2020

1 Year in RESEARCH

at Université de Bretagne Occidentale
MY THESIS IN 180 SECONDS

The contest “My Thesis in 180 seconds” challenges doctoral students to give a three minute presentation on their research to a broad and diverse audience. In 2020, UBO hosted the inter-regional final for entrants from the Brittany/Loire School of Doctoral Studies and on 12 March, 16 research students from the Universities of Angers, Brest, Le Mans, Lorient, Nantes and Rennes met on stage in the petit théâtre at the Quartz Conference Centre. What an opportunity to share their passion for their subjects at an emblematic venue in Brest.

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2020 will most likely be remembered for the appearance of COVID-19 and the subsequent pandemic which led to two lockdowns that lasted several months, putting a brake on our research activities at UBO. One unforeseen but fortuitous consequence of COVID-19 is that we saw the government refer to scientific knowledge, or rather a lack of scientific knowledge about the virus, when making many decisions. Moving forward, dialogue between the scientific community and the authorities is going to be even more important given the major challenges the world faces as we prepare for the ecological, digital and energy transition. This should see science and innovation returning to the forefront of government action. Not as if it were the only source of knowledge, but by being the source of support that public authorities can and should rely on in both the short term (such as in a health crisis) and the long term (addressing climate change and the destruction of biodiversity). Short term economic demands should no longer be the deciding factor.

The questions the scientific community has been asked chime with a broader debate on the place given to science and innovation in policy-making, and on access to high quality knowledge generated through science in an ethical and sustainable way that will benefit future generations. However, it is still vital to keep the decision-making powers granted to democratically elected governments separate from scientific recommendations that set out options and anticipate multiple consequences to help these governments make informed decisions.

In these challenging circumstances, our research units have remained very active by adapting to new ways of working and an accelerating pace. Unfortunately, restrictions on international travel and access to our technical resources have had a heavy impact on our doctoral students due to the time-limited nature of their contracts. As a consequence this has disrupted the timescale for their visas by several months.

As you read this review, you will see that a number of our lecturer-researchers have received recognition this year, once again highlighting the resilience and daring our ecosystem has demonstrated in the face of the COVID-19 epidemic. 2020 may have reminded us that we tend to underestimate the role chance plays in our trajectories. But it has also been the year in which our research units have set out their ambitions for the next five years.

Additionally, 2020 has seen the launch of ReSEArch-EU (Reinforce Sustainable Actions, resilience, cooperation and harmonisation across and by the SEAda-EU Alliance) which will establish a network of research units within this European University’s consortium.

Let’s also remember the incredible fortune we had to be able to hold a week of research for the UBO community at the beginning of the year, just weeks before all the travel restrictions were introduced during the first lockdown. To finish, I would like to say a big “thank you” to UBO’s administrative services for helping to create our Research Review for 2020.

Christian Brosseau, Vice President Research and Innovation

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**Research at UBO in Ten Figures**

- **32** Research units
- **70** Million Euros: research budget
- **744** Lecturer-researchers
- **320** Accredited research supervisors
- **314** Research contracts
- **23** CIFRE* doctoral students
- **33%** International doctoral students
- **11** Doctoral schools
- **94** Doctoral graduates
- **505** Doctoral students across all disciplines

*CIFRE: Industrial research and training agreement*
32 research units and 4 institutes supporting innovation and knowledge

### Health

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**Health Agri-Environment-Materials**

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**Marine Sciences**

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**Humanities and Social Sciences**

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TWO NEW AGREEMENTS

In 2020, UBO increased its agreements with national research bodies by signing new contracts with the CNRS* and INRAP*. These special partnerships will enhance the university’s influence and also strengthen cooperation, fostering a shared scientific approach and nurturing multidisciplinary research.

UBO and the CNRS work together on many projects via around ten research facilities or through shared services. A five-year agreement, which was signed on 2 July, has formalised this partnership and will cement operations between the two institutions. Through this agreement, UBO and the CNRS will support joint research projects by contributing human and financial resources, facilitating staff mobility and hosting doctoral students. They have also introduced joint policies to support international projects and boost the development of Open Science.

In November 2020, UBO signed a cooperative framework for a scientific, cultural and training partnership with INRAP which will consolidate cooperation between the two institutions. UBO and INRAP have worked together for almost 20 years through research projects, joint publications and more recently, the ArMeRIE Chair which was established in 2019. In signing this framework, they are demonstrating their desire for regular cooperation and to extend the scope of their activities, particularly in terms of training staff and students from both establishments.

UBO and INRAP have also set objectives to facilitate joint research projects, implement shared research tools and foster the exchange of scientific and technical information.

Despite the unusual circumstances, 2020 has been a productive year for research and innovation. UBO has stood out in all subjects and increased its partnerships, demonstrating its resilience, cross-disciplinary ethos and international outlook.

HIGHLIGHTS

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ÉLYNE DUGÉNY APPOINTED OCEAN ATLANTIQUE AMBASSADOR

On 4 December, Élyne Dugény a doctoral student at LEMAR* (UMR 6539), was appointed as an Ocean Atlantique Ambassador. As one of 25 All-Atlantic Ocean Youth Ambassadors from countries bordering the Atlantic coast, she will represent France. Her task is to promote ocean conservation to diverse audiences. For a term of one year, Élyne will therefore represent the voice of the ocean at events primarily targeting decision-makers and members of government, to encourage them to prioritise conservation for future generations. Throughout the academic year, Élyne will also visit classrooms from nursery level up to secondary as an ocean eco-consultant - a scheme run by the ocean discovery park Océanopolis. She will share her experience with pupils and encourage them to think of solutions and action they can take to protect the ocean.

