

The scientific diving network at INRAE

JACQUET Stéphan*

BERTRIN Vincent, DUBLON Julien, JAMONEAU Aurelien, LE COZ Jérôme, LEPAGE Mario, QUEMERE Erwan, SALMON Quentin, WESTRELIN Samuel

I. SUMMARY

Scientific diving is now recognized as an essential tool within research institutes and INRAE** (created in 2020, by the fusion between INRA and Irstea) has seized it through the establishment of a dedicated network, supported in particular by the AQUA department. With a little bit more than twenty divers with specialties ranging from hydrodynamics to sedimentary transport, the study of biodiversity (microorganisms, invertebrates, fish) or ecological monitoring, the scientific diving network of INRAE (SDNI) is gradually being set up. INRAE divers mainly operate in freshwater environments (lakes, rivers, estuaries...) in scuba (air, nitrox or trimix) or apnea (free diving). The underwater activities include measurements, observations, fish counts, research of alien species, photography, instrumentation (acoustic monitoring of animals such as fish, water/sediment samplers, etc.), or maintenance. The SDNI aims to promote the integration of diving as a tool among the scientific methods used within the institute. It aims at exchanging information on the different uses of diving and informs about ongoing projects involving certified divers. The SDNI is also useful for the sharing of feedbacks on methods, best practices and equipment. It helps to keep knowledge of current regulations up to date and to identify the types of intervention possible according to the regulations. Finally, the SDNI also helps to identify certified scientific divers in order to create synergies between the teams. The SDNI website also provides the right addresses for training and retraining the professional certificate of competence, as well as for following the activities of the National Scientific Diving Committee (CNPS), etc... The presentation of the SDNI and the communication around its existence can be a source of ideas for the emergence of broader collaborative work on aquatic ecosystems.

II. A WEB SITE AND A LOGO

The network was launched at the same time as the website dedicated to it (see the Flash Code). The latter presents scientific diving at INRAE, the members of the network and their specificity. In addition to providing "news", the site also relays the regulations in force, possible interventions, places to train and retrain, etc... Finally, it explains what the National Committee for Scientific Diving (CNPS) is.

Website of the network (in French)

