



Catalan Institute
for Water Research



HR EXCELLENCE IN RESEARCH

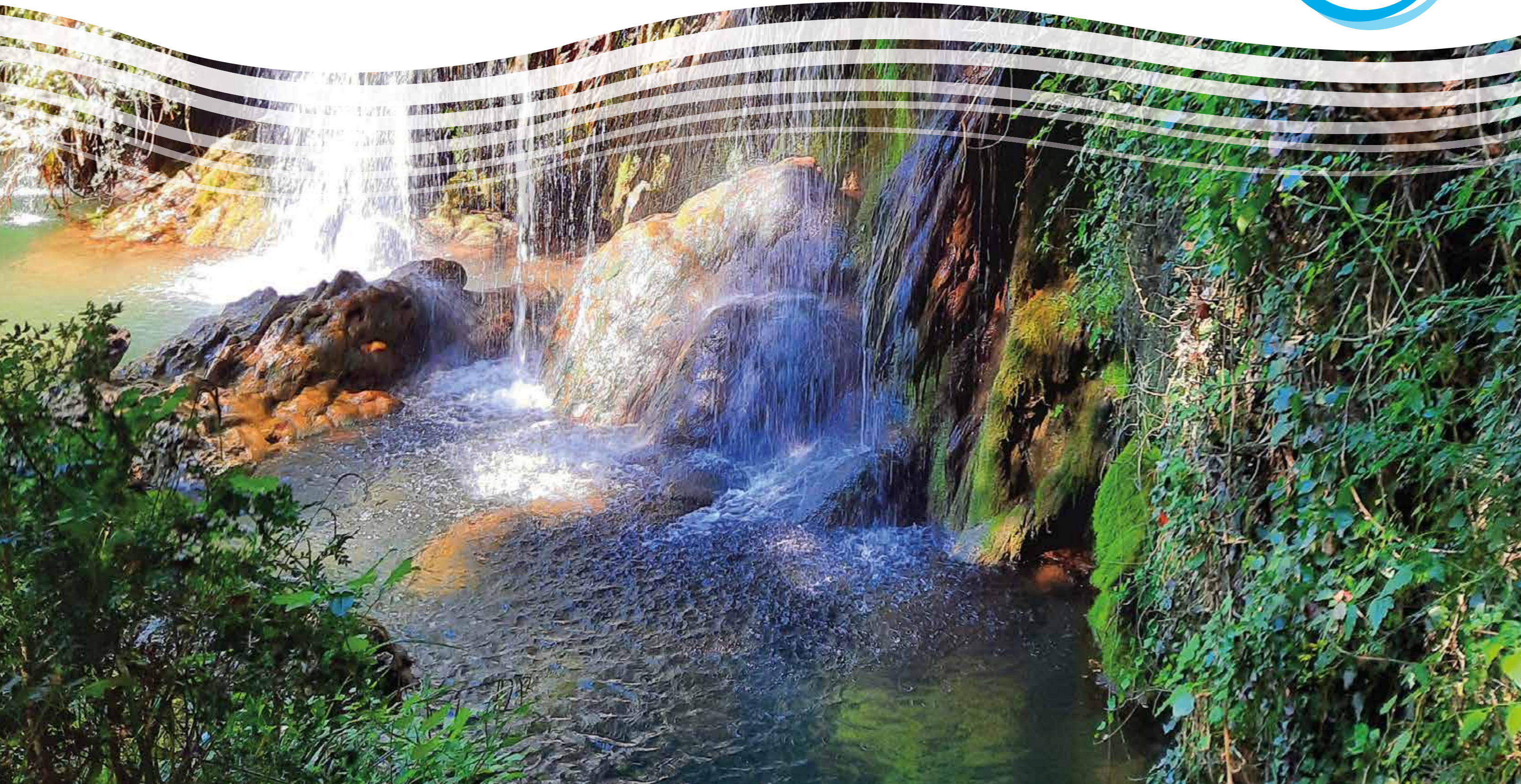
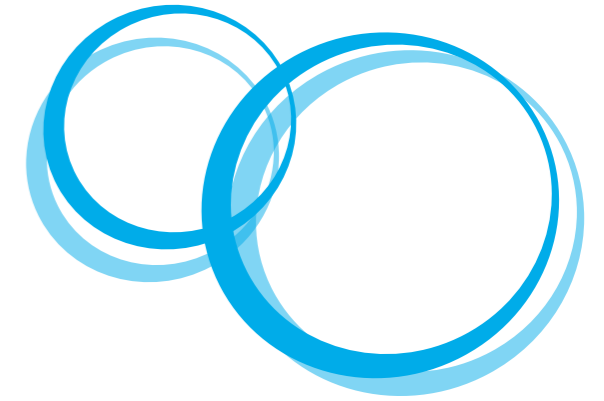


ANNUAL REPORT 2021

ICRA research institute attached to the university of Girona

Annual Report **2021**

This new proposed Directive on the quality of water for human consumption shall protect human health from any adverse effects of any contamination of water intended for human consumption and should promote as well the universal access of such water in all EU. (Drinking Water Directive).





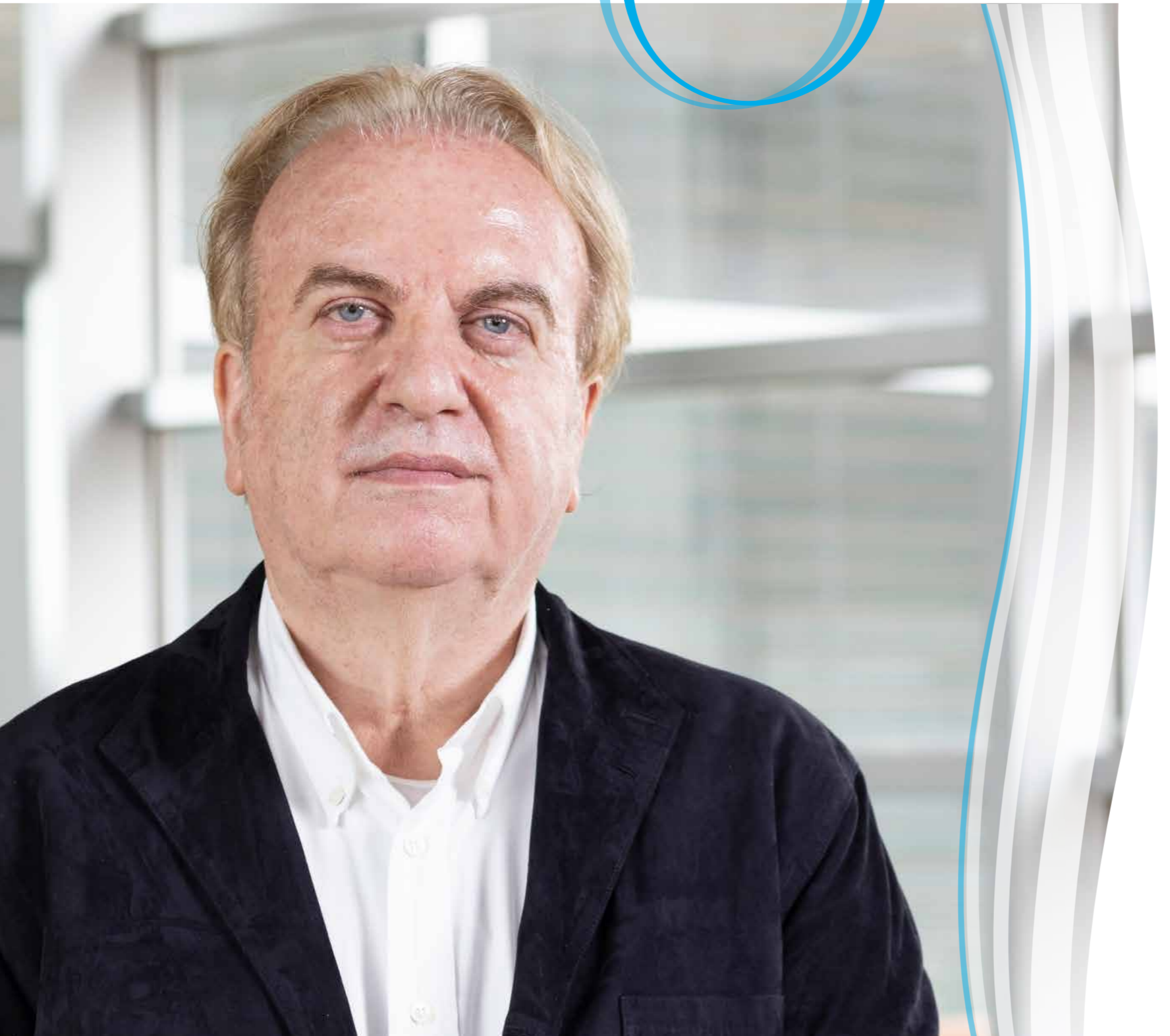
©Copyright 2022
 Report 2021
 Edition 2022. Catalan Institute for Water
 Research (ICRA)
 Graphic design amb layout
 Palíndromo (STARTUL ,S.L.)
 Corrections
 Palíndromo (STARTUL ,S.L.)



CONTENTS

00	PRESENTATION	7
01	DESCRIPTION	9
02	MISSION AND VISION	11
03	ORGANISATION	13
	BOARD OF TRUSTEES	14
	SCIENTIFIC ADVISORY COMMITTEE	16
	PUBLIC ADMINISTRATION AND BUSINESS MIXED COMMITTEE	18
	DEPARTMENTS & STAFF	19
	R&D&I SUPPORT SERVICES	20
	ADMINISTRATION	20
	R&D&I OFFICE	21
	TECHNICAL AND SCIENTIFIC PLATFORMS	22
04	RESEARCH AREAS	29
	RESOURCES AND ECOSYSTEMS RESEARCH AREA	32
	WATER QUALITY RESEARCH AREA	40
	TECHNOLOGIES AND EVALUATION RESEARCH AREA	48
05	PUBLICATIONS AND CONGRESSES	61
06	PROJECTS	77
07	CONTRACTS	89
08	AGREEMENTS	93
09	OTHER DISSEMINATION ACTIVITIES	99
10	AWARDS	115
11	FINANCING	117
12	ICRA IN THE NEWS & PRESS	119





00

PRESENTATION

As in previous years, we now send you the **2021 Report on the Activities** of the Catalan Institute for Water Research (ICRA), which this year nevertheless features a significant new development. This edition and all future editions will be in digital format, as a means of emphasising ICRA's responsibility as a centre dedicated to monitoring sustainability and the rational use of water.

The year 2021 represented a return to a more orderly normality, even if the lingering shadow of COVID was still present in our minds and activities. Nevertheless, 2021 was above all a very productive year in terms of projects, scientific articles, theses and the presence of ICRA in both domestic and international scientific conferences. This has enabled us to maintain and improve our position as a centre of excellence and of scientific prestige in the field of water and water resources.

During 2021 we administered a total investment of **€2.3 million in projects**, with a total scientific production of **186 publications, 162 of which were scientific articles**, with 94% of the total published in high-profile journals. We also took part in **47 meetings and conferences in both the national and international ambits**, and in which ICRA regularly played a major role. A total of **4 doctoral theses** were completed, being other **32 currently under way**.

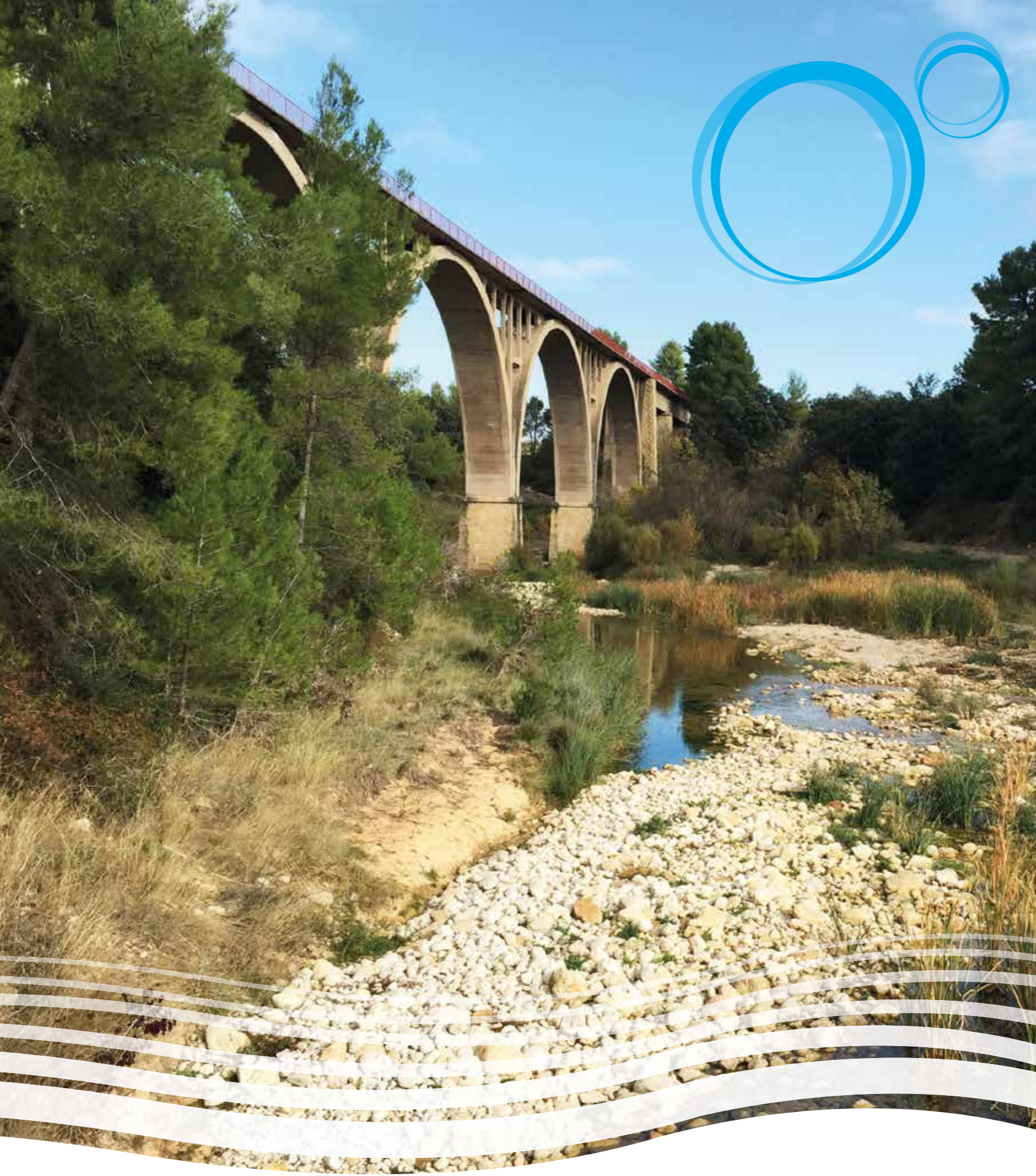
On a personnel level, it should be highlighted that in 2021 ICRA enlarged its **permanent research staff with a new Research Scientist position** in the Technologies and Evaluation department, consolidating the work of our existing Ramon y Cajal Researcher. As at the end of 2021, ICRA employed a **total of 106 staff members, 81 of whom were researchers, 7 in the Technical Scientific Departments, and 18 in either Technical or Administrative and Management support staff**.

These achievements would not have been possible without the commitment of the entire ICRA team, including our researchers, technical and support staff and administrative staff, who through their hard work and dedication have maintained ICRA's high standards of professionalism.

We hope that this new format will be as well received as that of all our previous reports.

I cordially invite you to read further details about our activities. Yours faithfully,

Damià Barceló
DIRECTOR



01

DESCRIPTION

The Government of Catalonia established the Catalan Institute for Water Research (ICRA), within the framework of its **Catalan Research Centres Programme (CERCA)**, on 26 October 2006. **ICRA forms part of the CERCA programme.**

ICRA is supported by its trustees: **the Catalan Ministry of Research and Universities, the Catalan Water Agency (ACA) and the University of Girona (UdG).**

ICRA is a **multidisciplinary water research centre**, covering the complete water cycle. Research at the Institute deals with a range of topics, including the availability of **water resources**, the importance of **biodiversity**, assessing **water quality** (chemical, microbiological, ecological, etc.) and the development and evaluation of **treatment technologies**, as well as the **transfer of this knowledge** to the wider society, industry and the business network.

ICRA's headquarters are located at the **H2O building at the University of Girona's Science and Technology Park**, inaugurated on 7th October 2009. The H2O building is equipped with cutting-edge facilities and technologies that are used to carry out national and international research projects. The Institute's scientific equipment was co-financed by the **Ministry of Economic Affairs and Digital Transformation (MINECO)** and the European Regional Development Fund (ERDF), within the framework of the **ERDF Operational Programme for Catalonia 2007-2013**. Furthermore, between 2010 and 2011, and within the framework of the **2010 Spanish budget (MICINN, now MINECO)** ICRA was awarded a nominal subsidy to purchase the equipment required to commission artificial river facilities.



02



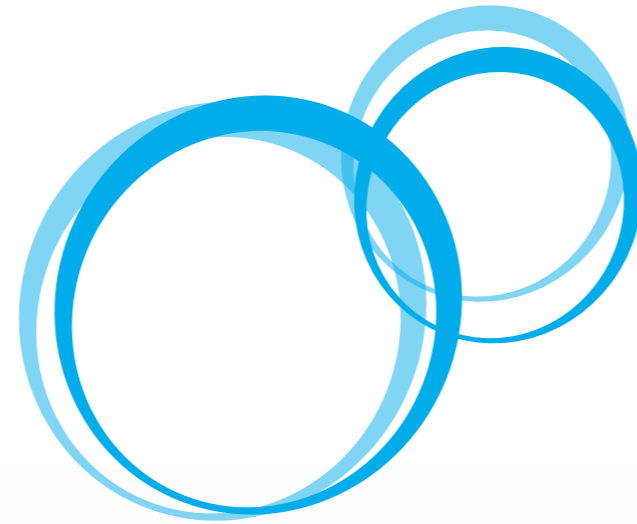
MISSION AND VISION

MISSION

ICRA's mission is to attract the scientific talent and financial resources necessary to maintain a center of excellence in water. The Institute generates essential knowledge on hydrological processes, aquatic ecosystems (including human and ecological health), and chemical and microbial contaminants, particularly under conditions of water scarcity and environmental extremes (such as droughts and floods). ICRA enforces the development of appropriate technologies for water treatment, improvement, and reuse. ICRA conducts fundamental research with an interdisciplinary approach and translates this knowledge to administration, industry, scientists, decision makers, and society in general.

VISION

ICRA's vision is to continue to be a center of excellence in water and to respond efficiently and competitively to the problems and challenges related to the cycle of water in general and to the state of ecosystems, water resources, impacts of new products, new treatment technologies and sustainable use of resources within (though not exclusively) the Mediterranean climate.



03



ORGANISATION

BOARD OF TRUSTEES

SCIENTIFIC ADVISORY COMMITTEE

PUBLIC ADMINISTRATION AND BUSINESS MIXED COMMITTEE

DEPARTMENTS & STAFF

R&D&I SUPPORT SERVICES

ADMINISTRATION

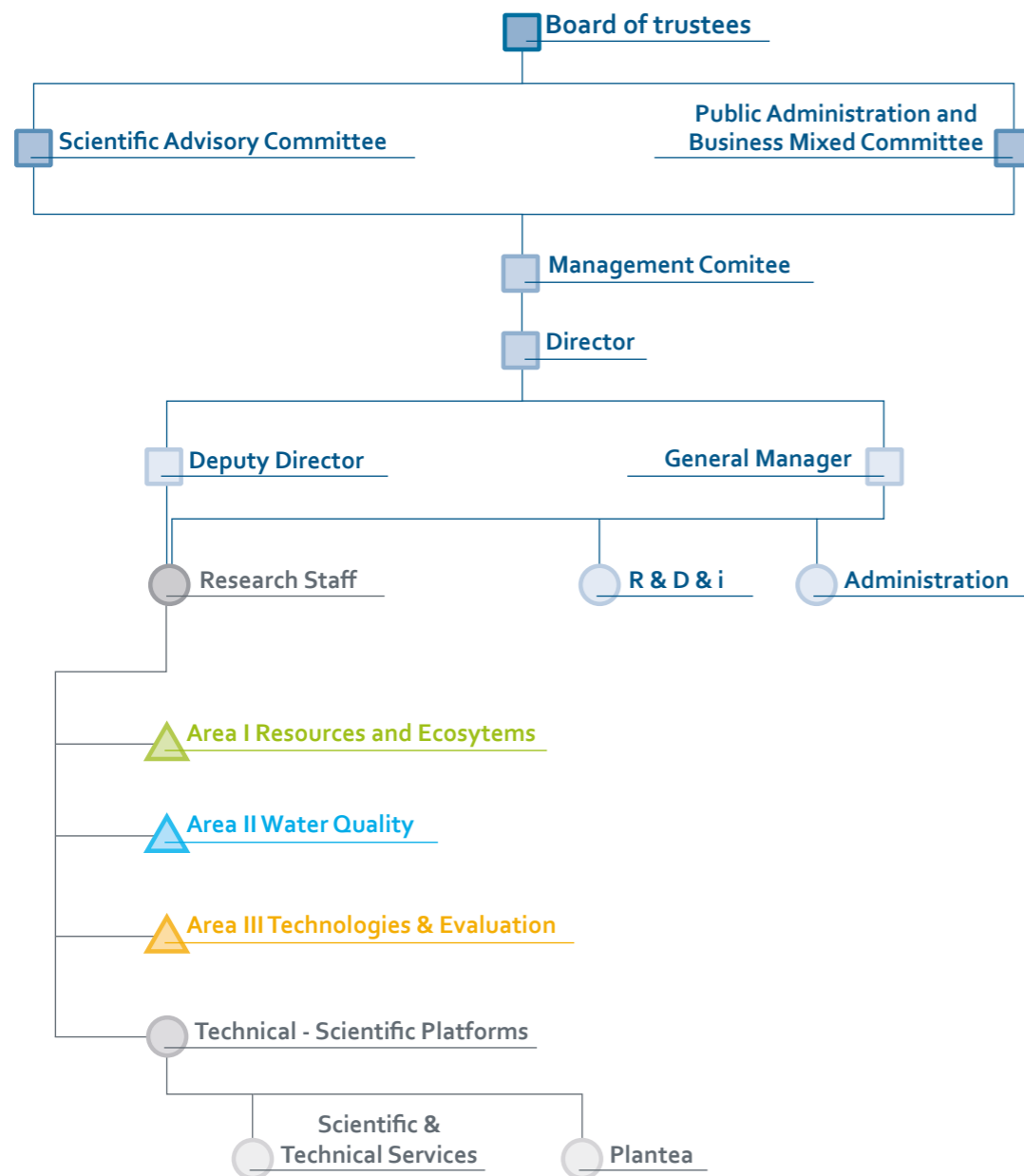
R&D&I OFFICE

TECHNICAL AND SCIENTIFIC PLATFORMS

BOARD OF TRUSTEES

The Board of Trustees is ICRA's highest governing body. The trustees are the Ministry of Research and Universities of the Catalan Regional Government (REU), the Catalan Water Agency (ACA) and the University of Girona (UdG).