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Published in January 2020 in the European Journal of Human Genetics, the Genetic History of France, analysed by researchers from GGB* (UMR 1078) and the Institut du Thorax in Nantes, is the first exhaustive study of the genetic structure of the French population. The study is based on analysis of genetic data from more than 2100 French people. Although continuity in the population was observed across the country, the results identified distinct genetic groups that correspond to geographic, historic and linguistic barriers. These borders have provided a model for the genetic history of France. Rivers and mountain ranges form natural barriers which make a significant contribution to genetic differences between populations. The River Loire for example is an extensive watercourse that limited trading between its two banks for a long period. But it also formed a cultural and political border between the north and south of France creating a significant division between populations from the two areas.

Regions with strong and distinctive cultural features also tend to display differences, particularly in Brittany. This differentiation can be explained both by its geographic position, at the furthermost edge of the continent, and its history, with Brittany being an independent region with a stable border for many decades. In addition to differences in the genetic structure of different populations, the study also uncovered major events in the genetic history of France. As has been observed in the rest of Europe, the effective population size increased considerably over the last 4500 years, or 150 generations. However, between 1300 and 1700, there was a significant drop in the population which seems to coincide with the arrival of the Black Death in the Middle Ages.

GGB’s study of the genetic history of France fills a gap in the demographic history of the genetic landscape in Europe and will enhance understanding of phenomenon in the fields of medical genetics, history and archaeology.

FRANCE’S GENETIC HISTORY REVEALED

AWARD FOR BEST PAPER AT THE IEEE SPIES CONFERENCE 2020

The paper, A Frequency Separation Rule-based Power Management Strategy for a Hybrid Fuel Cell-Powered Drone* has received the prize for best article at IEEE* SPIES 2020. It is the culmination of a productive collaboration between Université de Bretagne Occidentale and the University of Salento in Italy and was cowritten by Mohamed Nadir Boukobrine a doctoral student at IRDL (UMR 6027), Zhibin Zhou, Teresa Donateo and Mohamed Benbouzid, Professor at the Institut de Recherche Dupuy de Lôme.

This article is based on research that focuses on a power management strategy for fuel cell powered drones to extend their endurance and hence the lifespan of the cell. The desired goal is to find an energy management technique to optimally increase flight times.

In real conditions, drones are used to inspect solar and wind farms. Very often, these facilities cover a large surface area and as the majority of drones used are only fitted with batteries they have a relatively limited endurance. The Franco-Italian team designed a prototype for a drone with a battery that uses both Lithium-ion technology and a fuel cell with a hydrogen reservoir to increase endurance. This will be tested at UBO. The article showcases hybrid technology that uses a frequency separation approach to manage two sources optimally. During take-off, which is a particularly energy consumptive stage, the drone is powered by the fuel cell but once its position has been stabilised, it is powered by the battery. Tests showed that at the same time as gaining an extra 12 minutes flight time, the lifespan of the fuel cell was also extended.

* French title - Stratégie de gestion de l'alimentation basée sur la séparation des fréquences pour un drone à pile à combustible
* Institut de Recherche Dupuy de Lôme-IRDL, UMR 6027, CNRS-UBS-ENSTA-UBO-ENIB
Institute of Electrical and Electronics Engineers
OUR RESEARCHERS
in the Spotlight

Once again, our researchers have been recognised this year for their excellence, their careers and their contribution to their fields of expertise. In their respective areas, every one of them is helping to further understanding of the challenges facing society.

Laurent Chauvaud, CNRS research director at LEMAR (UMR 6537), and head of the “Génie des Monuments Historiques” associated laboratory with the Ministry of Culture, has been appointed to the CNRS Management Board as project coordinator. He will set up and run a multidisciplinary research group for the ocean sciences.

From experts on the coastline to specialists in the deep sea, a wide range of researchers are involved in researching ocean sciences across the ten CNRS laboratories. Whether working on oceanographic campaigns, marine stations, satellite data or innovative techniques, each laboratory has an interest in this vast field of research which brings together oceanographers, ecologists, chemists, biologists, mathematicians, physicists and many more. Laurent will manage and coordinate the scientific research involving this scientific community.

He will also take on another role on the CNRS Management Board to make sure that its work continues to make a compelling contribution to ocean sciences research internationally. Last year, the United Nations launched a Decade of Ocean Science for Sustainable Development (2021-2030). The European Commission also introduced Mission Starfish as part of the Horizon Europe initiative. And at international level, the “Priority Research Programme” has adopted a strategic ocean research project. Entitled “a sea of solutions”, it was developed jointly by the CNRS and IFREMER and focuses on three thematic areas: the digital ocean, sustainable use of oceans and the exposome of the ocean.

Creation

The Centre national de la recherche scientifique, the Ministry of Culture and the CNRS formed a partnership, the CNRS-Ministry of Culture Notre-Dame Project, to bring it to fruition and provide a working structure. The organisational model chosen is the same as for the LRMH* at the Ministry of Culture, with laboratories dedicated to specific materials. Arnaud Ybert is the manager of the “stone work” group which is made up of geologists, archaeologists, civil engineering experts and art historians. The 30 or so experts in the group are conducting research on stonework which collapsed and elevations that were saved. Their task is to identify construction techniques used in the 12th and 13th centuries to improve understanding about the building, to date it, and to provide technical information to the contractors and contracting bodies who are managing the restoration.

NEW APPOINTMENT

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CONGRATULATIONS

Physicist Dimitris Visvikis is recognised by his peers as one of the greatest experts in nuclear medicine imaging. He has received the Edward J Hoffman Award in acknowledgement of the important contribution he has made to PET imaging and his leading role in training and disseminating knowledge within the scientific community.

Dimitris is research director at LATIM (UMR 1101), which specialises in the efficient integration of multimodal imaging (PET/CT/MRI) in a therapeutic context for oncology. He and his team are working on and developing several lines of research. The first of these involves improving quantitative and qualitative precision in imaging in order to be able to identify biomarkers more accurately and then select and evaluate an appropriate therapeutic regimen. The second focuses on extracting biomarkers and developing multi-parametric models to characterise tumours through a multimodal and multiscale approach. The third area is dedicated to radiotherapy, which along with surgery, is the most common therapeutic option in oncology.