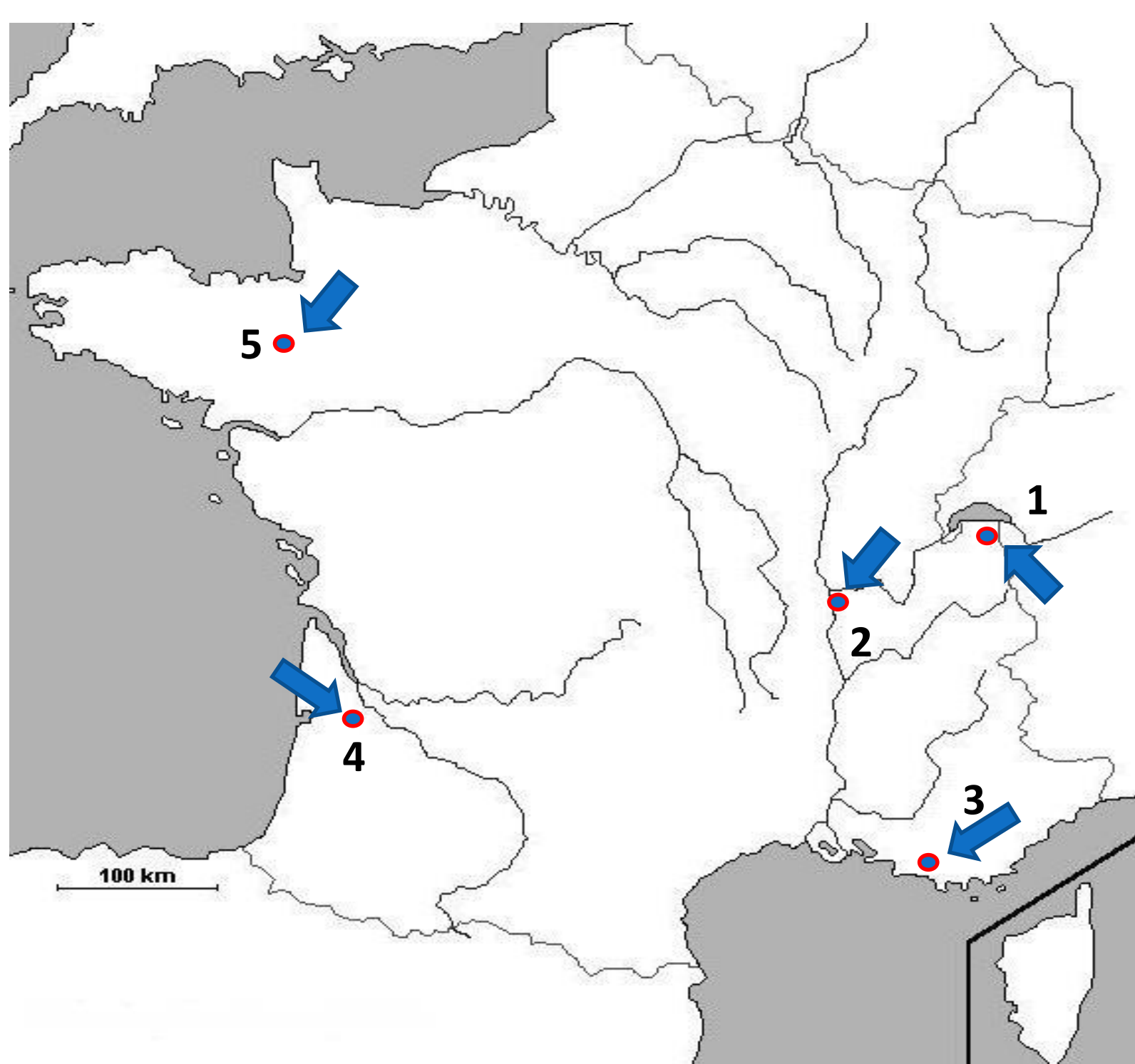


The logo designed for the diving network at INRAE ensures a strong identity and is reminiscent of the logo of the institute. It was imagined and created for this purpose. It is intuitively understood that the outline refers to a mask, the "L" to a snorkel and that the final "e" as well as the color code refer to the standard signature of the Institute.



"This logo lives alone, without associated signs; It is simple, timeless, international. Its emerald green color evokes water, sky, vegetation. A soft and luminous color, a symbol of hope that resonates with the great challenges of life, humanity and the earth that INRAE is confronted with"

III. WHO? WHAT? WHERE?



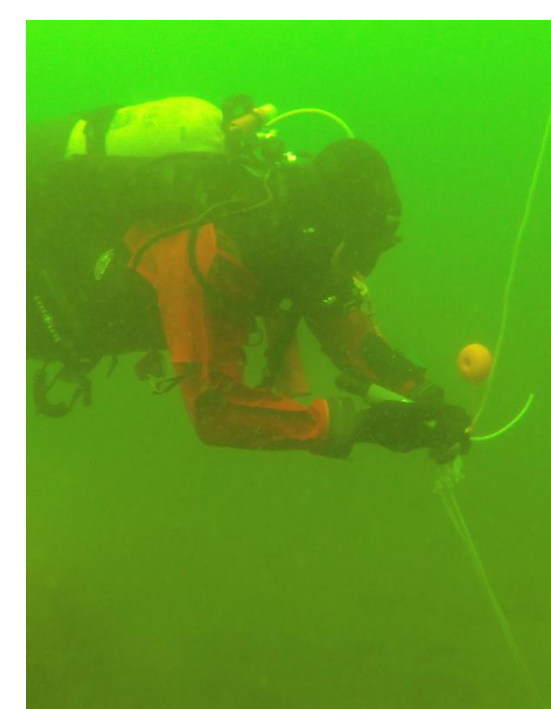
The main laboratories concerned are located as shown on the map.

