages active against *Brachyspira,* the cause of swine dysentery.

This line includes the creation of an intelligent tool to predict host range, supporting the **rapid design and selection of existing phage formulations** against specific pathogens. Phage formulations are being designed for application both on farm (via water, feed or food) and in slaughterhouse and processing settings (surfaces, equipment and final products), and will be validated under real production conditions with partners including CECAV, Exopol, Cuarte, Sánchez Romero Carvajal, OBlanca and COBB.

AZTI's ultimate aim is to **reduce the use of antibiotics,** curb antimicrobial resistance and make meat production safer, more efficient and more sustainable—for the benefit of farmers, the food industry and consumers.

4.9
CONSUMER BEHAVIOUR AND TRENDS

We research trends in food habits, preferences and motivations and turn this into action.

We combine competitive intelligence, neuromarketing, sensory analysis, consumer surveys and digital tools to anticipate trends and offer industry off-the-peg solutions to boost innovation and improve their connection with the global market.

4.9.1. IDENTIFYING TRENDS AND PATTERNS IN FOOD CONSUMPTION

We anticipate the future of food by analysing change in consumer and shopping habits. Through strategic analysis and vigilance, we spot opportunities and risks to guide innovation and help position products on international markets.

Science-based food trends to guide business innovation

With the **EATrends 2025–2027 report,** AZTI strengthens its role as a strategic partner for companies that want to innovate by grounding decisions in market insight. The report identifies eight major forces reshaping the food system: climate resilience, sustainability, protein diversification, transparency, food safety, oceans as a source of food, personalised nutrition and holistic wellbeing.

EATrends provides **a practical framework for reshaping innovation roadmaps,** spotting new opportunities and developing solutions aligned with real consumer needs and the challenges of the food transition.

Alternative proteins: strategic insights to lead the protein transition

In 2025, AZTI carried out an in-depth analysis of the alternative-protein market in Spain, finding that **30% of the population already identifies as flexitarian,** and that willingness is growing to replace part of animal protein with options that have a lower environmental impact and a better nutritional profile.

Based on consumer segmentation, motivations, purchase barriers and acceptance of different sources (plant-based, algae, mycoproteins, hybrids, insects and cultivated meat), the study provides the food industry with **actionable intelligence to design new products, refine pricing and messaging,** prioritise high-potential categories and position itself advantageously in a growing market.

4.9.2. BEHAVIOUR AND CONSUMPTION ANALYSIS

We work with expert panels and real consumers to assess which attributes drive choice and satisfaction, so ensuring that products will stand out and cement their position on the market.

Understanding consumers to design healthier, chosen diets

AZTI studies why we eat what we eat—tradition, marketing, emotions, values and science—to help industry develop products that balance health, sustainability and enjoyment.

Through advanced sensory analysis, emotional-response studies, participation in the **EIT Food Consumer Observatory** and dedicated projects in children's nutrition (such as TITAN and FoodEducators), the centre identifies what people are really looking for and how decisions are made. It translates this insight into better-adapted foods, AI-powered educational tools and solutions that make healthier, more sustainable eating easier from childhood.

Food education and digital tools to cut waste from an early age

Through European projects such as **FoodEducators** and TITAN, AZTI supports the training of young generations as agents of change tackling food waste and unhealthy habits.

On the one hand, it **contributes to multilingual teaching materials that help educators** address—in a practical, participatory way—the causes of food waste and the solutions.

On the other hand, it supports the **development of a nutrition chatbot for children and families** that uses artificial intelligence to encourage healthy habits in a playful, approachable way.

4.10
BIOTECHNOLOGY

We drive advanced biotechnological solutions for the development of innovative ingredients, processes and products that add value to the food, health, aquaculture and environmental sectors.

By harnessing the **potential of microorganisms, enzymes, phages and biomolecules from marine sources or underutilised food resources**, we design safer, more sustainable and competitive alternatives that address the current challenges facing industry and society.

4.10
BIOTECHNOLOGY

Biotechnology to produce caviar more efficient and sustainable way

AZTI has patented **the first early sexing method for sturgeon based on real-time PCR,** enabling the sex of animals to be identified at the age of just 1–2 from a small blood or tissue sample.

Validated on 296 samples from several species and developed together with Caviar Riofrío (Osborne Group), **the tool avoids rearing males for years when they will not produce caviar,** significantly reducing costs related to feed, space and handling.