* Centre National de la recherche scientifique
* Centre de Recherche Electronique et Cellulaire (CRIBIC, EA 4531, UBO)
* Centre national de la recherche scientifique
* Laboratoire des Sciences de l’Environnement Marin (LEMAR, UMR 6537, UBO-CNRS-IRD-Ifremer)
* Laboratoire international associé
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* Laboratoire international associé

* Position Emission Tomography
* Laboratoire de Traitement de l’Information Médicale (LATIM, UMR 1101, UBO-IRD-INERIM)
* Computerised Tomography
* Magnetic Resonance Imaging

Creation

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Under the name Scientists at the Service of the Restoration of Notre-Dame de Paris, the association has more than 300 expert members including historians, archaeologists, conservators, archivists, anthropologists, art historians, sociologists, theologians, physicists, chemists, paleoclimatologists and musicologists from all backgrounds and of all nationalities. They are all united by the same desire to pool their skills and expertise for the benefit of the monument and its restoration.

Arnaud Ybert chairs the association, contributes to CNRS-research programmes and works on creating scientific projects with departments within the Ministry of Culture, but his input doesn’t stop there. One of his tasks is to disseminate information accurately and in an easy to understand way. Too much incorrect information has been circulated to the general public, however, as Arnaud points out, “we can’t criticise politicians and journalists for not working with the right data if we don’t provide them with it.”

In response to this spontaneous initiative from the research community, the Ministry of Culture and the CNRS formed a partnership, the CNRS-Ministry of Culture Notre-Dame Project, to bring it to fruition and provide a working structure. The organisational model chosen is the same as for the LRMH at the Ministry of Culture, with laboratories dedicated to specific materials. Arnaud is a member of the “stone work” group which is made up of geologists, archaeologists, civil engineering experts and art historians. The 30 or so experts in the group are conducting research on stonework which collapsed and elevations that were saved. Their task is to identify construction techniques used in the 12th and 13th centuries to improve understanding about the building, to date it, and to provide technical information to the contractors and contracting bodies who are managing the restoration.

LABO DE TRAITEMENT DE L’INFORMATION MÉDICALE
2020 WINNER OF THE PRIX ANDRÉ PRUD’HOMME

In June 2020 Lia Siegelman, a doctoral student at LEMAR (UMR 6539) was awarded the Prix André Prud’homme by Météo et Climat. This prize for young atmospheric science and climatology researchers is awarded for a doctoral thesis in meteorology, atmospheric physics and chemistry, paleoclimatology or climatology. Lia received the award for her thesis “Ageostrophic Dynamics in the Ocean Interior” which she completed at UBO in 2019 with funding from the CNES. Her research, conducted at UEM’s*, LEMAR (UMR 6391) and LOPS (UMR 6523) laboratories, focused on heat transfers in the ocean. It developed a novel approach to observation, combining existing satellite observations with direct observations from within the marine environment via sensors placed on elephant seals. These mammals live in the Southern Ocean and can dive to a depth of 1000m. The existence of numerous small-scale ocean fronts has therefore been verified, confirming their impact on both the ocean’s heat absorption capacities and the behaviour of marine mammals, which are an indicator of the health of this ecosystem.

Now undertaking postdoctoral studies at the California Institute of Technology Lia has received various accolades. In 2019, she was awarded a L’OREAL-UNESCO grant for this same piece of research.

Jonathan Guia, oceanographer, physicist and lecturer-researcher at LOPS (UMR 6523) became a junior member of the IUF in October 2020. This status is granted to young lecturer-researchers, university professors and senior lecturers by an international panel, in recognition of the exceptional quality of their research. From the moment they are appointed, and for a five-year term, junior members must concentrate on their research with the goal of creating and innovating. Jonathan’s work focuses on ocean turbulence and the dynamic processes that control interactions between different spatial and temporal scales of flow. He is particularly interested in the mechanisms behind unstable currents, mesoscale eddies (10-100 km), interactions with internal waves and smaller scale processes (1-10 km) that influence the dispersal of energy, mixing, and vertical flows of tracers in the ocean. He uses theory, very high-resolution realistic modelling and observations to characterise these processes and define their impact on large scales.

In 2019, in an article published in the Geophysical Research Letters, Jonathan and his American colleagues demonstrated the existence of small-scale eddies below the surface of the ocean. This fundamental discovery has made an important contribution to oceanography and is one of the reasons for his nomination to the IUF.

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2. Centre National d’Etudes Spatiales
3. Institut Universitaire Européen de la Mer
4. Laboratoire d’Océanographie Physique et Spatiale (LOPS, UMR 6523, CNRS-Ifremer-IRD-UBO)

RESEARCH

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A new scientific encyclopaedia, “Oceans - evolving concepts” co-written by Paul Teguer, University Professor at LEMAR (UMR 6539), Guy Jacquès (CNRS* and Harlé Meckler (FREMER) has been published in French and English by ISTE Editions. This richly illustrated book is intended for informed readers and students, and more broadly, anyone interested in the history of oceanography and ocean sciences. It stands out for going beyond the history of oceanography, from its creation in the 19th century to the present day, to look at the evolution of concepts that form the basis for major international programmes. It also gives a prominent place to French scientists who have played and still play an important role in oceanography and marine ecology internationally.

“Oceans” draws on data produced from new satellite and oceanographic tools and acquired through international interdisciplinary programmes. It describes the processes that control how the ocean functions on different spatial and temporal scales. After considering the evolution of concepts in physical, chemical and biological oceanography, the book outlines the future of a warmer, acidified, less oxygenated ocean. It shows how visualizing the ocean at different scales changes how we understand it. It also sets out the challenges facing the ocean in terms of exploitation of biological and mineral resources, in a context of sustainable development and regulation on climate change.

The French version “Océans-évolution des concepts” is published by ISTE and the English version by ISTE-Wiley.

