
# Cefas Science and Evidence Strategy (2019-2025)

*"informing our understanding, guiding our actions"*

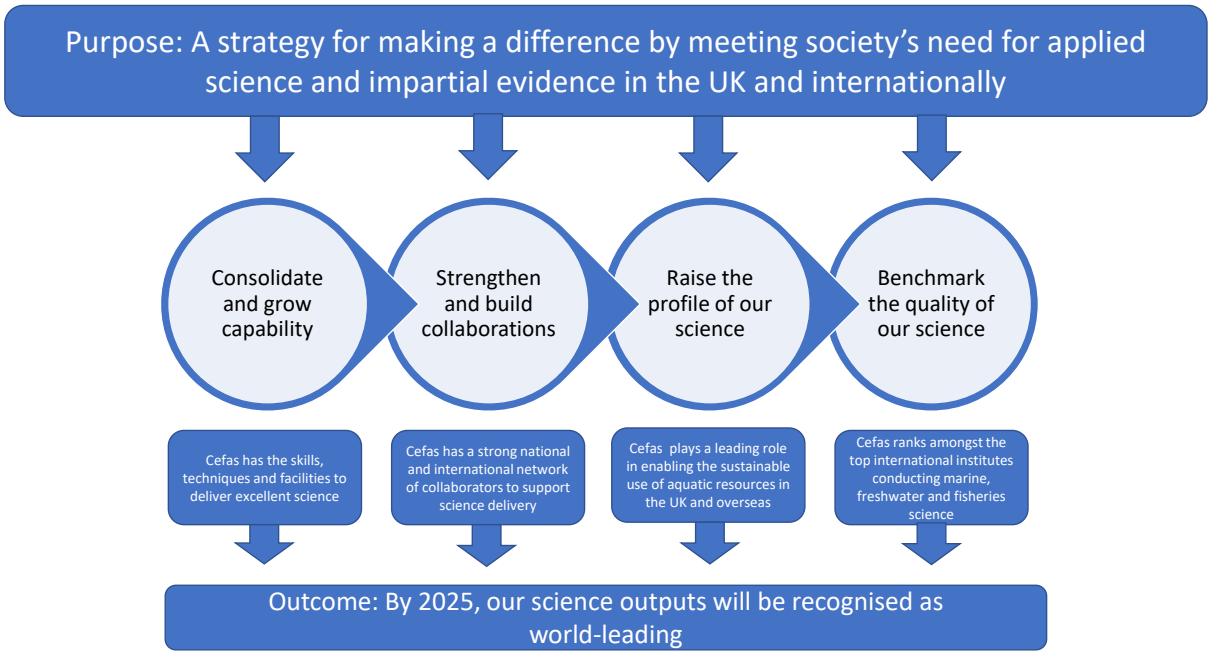
# Excellent science: our science outputs will be recognised as world-leading

***The Cefas Science and Evidence Strategy (2019-2025) sets the context and direction for Cefas.***

We will develop and grow the influence of our science and technology on decisions concerning the sustainable use and protection of the aquatic environment. Our professional scientists and technologists will innovate and collaborate to build a world-leading reputation. We will be well-known around the world for the impact of our work, and we will extend our reputation by maximising the number and variety of our outputs, including peer-reviewed publications in leading scientific journals, available where possible through open access. We will champion our unpublished work that has had a direct and identifiable impact on policy formulation and legislation in the UK government and around the world. We will create an environment in which our scientists and technologists are supported in their professional development through mentorship and training programmes. The Science and Evidence strategy (2019-2025) sets the direction for the development of our science and technology and its application under four science themes. Internal investment in our scientific capability will ensure that we continue to meet our science excellence targets.

# 1. Making a Difference - The Cefas Science and Evidence Strategy (2019-2025) and you

The Cefas Science and Evidence Strategy (2019-2025) describes Cefas scientific priorities and how we ***make a difference*** by meeting society's need for applied science and impartial evidence in the UK and internationally.




**Who is it for?** The strategy has been written for Cefas staff, using language that will also be familiar to our customers and collaborators.

**What is it for?** The strategy describes how our science and scientists will support UK and international Governments to protect, sustainably manage, and restore ecosystems. The strategy will guide investment to strengthen our science and technology, develop capability, and raise the profile of our science and scientists nationally and internationally.