In 2021, the ICRA Board of Trustees has met once in ordinary session on 02/06/2021.



MEMBERS

CHAIR

Ramon Tremosa (until April)

Minister for Business and Knowledge
Regional Government of Catalonia

Lluís Ridao (until August)

Director of the Catalan Water Agency
Catalan Water Agency
Ministry of Territory and Sustainability
Regional Government of Catalonia

PRESIDENT

Gemma Geis (since May)

Minister of Research and Universities
Regional Government of Catalonia

Samuel Reyes (since September)

Director of the Catalan Water Agency
Catalan Water Agency
Ministry of Climate Action, Food and Rural Agenda
Regional Government of Catalonia

DEPUTY CHAIR

Joaquim Salvi

Rector
University of Girona

TRUSTEE SECRETARY

Lluís Rovira

Director of CERCA (Catalan Research Centres)
Ministry of Research and Universities
Regional Government of Catalonia

MEMBERS

Francesc Xavier Grau i Vidal

Secretary for Research and Universities
Ministry of Research and Universities
Regional Government of Catalonia

Joan Gómez Pallarès

Managing Director of Research
Ministry of Research and Universities
Regional Government of Catalonia

Anna Albar

Managing Director
Science and Technology Park
University of Girona

Josep Calbó

Vice-rector of Strategic Projects
University of Girona

NON-TRUSTEE DEPUTY SECRETARY

Josep M. Alcoberro

Legal advisor of CERCA (Catalan Research Centres)
Ministry of Research and Universities
Regional Government of Catalonia

SCIENTIFIC ADVISORY COMMITTEE

The **Scientific Advisory Committee** is appointed by the Board of Trustees and includes an unspecified number of scientists of acknowledged repute and expertise in the field of water and all other related areas of science. This Committee's membership represents the ICRA's different priority areas of research. One of its most significant tasks is to ensure the quality of the research carried out at the ICRA. Accordingly, it acts as an advisory body for all issues relating to the scientific activities submitted for its consideration and, when requested, it will also act as an evaluating body for these activities. On April 22, a meeting was held to present the proposal of the new Strategic Plan of the entity for the years 2021-2030, as well as the proposal for the reformulation of the entity's lines of research, which was supported by a SWOT analysis.

Members of the Scientific Committee



Bernd Bilitewski

Chair of the Scientific Advisory Committee. Emeritus Professor of the Institute for Waste and Pollutant Management, Dresden University of Technology (DE).



Jeanne Garric

Director of the Ecotoxicology Laboratory, Aquatic Ecosystems Biology Unit, Department of Water Quality and Pollution Prevention, INREA (National Institute of Agricultural Research) (FR).



Clifford Dahm

Emeritus Professor of Department of Biology, University of New Mexico, Albuquerque (USA)



Jörg Overmann

Director of the Leibniz-Institute German Collection of Microorganisms and Cell Cultures (DSMZ) and Head of the Department of Microbial Ecology and Diversity Research, Leibniz Institute (DE)



Amadeo Rodríguez Fernández-Alba

Head of the European Reference Laboratory for Pesticides and Faculty member of the Department of Hydrogeology and Analytic Chemistry, University of Almería, Almería (ES)



Maria Reis

Full Professor in Environmental Biotechnology, Department of Chemistry, Sciences and Technology Faculty, NOVA University Lisbon (UNL) (PT)



Peter Vanrolleghem

Holder of the Canada Research Chair on Water Quality Modelling (modelEAU) and Professor of the Department of Civil Engineering and Water Engineering, Université Laval, Quebec (CA).



Fang Wang

Professor, Institute of Soil Science, Chinese Academy of Sciences (CN).



Paola Verlicchi

Professor in Environmental and Sanitary Engineering, Engineering Faculty, Department of Engineering, University of Ferrara (IT)



Yolanda Picó García

Full Professor, University of Valencia, Desertification Research Centre (CIDE) (ES)



Stan Gregory

Emeritus Professor, Department of Fisheries and Wildlife, Oregon State University (USA)



Krishna Pagilla

Ralph E. & Rose A. Hooper Engineering Professor and Chairman, Civil and Environmental Engineering Department and Director of the Nevada Water Innovation Institute, University of Nevada.



Susan D. Richardson

Professor of Chemistry, Department of Chemistry & Biochemistry, University of South Carolina (USA).



Despo Fatta-Kassinou

Associate Professor, Director of Nireas-IWRC, Department of Civil and Environmental Engineering and Nireas International Water Research Center (Nireas-IWRC), University of Cyprus (CY).

PUBLIC ADMINISTRATION AND BUSINESS MIXED COMMITTEE

The Public Administration and Business Mixed Committee is the body for business participation in the Foundation. It may be consulted by the Board of Trustees and by the director and may issue recommendations for guidance.

The ICRA Board of Trustees met in June 2021 and agreed to renew all the members of the Public Administration and Business Mixed Committee, incorporating representatives of the most representative companies and associations of the sector, as well as the appointment of a new chairman.

On July 19, 2021, the new members of the Committee met in an online meeting where a general presentation of ICRA was made by the management and ICRA researchers.

The functions of the Public Administration and Business Mixed Committee are:

- Assisting in detecting industry needs and suggesting specific business proposals.
- Identifying attractive technology development opportunities.
- Promoting participation in joint research projects and facilitate access of the Foundation to public and private resources.
- Assisting in the creation of spin-offs.
- Participating in activities related to the Foundation's objectives.

MEMBERS



Jordi Agustí
Chair of the Business Committee
Manager (Consorci d'Aigües Costa Brava Girona)



Amadeu Ros
Chair (Associació Catalana de Comunitats de Regants - ACATCOR)



Carlos Montero
General Director (CETAQUA - Water Technology Centre, Private Foundation)



Lara Duro
CEO (AMPHOS 21 Group, SL)



Xavier Amores
Director (Catalan Water Partnership - CWP)



Joan Sanz
Technical Direction (VEOLIA - Water Technologies)



Teresa de la Torre
Head of R&D Purification and Reuse - ACCIONA (until august 2021)



Begoña Martínez
Territory Manager (Besòs-Tordera Consortium)

DEPARTMENTS & STAFF



DIRECTOR
Damià Barceló
Research Professor of the Institute of Environmental Assessment and Water Studies (IDAEA), of the Spanish National Research Council (CSIC).



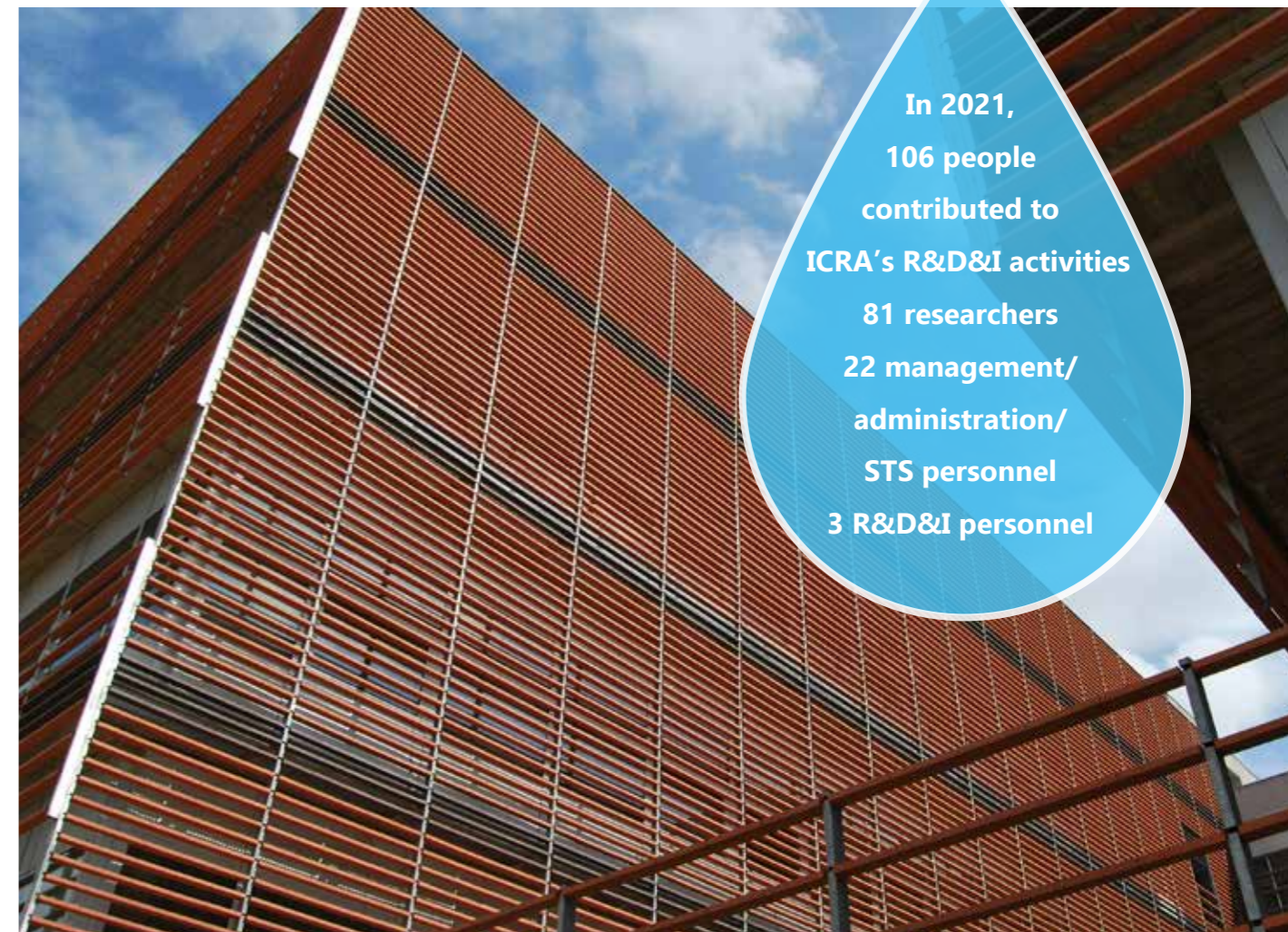
DEPUTY DIRECTOR
Sergi Sabater
Full Professor of Ecology at the University of Girona



GENERAL MANAGER
Iván Sánchez
General Manager



EXECUTIVE SECRETARY
Olga Corral
Executive Secretary, Director's Office



In 2021,
106 people
contributed to
ICRA's R&D&I activities
81 researchers
22 management/
administration/
STS personnel
3 R&D&I personnel

R&D&I SUPPORT SERVICES

The General Manager of ICRA is responsible for all the basic services that provide support for R&D&I:

- Administration
- R&D&I Office
- Technical and scientific platforms:
 - > Scientific and Technical Services (STS)
 - > PLANTEA

ADMINISTRATION

In 2021, the active administrative services that performed specific functions within each field of activity were:

- Human Resources
- Purchasing and Procurement (Outsourcing)
- Finance and Accounting
- Information Technologies
- Communication, Image and Promotion
- Quality and Environment
- General Services

The **Outsourcing Service** has managed three types of contracts: services, supplies and construction, with the objective of providing ICRA's three research areas and the STS with both basic and special scientific equipment.

This equipment has been 50% co-financed by the EU's European Regional Development Fund (ERDF)

under the Catalan ERDF Operative Programme 2007-2013 and it also received funding from MINECO (the Spanish Ministry of Economic Affairs and Digital Transformation), directly and through the Third Additional Provision (DA3a) of the Catalan Statute of Autonomy.

General Manager - Iván Sánchez
 Executive Secretary, Director's Office - Olga Corral
 Human Resources Head - David López
 Ecofin Head - Susana Roca
 Accounting and Support to Research - Janina Manrique
 Administration Technician - Laura Sancho
 Administration Officer - Yamila Zambrano
 IT Head - Rubén Díaz
 Reception - Pere Royo, Sandra Monleón
 Reception (non laboral ICRA) - Alba Martín
 Administration visiting student - Ayub Ahammar,
 Internship Student, Montilivi HS (Girona)



R&D&I OFFICE



Jaume Alemany
R&D&I Office Manager



Laura Bertolini
European and International Project Officer



Rina Weltner
Project Manager

Objectives and activities of the R&D&I Office

The R+D+I Office aims to contribute to increase the capacity of the ICRA in order to obtain and execute research projects and to gain international prestige from obtaining external funding and establishing international alliances. The Office helps researchers to increase their participation in basic and applied research projects, at both national and international level, and to increase their relationship with the productive and industrial sector for the implementation of research results.

The Office helps researchers from ICRA in the definition and implementation of a strategy for their participation in public calls for research funding at local, national and international level. From the Office we offer our researchers help in finding calls, for preparing and submitting proposals, and we also offer them advice on financial and legal issues relating to calls. Finally, the Office also provides support for the administrative and financial management of the projects granted and the contracts for the transfer of knowledge with local, national or international companies.

In terms of national funding, a total of 22 proposals were submitted to Spanish and Catalan funding agencies in 2021. Nine of them were awarded for a total amount of €1.57 million. At this moment, 2 proposals from 2021 calls are still pending its resolution for a global amount of €351 million.

In 2021, the National Projects Unit managed a total of twenty-three research projects, seventeen of them funded by the Spanish State Research Agency and the Spanish Ministry of Science, Innovation and Universities (AEI-MCIU), and six funded by the Secretariat of Research and Universities of the Catalan Government. Also, this unit managed 22 fellowship grants (thirteen funded by AEI-MINECO and nine funded by the Catalan Government), and two networking projects also funded by the Catalan Government.

As for the Knowledge and Technology Transfer Unit (KTT), a total of nine collaborative contracts were signed with private companies and public entities

during 2021, a total amount of €368,000. During the period of the COVID-19 pandemic (2019-2021) the number of projects remained stable. The average budgeted per project (€41 million) in 2021 slightly increased from 2020.

Regarding IPR management, three assets emerging from research results have been evaluated in collaboration with researchers (inventors) for protection and possible future commercialization. ICRA, jointly with ICREA, applied for a European patent related to electrodes for water treatment. Finally, ICRA, in collaboration with the University of Girona, are in the process of creating a spin-off company related to a European patent on recycling inverse osmosis membranes.

Only in the last 5 years (2016-2021) more than 100 European proposals were presented with ICRA presented as coordinator, 29 of which were successful (around 25% success rate).

Among them, 10 H2020 and Horizon Europe collaborative projects (EMERGE, SCOREwater, HYDROUSA, DWC, DRYver, iWAYS, MULTISOURCE, EdiCitNet, MERLIN and SmartWaterTwin), 3 Marie Skłodowska-Curie Actions Innovative Training Networks (Nowelties and inventWater as coordinator, MANTEL as beneficiary) 5 Marie Skłodowska-Curie Actions Individual Fellowships (RESOURCE, MICROWATER, SCHEME, ENVIROSTOME and Smart Workflow), 1 ERC Starting Grant (ELECTRON4WATER) and 2 projects funded by the LIFE programme (LIFE NEWBIES and LIFE RECYCLE) for a total of almost 9 million euros.

In these last 5 years ICRA has also been successful in obtaining funding from the Spanish Ministry participating in joint programming and COFUND initiatives. At the moment we are running 3 of these projects: PhageLand as coordinator (Joint Programming Initiative on Antimicrobial Resistance, JPIAMR), ARENA (AquaticPollutants Joint Transnational Call 2020) and SAFE (Programme for Research and Innovation Solutions in the Mediterranean region, PRIMA), for a total of 0.6 million euros.

TECHNICAL AND SCIENTIFIC PLATFORMS

Since one of the objectives of ICRA is to transfer knowledge and provide practical solutions, the Scientific and Technical Services (STS) provide analytical services and PLANTEA for scaling up processes to pilot plant scale.

THE PLATFORMS ARE THE FOLLOWING:

SCIENTIFIC AND TECHNICAL SERVICES (STS)

After an atypical period affected by the impact of COVID, the year 2021 meant a full return to normal activity for the Scientific and Technical Services (STS). The Catalan Institute for Water Research (ICRA), and by extension the STS, adapted to the restrictions and regulations required by the health crisis without reducing the quality of the service provided.

During the course of 2021 we were able to undertake many of the projects that had been initiated and subsequently postponed during the previous year, while at the same time responding to requests arising from new calls for tender for research and knowledge transfer, both public and private. This well-developed reactivity was aided by the renovation of our pool of **server computers**, together with **data acquisition and processing software** for scientific equipment such as a total organic carbon (TOC) analyser, a combined liquid chromatograph and mass spectrometer (TSQ Vantage), an ion chromatograph (IC), a chemical oxygen demand (COD) evaluator and a discrete analyser.

During the course of this year we also launched the **Biological Safety Cabinet** for handling and weighing toxic and cytotoxic substances, and which is currently located in an area that is carefully controlled to ensure the safety of the users of the infrastructure. For this purpose we have approved a standard operating procedure that includes all the guidelines required for the correct use of this unique facility.

In line with ICRA's commitment to the continual renewal of its equipment, during the course of 2021 the acquisition of a new **real-time thermal cyclor** was also completed. This purchase not only reinforces the Institute's determination to continue to be a benchmark for resistome studies, but also allows for the in-house identification of the different variants of SARS-CoV-2 that have appeared during the course of 2021 within the structure of the Surveillance Network of which ICRA is the coordinator.

Following the same strategy of updating equipment concerning the need to ensure access to the most innovative technology, we have acquired a **combined gas chromatograph and triple quadrupole mass spectrometer**, which includes a module for automated solid phase micro-extraction (SPME). This equipment has enabled us to develop new methodologies for identifying disinfection by-products (DBPs), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), triclosan, metabolites and nitrosamines.

We also acquired a **combined liquid chromatograph and high-resolution mass spectrometer** (LC-HRMS), Orbitrap Exploris 120, with which we aim to launch a pioneering service for the non-target analysis of organic compounds in water samples, for both internal and external projects. In terms of technological transfer, the Mass Spectrometry Unit (MSU) will make this service available to private companies and public entities that do not have the necessary analytical capacity and experience, thus ensuring that scientific and technological progress is available to a larger number of users.

In parallel with the above developments, during the course of 2021 we concluded the contractual procedure for the acquisition of a **pyrolyser installed in a combined gas chromatograph and single-quadrupole mass spectrometer** with a view to the exploratory analysis of microplastics, an application of the greatest possible interest in view of the problems of environmental pollution that microplastics represent at a global level.

On the occasion of the call for competitive applications in order to aid for the acquisition of scientific and technical equipment financed by Next Generation EU funding, the Scientific and Technical Services participated by proposing an ion chromatograph (IC) with multiple detection capacities: high-resolution mass spectrometry (HRMS), conductivity (CD) and ultraviolet visible (UV/VIA). Although this application was refused, the equipment requested can be considered as contributing to the consolidation of the services to be provided, and will consequently be proposed for future rounds of applications.

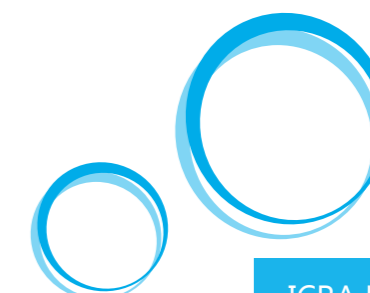
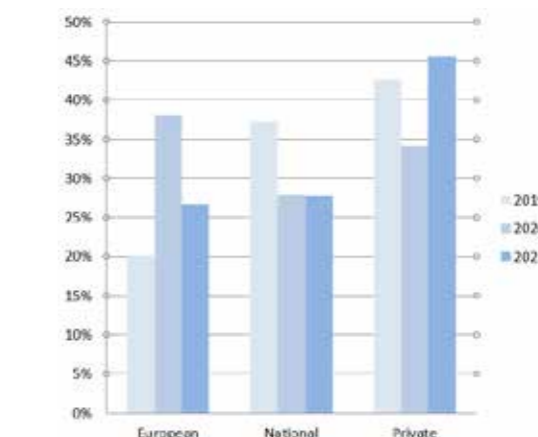
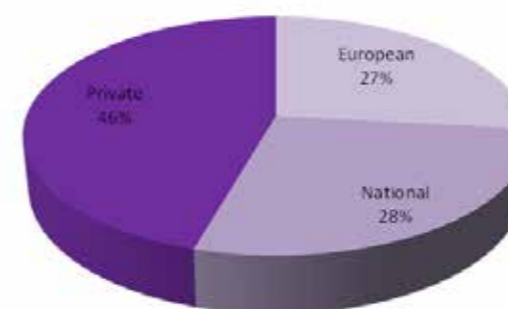
On the subject of consolidation of infrastructures, through its Scientific and Technical Services ICRA forms part of the GINYS ("Widgets") Project promoted by the Institute of Catalan Research Centres (I-CERCA) Foundation. The main aim of the programme protocol is to create a platform to access the scientific and technical infrastructures and/or services derived from the CERCA system, both for the participants in the project and for private requests.

It is an opportunity to apply common logic with a view to sharing good practices, optimising resources, gaining access to financing for maintenance and/or repair operations and seeking out resources to perpetuate this collaborative framework even after the completion of the project.

Finally, in addition to the investment in scientific and technical equipment, we have also expanded the human resources making up our STS team. To this end, Dr Mira Celic joined us in September 2021 as a temporary support assistant in the MSU.