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PUBLICaton

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COORDINATOR

In November 2020, the CNRS INEE* appointed Olivier Raguenau, who is CNRS* research director at LEMAR (UMR 6539) as a project coordinator. He will run the Réseau des Zones Ateliers network (RZA) and coordinate the IR-RZA research infrastructure for the ALLIANCE pour l’Environnement (ALLENv). The RZA is the overall network for around fifteen Zones Ateliers (ZA) in France, representing 1500 scientists and lap partner establishments including 67 universities. ZAs are geographical areas, usually covering a region, with a common functional unit such as a forest, river, mountain range, city, or coastline. Their focus is on exploring the past, present and future trajectories of socio-ecosystems. They adopt highly interdisciplinary approaches, particularly across the broad fields of natural sciences and human and social sciences, and also conduct cross-disciplinary research between stakeholders on the ground and researchers.

Boasting several decades of experience - the longest established ZAs were formed under the PIREN* programme in the 1980s - the Réseau des Zones Ateliers comes within the scope of the sustainability sciences which emerged in the early 2000s and are prominent in the English-speaking world. The network is the only social and environmental research infrastructure of its kind in the country and its aim is to shape thinking and action that will foster a stronger ethos of sustainability in the regions of France.

OLIVIER RAGUENAU
will coordinate the zones Ateliers network.
OUR DOCTORAL STUDENTS
in the Spotlight

UBO’s doctoral students are committed to disseminating scientific understanding and sharing their expertise both with their peers and the general public. A number of them have received national distinctions, helping to raise the university’s profile.

MY THESIS IN 180 S

The Brittany/Pays de la Loire inter-regional final of “My Thesis in 180 s” 2020 was held on Thursday 12 March on the national stage of the Quartz Centre in Brest. 16 young researchers from universities in Brittany and the Loire gave three-minute presentations on their research to a broad audience. In addition to sharing their passion, entrants hoped that by convincing members of the public and a panel of judges, they would win a prize and qualify for the national final.

LEMAR* (UMR 6537) doctoral student Élyne Dugény’s enthusiasm and emotion won her the audience prize. Her research focuses on the Pacific oyster and its interactions with neighbouring species and its ecosystem. A sentinel of the ocean, the oyster is in permanent contact with other species. Some of these are beneficial but others are detrimental to its health. One such case is green algae which exacerbate the death rate for oysters exposed to a virus. They destabilise the oyster’s microbiota by altering the balance of its symbiotic bacteria which are key to its well-being. This unexpected discovery highlights how important the environment is to the integrity of an animal which sits at the centre of complex interactions.

Because of the public health situation, the national final of “My Thesis in 180 Seconds” 2020, had to be cancelled but Élyne has joined a new batch of regional entrants for the 2021 competition.

*Laboratoire des Sciences de l’Environnement Marin (LEMAR, UMR 6537, UBO-CNRS-IRD-Ifremer)

ÉLYNE DUGÉNY
Received the audience prize at the 2020 inter-regional final of “My Thesis in 180 s”
Microwaves and Materials Characterisation Days are a forum for presenting and showcasing recent advances in basic and applied research in the fields of materials and microwaves to the scientific community. Every year, the event’s scientific committee awards two prizes for excellence to students: one for oral communication (the Prix IEEE MTT-S France) and one for visual, the Prix Patrick Queffelec for the best poster.

At the sixteenth event, in November 2020, Matthiuk Longo, a doctoral student at Lab-STICC* (UMR 6285), received the Prix Patrick Queffelec for best poster. This award recognises both his research activities at the interface between materials and microwaves, and the quality of his presentation.

Matthiuk’s thesis focuses on marine biofilms, thin layers made up of microorganisms which develop on submerged surfaces, and their characterisation. His goal is to create a radio-frequency sensor, based on electromagnetic waves, that can detect the growth of biofilms of bacteria and/or microalgae. The first stage in developing this sensor, which he presented at the event, was to study the dielectric characteristics of biofilms, that is, their capacity to act as an electrical insulator. Characterising biofilms in this way facilitates understanding of the behaviour and influence of different components under microwave frequency conditions. The experiment was broken down into two parts: a study of the dielectric permittivity of the principal components in a biofilm, to identify how components respond to an electric field; and then monitoring growth of a real bacterial biofilm, using an experimental sensor, in controlled conditions. Additional analyses are in progress to validate the initial findings and then anti-biofilm materials will be used to validate the experimental sensor.

*Centre d’Études des Correspondances et Journaux Intimes (CECI-CA EA 9289, UBO)
The University’s scientific strategy responds to key issues in current research, which reflect societal concerns such as the digital transition and sustainable development.

UBO’S COMMITMENT TO OPEN SCIENCE

S

purred on by the digital transition, the Open Science movement promotes restriction-free dissemination of scientific research findings. To roll out an ambitious policy for open sciences across the country, France has had a national plan for Open Science since 2018. This action plan focuses on three areas: increasing open access to publications; structuring and opening up research data; and adopting a sustainable, European, and international outlook. In the long term, a widespread open science approach, with more data and funding pooled, will increase the impact of research.

This year, in the context of a health crisis which has illustrated the importance of sharing scientific data, Open Science has gained even more traction. Indeed, in 2020, the number of publications available in open-access format at UBO passed the 50% mark and our goal is to increase this to 100% in the coming years. The challenge for open sciences now is research data. Managing open data is a significant issue when it comes to research at UBO. This is why Mathieu Hatt, head of research for INSERM* at LATIM*, has been appointed as project coordinator for “research data.” A new working group has been set up to support him. It is tasked with understanding open science practices in different fields of research, drawing up a list of needs, ascertaining the resources required and developing plans for implementation.

UBO’s open science policy is both cross-disciplinary, as it involves all the University’s research units, and cross-functional. This cross-functional approach takes the form of cooperation between different central services including research, innovation and commercialisation (DRiVe), shared documentation (SCD) and information systems and digital technologies support (DSIUN). DRiVe and SCD work in particularly close collaboration to support researchers with developing data management plans. These plans make sure that data is considered in the early stages of a project and that FAIR principles are applied, i.e. the data must be Findable, Accessible, Interoperable, and Reusable. They cover the data’s entire life-cycle (collection, sharing, storage, backups, and safeguarding sensitive data) and also take account of issues and challenges specific to different disciplines.