**What major changes does the strategy identify for our future science and evidence?**

- Our ecosystem science and social and economic research will be much more integrated. New perspectives on understanding, anticipating and managing the interactions of humans with aquatic ecosystems will ultimately lead to environmental, economic and social sustainability.
- A wider range of customers over broader geographical scales will expand our international data collection, yield a better understanding of global aquatic ecosystems, and offer new opportunities to provide excellent comprehensive data and scientific advice.
- The combination of in situ and remote observations, technological developments (e.g. autonomous surface vehicles, sensors, genomics), and free and open sharing of rapidly

growing volumes of data will offer new ways to generate, disseminate and communicate knowledge that underpins our science and advice.

- A wider range of research and societal actors, including researchers in the humanities, non-empirical disciplines, and non-academics such as citizen scientists will create a richer fabric of science and evidence for us to use, build on and communicate to diverse audiences.
- The COVID-19 pandemic has demonstrated the increasing importance of digital/virtual methods when developing, delivering and communicating our science and technology.

**How do I use it?** The strategy should be used as an aid to help communicate your science better (e.g. use national/international context to build engaging science stories from your work, section 2), to develop your science career (section 3), and to develop thinking around your science (sections 3, 4 and 5). Specifically, the strategy is arranged in the following sections:

- **Cefas science and evidence in a national and international context** describes how our scientific priorities guide decision-making on the sustainable use and responsible management of aquatic environments.
- **Our capabilities in a changing world** identifies the skills, techniques and facilities we require going forward, and how we will support the development of these.
- **Our science themes and investment priorities** describe how our science is organised, with key areas of focus for priority investment under each theme.
- **Impact and outreach of Cefas science and evidence** identifies how our science is communicated, how we measure the success of our science outputs, and how these outputs contribute to our science having a world leading reputation.

# 2. Cefas science and evidence in a national and international context

Through the Cefas Science and Evidence Strategy (2019-2025) we will make a difference by delivering the scientific evidence and advice that UK and international Governments need to move towards a sustainable blue future**,** where aquatic environments provide a vital source of food, energy, employment and recreation. In doing so, we aspire for our science to be recognised as world-leading.

The United Nations rank the health of the world's oceans as one of our most pressing development challenges. The Sustainable Development Goal 14 "Life below Water" calls on the international community to conserve and sustainably use the oceans, seas and marine resources to benefit present and future generations.

The UK Government's commitment to deliver the Sustainable Development Goals is reflected in Defra's ambitious 25-year environment plan (25 YEP). The 25 YEP aims to achieve clean, productive and biologically diverse seas and oceans within a generation by prioritising the protection and enhancement of the natural environment (e.g. by developing our science through a natural capital[1] perspective). The UK's ambition to be leaders in international marine stewardship will also direct action towards the oceans to balance their protection with sustainable use.

Enabling decisions on the sustainable use and responsible management of aquatic environments requires scientific evidence and advice based on an understanding of stakeholder and societal needs. For over 100 years, Cefas has been providing just that, working closely with our colleagues across UK and international governments, universities, research institutes, maritime and fishing industry and non-governmental organisations.

Our science will be directed towards safeguarding human and aquatic animal health and enabling food security, thereby supporting marine economies. The evidence we generate will include the provision of nature-based solutions for society and will underpin major policy decisions on the protection and enhancement of natural assets, with implications for generations to come. These decisions include measures to develop sustainable, safe food supplies, measures to protect and, where appropriate, recover biodiversity and measures to help society mitigate and adapt to climate change.

[1] Natural capital are the elements of nature that either directly or indirectly contribute to people's lives, e.g. by providing us with food, clean water, wildlife, energy, recreation and protection from hazards.

# 3. Our capabilities in a changing world

Through the Cefas Science and Evidence Strategy (2019-2025) we will consolidate existing and ***grow new capabilities and strengthen collaborations*** to deliver our science and evidence.

We will:

- develop truly multi-disciplinary approaches. The most exciting advances in our science will occur at the interface between disciplines,
- strengthen our social science and economics capabilities both in-house and via external partnerships,
- grow our numerate skills, including modelling, statistics and 'big data' handing,
- develop and apply capability in high-throughput sampling and analyses, with a focus on genomics, to connect the local and global scales of our investigations,
- embed the use of cloud-based virtual servers for storing and analysing data and build advanced science computing capability at Cefas
- ensure that our science computing systems have the architecture and processing speeds to handle the volumes and types of new data, and that high-quality data are available in simple formats for decision-making purposes.