TECHNOLOGY TRANSFER

The overall financial allocation for 2021 arising from STS activities for the carrying out of analytical requests can be divided into three sources of funding: domestic projects, European projects and external collaborations (with the private sector). As can be seen from the figure below, the work dedicated by our STS to internal projects is broadly similar to that allocated for the management of private requests (46%), which shows the extent to which the STS is establishing itself as a platform for external services.



ICRA Head of STS:

Sara Insa Aguilar
(Chemical Analysis Unit)

Àlex Sánchez Melsió
(Biological and Molecular Techniques Unit)

Diana Álvarez Muñoz
(Mass Spectrometry Unit)

ICRA STS Technicians:

Olga Montojo Jordan

Natalia Serón Mallo

Irene Latorre García

Mira Celic



WATER SCIENCE AND TECHNOLOGIES-RESEARCH PLATFORM (PLANTEA)

The Catalan Institute for Water Research (ICRA) is the home of the Water Science and Technologies-Research Platform (PLANTEA).

The Water Science and Technologies-Research Platform (PLANTEA) is a space where research and industrial development projects can be carried out with pilot plants of different sizes (up to semi-industrial scale).

These pilot plants make it possible to carry out research projects on advanced treatment of both wastewater and treated water or water that can be made potable, and on projects for monitoring, eliminating, and evaluating the effects of contaminants in water, as well as studies that require large-scale equipment.

This facility has been 50% co-financed by the EU's European Regional Development Fund (ERDF) under the Catalan ERDF Operative Programme 2007-2013, and it also received funding from MINECO (Spanish Ministry of Economic Affairs and Digital Transformation) directly and through the Third Additional Provision (DA3a) of the Catalan Statute of Autonomy.

SCIENTIFIC-TECHNICAL PLATFORMS

The PLANTEA test platform currently provides ICRA with benchmark facilities for carrying out three different aims:

- The study of wastewater transport and treatment systems in conditions as similar as possible to the real world (pilot plants).
- The study of the response of fluvial ecosystems in different conditions thanks to the installation of an experimental stream facility (ESF).
- An artificial aquatic mesocosm ecosystem that makes it possible to carry out studies on exposing organisms such as mussels and/or fish to chemical contaminants.



LAB AND PILOT SCALE PLANTS AT PLANTEA UNIT (LABORATORY L06 AND HYDROPONICS PILOT)

During 2021 there have been several pilot plants in operation in the PLANTEA platform to mimic wastewater and water treatment systems.

Within the context of the ANTARES project, funded by the State Research Agency (Spanish Government), an anaerobic membrane bioreactor (AnMBR) has continued its operation. The reactor focuses on the anaerobic treatment of municipal wastewater with the aim of enhancing the biodegradation of certain micropollutants. To achieve this, graphene oxide has been added to the reactor under different concentrations to study the effect of this conductive material and the anaerobic biomass. Results indicate an improvement in the degradation of certain pollutants. This is currently being explored in batch. The operation of this reactor is ongoing to test the effect of organic loading and the presence of sulphate.

Regarding oxidation technologies, PLANTEA counts with equipment to carry out lab-scale ozonation and UV based oxidation processes (medium pressure mercury lamps, low pressure mercury lamps), enabling to study traditional and novel advanced oxidation processes (UV/persulfate, UV/HOCl). Finally, on pilot scale a 254nm UV installation is available for up-scale trials.

Also, an automated filtration unit for testing ceramic micro and ultrafiltration has been operated during 2021 in the context of the Nowelties project. The ozonation set-up and the ceramic filtration set-up can also be operated in an integrated manner to research catalytic ozonation.

In the framework of the circular economy pillars, the feasibility of nature-based solutions (NBS) is being explored for reuse, including the irrigation of crops in cities for more sustainable food production in the CLEaN-TOUR (2018-2021) and ReUseMP3 (2021-2024) projects. In more detail, two hydroponic constructed wetlands have been operated. The first one is installed at the Hotel Samba (Lloret de Mar) with ornamental and edible plants (although it was on stand-by most of 2021 because of COVID). At the same time, a new hydroponic pilot plant was built at ICRA's PLANTEA laboratories. It is made up of several lines that can work in parallel, with distinct influent water, and sensors for temperature, humidity, and light intensity. Its operation has been also evaluated coupled to forward osmosis hollow fiber membranes. Other irrigation and/or NBS systems are being designed/evaluated at ICRA itself (vertical wall irrigated with greywater) and/or in other field sites (e.g., urban gardens, municipal gardens, and crops).

The PLANTEA laboratory has unique facilities that allow us testing different wastewater transport and treatment technologies and processes. The fact that has a direct connection to a sewage pumping station facilitates the use of real wastewater for the experiments conducted in the PLANTEA pilot plants. There are three pilot scale sewer systems simulating two rising mains from a sewer network and one gravity section, which are being operated to study the biochemical transformations occurring in these systems. These installations, the first of their kind in Europe, allow researchers to investigate why and how sulphide and methane form during wastewater transport and how their formation can be prevented. Also, PLANTEA offers the possibility of operating 5 reactors to investigate different wastewater treatment processes. All these installations are fully monitored and controlled by different PLC systems connected to a SCADA program, allowing real-time control of the processes taking place in each of the pilot plants. This is possible thanks to the numerous monitoring systems in PLANTEA facilities, such as dissolved oxygen, pH, redox, nitrate and hydrogen sulphide sensors and online gas analysers for the online monitoring of two potent greenhouse gases, nitrous oxide and methane.

Finally, it is worth mentioning the wide set of commercial and custom-made apparatus for field studies, such as several refrigerated autosamplers, a multi-hood system for online monitoring of greenhouse gas emissions from bioreactors, online ion-selective electrodes, etc., that allow us to conduct a wide range of experimental field work in all the parts of the urban wastewater system.

THE EXPERIMENTAL STREAMS FACILITY MAKES IT POSSIBLE TO SIMULATE THE RESPONSE OF FLUVIAL ECOSYSTEMS TO DIFFERENT ENVIRONMENTAL CONDITIONS

Experiments at the facility were postponed to 2022 due to the COVID-19 pandemic. Although activities began on a tentative basis in late May 2020, it was decided that the facility would not initiate any experimental processes, given that it was impossible to guarantee the continuity of the experiments in the context of the pandemic. We also took into account both the high financial costs and the weeks of work involved in launching this experiment, with the result that the launch was temporarily postponed until 2022, subject to the stabilisation of the situation concerning the pandemic.



ARTIFICIAL AQUATIC ECOSYSTEM

Under the scope of the project PLAS-MED, the fluvial mesocosms of the Experimental Streams Facility (ESF) of ICRA have been used to perform exposure experiments with river biofilms using emerging contaminants, namely pharmaceuticals and personal care products. Two studies were conducted, which aimed to understand the impact of antibiotics and/or a bactericide (triclosan) on the toxicity, bioaccumulation and biotransformation of emerging contaminants on river biofilms.

Artificial mesocosms were used to perform two short-term exposure experiments:

- Experiment 1, which consisted in the exposure of river biofilm to three concentrations of the antibiotic clarithromycin for 7 days. In the experimental setup, stones colonized with river biofilm collected directly from a non-impacted stream were exposed to 4 different conditions: a) control, without addition of contaminant; b) an environmental relevant concentration of clarithromycin (0.5 µg/L); c) a low concentration of clarithromycin (5 µg/L); d) a high concentration of clarithromycin (50 µg/L) (Figure 1).



Figure 1 - Artificial mesocosms used for the exposure experiment of river biofilms to clarithromycin.

Biofilm samples were collected at the end of the exposure experiment (day 7) for the analysis of clarithromycin, quantification of resistance genes and determination of ecotoxicological parameters (e.g., photosynthetic activity, metabolism, extracellular enzymatic activity, extracellular polysaccharide matrix (EPS), etc.). Water samples were also collected every 24 hours to monitor the concentration of clarithromycin in the water and to analyse the nutrients balance.

Preliminary results showed that river biofilm has the potential to accumulate clarithromycin and the concentration of clarithromycin in biofilm increased with the increment of the exposure concentration. A decrease in the EPS concentration was observed in the high exposure concentration (50 µg/L).

- Experiment 2, in which river biofilm was exposed to two antimicrobials, individually and in combination, for 5 days, followed by an equivalent recovery period. Namely, sulfamethoxazole (antibiotic) and triclosan (bactericide) were used to address the potential of the latter in the development and spread of antibiotic resistance genes (ARGs) within natural microbial communities, and its reversibility upon removal of chemical stressors. Two concentrations of triclosan were tested (10 and 100 µg/L) alongside with the antibiotic (10 µg/L). Preliminary results show potential bioaccumulation of triclosan (up to 261 ng/g dw) and sulfamethoxazole (up to 369 ng/g) in river biofilms. Furthermore, the bioaccumulation of triclosan and its main biotransformation product seems enhanced with co-exposure to sulfamethoxazole. Also, after the recovery period, triclosan was not fully eliminated from biofilms. Altogether, these preliminary results highlight potential interactive effects in the biofilm resistome, which will be further studied.

CATALAN SURVEILLANCE NETWORK OF SARS-CoV-2 IN SEWAGE

The Catalan Institute for Water Research (ICRA) is coordinating the Catalan program for the surveillance of SARS-CoV-2 in sewage. SARSAIGUA started in July 2020 by monitoring 56 WWTPs that assist 193 municipalities, representing 80% of the Catalan population. Within less than 72 hours, weekly samples are collected, analyzed, and the results are reported to Health Authorities and finally published in an online dashboard (<https://sarsaigua.icra.cat>). After 19 months of monitoring (July 2020 - January 2022), the normalized daily loads of SARS-CoV-2 genes in the 56 WWTPs monitored fairly matched the sum of COVID-19 cases along the successive pandemic waves. Moreover, a good fit was obtained between the aggregated viral load (gen copies/day/100,000 inhabitants) and the epidemiological evolution of diagnosed cases in the municipalities served by the monitored WWTPs (Pearson regression coefficient = 0.59). In November 2021, SARSAIGUA started the monitoring of SARS-CoV-2 variants by sequencing sewage samples every two weeks using Oxford Nanopore Technology and ARCTIC Primers targeting the S gene. The deployment of this sequencing approach has allowed to track the introduction and spread of the Omicron variant and the concomitant wane of the Delta variant across the territory. It should be noted that all data generated is free for scientific use, and it can be downloaded from a public repository at the Zenodo website (<https://doi.org/10.5281/zenodo.4147073>).

SARSAIGUA is a collaborative project promoted and funded by the Public Health Agency of Catalonia (ASPCAT) and the Catalan Water Agency (ACA) from the Catalan government. Laboratories involved in the surveillance network are: i) the Enteric Virus Laboratory, led by Prof A. Bosch and Prof R. Pintó (UB, Barcelona); ii) the Laboratory of Viruses Contaminants of Water and Food, led by Prof R. Gironés and Dr S. Bofill (UB, Barcelona); and iii) the Center for Omic Sciences from the Biotech Area of the Eurecat Technology Centre (Reus, Tarragona).

HR EXCELLENCE IN RESEARCH AWARD

In December 2015, the Catalan Institute for Water Research (ICRA) received the HR Excellence in Research Award from the European Commission.

This award and its logo recognise that ICRA endorses the policies and practices of the Human Resources Strategy for Researchers (HRS4R), established by the European Commission to implement principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of researchers (Charter & Code).

In December 2018, ICRA performed Internal Review for the HRS4R Interim Assessment.

Work is also being done integrating the OTM-R Policy (Open, Transparent and Merit-based Recruitment of Researchers) into ICRA's HR Policy.



HR EXCELLENCE IN RESEARCH

Since the last CERCA Assessment, ICRA has started a long process of internal reflection on its mission, which has led to the reformulation of the present research lines. This new arrangement was already presented and discussed during the meeting with the Scientific Advisory Board in April 2021, and later presented to the Board of Trustees in June 2021. This reordination was accompanied by a SWOT reflection, which was organized in a bottom-up approach, including not only the research areas but also the administration and technical support areas of the Institute.

The obtained interaction and feedback have resulted in the new formulation, which needs to be seen as an update of the current research aims of ICRA, and also a response to the recommendations given during the last evaluation.

The present formulation stresses that ICRA is particularly interested in addressing the impacts of water scarcity along with the aspects of quality in water treatment and reuse, dedicating attention primarily to the Mediterranean area. ICRA's new formulation is then adapting its current Research Plan, which remains structured in three research areas:



04

RESEARCH AREAS

▶ RESOURCES AND ECOSYSTEMS

LINES

- R&E1. HYDROLOGICAL PROCESSES AND WATER RESOURCES
- R&E2. AQUATIC BIOGEOCHEMISTRY
- R&E3. BIODIVERSITY AND FUNCTIONS OF AQUATIC ECOSYSTEMS
- R&E4. FRESHWATER-RELATED ECOSYSTEMS SERVICES & NATURE-BASED SOLUTIONS

▶ WATER QUALITY

LINES

- WQ1. CHEMICAL CONTAMINANTS AND MICROPLASTICS IN THE AQUATIC ENVIRONMENT
- WQ2. CHEMICAL CONTAMINANTS IN WATER TREATMENTS
- WQ3. WATER MICROBIOLOGY
- WQ4. WATER AND HUMAN HEALTH

▶ TECHNOLOGIES AND EVALUATION

LINES

- T&E1. CONVENTIONAL AND ALTERNATIVE WATER SUPPLY
- T&E2. WASTEWATER TRANSPORT, TREATMENT AND MANAGEMENT
- T&E3. NEXT-GENERATION AND NATURE-BASED TECHNOLOGIES
- T&E4. MODELLING, ASSESSMENT AND DECISION SUPPORT FOR URBAN WATER SUSTAINABILITY AND RESILIENCE



RESOURCES AND ECOSYSTEMS RESEARCH AREA



LINES

- ▷ R&E1. HYDROLOGICAL PROCESSES AND WATER RESOURCES
- ▷ R&E2. AQUATIC BIOGEOCHEMISTRY
- ▷ R&E3. BIODIVERSITY AND FUNCTIONS OF AQUATIC ECOSYSTEMS
- ▷ R&E4. FRESHWATER-RELATED ECOSYSTEMS SERVICES & NATURE-BASED SOLUTIONS



1 Technical Support Personnel
Carmen Gutiérrez

27 RESEARCHERS IN THE AREA

Group leader
Vicenç Acuña

2 research professor (UdG associated)
Sergi Sabater
Josep Mas Pla

1 research professor (UdL associated)
Ramón Batalla

2 Research Scientists

Vicenç Acuña
Rafael Marcé

7 Postdoc Researchers

Anna Freixa
Julio César Lopez
Didac Jorda
Daniel Augusto Mercado
Elisabet Tornés
Laura Jiménez
Ernesto Pasten

3 Predoctoral Researcher

Oriana Llanos
Paula Córdoba
Daniela Henry

11 Research Technicians

Joana America Castellar
Adrià Riu
Joan Saló
Laia Verdura
Noel Carrión
Zineb Moumen
Geraldine Backman
Elisabet Sañe
Jaime Ordóñez
Xavier García
Nils Gutiérrez

1 Support Research Technician

Ventura Campillo

RESOURCES AND ECOSYSTEMS RESEARCH AREA

The activities of the ICRA Resources and Ecosystems area have been developed through projects that are coming to an end this year and with the start of new projects and activities with companies and public bodies. Postdoctoral researchers (Drs. J. C. López, E. Tornés, A. Freixa, E. Pastén-Zapata, D. Mercado, J. Castellar, N. Perujo, Z. Moumen, X. Garcia) have contributed to research projects in the area, as well as research technicians (A. Riu, C. Gutiérrez, N. Gutiérrez, J. Saló, V. Campillo) and some postgraduate students working on their doctorates (O. Llanos, G.P. Córdoba-Ariza, L. Verdura) or having a research stay.

In 2021, the lines of research have been modified in accordance with the projects that have defined them in recent years and in the projection expected for future ones. Hydrological processes have continued to be studied with the gathering of field data regarding the availability and quality of water resources. Specifically, different components of the hydrological cycle have been monitored in the Onyar river basin and the study of the presence and transport of pollutants of agricultural origin (nitrate, pharmaceuticals, antibiotics, resistance genes) has been continued in the aquifers of Osona and Baix Fluvià.

In the new line of aquatic biogeochemistry, new tools have been developed for the prediction of the water quality in river networks, lakes and reservoirs in the context of international projects. These have also considered the effects of climate change on water quality and ecosystem services. In this context, carbon emissions in dry lakes continue to be an active line of research in the group and has a large international projection.

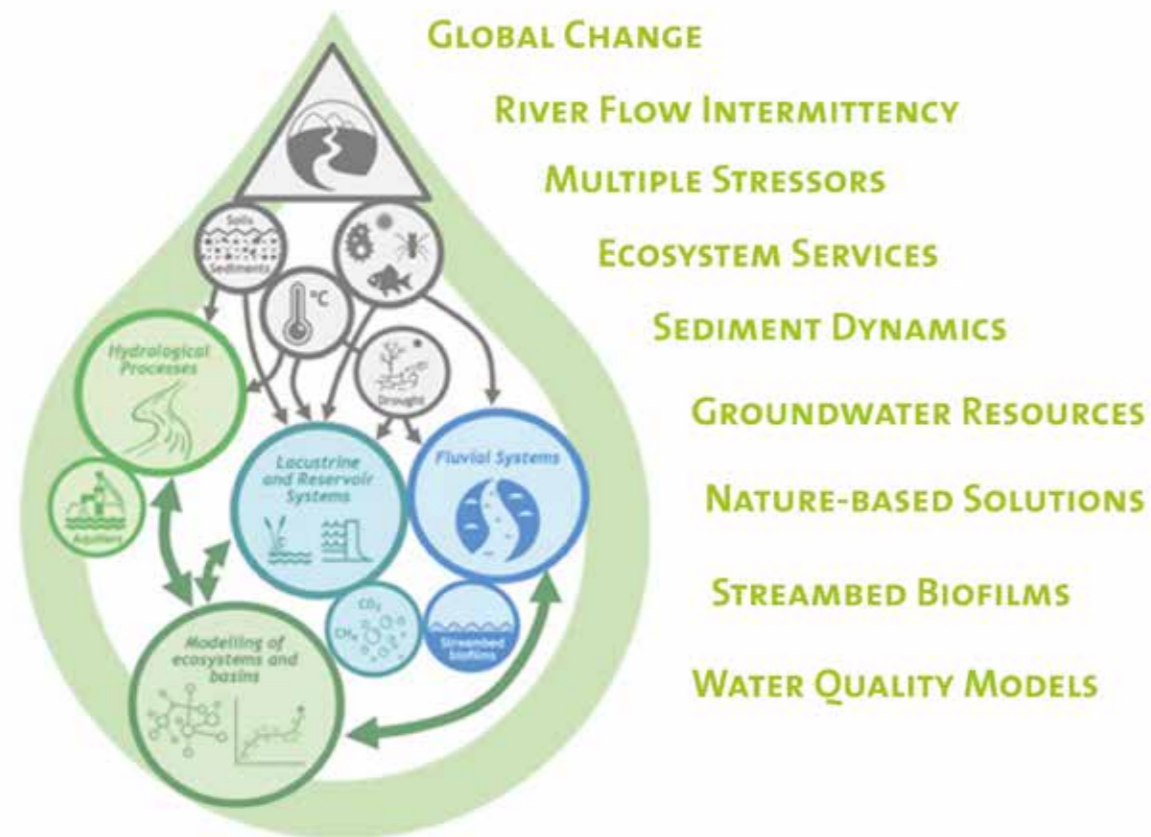
In relation to research in biodiversity and functional ecology, work has progressed in the research on the relationship between stressors and ecological responses in rivers through the study of nutrient balances and the impact on bacterial and algal communities. In this sense, altogether with fieldwork, advances have been made on the modeling of different ecological parameters which, once completed, will allow the interpretation of the effects of environmental pressures. These ecological dynamics are studied in different projects, each of which aims at various aspects of the stress-response relationship in river biodiversity. Moreover, the effects of variations in the pollutant load of rivers on the quality of food webs have also been published.

The line of research related to the ecosystem services of freshwater aquatic systems and the application of "nature-based" solutions is developed in five projects, one of which with the participation of the ACA. These studies involve the development of models to assess the quality of ecosystem services in different scenarios of environmental pressures, especially those affecting surface water quality. In collaboration with other areas of ICRA, an online tool has been created to recommend which nature-based solution is optimal for wastewater treatment, while considering the socio-environmental context.

The detailed content of each area highlights the progress of previous projects and how in 2021 was possible to start new projects that indicate the scientific evolution in these new lines of research.



Oriana Llanos – Carmen Gutiérrez – Laia Verdura – Josep Mas – Joan Saló – Xavier Garcia – Rafael Marcé – Vicenç Acuña – Nonito Ros – Anna Freixa – Paula Gabriela Córdoba – Daniel Mercado – Javier Ortiz – Sergi Sabater – Daniela Henry



The lines of research of the Resources and Ecosystems area are:

R&E1. HYDROLOGICAL PROCESSES AND WATER RESOURCES

In this area, during 2021 work has continued to monitor the flow at the Vernegà hydrometric station (Gavarres massif) to obtain data for this intermittent course, with the aim of assessing the hypothetical effects of flow reduction on the community of invertebrates. The sampling point has been re-equipped with pressure sensors, and it is also planned to use it to test state-of-the-art hydrometric sensors. The team has installed three more hydrometric points in the drainage network of the Onyar river basin and six wells has been instrumentalized with sensors for the groundwater head level, temperature and electrical conductivity measurements to analyze the effects of land use, ecological quality and climate change on the circulating flow and water balance of the basin.

the context of the PACE-IMPACT project in the Baix Fluvià, Onyar and Osona field sites. Interdisciplinary work with the ICRA Quality area has established the relationship between the presence of antibiotics and certain compounds of groundwater dissolved organic matter. At the same time, the risk of the presence of antibiotics in the subsoil has been assessed, both for organisms that may meet groundwater and for their ability to generate microbial resistance. In association with antibiotics and resistance genes, work has continued the GW-Gen project with the aim of presenting a competitive project.