Thanks to this synergy between services, researchers receive comprehensive support with managing and sharing both publications and research data. The involvement of the technology transfer acceleration company Ouest Valorisation in the University’s open science policy is proof of a truly all-encompassing approach to this issue.

UBO has introduced an open science barometer to track developments and produce statistics and indicators. More than 50% of publications issued in 2019 are available in open access. These papers, by researchers from UBO, are issued either via a publisher or directly in open archives. Publications listed as “publisher and open archive” can be accessed both on publisher platforms and open archives.

Proportion of open access publications in 2019 (assessed in 2020)

Between 2017 and 2019, the number of open access publications progressed by more than 5%. This increase reflects digital law which requires reviews to open up access to publications after a specified time period.

Changes in open access rates for publications 2017-2019

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Key figures on open science at UBO

The University’s scientific strategy responds to key issues in current research, which reflect societal concerns such as the digital transition and sustainable development.
Labos 1 point 5 study on reducing the environmental footprint of research

Labos 1 point 5 is a collective of academic researchers. It has three main objectives: to index and disseminate essential aspects of scientific literature and information about current initiatives in French laboratories; to produce data on the environmental footprint of the research sector’s activities; and to develop solutions by creating spaces for discussion and exchange.

By pursuing these goals, the collective aims to reduce the research sector’s environmental impact; its carbon footprint in particular. Several teams are involved, including a “Footprint” team which has developed GES-point5 - a tool laboratories can use to assess their greenhouse gas emissions with a standardised protocol. Olivier Raguenéau, a research director at LEMAR (UMR 6539), is a member of the “Think Tank” team. He has over a dozen publications on the higher education and research sectors’ responsibilities in these uncertain times. There are three aspects to these responsibilities: rethinking the purpose of research, rethinking working practices. When the study is published, the idea is to initiate action that reduces environmental footprint and then to use this as a springboard to rethink working practices. In this sense, the study is like a microcosm of society in that today, all sectors must work together to address climatic constraints which are becoming harder and harder to ignore.

New discoveries about the relationship between keratinocytes and sensory neurones

Keratinocytes are the main type of cell in the epidermis, the outermost layer of the skin. They can perceive temperature, pain and itching, and also transmit this information to sensory neurones in our skin. A new study conducted at LIEN* and led by Matthieu Talagas (senior lecturer and a medical practitioner at the CHRU* in Brest) has set out to identify the mechanisms of communication between epidermal keratinocytes and sensory neurones. Until now, these mechanisms have been poorly understood.

For this study, connections between keratinocytes and neurones were investigated with a morphological, molecular, and functional approach and by means of in vitro and in situ observations. The results of this study have significantly advanced understanding about the mechanisms of cutaneous sensory perception, paving the way for new targeted therapeutic approaches to treating pain and itching. An article about the study was also published in the December 2020 edition of Annals of Neurology.

* Centre Hospitalier Régional Universitaire Matthieu Talagas
* Laboratoire Interactions Épithéliums Neurones (LIEN, EA 4685, UBO)
* Laboratoire des Sciences de l’Environnement Marin (LEMAR, UMR 6539, UBO-CNRS-IRD-Ifremer)

*Gaz à effet de serre
Between 7 and 20 October 2020, a first expedition under the EU-funded, FOCUS project went off the coast of Catania in Sicily, which is home to about 1 million residents. Its objective was to monitor and shed light on the movements of an 80km seismic fault at the foot of Mount Etna. Marc-André Gutscher, who heads up the LGO* (UMR 8538) at IUEM*, and his team laid a six-kilometre long underwater cable using an innovative laser interferometry technique which until now had never been employed in this context. The expedition, known as FocusX1, and carried out on board the French oceanographic fleet’s research vessel Pourquoi Pas, is the first of its kind. The fibre-optic cable is connected to the Catania Institute of Physics’ Test Site South (TSS) observatory. Laying it at a depth of 2100 km proved to be a particularly delicate operation. A plough specifically designed by IFREMER, and driven by the Remotely Operated Vehicle (ROV) Victor 6000, was used to deploy and bury the six-kilometre long cable under sediment on particularly rocky terrain.

Eight geodetic seafloor stations, tested in Brest Harbour, were then installed on each side of the fault line. This system, which uses a laser reflectometry technique known as Brillouin Optical Time Domain Reflectometry (BOTDR) will measure tectonic plate movement to monitor seismic activity. This technique is usually used to analyse movements in large-scale infrastructures such as bridges or dams. Here however, it will measure movement in faults.

This European Research Council (ERC) project will receive five years of funding from the European Union. It will provide a better assessment of the activity of the North Alfeo Fault and could form the basis for a warning system for neighbouring populations.

A new technique for measuring seismic activity underwater

A team of researchers from the ESE* (University of Paris-Saclay) and LUBEM* (UBO) have identified a domestication process in the mould Penicillium camemberti. They published their findings in an article in Current Biology in September 2020. In spite of its economic importance, there have been few studies of the fungus responsible for the formation of the white mould on Camembert and Brie. To enhance their understanding of the species, the research team began by sequencing the Penicillium camemberti genome. They then went on to compare it to another cheese-related mould, P. biforme, and the wild fungus P. fuscoglaucum, found in natural environments.

Analyses showed that the two “cheese specific” species are sister groups and very close genetically, whereas P. fuscoglaucum is more distant. This therefore suggests that selection pressure caused the separation of P. fuscoglaucum and P. biforme. Because the latter forms a blue-green mould, Brie was therefore a blue cheese until the middle of the 20th century.

After selection of a white mutant fungus, a second and more recent domestication event produced the white fluffy P. camemberti line. Thanks to human selection, the two domesticated species play a beneficial role in maturing cheeses compared to the neighbouring wild species. They are whiter and grow more rapidly on cheese in cellar maturation conditions. Additionally, they produce no, or very few toxins that pose a potential risk to human health, and also stop undesirable moulds from growing.