1 CARTEL Thonon-les-Bains

Ecosystems investigated:
Large and deep peri-alpine lakes (Aiguebelette, Annecy, Bourget, Geneva), mountain lakes

Work regularly or currently done:
Site instrumentation, monitoring of biodiversity, survey of invasive alien species, sampling of water or animals, photo/video

Project(s) in progress:
Survey of *Hemimysis anomala* (MYSILAC)
Sampling of biofilms (Bio-DIV-E)
Sampling and analysis of quagga mussels (QUALAC)



2 RIVERLY Lyon-Villeurbanne

Ecosystems investigated:
The Rhône river (Bugey, Caderousse, Arles) et other rivers (Hérault, Saône, Isère, Ain, Allier)

Work regularly or currently done:
Site instrumentation and maintenance, search for lost instruments, photo/video

Project(s) in progress:
Rhône Sediment Observatory (OSR)
Acoustic fish monitoring



3 RECOVER Aix-en-Provence

Ecosystems investigated:
The hydropower reservoir of Serre-Ponçon, the small lake petit-Saut, other water places

Work regularly or currently done:
Fish counting, artificial substrates collecting, site/floating structure instrumentation and maintenance, photo-video

Project(s) in progress:
Artificial floating islands for hydropower reservoir mitigation (UROS)

RECOVER

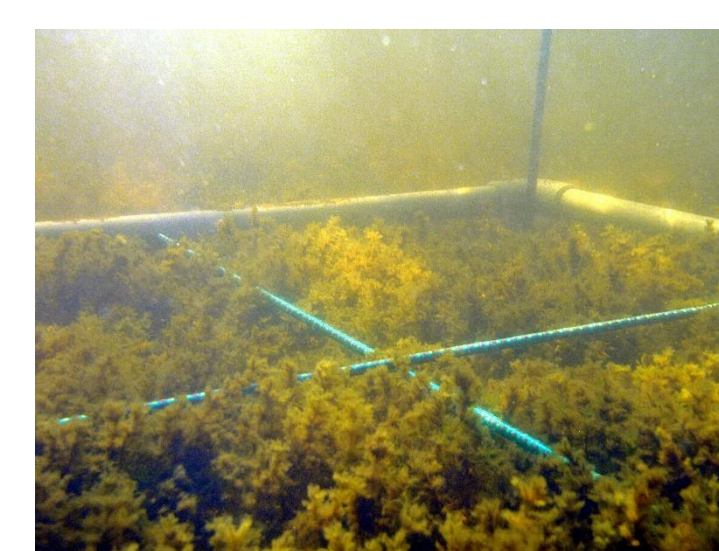


4 EABX Cestas

Ecosystems investigated:
Rivers Garonne and Dordogne, lakes of Bariousse, Carcans-Hourtin, Lacanau, Cazaux-Sanguin Parentis-Biscarrosse, Lake Leon

Work regularly or currently done:
Long-term monitoring of aquatic vegetation, artificialization of aquatic biotopes, survey of invasive alien species, experiments and sampling to assess the role of sediment in the release of nutrients

Project(s) in progress:
Vigie-lacs (macrophytes), Leon-Bloom (cyanobacterial blooms)