In relation to groundwater quality, research has been done on the interpretation of pharmaceutical products and antibiotic transport processes in aquifers in

The team has continued to publish research papers on hydrogeomorphological and hydrogeological processes and works on national and international collaborations with the aim of helping to consolidate and internationalize their research as a contribution to the Resources and Ecosystems area achievements.

R&E2. AQUATIC BIOGEOCHEMISTRY

The importance of predicting water quality for the aquatic biogeochemistry line was confirmed in 2021. With the start of the inventWater project (Inventive forecasting tools for adapting water quality management to a new climate), an MSCA ITN coordinated by ICRA, a new impulse has been given to the development of tools for predicting water quality in lakes, reservoirs, and river networks. Of the 15 students in the network, two are ICRA-based, and a larger number will do research stays at RiE. This project is expected to produce innovative tools for predicting water quality both in the short term (weather production) and in the long term (climate projections).

Our role in coordinating ISIMIP Lake Sector and GLEON networks has begun to bear fruit, with the publication of several papers in influential journals on the impact of climate change on lakes. DryFlux-II was also launched in 2021, a new collaborative research that is a continuation of DryFlux, which was very successful.

In the context of the MANTEL project (ITN H2020, "Management of Climatic Extreme Events in Lakes and Reservoirs for the Protection of Ecosystem Services"), ITN student Elias Munthali has established new methodologies for detecting extreme events in historical data series of water quality at Sau reservoir. The analysis of how these events affect water quality in the reservoir has also been completed, using an inventive approach based on causality-in-quantile methodology. A series of experiments and on-site evaluations were also conducted on the impact of natural organic matter on the formation of disinfection by-products, a topic of interest to ATL. All these results are already under review in scientific journals.

In addition, research into the fate of sedimentary carbon in dry lakes in the C-HydroChange (Excellence) project is progressing well after some turbulence related to staff departures due to the COVID-19 crisis. Mention should be made of the publication of a high-impact study on the role of inland water drying in the global carbon cycle. On the other hand, the new Alter-C project (alteration of carbon sinks and sources in shrinking inland waters) has started this year. It can be considered a continuation of C-HydroChange, with a differentiating fact, the ambition to gather samples in the Aral Sea.



R&E3. BIODIVERSITY AND FUNCTIONS OF AQUATIC ECOSYSTEMS

During this reporting period, research has continued on the effects of flow intermittency on the stream biota, the stream biogeochemistry, and the effects of pollutants, on the biodiversity, functions, and ecosystem services of freshwater ecosystems.

Most of this research has been carried out within the framework of the National Projects SPACESTREAM (CGL2017-88640-C2-1-R) and the new "Multiple stressors impacting rivers: biodiversity and ecosystem function responses" (RIVSTRESS; PID2020-115708RB-C22). SPACESTREAM has allowed to characterize the hydrological dynamics within a river network, its effects on the organic matter transport and transformation, and the responses of bacterial and algal communities. The hydrological patterns of intermittency in the Algar basin have been modelled using the SWAT+ platform, as one of the main tasks of the PhD thesis of Oriana Llanos. After this modelling, the longitudinal and temporal patterns of suspended and benthic organic matter will be modelled, in a work that demands improving the platform with new parameters and completion of existing modules. This work, when finalized, will allow us to predict the variation in the transport and transformation of organic matter dynamics under different climatological scenarios, including those foreseen by climate change. SPACESTREAM runs in parallel to the CLIMALERT project ("Climate Alert Smart System for Sustainable Water and Agriculture; PCIN-2017-068), also finalized during 2021. This project has benefited from the interaction of the University of Minho, in Portugal, which has allowed the integration of ecosystem services in the water management. This work has allowed us to gain insights in the modeling of socio-environmental systems driven by water scarcity.

The RIVSTRESS project, currently in its first phase, aims to investigate the co-occurrence of stressors affecting river ecosystems and their impact on their biodiversity, functions, and services. To achieve this goal, RIVSTRESS will define the effect of some of the most common stressors in Mediterranean watercourses (i.e., hydric stress, increased in water temperature, nutrient excess, presence of pesticides), and will investigate their effects when i) their order of occurrence differs, from the less intense to the most intense, or its reverse; ii) their occurrence and co-occurrence is not linear, but as much as it occurs in nature they reach ecosystems as pulses, escalating ramps, or continued pressures; iii) their effects are conditioned by the previous impacts of alternate stressors, causing legacy effects. These goals will be clarified by combining field and laboratory approximations.

Besides these two national projects, the EU project DRYvER (H2020-grant agreement 869226-2) currently explores the metacommunity structure and implications for functions and services in intermittent river networks. ICRA will soon develop modelling tasks on the upscaling of ecosystem services apportioned by intermittent streams to European scale. The modelling will integrate biological processes such as greenhouse gas production, decomposition, and primary production in drying river networks, aiming to characterize the spatial processes occurring on systems submitted to periodical drying, at both selected river basins and European scales.

We also completed a small project on the effect on pollutants in trophic food chains. The first has produced a paper (Sabater et al., STOTEN) regarding the different effects of chronic and acute inputs of contaminants (copper) in the brown food chain (based on decomposers) and in the green food chain (based on primary producers). The two trophic chains perform specific ecosystem functions which may be altered by the effect of contaminants. The experiment provided evidence that copper affected the two trophic food chains, though unequally, then highlighting the need to consider the different compartments within the stream trophic web when evaluating the effects of a contaminant.

Related to the goals of this project, we completed a paper on the impacts of environmental stressors on food webs. Mor et al. studied food-web-level impacts of urban wastewater pollution, a widespread source of degradation that can alter stream food webs via top-down and bottom-up processes. Wastewater may either subsidize primary producers by decreasing nutrient limitation, then inducing a wide-bottomed trophic pyramid; but wastewater may reduce the quality and diversity of resources, which could decrease energy transfer efficiency by reducing consumer fitness, leading to predator starvation. Additionally, if higher trophic levels are particularly sensitive to pollution, primary consumers could be released from predation pressure. Results of the analysis of 10 different site studies show that wastewater pollution can impact stream food webs via a combination of energy limitation to consumers and extirpation of pollution-sensitive top predators. This paper has been published in Ecology.

Finally, the relevance of climate change for the biota has been object of several approaches during this reported period. We completed a study on the response of diatom assemblages to scenarios of climate change. Those already detected in intermittent systems (Tornés et al. 2020) have shed light to further insights on the ability of these small algae as early-warning indicators of future changes in water availability. This has resulted in a paper that will be published soon and that describes how the impact of

climate change might be devastating on mineralized rivers, on which we predict higher homogenization in the composition of assemblages, higher proportion of planktonic taxa, and a potential increase of terrestrial and aerophilic taxa, as the best adapted to the harsh conditions imposed by runoff reduction. Another study evaluating the effects of event vs trend climate change is underway at the moment and will be published soon.

R&E4. FRESHWATER-RELATED ECOSYSTEMS SERVICES & NATURE-BASED SOLUTIONS

This is the first year this research line has been active, as it is one of the new lines within the research area of Resources and Ecosystems, created in 2021. During 2021, we have been working on mainly 3 research projects, 1 basic research project (EESAM) and 2 research transfer projects (TRAÇA and WIAT), which are described in the Technology Transfer section. The EESAM project (integrating ecological status and ecosystem services for the design and prioritization of management actions) is a project shared with the Catalan Water Agency, in which a co-developed decision support system will allow river basin district authorities to identify the management actions providing a better relationship between the costs and the benefits associated with the action, hence considering as benefits the gain in ecological status and on the benefits of freshwater-related ecosystem services. The project has 4 blocks or main tasks. The first concerns the development of biophysical models, while the second is about the development of the modeling for the estimation of the benefits associated with the considered freshwater-related ecosystem services. The third block involves the design of the decision-support system. Finally, the fourth block concerns the communication to lay people as well as dissemination to intended users at river basin district authorities. Regarding the first block, we have implemented the model SWAT+ at the inner Catalan basins for the simulation of hydrology and coded a series of additional processes such as point-source pollution of domestic and industrial origin. Regarding the second, we have codeveloped a valuation scheme with technicians from the Catalan Water Agency and have coupled the biophysical model with the ecosystem services and their benefits. Not much has been done regarding the third point, but the strategies to set priorities between management actions have been defined. Finally, regarding the fourth block, we have developed a dissemination video on the relevance of integrating ecosystem services in river basin management. The project started in 2019 and will end by mid 2022, when most deliverables will appear.

The SANNAT project has been carried out with research institutions and companies from the water treatment sector from around the world. The project is funded by The Nature Conservancy, the Wildlife Conservation Society, and by the synthesis research center NCEAS (all of them from the US). Researchers from the areas of Technologies and Evaluation (Joaquim Comas and Lluís Corominas) and Resources and Ecosystems are involved in the project. It was launched in 2018, and during 2021 we have been improving the web-based decision support system (<https://snapp.icra.cat/>). In 2022, this DSS is further validated and extended with economic and environmental impact criteria under the recently awarded EU Green Deal MULTISOURCE project.

The MERLIN project (Building a low-carbon, climate resilient future: Research and innovation in support of the European Green Deal), funded by Horizon 2020, was launched at the end of 2021. So far, we have defined the overall project goals, as well as ICRA's contribution to these goals. Specifically, our role as Resources and Ecosystems research area, will be to contribute to the determination of ecosystem services in one of the case-studies, as well as developing a European scale model in order to determine the demand of ecosystem services, thus allowing the identification of the best places to perform river restoration activities.

TECHNOLOGY TRANSFER

The TRAÇA project (which involves the analysis of the improvement in urban sanitation and chemical fate studies on the pollution caused by the industry) is a contract with the Catalan Water Agency developed in 2021. The main achievements during 2021 have been the creation of a unified database with all the data on point source industrial pollution, as well as data from the quality control networks and data from gauging and meteorological stations; all of them embedded in PostgreSQL and linked to QGIS, and to the biophysical models for the simulation of industrial pollution at the inner Catalan basins.

WIAT is a contract with the World Business Council for Sustainable Development, which has been carried out during 2021 and has resulted in an online tool to

determine the impact of industrial facilities on 3 aspects: climate change, local water security and biodiversity. The tool has been co-developed with a series of end-users, reviewed by a group of experts, and it's already available to members of the World Business Council. During 2022, it will be continuously upgraded, and a global database on industrial point sources will be created, in a joint effort by ICRA, UN-Habitat, UN Industry, the CDP, the World Bank and other entities.

Finally, a transfer project has been executed with the company ATL to set up an SQL database with the historical data of the Sau and Susqueda reservoirs.

AI - PHD DISSERTATIONS

Rafael Marcé (Co-director), Cecilia Hegoburu, *Dinámica del fósforo en arroyos pampeanos: patrones espaciales y temporales e implicancias del cambio climático*, University of Buenos Aires, Argentina.

AI - VISITING SCIENTISTS

Van Horn, David - University of New Mexico

Donato Rondon,
Jhon Charles - National University of Colombia

AI - VISITING STUDENTS

Costa Antunes, Ilisa Daniela - University of Minho

Font Martínez, Pere - University of Girona (UdG)

Besoli Mestres, Neus - University of Girona (UdG)

Gubert Roldan, Eudald - University of Girona (UdG)

Equisuany Ruiz, Anna - University of Girona (UdG)

Recalde Aza, Yarima Cumandá - University of Girona (UdG)

Auro Sanchez, Mar - University of Vic

Zannin Boscarolo, Silvia - Iuav University of Venice

Cutillas Galindo, Marc - University of Girona (UdG)

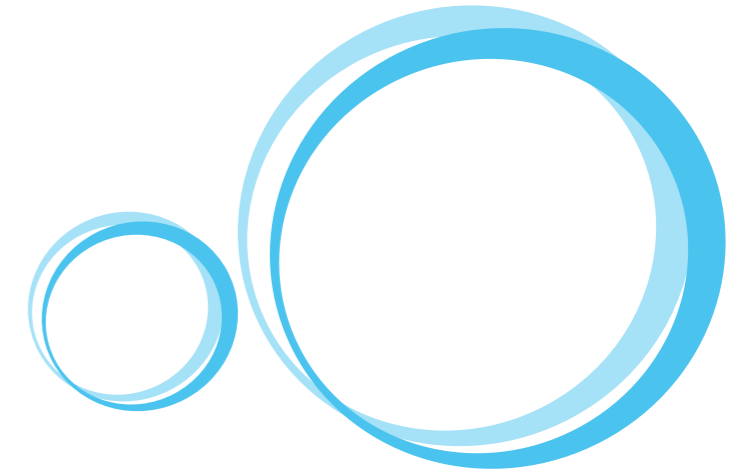
Benito Guasch, Abel - University of Girona (UdG)



▶ WATER QUALITY RESEARCH AREA

LINES

- ▶ WQ1. CHEMICAL CONTAMINANTS AND MICROPLASTICS IN THE AQUATIC ENVIRONMENT
- ▶ WQ2. CHEMICAL CONTAMINANTS IN WATER TREATMENTS
- ▶ WQ3. WATER MICROBIOLOGY
- ▶ WQ4. WATER AND HUMAN HEALTH



1 Technical Support Personnel

Núria Càceres

21 RESEARCHERS IN THE AREA

Group leader

Mira Petrović

1 research professor (ICREA associated)

Mira Petrović

1 research professor (CSIC associated)

Damià Barceló

1 research professor (UdG associated)

Carles Borrego

3 Research Scientists

José Luis Balcazar

Sara Rodríguez Mozaz

Maria José Farré

7 Postdoc Researchers

Natalia Ospina

Ivan Senta

Victoria Osorio

Ana Maganha

Laura Guerrero

Meritxell Gros

Josep Sanchis

3 Predoctoral Researchers

Jose María Castaño

Barbara Topolovec

Angela Pedregal

5 Research Technicians

Elisa García

Natalia de Paiva

Miyako Nitta

Oriol Sacristán

Aina Cuixart

WATER QUALITY RESEARCH AREA

The research conducted at the Water Quality area follows three main lines:

- i) chemical contaminants and microplastics in the aquatic environment;
- ii) chemical contaminants in water treatments; and
- iii) water microbiology. The main activities and results obtained in 2021 within these three research lines are summarized below.

WQ1. CHEMICAL CONTAMINANTS AND MICROPLASTICS IN THE AQUATIC ENVIRONMENT

Combination of AOPs with biological treatment for the removal of pharmaceuticals from wastewater and evaluation through target and suspect screening analytical methodologies

The optimal combination of the wastewater treatment steps depends on several factors, including wastewater characteristics, further use of treated effluent, or cost efficiency. The performance of different wastewater treatment trains was evaluated in terms of removal of pharmaceutically active compounds (PhACs). As AOP, UV/H₂O₂ oxidation process was combined in parallel with conventional activated sludge (CAS) and fungal treatment (FG) as the pre-treatment and post-treatment step of hospital wastewater, in a collaboration study with researchers from the UAB and IQS of Barcelona. Up to 80 target PhACs were monitored during lab experiments with real hospital wastewater. Special attention was paid to the generation and removal of transformation products as they can sometimes be more toxic or persistent than the parent compounds. A target analytical method based on a liquid chromatography system coupled to a mass spectrometer LC-MS/MS for the determination of known transformation products and metabolites of PhACs was first used. In addition, a comprehensive study of the transformation of the β -blocker, metoprolol was also carried out via a suspect screening methodology using a LC system coupled to a high-resolution mass spectrometer (LC-LTQ-Orbitrap-MS/MS). Comprehensive studies of the transformation products generated are highly recommended when evaluating combined treatments, since the target analysis of parent compound do not provide complete information to draw conclusions of the best treatment performance to use.

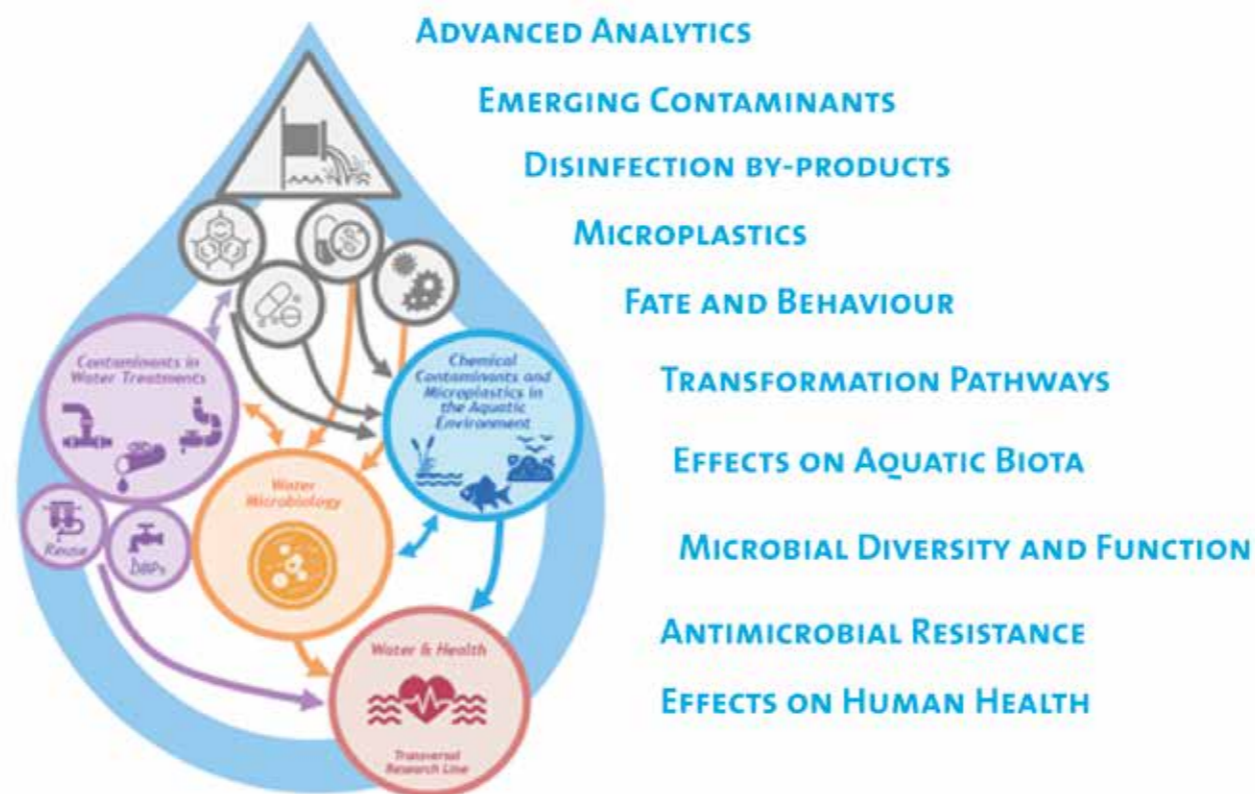
Occurrence, distribution and risk assessment of antibiotics in the environment

Among pharmaceutical compounds, antibiotics are a family of compounds of high consumption and environmental concern. The distribution of antibiotics at the Ebro Delta in Spain was studied in a monitoring study in the frame of the project **PLAS-MED** (Microplastics and microcontaminants in the Mediterranean coast: Toxicity and environmental and human health impacts (MINECO CTM2017-89701-C3-2-R)), its results were reported in 2021. Water samples (wastewater, river water and seawater) and biofluids (fish plasma and mollusk hemolymph) were evaluated for the presence of antibiotics following two different approaches: an effect-based methodology based on microbial growth inhibition and an analytical method based on liquid-chromatography coupled to mass spectrometry (LC-MS). Also, during 2021, and in collaboration with colleagues from the University of Córdoba (Argentina) we finished and published our work about the fate of different antibiotic families in water, biofilms and sediments simultaneously under a real urban river scenario.

In both studies, in Argentina and Spain, the antibiotic occurrence data in the respective water bodies was used to evaluate its impact on microbial communities in aquatic systems and on the evolution of antibiotic resistance. An environmental risk assessment (ERA) strategy specific to antibiotics was thus applied to the monitoring data in both studies.

Evaluation of the effect of microplastics in the impact of organic micropollutants in aquatic organisms

New emerging pollutants such as microplastics and nanoparticles can act as carriers of organic contaminants and alter their impact in aquatic organisms. The project **PLAS-MED, Microplastics and microcontaminants in the Mediterranean coast**: Toxicity and environmental and human health impacts (MINECO CTM2017-89701-C3-2-R) finished in 2021 and had the aim of studying the role of microplastics in the transference, bioaccumulation and toxicity of pharmaceuticals and other emerging pollutants in aquatic organisms. The impact of microplastics on bioaccumulation and biotransformation (including the spread of antibiotic resistance) of antibiotics and bactericides in river biofilms in mesocosms experiments were evaluated in 2021 and the corresponding papers are being prepared. A review paper and a chapter were published related to this topic (contaminants associated with microplastics) in 2021. In addition, a metabolomics approach, a powerful tool to better evaluate the ecotoxicological response of aquatic organisms in areas impaired by the presence of such contaminants, was applied both to these mesocosms experiments but also to field biological samples of the monitoring campaigns carried out during the PLAS-MED project at coastal areas in Spain (the Ebro estuary and in the Mar Menor lagoon in Murcia). A paper reviewing environmental metabolomics strategies was also published in 2021.



Study of occurrence and fate of disinfection by-products and their precursors in drinking and recycled water

Two new projects, waterDOM (No-PID2020-114065RB-C21) and Scan2DBP (No-PDC2021-121045-I00) have started this year. WaterDOM is part of the coordinated project waterPRINT (team: CSIC and ICRA, coordination: ICRA) Comprehensive characterization of organic matter and biomarkers in the water cycle: An integrated study using environmental proteomics and small molecule-high resolution mass spectrometry. In particular, waterDOM subproject Small-molecule mass spectrometry fingerprinting as a diagnostic tool in water quality surveillance and treatment optimization aims at providing rigorous analytical methods and tools for the holistic characterization of water samples based on high-resolution mass spectrometry (HRMS) fingerprinting of the dissolved organic matter (DOM). WaterDOM will validate the mass spectrometric approaches for the characterization of DOM profiles through (waste) water treatment to estimate and optimize treatment efficiency and investigate changes on drinking water sample fingerprints to predict treatment side effects such as formation of disinfection by-products (DBPs). With similar objectives, the group collaborates with the University of Lille in the project NOMIC ANR JCJC 2021, Natural Organic Matter Innovative Characterization and transformation by-product prediction.