These findings from ESE and LUBEM could have a significant impact on cheese production and the industry, by steering mould selection to match the desired characteristics and final appearance of cheeses.

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Hydrothermal vents:
understanding and describing these ecosystems and their fauna

Hydrothermal vents are found at a depth of between 500 and 5000 metres and form along mid-ocean ridges where tectonic plates are separating. They emit water spirals rich in chemical elements and dissolved metals, including sulphur and methane, at temperatures that can exceed 350°C. These fluid emissions trigger the formation of chimneys which can reach heights of several dozen metres and that provide hydrothermal ecosystems rich in biodiversity at their bases. A number of IUEM* laboratories study these distinctive ecosystems to better understand them and also find out which organisms live there. The microorganisms that populate hydrothermal ecosystems include unicellular organisms, also known as Archaea. Knowledge of archaeal virus-es is limited; even more so when it comes to marine ecosystems. A team from LM2E* (UMR 6197) therefore set out to acquire new data on viruses that infect hyperthermophilic methanogenic archaea in hydrothermal marine ecosystems. These ecosystems play an essential role in the overall carbon cycle by producing methane.

The study discovered and characterised Methanocaldococcus fervens tailed virus 1 or MFTV1, the first virus infecting deep sea hyperthermophilic methanogens. Its ‘head-tail’ morphology unequivocally demonstrates that this morphotype can propagate at very hot temperatures of more than 90°C. This is the first time ever that a head-tailed virus has been isolated from hyperthermophilic microorganisms, raising questions about the thermostability of this morphotype.

The study also shed light on genetic transfers from M. fervens to other hyperthermophilic methanogens. This finding opens up new avenues for research and raises questions about the thermostability of this morphotype.

Data on behaviour showed that on hydrothermal vents, B. azoricus manifests cyclic activity. Having established this, Audrey then focused on the mollusc’s physiology. Reflecting the exploratory nature of the project, she developed a cutting-edge protocol which involved sampling the molluscs every two hours and four minutes over a period of 24 hours and 48 minutes, corresponding to two cycles of the tide. Samples were taken and stabilised under red light directly in the deep sea. The success of this approach made it possible, for the first time, to produce a high-resolution temporal transcriptome of a deep sea species directly in its environment. The transcriptome represents all genes expressed at a given time, which provides a snapshot of the physiological condition of an organism. These molecular analyses revealed that in situ, at a depth of 1700 metres, a 12.4 hour cycle dominates the mollusc’s physiology whereas in the laboratory, a daily cycle prevails in mussels exposed to an alternating light/dark cycle. These results show that life in the deep sea is not aperiodic. What’s more, they suggest that the mollusc’s cyclical activity could be interconnected with its symbionts’ needs for sulphide and methane which are found in the hydrothermal fluids that make up these species’ environment.

Audrey Mat’s postdoctoral studies have focused on a previously unexplored theme: the biological rhythms of Bathymodiolus azoricus. She has carried out her research under the umbrella of the LabexMer cluster and through a collaboration between LEMAR* (UMR 6539) and the Laboratoire Environnement Profond (IFREMER). An article about her study appeared in the July 2020 edition of Nature Communications.

Bathymodiolus azoricus is a species of bivalve mollusc that thrives on the hydrothermal vents of the Mid-Atlantic Ridge. Audrey’s research sought to understand the temporal organisation of this species and its relationship with its distinctive environment. To this end, her studies were based on behavioural and molecular observations both in situ, at a depth of 1700 metres, and in the laboratory.

Photo Credits: Claire Geslin

*Institut Universitaire Européen de la Mer
Laboratoire de Microbiologie des Environnements Extrêmes (LM2E, UMR 6197, Ifremer-UBO-CNRS)
Laboratoire des Sciences de l’Environnement Marin (LEMAR, UMR 6539, UBO-CNRS-IRD-IFREMER)
In 2020, UBO’s laboratories focused on completely new subjects and their research has led to discoveries that have attracted the attention of the scientific world. The University’s research programmes have stood out in every field, showing once again that UBO is at the cutting edge of innovation.

Kalsiom secures 2 million euros from Go Capital and Advent France Biotechnology

Olivier Mignen, senior lecturer at the LBAI (UMR 1227) has set up a new business after 15 years of research in France and the USA during which he has focused on the calcium ion and its role in cell function and dysfunction. Olivier first began to study deregulation of calcium signalling pathways in a pathological context at the GGB (UMR 1078) in the middle of his stint in an INSEEA “Chaire d’Excellence” position. Then, in collaboration with immunologists from Brest, whom he joined at the LBAI, he turned his attention to the involvement of this deregulation in lymphocyte B related diseases - chronic lymphocytic leukaemia initially and then, lupus and rare autoimmune disease.

Having decided to commercialise his research, Olivier began prospecting for funding and partners. Herve Brail, a multi-entrepreneur and the founder of Innate Pharma, and biotechnology expert Mathieu Bleyr were both convinced by his project and decided to join him. Pooling their knowledge, skills and experience, they launched Kalsiom in 2018. This start-up specialises in developing antioxidant calcimimetics to modulate calcium signalling pathways in order to treat autoimmune disease. It works in close collaboration with numerous clinicians at the CHRU*. To bring the venture to fruition, Olivier filed several patents and with the support of the SATT* Ouest Valorisation drew up three development plans to structure the project. Once these plans were implemented, new patents were filed. In parallel, Olivier won the Matwin competition on two occasions.

In 2008, Gwenaël Guillard, the founder of Intradys joined the interdisciplinary team at LaTIM* (UMR 1101) where his research focused on modelling the link between the form and function of human joints. While he was there, he developed mathematical tools that generated morpho-functional signatures useful for classifying arthritic pathologies, guiding osteotomy procedures and facilitating prostheses positioning in knee replacement surgery. After completing his funded thesis in 2005, he moved to the University of Geneva to work on the 3D Anatomical Human project which set out to model the human body on a range of scales. As well as managing this project, he developed a specific interest in medical imaging of the musculoskeletal system.