**Personal development.** We will continue to encourage and fund ambitious Personal Development Plans to develop the new skills we need. We will attract a new generation of scientists and our People Strategy will ensure that we continue to retain, develop and attract world-class talent. We anticipate a workforce of at least 460 full-time scientists and technologists.

**Facilities.** Our Science Services will ensure we have suitable facilities for conducting world class experimental, analytical and diagnostic testing and that our Research Vessel is equipped to lead excellent marine monitoring.

**Partnership and collaboration.** We will grow our national academic outreach and strengthen our science through our two UK Strategic Alliance universities; our Collaborative Centre for Sustainable Use of The Seas with the University of East Anglia and our Centre for Sustainable Aquaculture Futures with Exeter University. Working with our wider University network, sustained investment in doctoral training, and targeted recruitment of our most promising students, will bring fresh skills to Cefas and support succession planning. Partnering with leading international universities and Research Institutes will foster new relationships focusing on science excellence in complementary areas of research, spanning animal genetics to marine insurance algorithms.

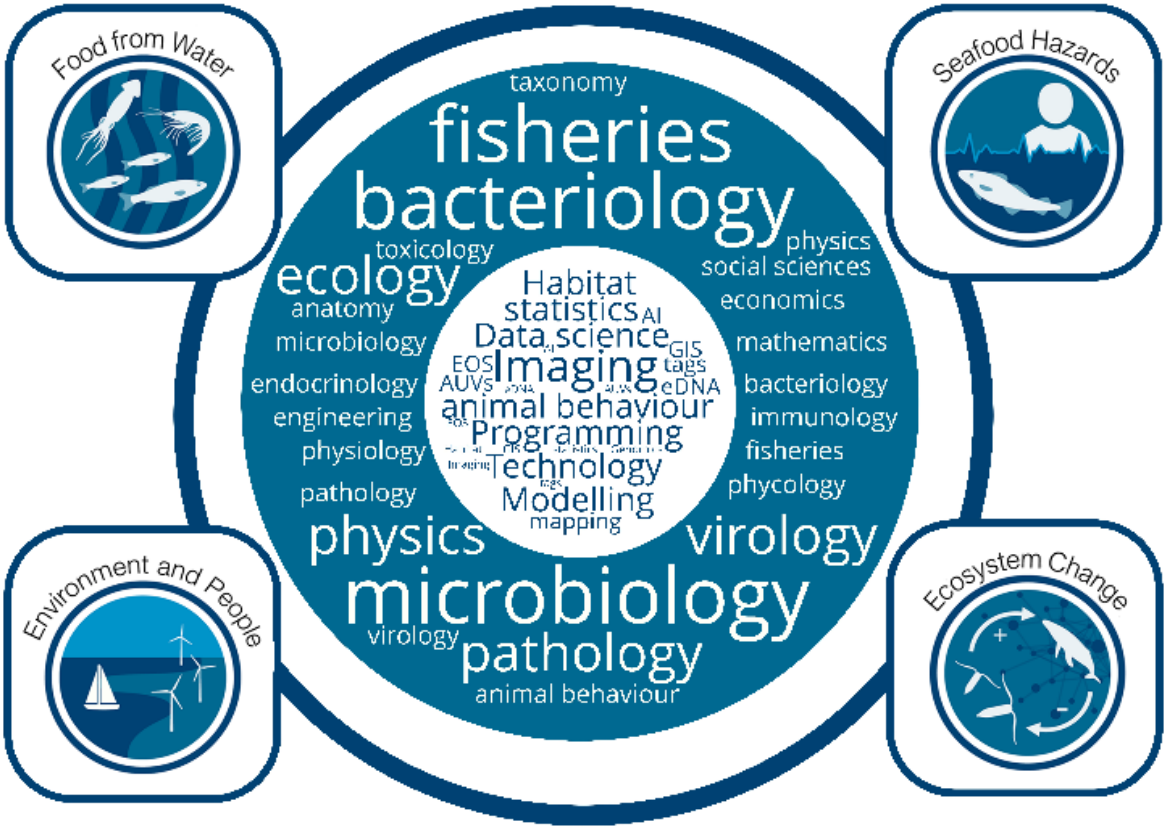
**Showcasing capability.** Investment in our newly launched International Centres of Excellence (iCoEs) will provide independent external validation of our capabilities. Agreements with the Food and Agriculture Organization of the United Nations (FAO) and the World Organisation for Animal Health (OIE) for international collaborations covering Anti-Microbial Resistance (AMR), aquatic animal disease and bivalve mollusc sanitation, will build new capability and cement our international profile in these areas. Our International Marine Climate Change Centre (iMC3) will bring together expertise from across Cefas and through collaboration with external partners to provide scientific evidence and applied advice on marine climate change. Within the next two years, we will expand our iCoEs to include Sustainable Fisheries.