5 DECOD Rennes ?

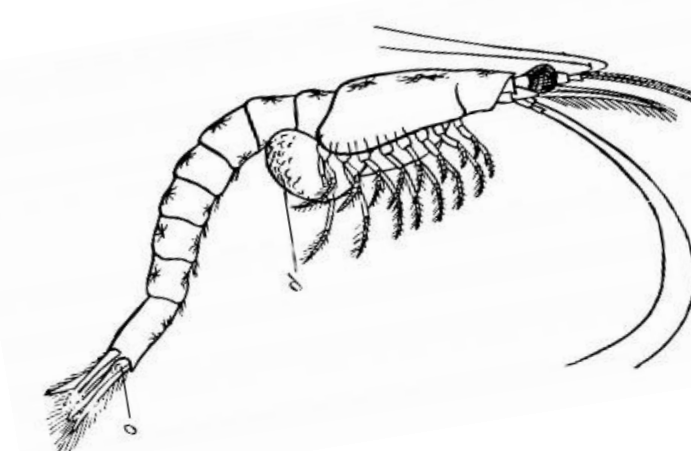
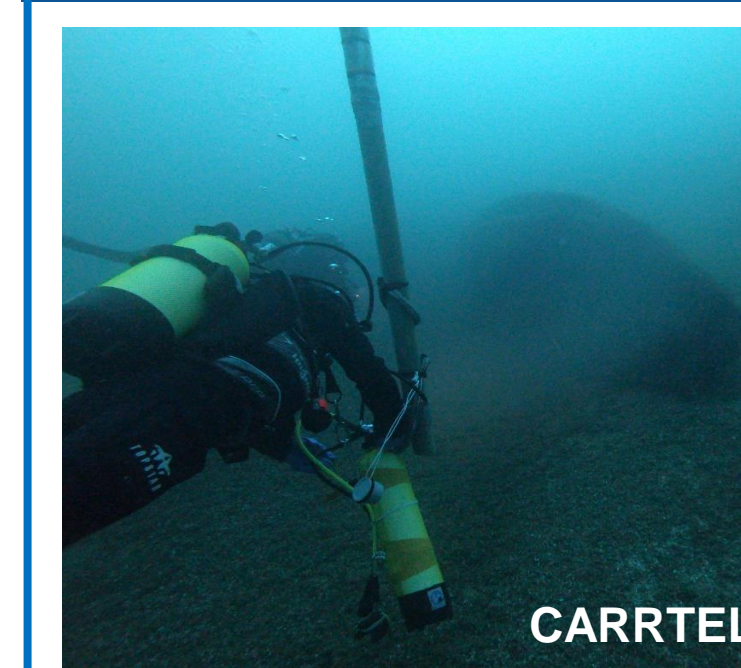
Ecosystems investigated:
Kelp forests along Brittany's coast

Work regularly or currently done:
Monitoring of biodiversity, sampling of fish, macroinvertebrates, micro-invertebrate in kelp blades

Project(s) in progress:
Using dietary eDNA to investigate variations in food webs in Breton kelp forests (LAMINET)