In 2008, Gwenaël joined Imorphics, a start-up based in Manchester in the UK. To begin with, he worked on developing automated medical imaging technology for use in planning and guiding prostheses positioning in knee and hip replacement surgery. He then extended the technology’s capabilities into developing image-based biomarkers to quantify arthritis. In 2019, having decided to create his own medical technology company, he returned to Brest and co-founded Intradys. This start-up aspires to serve as an ecosystem for interventional neuroradiology, a specialised technique in stroke treatment. To achieve this goal, Gwenaël maintains very close links with the CHRU* in Brest and more specifically its interventional neuroradiology unit, run by Professor Gentric. Through this partnership, Intradys has been able to develop some initial algorithms and an initial telemedicine solution based on mixed reality. The CHRU, which owns a stake in the company, granted access to medical data from 500 patients, with their prior permission. Intradys also works with the UBO Open Factory who supplied 3D printed models to validate the algorithms.

The telemedicine solution is currently under evaluation. It will enable two interventional radiologists, one who is in the room with the patient, to communicate both by voice and with the assistance of 3D holographic tools. In this way, the technology enables the radiologist to have these tools to hand and to interact as closely as possible with their patient.

Carnot Agrifood Transition becomes a Carnot “Institute”

The Carnot excellence label was created in 2006. It is awarded to research establishments who apply and meet the criteria for accreditation. Since 2016, the Carnot “springboard” system has served as a preparatory phase for research facilities wanting to develop their contractual relations with businesses. Carnot Institutes bring the worlds of public research and business/industry together to speed up the transition from research to innovation and increase the transfer of technology to economic stakeholders. The Carnot label is reviewed regularly.

In February 2020, the Carnot springboard Agrifood Transition was awarded the label and became the Institut Carnot Agrifood Transition*. For his doctoral studies, Gwenaël Guillard, founder of Intradys joined the interdisciplinary team at LaTIM* (UMR 1101) where his research focused on modelling the link between the form and function of human joints. While he was there, he developed mathematical tools that generated morpho-functional signatures useful for classifying arthritic pathologies, guiding osteotomy procedures and facilitating prostheses positioning in knee replacement surgery. After completing his funded thesis in 2005, he moved to the University of Geneva to work on the 3D Anatomical Human project which set out to model the human body on a range of scales. As well as managing this project, he developed a specific interest in medical imaging of the musculoskeletal system.

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* https://www.agrifood-transition.fr/
* Laboratoire Universitaire de Biodiversité et Écologie Microbiennes (LUBEM, UMR 1381, UBO)
Multi-disciplinary partnership on marine technology
formalised through creation of the Cormorant consortium

Cormorant is a scientific interest consortium (GIS) that has been set up to amalgamate the research activities of key players in the Brest Océane district specialising in marine technology, particularly for the naval and aeronautical industries. Its expertise focuses on observation, surveillance and security, and embedded infrastructures - airborne, surface and submarine. The consortium was formally established in 2020, inspired by a desire for a unique partnership between industrial and academic stakeholders with expertise in maritime embedded electronic systems for various operational applications (airborne, naval and submarine systems). An agreement has been signed for five years. Cormorant will be governed by a joint steering committee and will work to a long-term road map which sets out its overall direction. This multidisciplinary partnership brings Thalès out its overall direction.

Cooperation between GIS Cormorant partners therefore covers several main objectives:

- To deploy the research teams best qualified to respond to scientific and technological issues raised by Thalès-DMS as part of its development strategy and to maintain and extend these teams’ expertise;
- To capitalise on joint intellectual property by pursuing a collective strategy;
- To set up collective training and mentoring activities.

The consortia between companies in the field.

The main signatories are Lab-STICC (UMR 6285) and its six supervisory bodies CNRS, ENIB, ENSTA Bretagne, IMT Atlantique, UBO and UBS, IRENAV and LjubiSEN (ISEN-Yncréa Ouest). Céladon, which manages the SeaTestBase platform for sea trials, is an associate partner to the initiative. Cormorant’s research and innovation activities are organised into three key fields: independence of maritime systems; human-system interactions and human factors; and sensors and smart processing.

The partnership will facilitate cross-disciplinary research and technical innovation as well as making provision for activities at the interface between industry and research, much like a shared laboratory offering, for example, joint supervision of CIFRE doctoral studies. Consortium members could also team up to respond to national and European-level joint calls for tender.

Cormorant’s research and innovation activities have been set up to support research and innovation. Funded under a call from Horizon 2020 - Science with and for Society (SWAFS), it began in January 2020 and will run for three years.

In line with SEA-EU’s long-term strategy, the Alliance’s six universities are pooling their complimentary expertise to:

- Build an anti-fragile (beyond resilient and robust) and innovative pan-European Alliance;
- Align expertise and resources with the needs of the production system;
- Co-design, co-create and co-deliver knowledge with and for stakeholders and citizens;
- Establish a common policy on Open Science and Open Research data.

In 2020, UBO once again made its mark on the international research landscape. From its placement in the best university rankings to its involvement in creating a European research-based university, UBO’s projects are focused, definitively, on the international arena.

SEA-EU Alliance obtains European funding for its ReSEArch-EU project

UBO has continued to make its mark internationally through the European SEA-EU Alliance and a place in the Shanghai rankings, a barometer of excellence for universities worldwide.

The ReSEArch-EU programme has been set up to support research and innovation. Funded under a call from Horizon 2020 - Science with and for Society (SWAFS), it began in January 2020 and will run for three years.

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The goal is to establish a robust and trustworthy research structure for the Alliance by strengthening links between scientific, citizen and socio-economic communities, involving institutions in joint projects, making a contribution to local economic development and rising to the societal and environmental challenges facing its members. It will be visible to, and active with key stakeholders in society (citizens, entrepreneurs, corporate bodies, administrators).

- University of West Brittany, University of Gdańsk, University of Oulu;
- University of Malta, University of Kent (Germany) and University of Split.