**Strategic self-investment.** Self-investment up to a level of 8% will ensure that the direction of travel as described here is attainable, that staff are able and equipped to follow strategic priorities, and that we have a portfolio of leading R&D projects to deliver world-class science.

## 4. Our science themes and investment priorities

Our science and technology centres around holistic approaches that reveal how interrelated parts of ecosystems work across space and over time. We will apply this systems thinking to develop and deliver our science and evidence through **four interlinked science themes**, supported by a cross-theme "**skills toolbox**". Across themes, our work will focus on better understanding and predicting how ecosystems work, how we impact on them and how they impact on us.

**Skills Toolbox**




**Ecosystem change: Understanding ecosystem change and variability.**
We will improve our understanding of the structure, function, ecology and food web dynamics of aquatic environments. Our multidisciplinary surveys, experiments and analyses of existing data and modelling studies will offer new insights into the status of natural assets and inform projections of likely future changes. The knowledge generated will underpin strategies for conservation and management to achieve national and global environmental commitments to inform and advise governments and stakeholders on nature-based solutions.

We will:

- identify and quantify the causes and consequences of biodiversity change on aquatic ecosystems at various scales,
- better understand how interactions between natural ocean cycles and human activities drive changes in the global climate on timescales of several decades,

- quantify and predict short and long-term trends and natural variations in the distribution and condition of natural assets in coastal waters, and how these vary at local, national and global scales,
- establish the role of aquatic ecosystems in storing and sequestering carbon for climate regulation (blue carbon),
- develop innovative integrated assessment tools to forecast and value changes in biodiversity, food webs and ecosystem function in response to environmental change,
- advise on marine protected areas and other management measures in the UK and overseas territories to help restore and maintain biodiverse aquatic ecosystems and the services they provide,
- develop new skills in cost and benefit analysis of management and conservation measures, including the value of natural assets lost or preserved,
- lead metric development of marine and fisheries indicators in the Defra 25 YEP and internationally in the United Nations Decade of Ocean Science (UNDOS),
- establish the operational use of earth observation imagery as a method in our shallow coastal water habitat mapping programmes.

**Environment and people**: **Understanding interactions between the environment and people.**

We will better understand and predict the impact of interactions between the aquatic environment and people and consequences of such interactions under conditions of global change. Combining our wide-ranging expertise in natural sciences and socio-economics, we will develop innovative approaches to understand the responses of aquatic ecosystems to multiple and cumulative anthropogenic drivers and interventions. We will work with governments and stakeholders to identify sustainable regimes of access and use.

We will:

- analyse and use both socio-economic and biophysical information to achieve a truly interdisciplinary understanding of the theory and practice of conservation,
- innovate the approaches we apply to the economics of coastal and marine natural capital and influence international ocean accounting guidelines,
- improve understanding and predictions of integrated impacts of contrasting human and climate pressures,
- assess human impacts on the status (including biodiversity) of estuaries, coastal and shelf waters across the freshwater to marine continuum,
- apply our truly integrated ecosystem monitoring programmes that use Research Vessels, autonomous systems, satellite imagery, sensors and high-resolution modelling to monitor the aquatic environment,
- inform prioritisation of management measures by generating engaging communications on measures that mitigate the effects of climate change and pollution e.g. report cards,
- maximise transferability of ‘fit-for-purpose’ scientific methodologies and techniques e.g. ecosystem assessment criteria, across disciplines, geographies and communities,

**Food from water: Predicting the future of fisheries and aquaculture.**
We will consolidate our reputation in international fora (e.g. International Council for Exploration of the Seas), to better understand ecological compatibility, economic dimensions, and social aspects of fisheries and aquaculture. Realising opportunities for enhancing the role of food from water in global food security, we will identify and predict the trade-offs and synergies between different strategies of aquatic food production and wild harvesting.