The new Scan2DBP proof of concept project aims at promoting and accelerating the transfer of knowledge and results generated in the already completed NDMA_{predict} project CTM2017-85335-R, How to predict and minimize NDMA formation in drinking and recycled water with advanced analytical techniques. The main objective of Scan2DBP is the creation of an application to be used as an early warning system to predict DBPs during water disinfection based on the organic matter fingerprint obtained with HRMS. First results on prediction of NDMA have already been published.

Finally, the group is also part of the inventWater network MSCA-ITN-ETN-No 956623, Inventive forecasting tools for adapting water quality management to a new climate, coordinated by researchers from Resources and Ecosystems at ICRA, where forecasting approaches for catchment characterization and prediction of DBP formation during drinking water production are investigated.



José Luís Balcázar – María José Farré – Nuria Cáceres – Carles Borrego – Carmen Gutiérrez – Oriol Sacristán – Saida Martí – Angela Pedregal – Mira Celic – Elisa García – Damià Barceló – Alejandro Margareto – Sara Rodríguez – Meritxell Gros – Mira Petrović – Lucía H. Santos – Laura Guerrero – Victoria Osorio – Ana de Almeida – Marc Castaño

WQ2. CHEMICAL CONTAMINANTS IN WATER TREATMENTS

Study of the occurrence, fate and elimination of emerging contaminants in engineered systems

Within the H2020 MSCA ITN-EJD project **Nowelties** Joint PhD Laboratory for New Materials and Inventive Water Treatment Technologies. Harnessing resources effectively through innovation, the group is studying the elimination of recalcitrant organic micropollutants (OMPs) in treatments based on advanced oxidation processes (AOP), such as non-thermal plasma. The main objective of this study is to evaluate the elimination and to elucidate transformation pathways of selected recalcitrant perfluorinated compounds within the group called PFAS: perfluoro(2-methyl-3-oxa-hexanoic) acid (HFPO-DA/GenX), perfluorooctanoic acid (PFOA), heptadecafluorooctanesulfonic acid (PFOS), undecafluorohexanoic acid (PFHxA), tridecafluorohexane-1-sulfonic acid (PFHxS), perfluorobutyric acid (PFBA), nonafluorobutane-1-sulfonic acid (PFBS) and dodecafluoro-3H-4,8-dioxanone (ADONA). Non-thermal plasma in liquid and gas-liquid environments generates in situ oxidizing species, such as hydroxyl radicals, ozone, hydrogen peroxide, peroxy nitrates etc., capable to degrade recalcitrant OMPs from the solution relatively quickly, and even using low power discharges. This oxidative breakdown is influenced by the scavenging capacity of matrix components, resulting in the accumulation of transformation products (TPs) rather than complete mineralization.

During 2021 experiments were performed in collaboration with the Institute of Physics Belgrade (Serbia) that aimed to study the degradation for several PFAS using atmospheric pressure plasma jet (APPJ). Results had shown very promising removal efficiency for most of the selected compounds, ranging from 70% up to 99%, within 10 minutes of treatment time. One of the long-chained PFAS, PFOS, was completely removed and transformation products were detected. PFBS and GenX had shown less degradation due to the fact that they are short-chained PFAS and with stronger C-F bonds. For all the compounds, rapid degradation is observed in the first 5 minutes, followed by slower increase in removal. Overall, experimental results showed promising performance of APPJ configuration and high degradation of PFAS. Argon was selected as a working gas for several reasons: it showed very good results in terms of efficiency of degradation, it is suitable from an economic point of view and it avoids the production of nitrogen species in water.

The H2020 project **EMERGE** focuses on studying the effects of different solutions used to reduce shipping emissions in Europe and to develop effective strategies to decrease the environmental and climatic impacts of shipping. Our role in the project focuses on the analysis of the most relevant organic contaminants in waste streams discharged from ships into the marine environment. The main concern is on scrubber waters, which are the wastewaters generated during the cleaning of exhaust gases with sea water.

Scrubber systems remove compounds from the exhaust gas (mainly SO_x, NO_x, PM, organic matter and metals) and they contain potentially toxic organic contaminants such as polycyclic aromatic hydrocarbons (PAHs) and their alkyl-derivatives.

Along this year, a target analytical method based on solid phase microextraction (SPME) coupled to gas chromatography and tandem mass spectrometry (GC-MS/MS) was optimized and validated for the analysis of the 16 priority PAHs and a list of representative alkylated derivatives, including compounds containing methyl, dimethyl, trimethyl and tetramethyl alkyl groups, and from two to four benzene rings. Target alkyl-PAHs were previously selected based on a suspect screening exercise using GC and high-resolution mass spectrometry (HRMS) and applied to sea and scrubber waters obtained from a pilot scrubber system. The developed method is currently being applied to the analysis of scrubber and sea waters from several case studies, such as those collected in an on-board sampling campaign and in different geographic areas with intense marine traffic, such as the northern Adriatic Sea in Italy, the Aveiro region in Portugal, Öresund in Sweden and the Eastern Mediterranean in Greece.

Sources, fate and risks of organic contaminants in agroecosystems

In 2021, the work conducted in this research topic focused on compiling the results obtained from previous projects about: (i) the occurrence of antibiotics, antibiotic resistance genes and antibiotic resistant bacteria in groundwater and (ii) exploring the potential relationships between antibiotics, environmental variables (e.g nitrates, phosphates, DOC) and dissolved organic matter (DOM), to get information on the DOM components that would have a major interaction with antibiotics.

Other activities in 2021 include: (i) the collaboration with researchers at the Technologies and Avaluation area on evaluating the potential of anaerobic digestion of livestock wastewater (e.g., slaughterhouse wastewater, animal manures, etc.) and sewage sludge to produce biogas and reduce pharmaceuticals, antibiotics, and antibiotic resistance genes concentrations; (ii) the evaluation of the environmental risks derived from blackwater fertilization in agricultural fields. This work was done in collaboration with the Swedish University of Agricultural Sciences (SLU) in Sweden, by analyzing pharmaceuticals, antibiotics, and antibiotic resistance genes in blackwater, soils and natural waters from blackwater fertilized agricultural fields; (iii) a collaboration with researchers at INIA-CSIC, on the evaluation of the potential toxicity of selected antibiotics to wild and cultivable plant species and on assessing their effects in the dissemination of antibiotic resistance.

Wastewater-based assessment of human exposure to chemical pollutants

Within the framework of the H2020-MSCA-IF SCHEME, Sewage chemical information mining – development of a novel concept for the assessment of human exposure to pollutants through wastewater analysis, an online solid phase extraction (SPE) method coupled to liquid chromatography and tandem mass spectrometry (LC-MS/MS) was developed for the determination of biomarkers of human exposure to chemicals from personal care and household products in wastewater. The list includes biomarkers of exposure to parabens, UV filters, phthalates and alternative plasticizers, phosphorous flame retardants/plasticizers, bisphenols, as well as oxidative stress biomarkers.

In 2021, the method was fully validated and successfully applied to the analysis of biomarkers of human exposure to selected chemicals in samples from 6 European cities: Girona, Barcelona, Jerez de la Frontera, Brussels, Antwerp (Belgium), and Zagreb (Croatia). After the analyses, mass loads of the selected compounds were determined and, for the substances in which quantitative excretion data was known, human exposure was assessed.



WQ3. WATER MICROBIOLOGY

Phages as vehicles for the mobilization of antibiotic resistance genes

Phages (viruses that infect bacteria) are the most abundant and diverse biological entities and transfer genetic material between their bacterial hosts via transduction. Despite their role in gene transfer, their contribution to the emergence and spread of antibiotic resistance has not been extensively studied. In fact, questions such to what extent phage-mediated transduction contributes to antibiotic resistance or what cost-effective interventions should be implemented to mitigate this potential risk remain unanswered. To shed some light in the issue, Dr Ana de Almeida Kumlien (Marie Skłodowska-Curie Individual Fellowship) and Dr Edgar González (Mexican National Council for Science and Technology (CONACyT) Fellowship) joined our research group as postdoctoral fellows to investigate the factors that promote phage-mediated horizontal gene transfer of antibiotic resistance genes. We have also isolated and sequenced a new member of the tequatrovirus (T4-like) genus, *Escherichia* phage vB_EcoM_C2-3, which exhibits lytic activity against multidrug-resistant *Escherichia coli* strains. Moreover, we have recently published an opinion article in the renowned journal *Water Research*, where we highlight current knowledge gaps, anticipate future trends, and suggest actionable insights to advance antibiotic resistance regulation in the water sector.

Role of migratory birds on the dissemination of antibiotic resistance genes

Project DARABi (ref. PID2019-108962GB-C22, State Research Agency, Ministry of Science and Innovation) is aimed to determine the role of migratory birds on the dissemination of antibiotic resistance. During the second year of the project, we have analyzed fecal samples of lesser black-backed gull (*Larus fuscus*) collected at different sites from Andalusia differing in pollution levels and analyzed for bacterial community composition and content of antibiotic resistance genes (ARGs) using 16S rRNA gene sequencing and high-throughput qPCR (HT-qPCR), respectively. Overall, the fecal microbiomes of all analyzed gulls were compositionally similar, but bacterial communities from landfills and wetlands were richer and more diverse than those from unpolluted sites (Doñana National Park). We also observed a lower relative concentration of most ARGs in feces from birds inhabiting unpolluted sites than those from landfills. Remarkably, the relative abundance of genes encoding resistance to aminoglycosides and betalactams was similar in bird's feces than in the environment (water and soil), suggesting that the environmental pollution might be a major driver for the enrichment

of the bird gut microbiota on antibiotic resistance determinants. We are currently analyzing results from a second dataset that includes feces from gulls and storks (*Ciconia ciconia*) collected from landfills and rice fields to assess the contribution of the bird species on the richness and abundance of the gut resistome and mobilome.

Phage treatment and wetland technology to prevent dissemination of antibiotic resistance in surface waters

PhageLand is a 3-year project funded by the Joint Programming Initiative on Antimicrobial Resistance (JPIAMR) within the 2021 call One Health interventions to prevent or reduce the development and transmission of antimicrobial resistance (AMR). This project aims to develop a novel intervention strategy combining the low-cost and eco-friendly purification capacity of passive treatment systems, namely constructed wetlands (CW), with a dedicated phage-based treatment to prevent the transmission of antibiotic resistance (AR) from wastewater into surface waters. PhageLand includes public health investigations targeting multidrug-resistant bacterial (ARB) pathogens in low and middle income countries (LMICs) in Eastern Europe. The phage-based treatment will be specifically tailored to eliminate these multidrug-resistant pathogens from wastewater. In parallel, PhageLand will also assess: a) the self-purification capacity of model full-scale CWs operating in Spain and Moldova in removing antibiotic residues, ARB and antibiotic resistance genes (ARGs), and b) the potential risk associated with the dissemination of ARB and ARGs within indigenous bacterial communities and among animals inhabiting CWs. Experimental tasks will include field and laboratory experiments involving cutting-edge chemical, biotechnological and (meta)genomic techniques as well as animal testing. Finally, a pilot-scale infrastructure will be used to scale-up the PhageLand technology and to assess its performance under real environmental conditions. This proof-of-concept will be used to demonstrate the efficacy and scalability of this nature-based technology to combat AR and to encourage stakeholders for its implementation in wastewater treatment, particularly in LMICs, where costly and power-demanding treatment plants are difficult to set up. The project consortium is led by ICRA as coordinator and includes research groups from the University of Warsaw and the Warsaw University of Life Sciences (Warsaw, Poland), the Katholieke Universiteit Leuven (Leuven, Belgium), the Quadram Institute Bioscience (Norwich, UK), the Delft University of Technology (Delft, the Netherlands) and the Nicolae Testemițanu State University of Medicine and Pharmacy (Chișinău, Moldova). The project will officially start on 1 February 2022 and will end on 31 January 2025.

TECHNOLOGY TRANSFER

✓ Collaboration with INIA-CSIC. Análisis de antibióticos en muestras de agua y suelos de ensayos de toxicidad en plantas. PIs: Sara Rodríguez-Mozaz; Meritxell Gros Calvo.

✓ Transfer contract with University of Minho (Portugal). Determination of pharmaceutical compounds related to SARS-COVID-19 in wastewater of Portugal. PI: Sara Rodríguez-Mozaz.

✓ Transfer contract with Dublin City University (Ireland). Determination of endocrine disruptors and other related contaminants in river water of Spain, Ireland and UK. PI: Sara Rodríguez-Mozaz.

✓ Transfer contract with the Catalan Agency of Water (ACA) and in collaboration with Resources and Ecosystems. Traçabilitat de les fonts de contaminació de substancies prioritàries i contaminants emergents en trams fluvials rellevants, i mesures de millora en el sanejament urbà al Baix Llobregat. CTN2000533. PIs: V. Acuña, M.J. Farré and W. Gernjak.

✓ Transfer contract with Canal de Isabel II. Estudio de formación de NDMA en estaciones de tratamiento de agua potable y eliminación de precursores de este subproducto. Contrato No88/2018. PI: M. J. Farré.

✓ Transfer contract with CSIR - South Africa on analysis of pharmaceuticals in aquatic environment in South Africa, including wastewater, surface water and sea water. PI: M. Petrović.

AII - PHD DISSERTATIONS

- Serra, Albert (March 2021), Analysis and impact of antibiotics in marine organisms. Laboratory experiments and field studies, University of Girona (UdG).
- Jaén, Adrián (May 2021), Removal of pharmaceuticals in wastewater combining different treatment technologies: Suspect screening identification and risk assessment of transformation products, University of Girona (UdG).

AII - VISITING SCIENTISTS

González Villalobos, Edgar - UNAM

Alonso, Lucas Leonel - ICYTAC

AII - VISITING STUDENTS

Jarma, Dayana - University of Cádiz

Moix Fernández, Ivan - University of Girona (UdG)

Karakatsanidou, Ioanna - University of Ioannina

Guzman Nieto, Maria - University of Girona (UdG)

Pico Tomas, Anna - University of Girona (UdG)

Ivanov Velikov, Dean - Autonomous University of Barcelona (UAB)

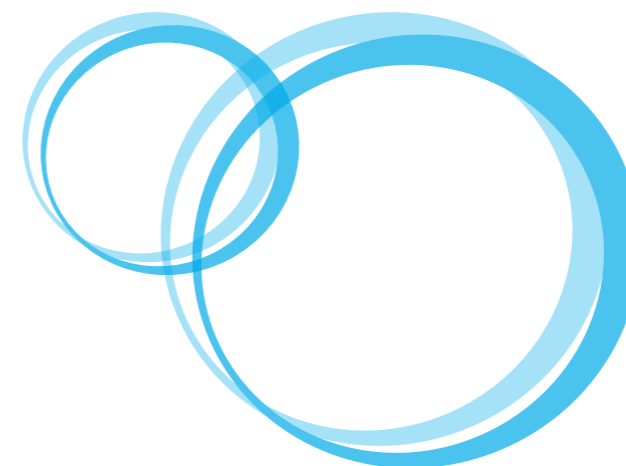
AII - PARTICIPANT PROJECTS

Chingate Barbosa, Edwin Antonio
(predoctoral researcher) - Technical University of Munich

De la Rosa, Francis
(predoctoral researcher) - University of Zagreb

AII - STAYS ABROAD

B. Topolovec, Institute of Physics (IPB), Belgrade, Serbia, 01/06/2021-25/06/2021 and 18/11/2021-26/11/2021



▶ TECHNOLOGIES AND EVALUATION RESEARCH AREA

LINES

- ▶ **T&E1. CONVENTIONAL AND ALTERNATIVE WATER SUPPLY**
- ▶ **T&E2. WASTEWATER TRANSPORT, TREATMENT AND MANAGEMENT**
- ▶ **T&E3. NEXT-GENERATION AND NATURE-BASED TECHNOLOGIES**
- ▶ **T&E4. MODELLING, ASSESSMENT AND DECISION SUPPORT FOR URBAN WATER SUSTAINABILITY AND RESILIENCE**



1 Technical Support Personnel

Verònica Rocasalva

34 RESEARCHERS IN THE AREA

Group leader
Maite Pijuan

2 research professors (UDG Associated)
Ignasi Rodríguez Roda Layret
Joaquim Comas

2 research professors (ICREA associated)
Wolfgang Gernjak
Jelena Radjenovic

3 Research Scientists

Gianluigi Buttiglieri
Lluís Corominas
Maite Pijuan

7 Postdoc Researchers

Morgan Abily
Simon Guerrero
Oriol Gutiérrez
Soraya Zahedi
Lucia Moreira Dos Santos
Josep Pueyo
Elisabeth Cuervo

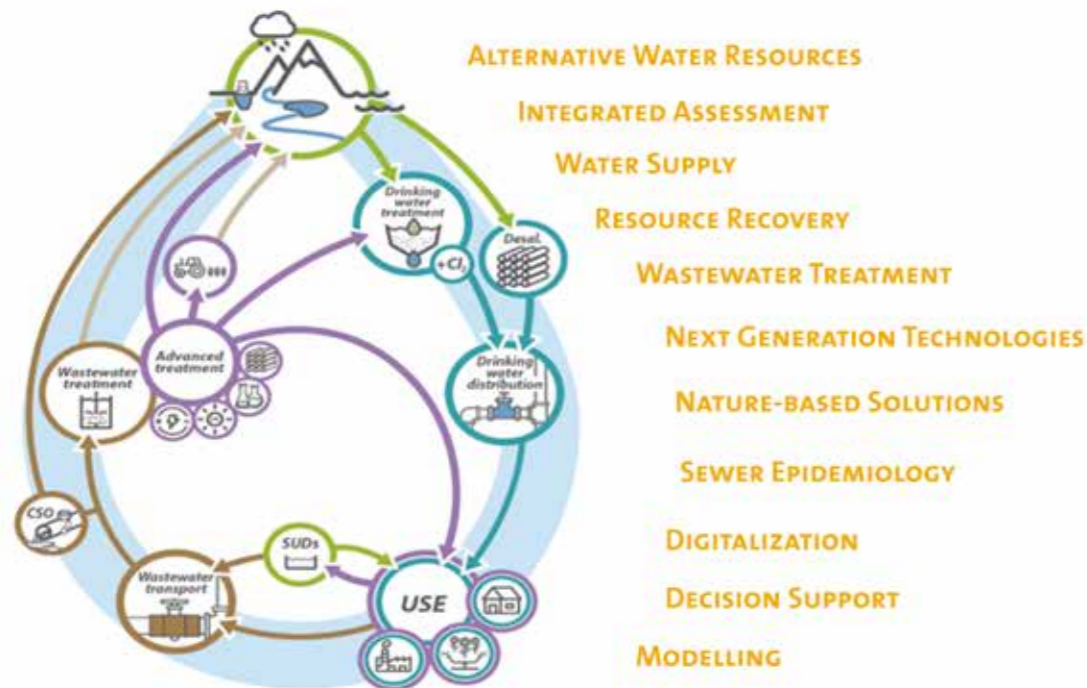
9 Predoctoral Researchers

Nikoletta Tsiarta
Natalia Ormeño
Marc Castaño
Norra Florjan
Michele Ponzelli
Nick Duinslaeger
Anna Segué
Oriol Casabella
Esther Mendoza

11 Research Technicians

Sadurní Morera
Natalia Sergienko
Silvia Busquets
Simone Schroter
Anna Pico
Ian Zammit
Neus Collado
Roser Bruges
Josephine Vosse
David Martínez
Mercè Font

▶ TECHNOLOGIES AND EVALUATION RESEARCH AREA



2021 has been a very fruitful year for the Technologies and Evaluation research area, with many research activities and collaborations. But before summarising our research activities first I would like to highlight the Catalan National Research Award for Young Talent awarded to Prof Jelena Radjenovic. This award aims to encourage and acknowledge young researchers who have stood out during their professional career for the quality and excellence of their scientific and research work. Dr Radjenovic is an ICREA research professor and the principal investigator of the project Electron4Water, a StartingGrant project funded by the European Research Council that focuses on the development and optimization of nanoelectrochemical systems for the treatment of water and wastewater. We are very proud to have Jelena as a part of our team.

We have also been very successful in securing research funding from the European Commission. Several projects have started during 2021 within the Horizon 2020 program, which will allow expanding our activities with the involvement of other research areas from ICRA. A clear example is the MULTISOURCE project (funded by EU H2020) led by Prof Joaquim Comas, which aims at demonstrating different enhanced natural treatment solutions treating

a wide range of urban waters. Within the scope of this project, one of the walls at the ICRA building will be converted into a green wall where the treatment of the greywater generated in-house will be tested. Also, the iWAYS project (funded by EU H2020), led by Prof Wolfgang Gernjak, aims at increasing water and energy efficiency in industrial processes through three main solutions: exhaust condensation, water treatment and waste valorisation. With 19 international partners, iWAYS started its activities during 2021.

Other projects were awarded towards the end of the year and will start their activities in 2022. We have been successful within the PRIMA and LIFE calls, with the projects SAFE, awarded to Dr Gianluigi Buttiglieri, and RECYCLO, a project led by Dr Sara Rodríguez-Mozaz from the Quality area and Dr Buttiglieri, and the project SmartWaterTwin, a HORIZON WIDERA action led by Prof Jelena Radjenovic. Also, it's important to highlight the project 4SM led by Dr Oriol Gutiérrez and awarded in the national call of R+D+I strategic lines projects, a public-private partnership with the strong involvement of two water companies, FACSA and ABM. Within this project, we are consolidating a research line focused on digitalization.



Josephine Vosse – Atefeh Tizchang – Marc Castaño – Elisabeth Cuervo – Silvia Morovic – Reynel Martínez – Gianluigi Buttiglieri – Natalia Sergienko – Lucia H. Santos – Morgan Abily – Oriol Gutiérrez – Nick Duinslaeger – Anna Segués – Maite Pijuan – Esther Mendoza – Verónica Rocasalva – Joaquim Comas – Camilo Sánchez – Ian Zammit – Joanna Papapanou – Wolfgang Gernjak – Janick Klink – David Martínez – Sofia Semitsoglou – Natalia Ormeño – Lluís Corominas – Mercè Font – Anna Picó – Laura Aixalà

During the past year Dr Corominas, together with Prof Borrego, from the Quality area, have continued the coordination of the wastewater-based surveillance system for SARS-CoV-2 in Catalonia, providing highly valuable information about the circulation of the virus in Catalonia. Funding has been secured from the Catalan Government for 2022 and 2023. We are also participating in two research projects (EpiSars and VIRWASTE) funded by La Marató of TV3.

2021 has brought some changes to our core team of T&E researchers. Dr Gianluigi Buttiglieri obtained a permanent research scientist position after completing his Ramon y Cajal fellowship, which will allow consolidating his research topics within the line of nature-based solutions. On the other hand, Prof

Ignasi Rodríguez-Roda, the former head of our area, left ICRA and returned to the University of Girona. We deeply thank him for his commitment and leadership during these years, as we have become a consolidated research team. We wish him every success in his new professional career.

Finally, we would like to acknowledge the continuous support of our industry partners and public water agencies, as they engaged in many of our ongoing research projects and provide us with invaluable feedback.

Below you can find a more detailed explanation of the activities conducted within our four research lines during 2021. The Technologies and Evaluation area's lines of research are:

▶ T&E1. CONVENTIONAL AND ALTERNATIVE WATER SUPPLY

The research line focuses on the development of novel processes and treatment trains, mostly focused on physico-chemical treatments, and water quality management in these processes. By increasing water supply diversity, including alternative water supply options, we will contribute to increase system resilience.

Within the research line several PhD projects have been focusing on different aspects of technology development. For example, as part of the Marie Curie ITN project Nowelties (coordinated by Mira Petrović, ICRA AII), the PhD student Nikolett Tsiarta (supervised by Wolfgang Gernjak, co-supervised by Lidija Čurković, U. Zagreb) continued her PhD thesis on catalytic ozonation using modified ceramic membranes,

with the aim to achieve increase micropollutant degradation and decreased membrane fouling. In turn, Amit Kumar (co-supervised by Wolfgang Gernjak) developed and evaluated a lab-scale plasma jet reactor for the abatement of organic microcontaminants.

Another two PhD projects are being carried out in close collaboration with Wetsus in the Netherlands (www.wetsus.nl), where PhD student Nimmy George Koor (supervisors: Wolfgang Gernjak, ICRA, and Bas Wols, Wetsus) develops novel AOPs making use of the 185 nm and the 254 nm component simultaneously emitted by low pressure mercury lamps. This

PhD project has a strong emphasis on computational fluid design modelling and reactor design. In 2020, two pilot plants were designed and built and were operated in 2021 at a drinking water production facility in the Netherlands. At the end of 2021, Yicheng Wang (supervisors: Wolfgang Gernjak, ICRA, and Bas Wols, Wetsus) has commenced her PhD project, which will follow Nimmy's work in order to deepen our knowledge of the vacuum UV initiated chemistry, specifically investigating the application opportunities presented by reductive pathways enabled by the photolysis of water and other reagents. Preliminary experiments in this sense to evaluate the abatement of perfluorinated substances with the UV/sulfite process have been already carried out in 2021 by Nour el Houda Slama during her visit to ICRA in the scope of her PhD.

Another technology development project is the iWAYS project (started in 10/2020), funded under the EU H2020 programme with 19 project partners. The project will develop a set of technologies to increase water and energy efficiency in industrial processes through three main solutions: exhaust condensation, water treatment and waste valorisation. iWAYS will consider alternative freshwater sources and will also develop robust technologies to reduce brine volumes and to recycle product water back to the manufacturing process, implementing principles from circular economy. The main technology studied by ICRA is membrane distillation and its potential use in the steel manufacturing industry. During 2021 detailed analysis of the process and a tailored solution for heat and water recovery in this sector have been developed. In 2022, systems will be built to be operated on the industry site in 2023.

A second pillar of the research line, besides developing new technology, is to conduct technology assessments in combination with the research line T&E4 and beyond.



The Spanish State Research Agency (AEI) funds the INVEST project (2019-2022). The aim of the project (PIs Wolfgang Gernjak and Lluís Corominas) is to establish a framework that can be used to make investment decisions to support attaining the implementation goals of the Water Framework Directive under different global change scenarios. Besides the PIs, Profs. Ignasi Rodríguez-Roda (ICRA-UdG), Manel Poch (UdG) and Morgan Abily (ICRA, postdoctoral researcher) complete the core project team.

In 2020 the Catalan Water Agency funded the SUG-GEREIX project, executed at ICRA by Wolfgang Gernjak, Joaquim Comas, and Mercè Font, among others. The project is carried out in collaboration with Eurecat (coordinating institution), CETAQUA and the Catalan Water Partnership, whereby one of ICRA's responsibilities is to develop a decision support system for the selection of appropriate treatment technology for the fit-for-purpose generation of reclaimed water. Knowledge acquired in this research line is also transferred to industry via consulting, through consulting contracts and honorary roles, such as the participation of Wolfgang Gernjak in the expert panel counselling ACA on water reclamation in the Prat de Llobregat WWTP.

Other activities of the research line include a strategic co-operation with the company s::can Messtechnik GmbH from Austria and its Spanish daughter company s::can Iberia SL. Within this line Mireia Plà Castellana will be finalizing in 2022 an industrial doctorate co-funded by the Government of Catalonia to work on chemometric methods for enabling contaminant detection using optical spectroscopic sensors. Also, in October 2020 the COST Action 19110 PIAgri (Plasma applications for smart and sustainable agriculture) commenced. Wolfgang Gernjak co-leads work group 4: Plasma treatment of agricultural wastewater, growth media and production of plasma activated water, whereby the first online work group meeting held in January 2021 gathered over 100 international experts in the field.

T&E2. WASTEWATER TRANSPORT, TREATMENT AND MANAGEMENT

Research conducted under this line aims to improve current technologies and develop novel tools for treating wastewater in the context of circular economy. The goal is not only achieving the desired treatment standards, but also recovering the valuable resources wastewater contains, such as energy, nutrients and water.

The goals of this line are achieving better treatment performance in terms of macropollutants and contaminants of emerging concern, recovering energy and nutrients and reducing the environmental impacts of the treatment facilities. The experimental approach ranges from fundamental to applied research, with most of the projects involving strong participation from industry partners and water utilities.

The main activities carried out during 2021 have focused on the following two research themes:

- Resource recovery from wastewater treatment.
- Fate of emerging pollutants in conventional and advanced wastewater treatment technologies.



Resource recovery from wastewater treatment

Within this block of activities, the project NEWBIES, awarded within the call LIFE17 ENVINL, coordinated by Wetsus and led by Dr Maite Pijuan and Dr Jelena Radjenovic, finished in December 2021. A pilot plant based on an innovative electro dialysis system coupled with a transmembrane chemisorption was operated. This was the first time that this kind of technology was operated outside a laboratory-controlled environment and at a semi-industrial scale. The aim of the pilot plant was the recovery of nitrogen in the form of ammonium sulfate from three wastewater streams with a high concentration of nitrogen: i) the digestate produced in the anaerobic digesters of a WWTP, ii) urine and iii) leachate. The NEWBIES plant technology was based on electro dialysis (ED) and was comprised of 65 cell pairs of BPM/CEM membranes, coupled to two TMCS modules. Results have demonstrated the feasibility of using ED and TMCS for selective extraction and recovery of ammonia from anaerobic digestate with a satisfactory NH_4^+-N product concentration and energy consumption. The team at ICRA was in charge of the operation of the pilot plant with digestate (with the help from Dr Federico Ferrari, a former PhD student) and the elaboration of a Life Cycle Assessment (LCA) analysis (conducted by Dr Sadurní Morera, also a former PhD student from our area) to assess the environmental impact of this technology. Results show that recovery of nitrogen from these three wastewater streams is feasible and environmentally sustainable if a green energy source is used. A publication with the results obtained during the pilot plant operation in Girona has been submitted to Water Research.

The other activities within this topic have been focused on the anaerobic treatment of different waste streams aiming at biogas recovery. Different highly polluted industrial wastewaters (WW) such as slaughterhouse wastewater and pig, poultry, and cattle manures have been used as substrates in different sets of experiments. Anaerobic treatment from these concentrated streams offers an excellent opportunity for the recovery of methane from the organic content. Also, there is a large production of these type of wastewaters which, if untreated, can result in substantial environmental impact. The anaerobic treatment of this type of streams not only offers the possibility of recovering the energy embedded in the wastewater in the form of biogas, but also reduces the environmental risk associated with the discharge of pharmaceutical compounds and antibiotic resistance genes.

into the environment. Dr Soraya Zahedi (a Juan de la Cierva research fellow) in collaboration with Dr Pijuan and other researchers from the Quality area (Dr Balcazar, Dr Gros and Dr Petrović) have explored different anaerobic treatment conditions aiming at identifying the best anaerobic treatment in terms of biogas production and removal of contaminants of emerging concern (antibiotics and resistance genes). Results from these experiments have been summarized in three scientific publications and several conference presentations.

Fate of emerging pollutants in conventional and advanced wastewater treatment technologies

The second research topic deals with expanding the knowledge of removing organic micropollutants and/or their biodegradation mechanisms. Within this line, the project ANTARES (PID2019-110346RB-C22), funded by the State Research Agency from the Spanish Government and led by Dr Jelena Radjenovic and Dr Maite Pijuan has continued during 2021. This project is coordinated by the Chemical Engineering Department from the University of Santiago de Compostela and investigates the fate and transformation of a wide range of micropollutants and antibiotic resistance genes present in municipal wastewater under different treatment technologies. Within this project, we are investigating the capabilities of a bio-reduced graphene oxide (GO) anaerobic system towards the removal of certain micropollutants. The hypothesis that is being tested is that graphene oxide can be biologically reduced by anaerobic biomass acting as redox mediator and facilitating the direct interspecies electron transfer process, thus enhancing the removal of several micropollutants, which are difficult to be biodegraded under conventional anaerobic processes. This is the topic of the PhD thesis of Oriol Casabella, who obtained a FI PhD grant from the Government of Catalonia in March 2020. An anaerobic membrane bioreactor with sludge amended with graphene oxide has been in operation and different conditions have been tested with regard to the GO addition. Also, a set of batch tests has been conducted to identify the optimal GO concentration in terms of biogas production and micropollutant removal. A scientific publication is being prepared with the obtained data.

Also, in this line of research, the PhD student Michele Ponzelli (supervised by Dr Jelena Radjenovic and Dr Jörg Drewes) has continued his training as part of the Marie Curie ITN project Nowelties (coordinated by Mira Petrović, ICRA AII). Michele has successfully demonstrated microbial reduction of GO to biologically reduced GO (bioRGO), and formation of a hydrogel-like sludge in anaerobic batch reactors. He transferred to the Technical University of Munich in September 2020 as part of his secondment to work in the lab of Prof Drewes to further explore the interactions between anaerobic sludge and graphene oxide.



T&E3. NEXT-GENERATION AND NATURE-BASED TECHNOLOGIES

The annual production of synthetic organic chemicals is estimated at 300 million tons, and a great majority of these reach water bodies and soils. Many of these chemicals are toxic and carcinogenic, have unexpected exposure pathways, and are persistent to currently employed water and wastewater treatment. Increased water scarcity is forcing us to contemplate alternative water supplies such as greywater, harvested rainwater, reclaimed wastewater and others, imposing new paradigms in water and the introduction of decentralized (waste)water systems. The shift from the mainstream, linear top-down model of urban water treatment towards a more circular model which prioritizes (waste)water treatment as near as possible to the original source, is expected to promote local water reuse schemes for non-drinking purposes and thus reduce pressure upon potable water supply. However, many technologies applied in large scale wastewater treatment plants are not well-suited for smaller-scale units. There is a need for the development of new technologies that offer robust, autonomous operation and are cost- and energy-efficient at smaller scale. Furthermore, many of the persistent organic contaminants, e.g., per- and polyfluoroalkyl substances (PFAS), among others, cannot be degraded using the currently applied advanced chemical oxidation methods.

Within the research line Next-generation and nature-based technologies, we are focusing on the development of new technologies and strategies for (waste)water treatment focusing mainly at decentralized scale. Our main motivation is to develop technologies that are truly low-cost systems, with minimum environmental footprint both in their construction and operation, in order to avoid the generation of polluted residual waste streams. To achieve sustainable and cost-effective (waste)water treatment system, we are investigating the following technologies:

- Nature-based solutions (NBS).
- Nanotechnology-enabled electrochemical treatment systems.

Regarding the first block of NBS, this line is expanding its activities within the HYDROUSA, CLEaN-TOUR, and ReUseMP3 projects, in the context of Mediterranean areas and tourist installations and the COST Action Circular City. Several activities are in collaboration with the Water Quality area (Sara Rodríguez-Mozaz) and/or T&E4 line (Joaquim Comas).

The H2020 project HYDROUSA (2018-2023, Gianluigi Buttiglieri, PI for ICRA) Demonstration of water loops with innovative regenerative business models for the Mediterranean region has been evaluating innovative, nature-based, water management solutions for Mediterranean islands and coastal areas for wastewater treatment and nutrient recovery, supplying fresh water from non-conventional water sources also for agriculture purposes. The final aim is to establish the water-energy-food-employment nexus creating jobs, boosting the economy, and making sure that the community and the stakeholders are engaged. Analytical protocols for the analyses of selected micropollutants have been upgraded in several water matrices and are being developed in crops (e.g., lettuce, oregano, lavender) in the framework of the PhD thesis of Marc Castaño. Sampling campaigns from the Greek islands in terms of water, soil, and crops were performed in the winter season (i.e., October-December 2021) and the results will be confirmed in the summer season (June-July 2022). Moreover, human health risk assessment related to the consumption of edible crops produced in the HYDROUSA activities is being evaluated by Dr Lúcia Helena Santos and Josephine Vosse.

The RETOS project CLEaN-TOUR (2018-2021, PIs Joaquim Comas and Gianluigi Buttiglieri) Circular economy to facilitate urban water reuse in a touristic city: centralized or decentralized? was being conducted in the framework of the PhD thesis of Esther Mendoza. Its aim was to demonstrate the safety of regenerated water for irrigation and other uses thus making a step towards circular economy in touristic regions. The analysis of centralized systems and decentralized systems (segregating different types of water) addressed: (i) the elimination of organic microcontaminants (ii) the evaluation of possible risks of water reuse, and (iii) the difficulties to select the most suitable scenario (centralized or decentralized) with innovative treatment technologies such as forward osmosis membranes and hydroponic technologies for greywater treatment with edible plants. A hydroponic pilot plant has been developed in the premises of ICRA to test crops production with greywater as well as organic micropollutants plant uptake. In parallel, the feasibility of a vertical ecosystem for sustainable (grey)water treatment and reuse in touristic resorts was evaluated at different scales.

The AEI ReUseMP3 project (2021-2024, PIs Sara Rodríguez-Mozaz and Gianluigi Buttiglieri) Integrating nature-based water reuse strategies with advanced monitoring of the presence and impact of micropollutants and microplastics (PID2020-115456RB-I00) has started recently. The PhD thesis of Josephine Vosse will be in the framework of Re-UseMP3.

Its aim is to explore the feasibility of using NBS with direct reuse purposes, including irrigation of crops for food production in cities in a more sustainable way. A range of analytical methodologies, including target analysis of known emerging pollutants but also a wide scope suspect and non-target analysis, are being applied to provide a better overview of the presence and removal of substances of emerging concern along the water reuse cycle as well as their impact on the environment and human health. Microplastics and their additives are also going to be monitored in these studies, which include lab-scale experiments under controlled conditions with real grey/wastewater, as well as field studies (e.g., Hotel Samba in Lloret de Mar; Girona urban gardens; Lesbos island in Greece). All the data collected during the project will also allow the development of innovative decision support tools for water management.

Also, ICRA is active in the Circular City (Implementing NBS for creating a resourceful circular city) COST Action (2018-2022) with Gianluigi Buttiglieri as MC for Spain and other ICRA researchers involved (e.g., Joaquim Comas, Joana Castellar). In this context, several reviews and research articles (coauthored by several international experts in NBS) have been elaborated towards the cross-sectoral view of NBS for enabling and managing circular cities and urban waters, and on how to close these water cycles in the built environment through NBS, with focus on the contribution of vertical greening systems and green roofs.

Another related research topic deals with organic micropollutants (pharmaceutical, endocrine disrupting compounds, and watch list compounds) to expand the knowledge of their removal and/or biodegradation mechanisms. Additional studies were performed to evaluate combining biological processes (activated sludge or fungi) with UV/H₂O₂ for the removal of pharmaceutically active compounds (and detailed studies on metoprolol and metoprolol acid) in real hospital wastewater, in collaboration with the Water Quality area. Finally, microalgae-based (*Chlorella vulgaris* and mixed algal-bacterial cultures) mechanisms for the removal of contaminants of emerging concern were studied, in collaboration with University of Ljubljana and the Jožef Stefan Institute, leading to the 2021 University of Ljubljana Best Research Achievement prize.

Regarding the second block of nanotechnology-enabled electrochemical treatment systems, electrochemical systems have several intrinsic advantages that make them ideal technologies for smaller-scale decentralized treatment of contaminated water. They do not use chemical reagents, only electrons, thus avoiding the costs associated with the production, transport, storage and handling of chemicals; they do not form a residual waste stream and they operate at ambient temperature and pressure. Furthermore, electrochemical systems have a small environmental footprint and modular design, making them easy to be combined with other technologies (e.g., adsorption, ion exchange) into hybrid (waste)water treatment units. Electrochemical systems are considered very robust, easily adaptable to changes in the influent wastewater composition and/or volume, and capable of degrading even the most persistent contaminants such as PFAS.

Nevertheless, electrochemical (waste)water treatment systems are struggling to be applied at a wider-scale due to major limitations of the existing electrode materials (i.e., boron-doped diamond (BDD), mixed metal oxide (MMO)): (i) high energy consumption, due to the low surface area of the pricey commercial electrodes, and (ii) rapid oxidation of Cl⁻ ions to free chlorine, chlorate (ClO₃⁻) and perchlorate (ClO₄⁻). Research conducted at ICRA has managed to overcome both limitations by the development of low-cost graphene sponge electrodes, in the scope of the ERC Starting Grant (StG) ELECTRON4WATER. Graphene sponge electrodes present several key advantages compared to commercial anode materials, mainly being that high electrochemical inertness to chloride. Even when polarized at high anodic current densities and in brackish water, graphene sponge electrodes do not form ClO₃⁻ and ClO₄⁻, and display very low current efficiency for chlorine formation (<0.1%), thus minimizing also the amount of the formed organochlorine by-products. At the same time, graphene sponge electrodes form in situ strong oxidants such as hydroxyl radicals (•OH), ozone (O₃), and hydrogen peroxide (H₂O₂), which can degrade a range of organic pollutants (e.g., pesticides, antibiotics and personal care products). Most remarkably, graphene sponge anode is capable of C-F bond cleavage and electrochemical defluorination of persistent PFAS. These achievements effectively enable the electrochemical treatment of brackish, PFAS-rich waste streams (e.g., reverse osmosis brine, landfill leachate), which was not possible previously without an enormous increase in toxicity, owing to the formation of chlorinated by-products at commercial anodes such as BDD. Furthermore, the nature of the graphene coating, with its high amenability to functionalization and insertion of dopants, two-dimensional materials and others, opens up the possibility to tailor these

materials for the removal and degradation of specific pollutants. Resorting to nanotechnology can thus enable the degradation of even the most persistent pollutants such as PFAS without using expensive noble metal catalysts. This work is currently being protected in the PCT international patent application (PCT/EP2021/076930).

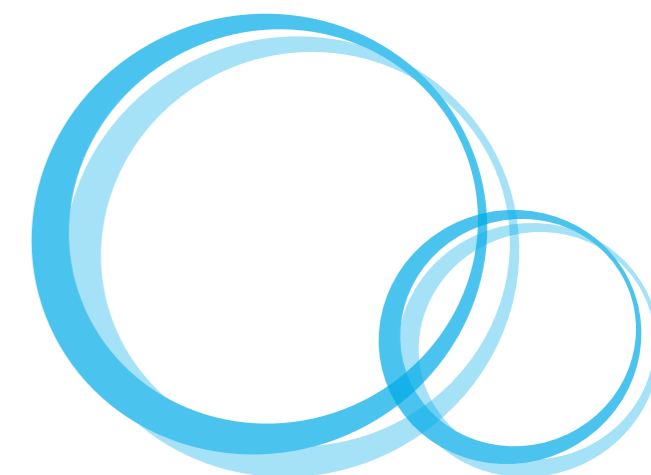
Another nanostructured material developed within the ERC StG ELECTRON4WATER is TiO₂ nanotube array (NTA)-based material coated with different manganese and manganese/molybdenum oxides. This material has been successfully applied for selective electrochemical oxidation of sulfide to sulfur, which has implications not only for sulfide removal from wastewater, but also for the treatment of other concentrated sulfide streams (e.g., scrubbing solutions from biogas treatment). In addition, electrochemical system equipped with manganese oxide based TiO₂ NTA electrode presents up to 5-fold lower cost compared with commercial mixed metal oxide-based anodes. We are currently exploiting other uses of this system, e.g., for the removal of toxic arsenic from groundwater and removal of other organic contaminants. The invention is currently being processed in a European patent application (21-0584-EP).

The ELECTRON4WATER team working on the nanotechnology-enabled electrochemical treatment systems currently counts with two postdoctoral research fellows, Dr Elisabeth Cuervo Lumbaque and Dr Natalia Sergienko, and three PhD students: Natalia Ormeño Cano, Nick Duinslaeger and Anna Segués Codina. Dr Natalia Sergienko successfully defended her PhD thesis in October, 2021 (Electrochemical control and minimization of hydrogen sulfide formation in anaerobic systems), under the supervision of Dr Jelena Radjenovic and Dr Oriol Gutiérrez, and was awarded a *cum laude* distinction by the University of Girona.

Besides electrochemical systems, the potential of nanotechnology to advance other wastewater treatment technologies has also been investigated within the Marie Curie International Training Network (MC ITN) project Nowelties, coordinated by Dr Mira Petrović. The PhD student Michele Ponzelli is currently conducting his thesis on the role and impact of graphene oxide on anaerobic biotransformation of organic pollutants and biogas production. Another project funded by the Spanish Ministry of Science and Innovation, ANTARES, led by Dr Jelena Radjenovic and Dr Maite Pijuan, is also conducted within the same domain of graphene-enabled anaerobic wastewater treatment. Details about this project have been provided in the previous research line.