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More visibility for research and innovation at UBO through the introduction of a subject category in the ARWU World University Ranking (Shanghai 2020)

The Shanghai “by subject” ranking 2020, which lists the best universities in each disciplinary field, was published in June. As in the last two listings, oceanography at UBO stands out, occupying thirteenth place in the world, which corresponds to fourth place within the European Union and second place in France. This good result once again proves that UBO is at the cutting edge of research in marine sciences.

In addition to this very high international placing, the University continues to gain momentum and now features in 11 rankings (compared with five in 2019), covering a broad range of subjects. In total, the University appears in 11 categories including earth sciences, medical technology, and electric and electronic engineering. This means that three of UBO’s four specialist research areas (marine science; digital; health-agri-environment-materials) are recognised in the rankings.

The Shanghai ranking is based primarily on research output, and specifically, contributions from researchers to international scientific reviews. The evaluation criteria focus on both the number of articles published and their impact on a global scale. They offer an external and independent view, based on public and reproducible indicators.

Although appearing in such rankings has never been a specific goal within the university’s strategy, Shanghai 2020 serves as an impartial means of validating UBO’s objectives and the prominent multidisciplinary aspect of its research.

Disseminating scientific, technical and industrial culture (CSTI) is one of the public service remits expected of French universities. Activities that guide CSTI policy at UBO are divided into five areas:

1. Educational courses and research policy at the university;
2. Devising and promoting scientific and technical events;
3. Building on the campus’s scientific and technical capital;
4. Strengthening dialogue on CSTI between the University and its locality;
5. Developing projects that share scientific, technical and industrial culture with all audiences.

In other words, the goal is to equip everyone with tools that enable them to improve their understanding of the challenges facing the world we live in today so they can make an informed contribution to public debate. In return, through these activities, researchers are better able to incorporate the views of civil society in their research choices. CSTI activities should inspire the youngest members of society to pursue careers in these fields. They should also help to counter inequalities in accessing knowledge and education by focusing on issues such as the place of girls and young women on scientific courses and in scientific careers. Additionally, it is hoped that these activities will encourage everyone to play a part in advancing research, for example by taking part in citizen science projects. CSTI also helps to desanctify science through conversation, fun and creativity. It is an integral part of culture, in its broadest sense, and is intended for everyone.

To fulfil its remit in this area, UBO has taken part in a range of nationally coordinated events such as My Thesis in 180 s, Brain Awareness Week, The Festival of Science, Pint of Science, Heritage Days, and European Researchers’ Night, and has also joined local events such as Health care Mondays, Days of Research, Cabinet de Curiosités, the Story of my Thesis, and the Story of my Research in partnership with other influential CSTI actors such as Océanopolis. Three services at UBO play a prominent role: Communication and Partnerships, Shared Documentation and Research, Innovation and Commercialisation.
A week of research at UBO to imagine tomorrow’s world

Having previously organised four “Days of Research” for the scientific community, this year, UBO took a different approach, putting on a full week of events dedicated to research, and aimed at all audiences. From 3-7 February 2020, more than 60 speakers took part in the 26 events (including lectures, roundtables, meetings, and exhibitions) held at the university’s different campuses and other venues across the region including Océanopolis, Dialogue bookshop and the Quartz theatre in Brest, le Chapeau Rouge in Quimper and the town hall in Morlaix. This event was the first of its kind to be held in this format in France and was designed to provide a relevant cultural space for all. Its aim was to make the results of research and innovation accessible to everyone, to share knowledge and expertise and to showcase the multidisciplinary nature of the University’s research activities. It was also an opportunity for stakeholders from the socio-economic world, the general public, students, the scientific community and external experts to meet, share ideas and debate.

A range of themes were covered, including climate, food, space, artificial intelligence, precision medicine and genetics. Topical subjects such as these are of equal interest to researchers and socio-economic stakeholders including citizens. Taking the overall theme of “Let’s Imagine Tomorrow’s World by sharing, transferring knowledge and meeting,” this first ever Week of Science was also a chance to think about the University’s place in current and future society.

The work of the University’s technological platforms service was also showcased during the Week of Research. This department, which is rarely visible to the general public, makes equipment and resources available for research. It also facilitates cooperation between researchers and different bodies, such as police forensics, enabling them to pool their scientific and technical knowledge and expertise.

To highlight the University’s partnership with police forensics, Nelly Kervairec, Philippe Elies and Gaëlle Simon from the technological platforms service organised an original event with the support of Anne-Typhaine Baude, officer at the National Gendarmerie Forensics Institute in Cergy Pontoise and Emilie Martin-Ozanne, medical examiner. Through the form of a lecture, fiction and an escape game, “the experts at UBO” offered an immersive “behind-the-scenes experience” at a police forensics investigation. The aim was to show how combining different scientific techniques with expert analysis from police forensics can be used to uncover the clues needed to solve a case.

In focus: during the Week of Research

To really celebrate tomorrow’s researchers, this year’s graduation ceremony for doctors was held during the Week of Research. 115 young researchers received their diplomas on 7 February 2020, marking the culmination of their doctoral studies.

As is traditional, two eminent personalities from the world of research sponsored UBO’s doctoral class of 2019. Monical Heller, anthrologist and sociolinguist and a professor at the University of Toronto, was chosen as a sponsor and also received an Honoris Causa doctorate from UBO on the same day. This honorary award recognises the international influence of her research and her inspiring personality. Monica’s research focuses on the role of speech and language in constructing differences and social inequality. Over several decades, she has worked particularly closely with the CRBC* on research projects and supervising students. Gérard Mourou, a professor and member of the Haut Collège de l’École Polytechnique, was also sponsor for UBO’s doctoral class of 2019. He is particularly well-known as the inventor of refractive femtosecond laser surgery for eyes and cataracts which is used to treat more than 1 million patients per year. In 2018 he received the Nobel Prize for physics for his work with lasers.

*Centre de Recherche Bretonne et Celtique (CRBC, EA 495, UBO)