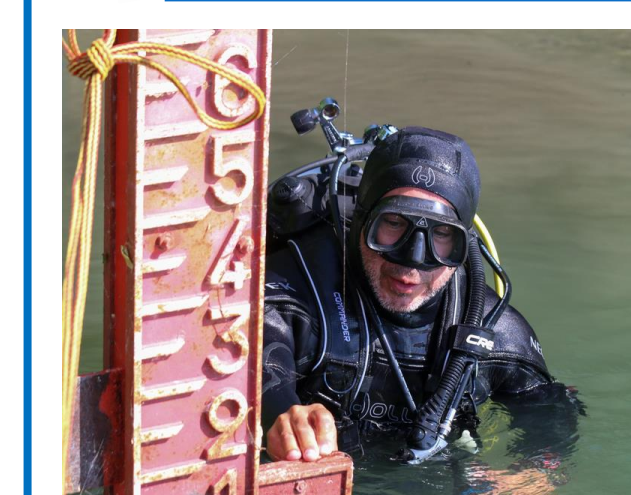


IV. SOME EXAMPLES OF RESULTS

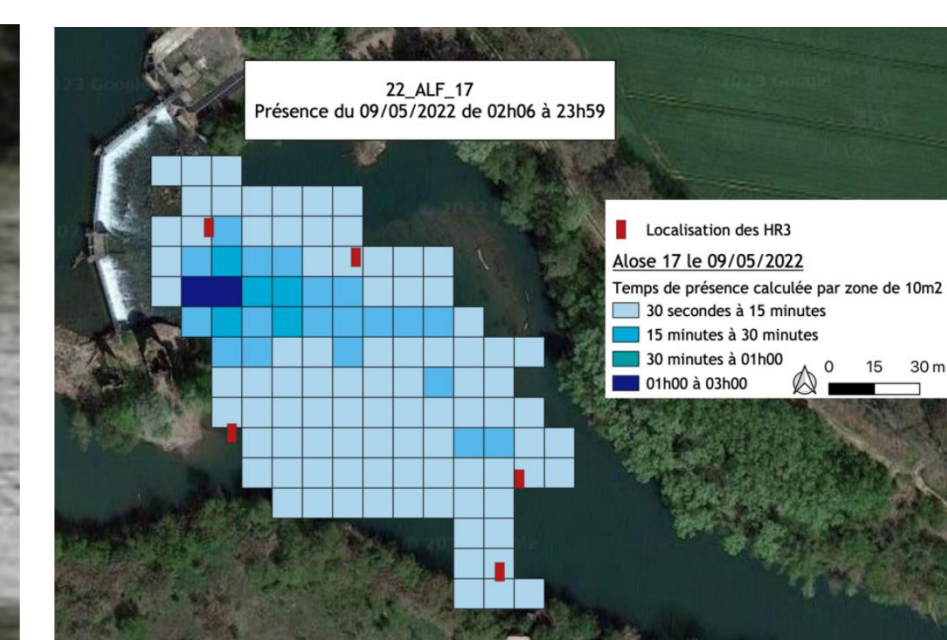


In the context of the Mysilac projects, diving and site instrumentation allowed us to study the presence, quantitative importance and phenology of winter swarms of the bloody-red mysid *Hemimysis anomala*, which is an invasive alien species recently settled in some large and deep alpine lakes. Among key and recent results, we tracked the behavior of a typical swarm using a real-time automated recorder, an acoustic camera, who allowed us to capture with an unprecedented resolution the exit (emergence) and entry (homing) inside an artificial shelter during a diurnal cycle, for several weeks. **Some results will be detailed in a talk programmed on Wednesday 17th 9:45 AM !**

Video of the swarm captured by the camera



Several projects involving the RIVERLY group have required underwater interventions (either scuba or free-diving) to install, maintain and uninstall hydrophones and associated cables for the monitoring of migratory fish previously equipped with transmitters (acoustic telemetry). Recently, diving interventions have focused on hydro-acoustic stations for monitoring the migration of silver eels in the Rhône between Arles and Caderousse (a project funded by the Compagnie Nationale du Rhône) and for monitoring and locating shads when approaching a fish pass in the Hérault River at Bessan, in collaboration with the Association Migrateurs Rhône Méditerranée.



Presence time of shad n°17 on 9 May 2022 in a 10 m by 10 m zoning, downstream of the Bladier Ricard fish pass on the Hérault River. The hydrophones (HR3) were installed by scuba diving and maintenance was carried out by free diving.



Test of artificial floating littoral zones as an innovative solution to mitigate the deleterious effects of the water level fluctuations in reservoirs on biodiversity (Serre-Ponçon) by the RECOVER group.

Video of the UROS project (in French)



The efficiency of these structures was assessed by monitoring their use by aquatic macrofauna (macro-invertebrates, fish) and by comparing it to the communities found in the "natural" littoral zones of the reservoir. The census of fish communities was made by scuba diving. Artificial structures were used by several species of fish, both at juvenile and adult stages. In particular, the aquatic vegetation of the floating structures sheltered pike larvae. However, the specific and functional compositions of fish communities in the floating structures showed slight differences from the communities in the littoral zone. The results of this study are being further validated over longer monitoring periods.

Vigie-Lacs (financed by Agence de l'Eau Adour-Garonne, DREAL Nouvelle-Aquitaine and Région N-A) aims to continue the long-term monitoring of aquatic vegetation initiated in Aquitaine's lakes in the 1980s, and to develop research focused on current issues supporting lake management in the context of global change, notably climate change, the artificialization of aquatic biotopes and invasive alien species. The objectives of Vigie-Lacs are to 1/ monitor the dynamics of relevant environmental variables and aquatic plant communities over the long term; 2/ conserve heritage species and aquatic biotopes, and evaluate the effectiveness of restoration operations and 3/ anticipate the effects of global changes on plant biodiversity, aquatic biotopes, and the biogeochemical functioning of lakes.



* Stéphan Jacquet is the creator and facilitator of this network - Contact: stephan.jacquet@inrae.fr

**INRAE is France's National Research Institute for Agriculture, Food and Environment, created on January 1, 2020. It was formed by the merger of INRA, the National Institute for Agricultural Research, and IRSTEA, the National Research Institute of Science and Technology for the Environment and Agriculture.



7th European Conference on Scientific Diving

Roscoff - France
14 - 18 May 2023