We will:

- bring together fisheries and aquaculture scientists to consider the cultural, economic and ecological benefits of integrating fisheries and aquaculture science to better serve global food security,
- embed the ecosystem approach in our science defining environmentally sustainable levels of utilisation for aquatic resources,
- lead method development and application for international fisheries stock assessment through risk-based approaches for data-limited, sensitive and protected species,
- lead the innovative development and application of ensemble modelling to support multispecies stock assessments,
- enable data collection and analysis from recreational fisheries to measure impacts and evaluate sustainability,
- build new partnerships to contribute to the sustainable development of the emerging seaweed aquaculture industry in the UK and abroad,
- apply cutting edge tracking and tracing technologies to foster sustainability in the international trade in aquatic wildlife,
- evaluate the benefits of recirculating, land-based aquaculture systems for improved biosecurity and production,
- enable stakeholder engagement to define governance in food production areas.

**Seafood Hazards: Protecting animal and human health.**
We will support the protection of humans and animals from biological and chemical hazards in water and seafood. Considering the health of our planet and all life as a continuum (One Health), our science will focus on cutting-edge methodological development and application for characterisation of aquatic animal and human pathogen and chemical hazards, in support of safe and sustainable seafood production and consumption at home and overseas.

We will:

- expand our world class capability to detect, quantify and characterise aquatic pathogens of concern to animal and human health,
- develop a health concept beyond single pathogen causality to consider the ‘pathobiome’, whilst maintaining world-class expertise for key aquatic pathogens,
- develop science which investigates the ‘susceptibility window’ (i.e. beyond simple presence of the hazard) that permits aquatic animals to succumb to disease in farmed and wild settings,
- widen our thinking to include natural and synthetic chemical hazards alongside pathogens which impact animal health and the safe consumption of seafood,

- investigate the threat of zoonotic, environmental and food-borne pathogens as well as the AMR risk in the context of seafood production and consumption, and their effects on human health,
- use meta-analysis to define the basis for disease emergence, spread and epidemiology by incorporating citizen, farmer, climate, public and specialist data,
- develop our capacity for the analysis, validation and monitoring of natural and anthropogenic toxins present in water, shellfish and finfish.

# 5. Impact and outreach of Cefas science and evidence

Achieving the goals set out in this strategy between 2019 – 2025 will require a commitment to continuous improvement. We will measure the impact of our evidence and advice on the management of aquatic ecosystems nationally and internationally, and we will benchmark our scientific performance and reputation against the wider scientific community.

**Continuous improvement.** Independent and regular review of the quality and sustainability of Cefas science will continue to play a key role in benchmarking our science, and successful implementation of the recommendations made by our review panels will ensure continuous improvement in how we are meeting society's need for excellent science and impartial evidence.

**Meeting our science excellence targets.** Working with Universities, Research Institutes and experts from around the world, we already have significant impact on the science community through our published work. We aim to publish over 200 peer-reviewed articles in the scientific literature annually. Based on citations in science journals, we currently rank in the top 5% of over 2,500 international institutes publishing in the same fields. Our focus on high quality and highly cited outputs will ensure that our marine and freshwater and fisheries science will be recognised as world-leading.

**Benchmarking our scientific performance.** We will better reflect the full extent and quality of all our science activities (e.g. policy and briefing documents, technical reports and report cards, delivered to our customers) and develop and report on new metrics that describe progress in these areas.

We will:

- record and grow our positions of influence (i.e. chairs / nominated positions / editorial roles / honorary positions)
- extend our engagement with international organisations such as ICES, OSPAR, and the Regional Fisheries Management Organisations
- maintain our existing iCOEs through increased investment by external partners create a new iCOE in Sustainable Fisheries
- record and grow the extent of uptake of our advice in policy.

**Telling a better story.** Being able to tell a better story through our science and evidence is critical to our future. Engaging with a wider range of audiences and describing our science in different ways that excites them, impresses them with our technical skills or makes them come and work with us takes time and practice. Bringing our strategy to life depends on these skills, and appropriate training will be provided.