In the context of the same previously mentioned Nowelties project, another PhD student, Danilo Bertagna, is currently conducting his thesis on photolysis and photocatalysis in water with UVA-LED. He first evaluated the state-of-the-art and current challenges for TiO₂/UV-LED photocatalytic degradation of emerging organic micropollutants and then he studied the impact of UV-LED photoreactor design on their degradation. He considered five contaminants of emerging concern evaluating the performance under different initial conditions. The design of experiments (evaluating the influence of bicarbonates, nitrates, and humic acids in aqueous solutions during photocatalysis) showed the different reactions to matrix alterations. Process optimization will depend on the analysis of each case-scenario, the reactivity of each target pollutant, and the final effluent's quality requirements.

Finally, the LIFE project RECYCLO (PIs Sara Rodríguez-Mozaz, Gianluigi Buttiglieri) RECYCLING waste water from small and medium sized laundries with advanced oxidation process aims to improve water resource efficiency and reduce pollutant discharge by providing an innovative recycling process for small and medium-sized laundries. A new technology, based on advanced oxidation process (AOP) for water reuse, is proposed by the consortium, a very promising performance to degrade emerging pollutants. The tree laundries involved as partners (in Spain, France, and Luxembourg) will become a showcase for the textile sector by demonstrating that the system works for different sizes and different wastewater qualities. ICRA will develop the monitoring protocol and adapt analytical methods for emerging pollutants in laundry wastewater, including pharmaceuticals, antimicrobials, preservatives, flame retardants, plasticizers, and other plastic additives, among others. The effluents of the three laundries will thus be characterized and the concentrations of emerging pollutants determined throughout their different treatment settings.



T&E4. MODELLING, ASSESSMENT AND DECISION SUPPORT FOR URBAN WATER SUSTAINABILITY AND RESILIENCE

The main focus of research line T&E4 is the development of tools and methodologies to support urban water system (UWS) management. Line T&E4 seeks the integration of subsystems (e.g. sewer systems, wastewater treatment plants and receiving water bodies) and planning of smart and sustainable cities.

The main activities focus on the following three themes:

- Digitalisation of the water sector.
- Planning of sustainable cities including nature-based solutions.
- Integrated management of urban wastewater systems.

Ongoing projects with contribution from this research line during 2021 are SCOREwater, DWC, EdiCitNet, INVEST, SARSAIGUA and SUGGEREIX. Clean-Tour, Eoadvisor and SNAPP finished in 2021. In 2021 the H2020 project MULTISOURCE started together with VIRWASTE (funded by AGAUR) and EpiSars (funded by La Marató de TV3). In 2021 T&E4 has managed around €1 million funding (expenditures).

Digitalisation of the water sector

The H2020 SCOREwater project continued during 2021. Led by Dr Corominas and together with BCASA, s::can Iberia, IERMB and Eurecat we have been monitoring for almost one year chemical and physicochemical variables in three neighborhoods of Barcelona with different socio-economic status. Ian Zammit and Aina Cuixart have made the sampling possible and the lab work for chemical and microbiological analysis from sewage samples. Results will be analyzed in tandem with health data during 2022.

Dr Corominas and Dr Collado from T&E4 are part of the coordination team (completed with Dr Laura Guerrero and Dr Carles Borrego from the Water Quality area) of the wastewater-based surveillance system for SARS-CoV-2 in Catalonia (sarsaigua.icra.cat). The network has successfully monitored the circulation of the virus and demonstrated great correlation with diagnosed cases. Funding from the Catalan Government has been secured for 2022 and 2023.

The H2020 project Digital water.city: Leading Urban Water Management to its Digital Future (DWC) (<https://www.digital-water.city/>) continued during 2021. Most of the year time has been devoted to the deployment and monitoring of the CSO sensors of the SENVES+ technology both in Berlin (Germany) and Sofia (Bulgaria) with very satisfactory results. Notably the solution was selected to be showcased in the 2021 United Nations Climate Change Conference COP26 held in Glasgow (Scotland). Several EU reports highlight that cities will need massive investments over the next ten years to ensure compliance with environmental protection and human health. This includes improved treatment capabilities, better control of rainfall events, and a significant reduction in sewer overflows. In this sense, ICRA's SENVES+ solution stands out for reducing the cost of these investments as it is a solution with great potential, effective and, above all, at a low cost.

Dr Corominas and Dr Comas are promoters of the information technologies (IT) lab at ICRA (itlab.icra.cat). ICRA collects all IT products resulting from research projects. Each product has a description and a link to the source-code is provided to foster its usage by the research community (whenever the license allows for it). A list of these products can be found in the Technology Transfer section.

Two new projects started in 2021 related to SARS-CoV-2 surveillance from sewage. First, VIRWASTE aims at enhancing wastewater-based epidemiology for SARS-CoV-2 surveillance. ICRA contribution is on building models to reliably estimate the real number of cases from wastewater concentrations of SARS-CoV-2. To feed and refine this model, VIRWASTE plans to analyze: 1) Fecal samples from COVID-19 patients to determine shedding rates; 2) Wastewater from hospitals with a registered number of COVID-19 patients to be used as reference; and 3) SARS-CoV-2 dynamics in lab- and full-scale sewers. The model will then be validated after the semi-automatic selection of sampling sites in sewer networks at neighborhood scale to resolve whether SARS-CoV-2 abundance in wastewater is a reliable predictor of COVID-19 cases at all population sizes. Wastewater may also be a useful tool for studying viral diversity and seeking new viral species using state-of-the-art metagenomics. The consortium of the project are UB (coordinator), ICRA, Eurecat and UdG. Secondly, EpiSars ICRA contribution is setting up a simple and cheap approach for the surveillance of SARS-CoV-2 circulation in sewage

from precincts. During 2021 the sampling campaigns of VIRWASTE in sewage from 3 neighborhoods of Barcelona and 1 hospital started. Also, the campaigns of EpiSars in 6 buildings (2 elderly houses, 2 primary schools, 1 university dormitory and 1 university campus). Anna Pico and Sergi Badia (UB, with supervision from ICRA) are involved in the sampling campaigns.

Planning of sustainable cities including nature-based solutions

T&E has been cooperating with R&E in the Sanitation for and by Nature project (SANNAT) as part of the Science for Nature and People Partnership (SNAPP). The team is led by Dr Acuña, with contributions in 2021 from Prof Comas and Dr Corominas. ICRA has been polishing the DSS to provide recommendations on using NBS for sanitation. At the end of 2021, ICRA finished the web-based DSS (<https://snapp.icra.cat/>) after being validated by experts. In 2022, this DSS will be further validated and extended with economic and environmental impact criteria under the recently awarded EU Green Deal MULTISOURCE project.

In 2021, T&E4, in collaboration with the Resources and Ecosystems area, has intensified its work on the H2020 project EdiCitNet (<http://www.edicitnet.com>), which aims to foster the systemic use of nature-based solutions for food production as a major step towards more sustainable, liveable and healthier cities. ICRA is leading the development of online tools (an interactive catalogue, design and planning, performance assessment, and an educational game supported by a database) to support public and private stakeholders in NBS learning and implementation. During 2021, ICRA researchers (Dr Castellar, Dr Pueyo, Dr Acuña, Dr Corominas, Dr Rodríguez-Roda and Dr Comas) finalized the co-design and implementation of the tools (available at <https://toolbox.edicitnet.com/>). The toolbox is currently being used for data collection of NBS for food production, called hereafter Edible City Solutions (ECS), among the cities worldwide. In 2021, a new taskforce led by ICRA was initiated to develop a joint online platform to unify all tools and services developed in the scope of the EdiCitNet project. Furthermore, in 2021 the framework and functionalities of the first prototype for the Edible City Game, a serious game for participatory urban planning and scenario simulation of ECS benefits, have been completed. Besides, two workshops were made with the municipalities of Sant Feliu de Llobregat, in Catalonia, and Šempeter pri Gorici, in Slovenia. Likewise, the game is under testing by EMWIS researchers, who are preparing a workshop for several French cities. This game aspires to be a valuable contribution to design the transition to more edible cities. This year, we have continued our contacts with NBS sister projects look-

ing for synergies and to amplify the project's impact, also through the EU NBS taskforces.

The EU MULTISOURCE project (multisource.eu) started in June 2021. The aim is (i) to demonstrate a variety of innovative NBS treating a wide range of urban waters, and (ii) to develop innovative tools, methods, and business models that support citywide planning and long-term operations and maintenance of NBS for water treatment, storage, and reuse in urban areas worldwide. The project includes seven pilots treating a wide range of urban waters, one of them in Girona. ICRA will be (i) leading the development and testing of the technology selection and design tool, a web-based decision-support tool for stakeholders to facilitate the selection and design of NBS for water treatment, and (ii) coordinating the Girona pilot based on a hybrid green wall to treat greywater, together with the municipality of Girona. The data and knowledge acquisition, the conceptualization of the tool and the construction project of the green wall have been just initiated. This project is led by Joaquim Comas and participated by Lluís Corominas, Gigi Buttiglieri, Joana Castellar and Josep Pueyo, as well as Vicenç Acuña (from R&E) and Sara Rodríguez-Mozaz.

Integrated management of urban wastewater systems

In the INVEST project, research professor Wolfgang Gernjak and research scientist Lluís Corominas are attempting to establish a framework that can be used to make investment decisions that contribute to achieve the implementation the Water Framework Directive goals under different global change scenarios. Prof Ignasi Rodríguez-Roda (ICRA-UdG), Manel Poch (UdG) and Morgan Abily (ICRA, postdoctoral researcher) complete the core project team. In 2021 we have defined strategic roadmaps for the selection of tertiary water treatment technologies based on the interpretation for the EU of the Shared Socioeconomic Pathways (SSPs) global change narratives.

Within the CLaEaN-TOUR Spanish RETOS project, in 2021 a first prototype of the multicriteria decision-making tool to support the planning of reclaimed water networks for water reuse in cities, including collection of wastewater or greywater, its treatment and the (re)distribution of the reclaimed water was developed. This DSS supports the generation and assessment of the most adequate water reuse decentralized (or centralized) scenarios. Output data include the optimal water reuse network as well as the change between current and future (water reuse) scenarios in terms of the number of inhabitants served, nexus flows (drinking water savings and energy footprint) and construction. The tool has been

tested and validated for the generation of reclaimed water networks for the cities of Girona and Lloret de Mar. The tool functionalities will be expanded with the assessment of decentralized scenarios and risk in water reuse and the operation and maintenance costs, within the frame of ReUseMP3 project (this was explained in research line III.3 and started in 2021 as a continuation of CLÉAN-TOUR). The tool has been developed in collaboration with the computer science research group BCDS (Broadband Communications and Distributed Systems) of the UdG. Josep Pueyo, Gianluigi Buttiglieri, Miquel Farreras, Lluís Corominas and Joaquim Comas (from ICRA), and David Martínez and Eusebi Calle (from UdG) form the interdisciplinary team working in this tool.

In 2021, T&E continued working on the development of an educational game in cooperation with GILab (University of Girona). Dr Corominas led the development of an educational game to educate primary school students about the urban water cycle (from the tap to freshwater ecosystems) in collaboration with GILab (University of Girona). The educational game has been expanded to incorporate new scenarios under the umbrella of the SCOREwater project.

During 2021, the first prototype of the SUGGEREIX decision support tool to support the selection of the most adequate water reuse scheme was developed. The tool also enables a multi-criteria analysis of viable alternatives, recommends a monitoring plan and provides similar successful cases. Besides, the EESAM DSS to analyze the impact of management strategies for improving the ecological status and assess ecosystem services has also progressed. The working team for these two projects includes Adrià Riu, Lluís Bosch, Wolfgang Gernjak, Mercè Font, Lluís Corominas, Gianluigi Buttiglieri, Ignasi Rodríguez-Roda and Joaquim Comas.

Finally, in 2021 a new project was funded; 4SM Spread Sewer Sensing for Sustainable Management, which obtained the 2021 call from the public-private partnership for the strategic lines of R+D+I projects. The main objective of 4SM is to create a new set of sensors and tools for the advanced and sustainable management of sewer systems. 4SM will address four of the most important challenges/opportunities for optimal sewer management such as i) promote the digitalization process of sewer networks, ii) improve capabilities of current monitoring tools, iii) tap into resource and energy recovery from sewers, and iv) develop highly innovative methods for corrosion, toxicity, and odour control. 4SM aims to simultaneously develop groundbreaking methods for advanced sustainable management of the infrastructure while also accelerating the connection between the sewer physical and digital world.

TECHNOLOGY TRANSFER

The list of products derived from the ICRA ITlab (itlab.icra.cat) can be found below:

- **SARSAIGUA.** A web-based tool to disseminate the results of the circulation of SARSCoV-2 in Catalonia through the analysis of wastewater. 18,000 users and 40,000 visits since its launch in November 2020.
- **ECAM.** the project Water and Wastewater Companies for Climate Mitigation (WaCClIM), a joint initiative between GIZ (Germany) the International Water Association (IWA). > 100 water utilities are using ECAM (more than 50% in developing countries) and helped them reduce greenhouse gas emissions by 20% on average. ECAM is being promoted by the United Nations Climate Change (UNFCCC.int).
- **SNAPP.** Science for Nature and People Partnership. Funded by The Nature Conservancy, the Wildlife Conservation Society and NCEAS (US). A webbased tool to promote the usage of nature-based solutions for water sanitation. To be launched in March 2022.
- **EdicitNet toolbox.** It is a social network for connecting activities at city level for sustainable food production, transformation and distribution. It has already 105 users and 190 edible city solutions registered since it was launched in February 2021.
- **Ecoadvisor for wise leading water management.** Funded by Aigües de Catalunya. A web-based tool for water utilities and water authorities to manage urban water infrastructure and rivers in an integrated manner. Ecoadvisor offers Aigües de Catalunya an advantage in terms for the management of sewer systems. Aigües de Catalunya is part of Global Omnium, a leading national and international business group with more than 125 years of history, technologically leading, serving more than 300 municipalities and more than six million people, with presence in Europe, Africa, Asia and Latin America.
- **SENVES+.** A device to monitor the frequency and duration of combined sewer overflows in wastewater networks; its origin comes from the patent described in previous section, and it is currently being converted into a commercial product within the DWC H2020 project. In 2021 SENVES+ has been tested in Berlin and Sofia and has just started to be implemented in Milan. Over this time, technological advancement has focused on the increase of data transfer using low-consuming methods and improving the accuracy detection to avoid false-positive overflow detection, one of the main concerns of water utilities in charge of storm-wastewater management.
- **RedCross HWT-DSS.** Provides decision support when choosing technologies to treat drinking water at household level in emergency situations.

AIII - PHD DISSERTATIONS

Sergienko, Natalia (October 2021), Electrochemical control and minimization of hydrogen sulfide formation in anaerobic systems. Supervisors: Radjenovic, J. (principal), Gutiérrez, O.

AIII - VISITING STUDENTS

Campillo Grau, Ventura - University of Girona (UdG)
Bergqvist, Miriam - ETHZ
Badia Latre, Sergi - Autonomous University of Barcelona (UAB)
Pompidó Pujol, Gerard - University of Girona (UdG)
Casellas Escola, Lluís - Universitat de Girona (UDG)
Arnaud de Aguiar, Nicole - University of Girona (UdG)
Recacha Borrell, Judit - Universitat de Girona (UDG)
El Houda Slama, Nour - Monastir Faculty of Science
Papapanou, Ioanna Melina - University of Patras
Vert Coll, Eduard - University of Girona (UdG)

AIII - PARTICIPANT PROJECTS

Sanchez Tobon, Camilo (predoctoral researcher) - University of Zagreb
Kumar, Amit (predoctoral researcher) - Institute of Physics Belgrade
Bertagna Silva, Danilo (predoctoral researcher) - University of Zagreb

AIII - STAYS ABROAD

Buttiglieri, G. Sanitary Engineering Laboratory of the Department of Water Resources and Environmental Engineering of the National Technical University of Athens (NTUA, Greece). 1st August-31st October 2021, Castillejo CAS19/00301.





05

PUBLICATIONS AND CONGRESSES

TOTAL PUBLICATIONS: 186



SCI PUBLICATIONS (SCIENCE CITATION INDEX 2021): 162

(Publications ordered alphabetically)

Abily, M., Vicenç, A., Gernjak, W., Rodríguez-Roda, I., Poch, M. & Corominas, L. (2021), "Climate change impact on EU rivers' dilution capacity and ecological status", *Water Research*, vol. 199. IF= 11.236, Q1

Agathokleous, E., Barceló, D. & Calabrese, E.J. (2021), "US EPA: Is there room to open a new window for evaluating potential sub-threshold effects and ecological risks?", *Environmental Pollution*, vol. 284. IF= 8.04, Q1

Agathokleous, E., Iavicoli, I., Barceló, D. & Calabrese, E.J. (2021), "Ecological risks in a 'plastic' world: A threat to biological diversity?", *Journal of Hazardous Materials*, vol. 417. IF= 10.39, Q1

Agathokleous, E., Iavicoli, I., Barceló, D. & Calabrese, E.J. (2021), "Micro/nanoplastics effects on organisms: A review focusing on 'dose'", *Journal of Hazardous Materials*, vol. 417. IF= 10.39, Q1

Alvarado-Ramírez, L., Rostro-Alanis, M., Rodríguez-Rodríguez, J., Castillo-Zacarias, C., Sosa-Hernández, J.E., Barceló, D., Iqbal, H.M.N. & Parra-Saldívar, R. (2021), "Exploring current tendencies in techniques and materials for immobilization of laccases – A review", *International Journal of Biological Macromolecules*, vol. 181, pp. 683-696. IF= 6.78, Q1

Aryal, R., Sidhu, J.P.S., Chong, M.N., Toze, S., Gernjak, W. & Mainali, B. (2021), "Role of environmental variables in the transport of microbes in stormwater", *Water (Switzerland)*, vol. 13, no. 9. IF= 3.17, Q1

Ávila, C., García-Galán, M.J., Borrego, C.M., Rodríguez-Mozaz, S., García, J. & Barceló, D. (2021), "New insights on the combined removal of antibiotics and ARGs in urban wastewater through the use of two configurations of vertical subsurface flow constructed wetlands", *Science of the Total Environment*, vol. 755. IF= 7.96, Q1

Ávila, C., García-Galán, M.J., Uggetti, E., Montemurro, N., García-Vara, M., Pérez, S., García, J. & Postigo, C. (2021), "Boosting pharmaceutical removal through aeration in constructed wetlands", *Journal of Hazardous Materials*, vol. 412. IF= 10.39, Q1

Baptista-Pires, L., Norra, G.F. & Radjenovic, J. (2021), "Graphene-based sponges for electrochemical degradation of persistent organic contaminants", *Water Research*, vol. 203. IF= 11.236, Q1

Batalla, R.J., Gibbins, C.N., Alcázar, J., Brasington, J., Buendía, C., García, C., Llena, M., López, R., Palau, A., Rennie, C.D., Wheaton, J.M. & Vericat, D. (2021), "Hydropeaked rivers need attention", *Environmental Research Letters*, vol. 16, no. 2. IF= 6.15, Q1

Bertagna Silva, D., Buttiglieri, G. & Babić, S. (2021), "State-of-the-art and current challenges for TiO₂/UV-LED photocatalytic degradation of emerging organic micropollutants", *Environmental Science and Pollution Research*, vol. 28, no. 1, pp. 103-120. IF= 4.01, Q1

Bertagna Silva, D., Buttiglieri, G., Babić, T., Ćurković, L. & Babić, S. (2021), "Impact of UV-LED photoreactor design on the degradation of contaminants of emerging concern", *Process Safety and Environmental Protection*, vol. 153, pp. 94-106. IF= 6.158, Q1

Bilal, M., Barceló, D. & Iqbal, H.M.N. (2021), "Occurrence, environmental fate, ecological issues, and redefining of endocrine disruptive estrogens in water resources", *Science of the Total Environment*, vol. 800. IF= 7.96, Q1

Bosch-Orea, C., Sanchís, J. & Farré, M. (2021), "Analysis of highly polar marine biotoxins in seawater by hydrophilic interaction liquid chromatography coupled to high resolution mass spectrometry", *MethodsX*, vol. 8. IF= 1.84, Q2

Botturi, A., Ozbayram, E.G., Tondera, K., Gilbert, N.I., Rouault, P., Caradot, N., Gutiérrez, O., Daneshgar, S., Frison, N., Akyol, Ç., Foglia, A., Eusebi, A.L. & Fatone, F. (2021), "Combined sewer overflows: A critical review on best practice and innovative solutions to mitigate impacts on environment and human health", *Critical Reviews in Environmental Science and Technology*, vol. 51, no. 15, pp. 1585-1618. IF= 9.028, Q1

Buonerba, A., Corpuz, M.V.A., Ballesteros, F., Choo, K.H., Hasan, S.W., Korshin, G.V., Belgiorno, V., Barceló, D. & Nadeo, V. (2021), "Coronavirus in water media: Analysis, fate, disinfection and epidemiological applications", *Journal of Hazardous Materials*, vol. 415. IF= 10.39, Q1

Calle, E., Martínez, D., Brugués-i-Pujolràs, R., Farreras, M., Saló-Grau, J., Pueyo-Ros, J. & Corominas, L. (2021), "Optimal selection of monitoring sites in cities for SARS-CoV-2 surveillance in sewage networks", *Environment International*, vol. 157. IF= 9.621, Q1

Castellar, J.A.C., Popartan, L.A., Pueyo-Ros, J., Atanasova, N., Langergraber, G., Säumel, I., Corominas, L., Comas, J. & Acuña, V. (2021), "Nature-based solutions in the urban context: terminology, classification and scoring for urban challenges and ecosystem services", *Science of the Total Environment*, vol. 779. IF= 7.96, Q1

Castillo-Zacarias, C., Barocio, M.E., Hidalgo-Vázquez, E., Sosa-Hernández, J.E., Parra-Arroyo, L., López-Pacheco, I.Y., Barceló, D., Iqbal, H.M.N. & Parra-Saldívar, R. (2021), "Anti-depressant drugs as emerging contaminants: Occurrence in urban and non-urban waters and analytical methods for their detection", *Science of the Total Environment*, vol. 757. IF= 7.96, Q1