It also makes it possible to tailor nutrition and husbandry for females, optimising maturation and making caviar production more profitable and environmentally sustainable.

The method received the **24th JACUMAR Award for Research in Aquaculture,** granted by Spain's Ministry of Agriculture, Fisheries and Food.

New microbial allies to better understand and harness "blue carbon"

A study coordinated by AZTI identified, for the first time, **marine bacteria associated with brown macroalgae that are able to degrade fucoidan**—a complex polysaccharide that plays a key role in carbon storage in the ocean.

Published in ***Nature Communications,*** the finding sheds new light on the capabilities of the microbiome in brown seaweed "forests" and its role in the global carbon cycle.

At the same time, characterising the enzymes that break down fucoidan opens up opportunities in biotechnology, biomedicine and marine biorefining, from the design of therapeutic compounds to the sustainable valorisation of algal biomass.

5

AWARDS AND RECOGNITION

5.
AWARDS AND RECOGNITION

The awards and distinctions received in 2025 **highlight the strength of AZTI's scientific and technological work** and its tangible impact on sectors that are strategic for Euskadi and Europe.

From food innovation and precision nutrition to circular economy approaches in the fisheries industry, sustainable aquaculture and excellence in marine ecology, these accolades reinforce the centre's international standing and underline its ability to turn knowledge into solutions that are useful to society.

At the same time, recognitions linked to the normalisation of Euskera reflect a broader **commitment that brings together science, culture and values shared with the territory.**

5. AWARDS AND RECOGNITION

Recognition of scientific-technical and gastronomic contribution

In 2025, AZTI received the **Special Award of the Basque Academy of Gastronomy**, one of the sector's most significant honours, recognising its contribution to healthier and more sustainable food.

The award highlights AZTI's development of new healthy foods, its pioneering research in precision nutrition and its extensive outreach activity, underlining its impact on gastronomy and on the health of Basque society.

Lighthouse Living Lab and international reference in dysphagia

The European Commission recognised AZTI as one of its "Lighthouse Living Labs", consolidating its leadership in transforming European food systems through open innovation and market-ready solutions.

Additionally, the centre has successfully completed the International **Pilot Programme of the International Dysphagia Diet Standardisation Initiative (IDDSI Academy)** as the only Spanish technology centre recognised in its category, positioning it as a benchmark in the research and development of solutions for dysphagia and certifying that it meets the most demanding international standards in this field.

Tuna Awards 2025 for the RESALTUN project

In fisheries, AZTI and the Basque canning company Hijos de Serrats were honoured at the Tuna Awards 2025 for the RESALTUN project, which **applies circular economy principles to the tuna industry.**

The initiative enables the reuse of residual brine from tuna processing, reducing saline discharges and waste, and has been recognised as an example of sustainability and effective collaboration between a company and a research centre.

5. AWARDS AND RECOGNITION

JACUMAR Award for Research in Aquaculture

In aquaculture, AZTI received the 24th JACUMAR Award for Research in Aquaculture, granted by Spain's Ministry of Agriculture, Fisheries and Food, for the project **"Method for identifying sex in fish of the family Acipenseridae".**

The technique, based on real-time PCR and protected through intellectual property—with a PCT patent under evaluation—enables early sex determination in different sturgeon species from a small sample. This tool **allows aquaculture companies to select females at an early stage,** reduce rearing costs and achieve more efficient and sustainable caviar production.

Odum Award for a career in marine ecology

AZTI oceanographer Ángel Borja received the Odum Award, one of the most prestigious international recognitions in marine ecology, becoming the first non-US scientist to receive it.

The award **recognises more than 35 years of work dedicated to the study and conservation of marine ecosystems** and places AZTI at the forefront of marine science worldwide.

Bai Euskarari Award 2025 for the normalisation of Euskera

In the linguistic and cultural sphere, AZTI was awarded the Bai Euskarari Award 2025, recognising its track record in the normalisation of Euskera and the collective commitment of its team.

The award highlights the work of the Euskera Group and reinforces the centre's **commitment to integrating the Basque language as an added value in its day-to-day scientific and technical activity.**

One more year at the service of a healthier and more sustainable society... because today, more than ever,

the answer lies in science


AZTI
MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE