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Scientific diving in France: an overview of the current practices in science

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The FRENCH NATIONAL COMMITTEE for SD

The French National Committee for Scientific Diving (CNPS) is a key actor for developing occupational scientific diving in France (Thouzeau et al., 2019). This inter-agency committee on occupational scientific diving created in 1999 involves:

- 16 French marine universities : Aix-Marseille, Bordeaux, Brest, Marseille, Lorient, Caen, La Rochelle, Lille 1, Dunkerque (ULCO), Montpellier, Nantes, Nice Sofia-Antipolis, Perpignan via Domitia, Sorbonne Université (Paris), Toulon, Toulouse III, Le Havre
- 11 research institutes: CNRS-INEE/INSU/INSHS, DRASSM, EPHE, IFREMER, INRAE since 2020 (former INRA + IRSTEA that decided to join), INSERM, IPEV, IRD, MNHN
- 1 medical research Centre specialised in hyperbaric medicine
- Personalities chosen for their expertise in the field of professional scientific diving.

The CNPS takes on different tasks including acting as an observatory of occupational scientific diving practices and innovations. The aims are to:

- ensure a scientific watch on the evolution of the professional scientific diving practices worldwide
- monitor/follow the innovations in scientific diving, technology, field practices and hyperbaric medicine
- define common frameworks and promote the best practices
- share information and feedback with the French scientific diver community
- participate in the training of vocational scientific divers
- represent France at the European Scientific Diving Panel (ESDP)
- provide high-level expertise and advices to the Ministries of Labour and Higher Education and Research

FRENCH OVERSEAS TERRITORIES & ABROAD

The French occupational scientific diving community, a very diversified population due to:

1. France's 18,000 -km -long coastlines and a strong presence overseas
2. The involvement of researchers in global science topics/fields from the poles to tropics.

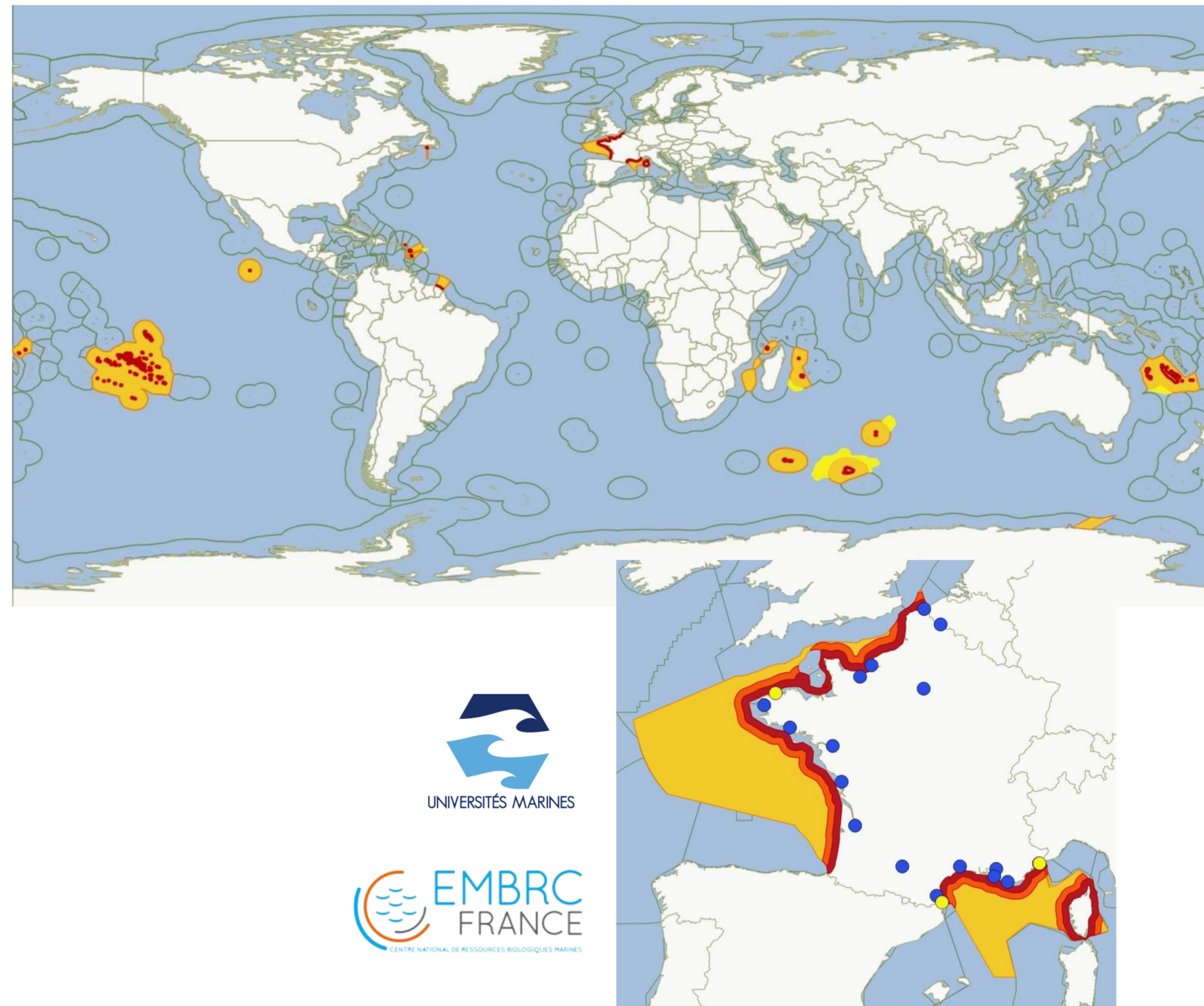


Fig 1.a: The French overseas departments and regions with the maritime zones ; 1.b The French network of 16 universities in marine sciences (representing France at the European Marine Board) (blue dot) and the 3 marine stations of EMBRC France (yellow dot).

PROFESSIONAL CERTIFICATIONS

Since 1991 in France, scientific diving has been recognized by law as an occupational sector and is therefore regulated with the aim to reduce the hyperbaric risk and facilitate mobility of scientist thanks to standards.

Professional diving certifications are required to practice in France (to be recycled every 5 years):

- around 10,000 certified divers CAH mention B (scientific and archaeological diving) issued since 1991 (source: DGT/Ministry of Labour)
- with depth classes (CAH 0: < 12m, CAH 1: < 30m, CAH 2: < 50m, CAH 3: up to 100 m depth)
- Note: Professional divers from industry have CAH mention A

ACADEMIC TRAINING

University courses and summer schools train scientists and prepare for professional diving qualifications (on top of CAH).



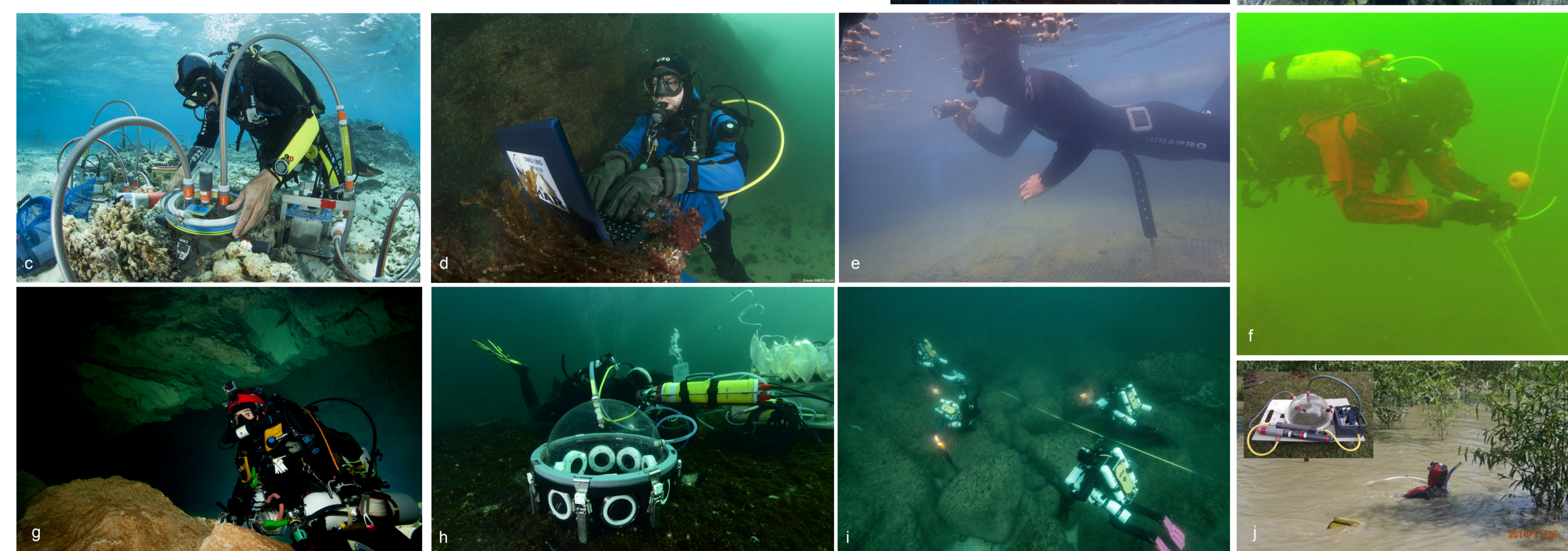
Several SD training modules offered by CEFREM in three Master's Degrees © G. Saragoni CEFREM

ALL DISCIPLINARY FIELDS...

Currently, French scientific diving encompasses many fields such as life sciences and ecology, geosciences, social & cultural sciences including archeology, health & food, engineering sciences, energy...

... AND VARIOUS ECOSYSTEMS

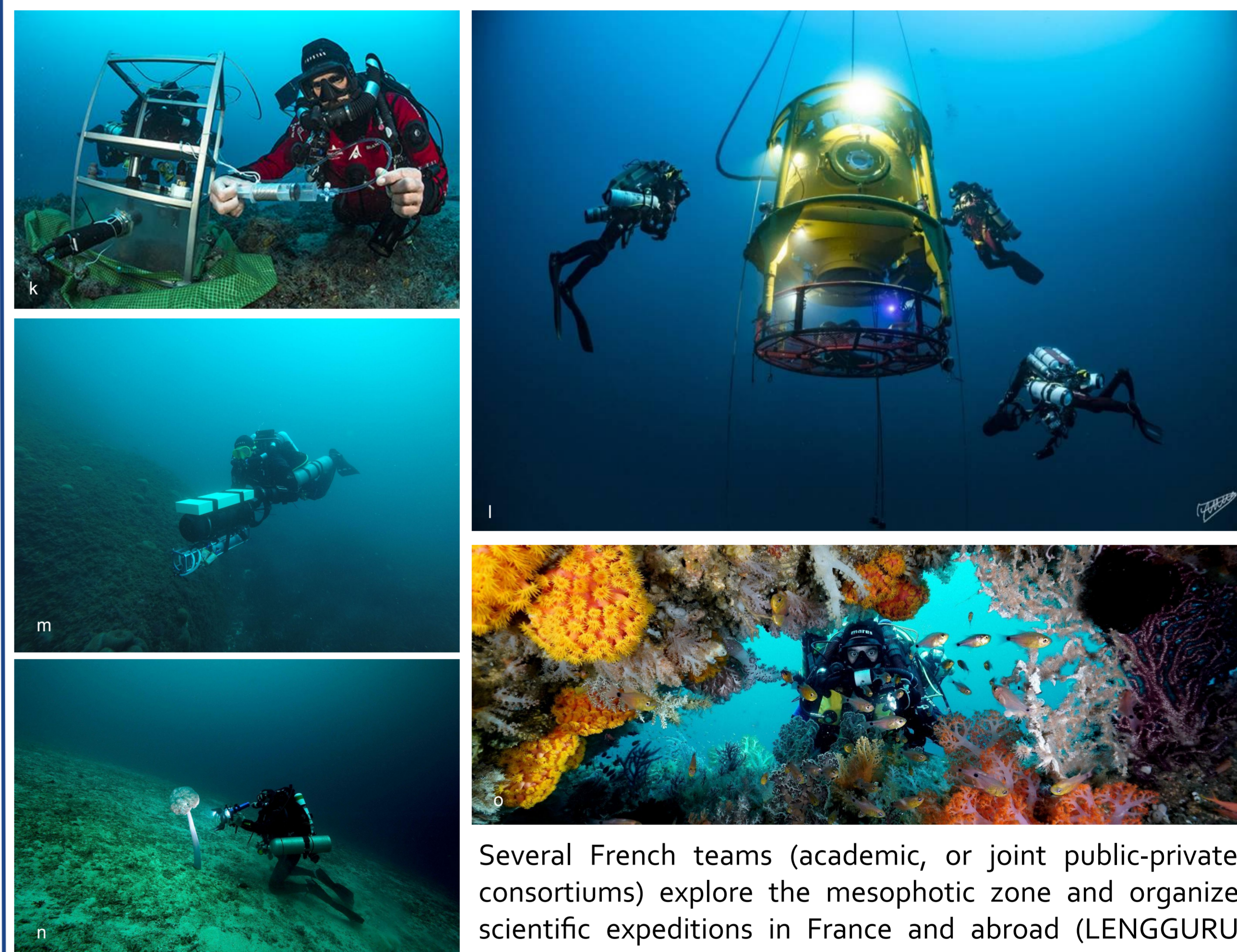
Due to the existence of overseas territories - with France's maritime spaces representing the world's second largest exclusive economic zone - French territories display an extensive variety of submarine habitats. Furthermore, the historical richness of scientific diving in France has led the French scientific diving community to be involved in all oceans worldwide. All subaquatic ecosystems, from the polar regions to the tropical belt, from drowned karsts to freshwater and high altitude lakes, including mesocosms and artificial structures are studied by diving scientists.



a) Inventory of cryptic benthic species - La Planète Revisitée expedition in Corsica (2019-2021) © MNHN, b) Underwater archaeological operation of Olbia de Provence. Operation leader L. Borel © L. Roux (CNRS, CCI), c, d) SD activities of LEMAR © E. Amice CNRS, e) Freediving verification of the UROS project structure (RECOBER) © INRAE, f) Maintenance of optodes in the ponds of the Aquitaine coast (EABX, INRAE Cestas) © INRAE, g) Exploration of Papuan karsts, Indonesia - LENGURU © G. Dimaimondo IRD, h) Projet CHAMAUT, Mediterranean coastal lagoons © R. Hocdé IRD, i) Photogrammetry, and ecology of submarine landscapes. Plateau des Roches Douvres © V. Danet MNHN Dinard, j) Study of the Guyanese mangroves, ANR BIOMANGO © G. Thouzeau LEMAR

MESOPHOTIC STUDIES

On top of the traditional diving methods (open circuit, hookah and apnea) scientific diving benefits in recent years from the use of closed-circuit rebreathers but also from combining CCR and saturation methods, which greatly enhanced the study of the mesophotic zones.



k) Sampling of water from the benthic chamber to analyze its acidity (Ph) © Laurent Ballesta / Expéditions Gombessa / Andromède Océanologie, l) Bathyal Station © Laurent Ballesta / Expéditions Gombessa / Andromède Océanologie, m) Long-term observatory of the mesophotic zone by environmental DNA, Calanques, France, Labcom DIAGeDNA/DeepHeart Project © R. Hocdé IRD, n, o) Mesophotic Coral Ecosystems study in Indonesia - LENGURU © E. Bahuët, G. Dimaimondo IRD

HIGH SCIENTIFIC PRODUCTION

In light of the diversity of environments, disciplines and scientific topics/fields, scientific divers are continuously innovating to perform outstanding research.



France participates significantly in this demonstration of the essential usefulness of occupational scientific diving to the realization of works published in scientific journals with high impact factor (>5) (source: [SD supported articles in IF>5 journals \(sorted by date\) - esdpanel.eu](https://sd.supported-articles.inlf>5-journals)).

References: Thouzeau G., Hocdé R., Beurrier J.-P., Coulange M. et al. (2019). The French National Committee on Scientific Diving (CNPS): a key actor for developing scientific diving in France. 5th European Conference on Scientific Diving (ECSD), Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland, Apr 2019, Sopot, Poland. pp.61-62, doi:10.23708/101.01007626

HYPERBARIC MEDICAL EXPERTISE

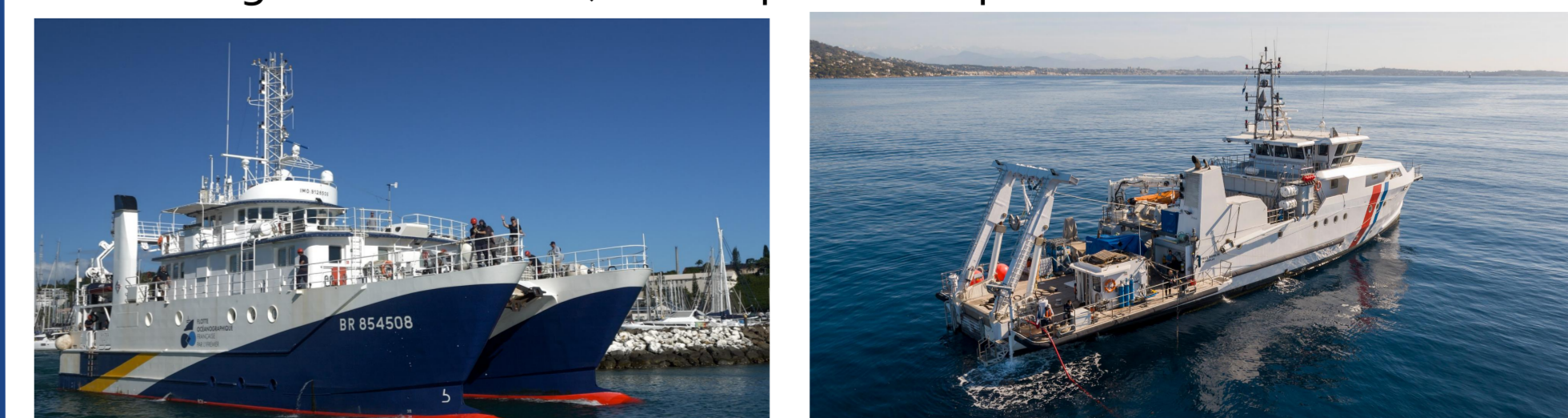


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Phymarex is a non-profit association with the aims to preserve health and optimize safety in maritime and extreme environments. It gathers doctors, medics, paramedical staff, researchers and people with an active contribution or a particular interest in the field of medicine and physiology in maritime environments, in isolated environments and in unusual physiological conditions.

OCEANOGRAPHIC SUPPORT VESSELS

The oceanographic vessels of the French Oceanographic Fleet research infrastructure (FOF RI) can be used to support scientific divers, as well as the scientific vessels of DRASSM (the French Department of Underwater Archeological Researches). Some private ships are also chartered.



ANTEA oceanographic vessel © IRD - JM Boré Alfred Merlin scientific vessel © P. Soubias DRASSM

- 1 MARBEC, Univ Montpellier, CNRS, Ifremer, IRD, Montpellier, France
- 2 LEMAR - UMR 6539, Univ. Bretagne Occidentale/CNRS/Ifremer/IRD, Plouzané, France
- 3 CNRS, Aix Marseille Université, CCI, Aix-en-Provence, France
- 4 C2VN, INSERM, INRA, Aix Marseille Université (AMU), Marseille France
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