Catalán, N., Pastor, A., Borrego, C., Casas, J.P., Hawkes, J.A., Gutiérrez, C., von Schiller, D. & Marcé, R. (2021), "The relevance of environment vs. composition on dissolved organic matter degradation in freshwaters", *Limnology and Oceanography*, vol. 66, no. 2, pp. 306-320. IF= 4.745, Q1

Čelić, M., Jaén-Gil, A., Briceño-Guevara, S., Rodríguez-Mozaz, S., Gros, M. & Petrović, M. (2021), "Extended suspect screening to identify contaminants of emerging concern in riverine and coastal ecosystems and assessment of environmental risks", *Journal of Hazardous Materials*, vol. 404. IF= 10.39, Q1

Chong, X.Y., Gibbins, C.N., Vericat, D., Batalla, R.J., Teo, F.Y. & Lee, K.S.P. (2021), "A framework for Hydrological characterisation to support Functional Flows (HyFFlow): Application to a tropical river", *Journal of Hydrology: Regional Studies*, vol. 36. IF= 5.119, Q1

Chong, X.Y., Vericat, D., Batalla, R.J., Teo, F.Y., Lee, K.S.P. & Gibbins, C.N. (2021), "A review of the impacts of dams on the hydromorphology of tropical rivers", *Science of the Total Environment*, vol. 794. IF= 7.96, Q1

Colls, M., Timoner, X., Font, C., Acuña, V. & Sabater, S. (2021), "Biofilm pigments in temporary streams indicate duration and severity of drying", *Limnology and Oceanography*, vol. 66, no. 9, pp. 3313-3326. IF= 4.745, Q1

Corominas, L., Gimeno, P., Constantino, C., Daldorph, P. & Comas, J. (2021), "Can source control of pharmaceuticals decrease the investment needs in urban wastewater infrastructure?", *Journal of Hazardous Materials*, vol. 407. IF= 10.39, Q1

Da Silva, J.J., Da Silva, B.F., Stradiotto, N., Petrović, M., Gros, M. & Gago-Ferrero, P. (2021), "Identification of organic contaminants in vinasse and in soil and groundwater from fertigated sugarcane crop areas using target and suspect screening strategies", *Science of the Total Environment*, vol. 761. IF= 7.96, Q1

Datry, T., Allen, D., Argelich, R., Barquin, J., Bonada, N., Boulton, A., Branger, F., Cai, Y., Cañedo-Argüelles, M., Cid, N., Csabai, Z., Dallimer, M., De Araújo, J.C., Declerck, S., Dekker, T., Döll, P., Encalada, A., Forcellini, M., Foulquier, A., Heino, J., Jabot, F., Keszler, P., Kopperoinen, L., Kralisch, S., Künne, A., Lamouroux, N., Lauvernet, C., Lehtoranta, V., Loskotová, B., Marcé, R., Martín Ortega, J., Mataushek, C., Miliša, M., Mogyorósi, S., Moya, N., Müller Schmied, H., Munné, A., Munoz, F., Mykrä, H., Pal, I., Paloniemi, R., Pařil, P., Pengal, P., Pernecker, B., Poláček, M., Rezende, C., Sabater, S., Sarremejane, R., Schmidt, G., Senerpont Domis, L., Singer, G., Suárez, E., Talluto, M., Teurlincx, S., Trautmann, T., Truchy, A., Tyllianakis, E., Väisänen, S., Varumo, L., Vidal, J.P., Vilmi, A. & Vinyoles, D. (2021), "Securing biodiversity, functional integrity, and ecosystem services in DRYing rivER Networks (DRYrVER)", *Research Ideas and Outcomes* 7: e77750. <https://doi.org/10.3897/rio.7.e77750>

Grant, L., Vanderkelen, I., Gudmundsson, L., Tan, Z., Perroud, M., Stepanenko, V., Debolskiy, A., Droppers, B., Janssen, A., Woolway, I.R., Choulga, M., Balsamo, G., Kirillin, G., Schewe, J., Zhao, F., Vega del Valle, I., Golub, M., Pierson, D., Marcé, R., Seneviratne, S. & Thiery, W. (2021), "Attribution of global lake systems change to anthropogenic forcing", *Nature Geoscience*, vol. 14, pp. 849-854. <https://doi.org/10.1038/s41561-021-00833-x> IF= 16.908, Q1

Dela Rosa, F.M., Papac, J., Garcia-Ballesteros, S., Kovačić, M., Katančić, Z., Kušić, H. & Božić, A.L. (2021), "Solar light activation of persulfate by TiO₂/Fe₂O₃ layered composite films for degradation of amoxicillin: Degradation mechanism, matrix effects, and toxicity assessments", *Advanced Sustainable Systems*, vol. 5, no. 11. IF= 6.271, Q1

Donis, D., Mantzouki, E., McGinnis, D.F., Vachon, D., Gallego, I., Grossart, H.P., De Senerpont Domis, L.N., Teurlincx, S., Seelen, L., Lüring, M., Verstijnen, Y., Maliaka, V., Fonvielle, J., Visser, P.M., Verspagen, J., van Herk, M., Antoniou, M.G., Tsariarta, N., McCarthy, V., Perello, V.C., Machado-Vieira, D., De Oliveira, A.G., Maronić, D.Š., Stević, F., Pfeiffer, T.Ž., Vucelić, I.B., Žutinić, P., Udovič, M.G., Plenković-Moraj, A., Bláha, L., Geriš, R., Fránková, M., Christoffersen, K.S., Warming, T.P., Feldmann, T., Laas, A., Panksep, K., Tuvikene, L., Kangro, K., Koreivienė, J., Karosienė, J., Kasperovičienė, J., Savadova-Ratkus, K., Vitonytė, I., Häggqvist, K., Salmi, P., Arvola, L., Rothhaupt, K., Avagianos, C., Kaloudis, T., Gkelis, S., Panou, M., Triantis, T., Zervou, S.K., Hiskia, A., Obertegger, U., Boscaini, A., Flaim, G., Salmaso, N., Cerasino, L., Haande, S., Skjelbred, B., Grabowska, M., Karpowicz, M., Chmura, D., Nawrocka, L., Kobos, J., Mazur-Marzec, H., Alcaraz-Párraga, P., Wilk-Woźniak, E., Krztoń, W., Walusiak, E., Gagala-Borowska, I., Mankiewicz-Boczek, J., Toporowska, M., Pawlik-Skowronska, B., Niedźwiecki, M., Pęczuła, W., Napiórkowska-Krzebietke, A., Dunalska, J., Sieńska, J., Szymański, D., Kruk, M., Budzyńska, A., Goldyn, R., Kozak, A., Rosińska, J., Szeląg-Wasielewska, E., Domek, P., Jakubowska-Krepska, N., Kwasiszur, K., Messyas, B., Pelechata, A., Pelechaty, M., Kokocinski, M., Madrecka-Witkowska, B., Kostorzewska-Szlakowska, I., Frąk, M., Bańkowska-Sobczak, A., Wasilewicz, M., Ochocka, A., Pasztaleniec, A., Jasser, I., Antão-Geraldes, A.M., Leira, M., Vasconcelos, V., Morais, J., Vale, M., Raposo, P.M., Gonçalves, V., Aleksovski, B., Krstić, S., Nemova, H., Drastichova, I., Chomova, L., Remec-Rekar, S., Elerseker, T., Hansson, L.A., Urrutia-Cordero, P., Bravo, A.G., Buck, M., Colom-Montero, W., Mustonen, K., Pierson, D., Yang, Y., Richardson, J., Edwards, C., Cromie, H., Delgado-Martín, J., García, D., Cereijo, J.L., Gomà, J., Trapote, M.C., Vegas-Villarrubia, T., Obrador, B., García-Murcia, A., Real, M., Romans, E., Noguero-Ribes, J., Parreño, D., Fernández-Morán, E., Úbeda, B., Gálvez, J.Á., Catalán, N., Pérez-Martínez, C., Ramos-Rodríguez, E., Cillero-Castro, C., Moreno-Ostos, E., Blanco, J.M., Rodríguez, V., Montes-Pérez, J.J., Palomino, R.L., Rodríguez-Pérez, E., Hernández, A., Carballeira, R., Camacho, A., Picazo, A., Rochera, C., Santamans, A.C., Ferriol, C., Romo, S., Soria, J.M., Özen, A., Karan, T., Demir, N., Beklioğlu, M., Filiz, N., Levi, E., Iskin, U., Bezirci, G., Tavşanoğlu, Ü.N., Çelik, K., Ozhan, K., Karakaya, N., Koçer, M.A.T., Yılmaz, M., Maraşlioğlu, F., Fakioglu, Ö., Soylu, E.N., Yağcı, M.A., Çınar, Ş., Çapkin, K., Yağcı, A., Cesur, M., Bilgin, F., Bulut, C., Uysal, R., Latife, K., Akçaalan, R., Albay, M., Alp, M.T., Özkan, K., Sevindik, T.O., Tunca, H., Önem, B., Paerl, H., Carey, C.C. & Ibelings, B.W. (2021), "Stratification strength and light climate explain variation in chlorophyll α at the continental scale in a European multilake survey in a heatwave summer", *Limnology and Oceanography*, vol. 66, no. 12, pp. 4314-4333. IF= 4.745, Q1

Eid, E.M., Shaltout, K.H., Alamri, S.A.M., Alrumman, S.A., Hussain, A.A., Sewelam, N., El-Bebany, A.F., Alfarhan, A.H., Picó, Y. & Barceló, D. (2021), "Prediction models based on soil properties for evaluating the uptake of eight heavy metals by tomato plant (*Lycopersicon esculentum* Mill.) grown in agricultural soils amended with sewage sludge", *Journal of Environmental Chemical Engineering*, vol. 9, no. 5. IF= 5.88, Q1

Eid, E.M., Shaltout, K.H., Almuqrin, A.H., Aloraini, D.A., Khedher, K.M., Taher, M.A., Alfarhan, A.H., Picó, Y. & Barceló, D. (2021), "Uptake prediction of nine heavy metals by *Eichhornia crassipes* grown in irrigation canals: A biomonitoring approach", *Science of the Total Environment*, vol. 782. IF= 7.96, Q1

Escolà Casas, M., Schröter, N.S., Zammit, I., Castaño-Trias, M., Rodríguez-Mozaz, S., Gago-Ferrero, P. & Corominas, L. (2021), "Showcasing the potential of wastewater-based epidemiology to track pharmaceuticals consumption in cities: Comparison against prescription data collected at fine spatial resolution", *Environment International*, vol. 150. IF= 9.621, Q1

Escudero, J., Muñoz, J.L., Morera-Herreras, T., Hernandez, R., Medrano, J., Domingo-Echaburu, S., Barceló, D., Orive, G. & Lertxundi, U. (2021), "Antipsychotics as environmental pollutants: An underrated threat?", *Science of the Total Environment*, vol. 769. IF= 7.96, Q1

Estelrich, M., Vosse, J., Comas, J., Atanasova, N., Castellano Costa, J., Gattringer, H. & Buttiglieri, G. (2021), "Feasibility of vertical ecosystem for sustainable water treatment and reuse in touristic resorts", *Journal of environmental management*, vol. 294. IF= 6.89, Q1

Flores, B., González, N., Bravo, A., Mora-Sánchez, B., Torres, D., Jirón, W., Sheleby-Elías, J. & Balcázar, J.L. (2021), "Identification of pathogenic bacteria in fishes caught in the Pacific off Nicaragua", *Ciencias Marinas*, vol. 47, no. 3, pp. 175-184. IF= 0.844, Q4

Forés, E., Bofill-Mas, S., Itarte, M., Martínez-Puchol, S., Hundeda, A., Calvo, M., Borrego, C.M., Corominas, L.L., Girones, R. & Rusiñol, M. (2021), "Evaluation of two rapid ultrafiltration-based methods for SARS-CoV-2 concentration from wastewater", *Science of the Total Environment*, vol. 768. IF= 7.96, Q1

Galizia, A., Mamo, J., Blandin, G., Verdaguer, M., Comas, J., Rodríguez-Roda, I. & Monclús, H. (2021), "Advanced control system for reverse osmosis optimization in water reuse systems", *Desalination*, vol. 518. IF= 9.55, Q1

Garau, E., Pueyo-Ros, J., Ribas Palom, A. & Vila-Subiros, J. (2021), "Follow the flow: Analysis of relationships between water ecosystem service supply units and beneficiaries", *Applied Geography*, vol. 133. IF= 4.40, Q1

Garau, E., Torralba, M. & Pueyo-Ros, J. (2021), "What is a river basin? Assessing and understanding the sociocultural mental constructs of landscapes from different stakeholders across a river basin", *Landscape and Urban Planning*, vol. 214. IF= 6.142, Q1

García-Pacheco, R., Li, Q., Comas, J., Taylor, R.A. & Le-Clech, P. (2021), "Novel housing designs for nanofiltration and ultrafiltration gravity-driven recycled membrane-based systems", *Science of the Total Environment*, vol. 767. IF= 7.96, Q1

Gil-Solsona, R., Álvarez-Muñoz, D., Serra-Compte, A. & Rodríguez-Mozaz, S. (2021), "(Xeno)metabolomics for the evaluation of aquatic organism's exposure to field contaminated water", *Trends in Environmental Analytical Chemistry*, vol. 31. IF= 9.6, Q1

Gil-Solsona, R., Rodríguez-Mozaz, S., Diaz-Cruz, M.S., Sunyer-Caldú, A., Luarte, T., Höfer, J., Galbán-Malagón, C. & Gago-Ferrero, P. (2021), "A protocol for wide-scope non-target analysis of contaminants in small amounts of biota using bead beating tissue lyser extraction and LC-HRMS", *MethodsX*, vol. 8. IF= 1.84, Q2

Gil-Izquierdo, A., Pedreño, M.A., Montoro-García, S., Tárrega-Martínez, M., Iglesias, P., Ferreres, F., Barceló, D., Núñez-Delgado E. & Gabaldón, J.A. (2021), "A sustainable approach by using microalgae to minimize the eutrophication process of Mar Menor lagoon", *Science of the Total Environment*, vol. 758, art. 143613, 1-15 IF= 7.96, Q1

Gionchetta, G., Fillol, M., Sánchez-Melsió, A., Gutiérrez, O., Balcázar, J.L. & Borrego, C.M. (2021), "Side effects of free nitrous acid on the sewer resistome and mobilome", *Chemical Engineering Journal*, vol. 405. IF= 13.07, Q1

Gómez-Gener, L., Siebers, A.R., Arce, M.I., Arnon, S., Bernal, S., Bolpagni, R., Datry, T., Gionchetta, G., Grossart, H.P., Mendoza-Lera, C., Pohl, V., Risse-Buhl, U., Shumilova, O., Tzoraki, O., von Schiller, D., Weigand, A., Weigelhofer, G., Zak, D. & Zoppini, A. (2021), "Towards an improved understanding of biogeochemical processes across surface-groundwater interactions in intermittent rivers and ephemeral streams", *Earth-Science Reviews*, vol. 220. IF= 12.413, Q1

Gómez-Morte, T., Gómez-López, V.M., Lucas-Abellán, C., Martínez-Alcalá, I., Ayuso, M., Martínez-López, S., Montemurro, N., Pérez, S., Barceló, D., Fini, P., Cosma, P., Cerón-Carrasco, J.P., Fortea, M.I., Núñez-Delgado, E. & Gabaldón, J.A. (2021), "Removal and toxicity evaluation of a diverse group of drugs from water by a cyclodextrin polymer/pulsed light system", *Journal of Hazardous Materials*, vol. 402, art. 123504. IF= 10.39, Q1

González-Fernández, D., Cózar, A., Hanke, G., Viejo, J., Morales-Caselles, C., Bakiu, R., Barceló, D., Bessa, F., Bruge, A., Cabrera, M., Castro-Jiménez, J., Constant, M., Crosti, R., Galletti, Y., Kideys, A.E., Machitadze, N., Pereira de Brito, J., Pogojeva, M., Ratola, N., Rigueira, J., Rojo-Nieto, E., Savenko, O., Schöneich-Argent, R.I., Siedlewicz, G., Suaria, G. & Tourgeli, M. (2021), "Floating macrolitter leaked from Europe into the ocean", *Nature Sustainability*, vol. 4, no. 6, pp. 474-483. IF= 9.65, Q1

González-Trujillo, J.D., Saito, V.S., Petsch, D.K., Muñoz, I. & Sabater, S. (2020), "Historical legacies and contemporary processes shape beta diversity in Neotropical montane streams", *Journal of Biogeography*, vol. 48, no. 1, pp. 101-117. IF= 3.83, Q1

González-Villalobos, E., Ribas-Aparicio, R.M., Montealegre, G.E.R., Belmont-Monroy, L., Ortega-García, Y., Aparicio-Ozores, G., Balcázar, J.L., Eslava-Campos, C.A., Hernández-Chiñas, U. & Molina-López, J. (2021), "Isolation and characterization of novel bacteriophages as a potential therapeutic option for *Escherichia coli* urinary tract infections", *Applied Microbiology and Biotechnology*, vol. 105, no. 13, pp. 5617-5629. IF= 4.70, Q1

Grant, L., Vanderkelen, I., Gudmundsson, L., Tan, Z., Perroud, M., Stepanenko, V.M., Debolskiy, A.V., Droppers, B., Janssen, A.B.G., Woolway, R.I., Choulga, M., Balsamo, G., Kirillin, G., Schewe, J., Zhao, F., Del Valle, I.V., Golub, M., Pierson, D., Marcé, R., Seneviratne, S.I. & Thiery, W. (2021), "Attribution of global lake systems change to anthropogenic forcing", *Nature Geoscience*, vol. 14, no. 11, pp. 849-854. IF= 16.908, Q1

Grant, L., Vanderkelen, I., Gudmundsson, L., Tan, Z., Perroud, M., Stepanenko, V.M., Debolskiy, A.V., Droppers, B., Janssen, A.B.G., Woolway, R.I., Choulga, M., Balsamo, G., Kirillin, G., Schewe, J., Zhao, F., Del Valle, I.V., Golub, M., Pierson, D., Marcé, R., Seneviratne, S.I. & Thiery, W. (2021), "Author Correction: Attribution of global lake systems change to anthropogenic forcing (Nature Geoscience, (2021), 14, 11, (849-854), 10.1038/s41561-021-00833-x)", *Nature Geoscience*. IF= 16.908, Q1

Gros, M., Catalán, N., Mas-Pla, J., Čelić, M., Petrović, M. & Farré, M.J. (2021), "Groundwater antibiotic pollution and its relationship with dissolved organic matter: Identification and environmental implications", *Environmental Pollution*, vol. 289. IF= 8.04, Q1

Guerrero-Cruz, S., Vaksmaa, A., Horn, M.A., Niemann, H., Pijuan, M. & Ho, A. (2021), "Methanotrophs: Discoveries, environmental relevance, and a perspective on current and future applications", *Frontiers in Microbiology*, vol. 12. IF= 5.64, Q1

Hernández-Fernández, J., Lopez-Martinez, J. & Barceló, D. (2021), "Development and validation of a methodology for quantifying parts-per-billion levels of arsine and phosphine in nitrogen, hydrogen and liquefied petroleum gas using a variable pressure sampler coupled to gas chromatography-mass spectrometry", *Journal of Chromatography A*, vol. 1637. IF= 3.205, Q1

Hernández-Fernández, J., Lopez-Martinez, J. & Barceló, D. (2021), "Quantification and elimination of substituted synthetic phenols and volatile organic compounds in the wastewater treatment plant during the production of industrial scale polypropylene", *Chemosphere*, vol. 263. IF= 7.086, Q1

Hom-Diaz, A., Jaén-Gil, A., Rodríguez-Mozaz, S., Barceló, D., Vicent, T. & Blánquez, P. (2021), "Insights into removal of antibiotics by selected microalgae (*Chlamydomonas reinhardtii*, *Chlorella sorokiniana*, *Dunaliella tertiolecta* and *Pseudokirchneriella subcapitata*)", *Algal Research*, IF= 4.401, Q1

Ibrahim, Y., Ouda, M., Kadadou, D., Banat, F., Naddeo, V., Al-safar, H., Yousef, A.F., Barceló, D. & Hasan, S.W. (2021), "Detection and removal of waterborne enteric viruses from wastewater: A comprehensive review", *Journal of Environmental Chemical Engineering*, vol. 9, no. 4. IF= 5.88, Q1

Jaén-Gil, A., Buttiglieri, G., Benito, A., Mir-Tutusaus, J.A., Gonzalez-Olmos, R., Caminal, G., Barceló, D., Sarrà, M. & Rodríguez-Mozaz, S. (2021), "Combining biological processes with UV/H₂O₂ for metoprolol and metoprolol acid removal in hospital wastewater", *Chemical Engineering Journal*, vol. 404. IF= 13.07, Q1

Jarma, D., Sánchez, M.I., Green, A.J., Peralta-Sánchez, J.M., Hortas, F., Sánchez-Melsió, A. & Borrego, C.M. (2021), "Faecal microbiota and antibiotic resistance genes in migratory waterbirds with contrasting habitat use", *Science of the Total Environment*, vol. 783. IF= 7.96, Q1

Jorda-Capdevila, D., Iniesta-Arandia, I., Quintas-Soriano, C., Basdeki, A., Calleja, E.J., DeGirolamo, A.M., Gilvear, D., Ilhéu, M., Kriaučiūniene, J., Logar, I., Loures, L. & Padlo, T. (2021), "Disentangling the complexity of socio-cultural values of temporary rivers", *Ecosystems and People*, vol. 17, no. 1, pp. 235-247. IF= Q1

Juan-García, P., Rieger, L., Darch, G., Schraa, O. & Corominas, L. (2021), "A framework for model-based assessment of resilience in water resource recovery facilities against power outage", *Water Research*, vol. 202. IF= 11.236, Q1

Kaletova, T., Rodriguez-Lozano, P., Berger, E., Filipa Filipe, A., Logar, I., Helena Alves, M., Calleja, E.J. & Jorda-Capdevila, D. (2021), "Considering temporal flow variability of non-perennial rivers in assessing ecosystem service provision", *Ecosystem Services*, vol. 52. IF= 5.454, Q1

Keller, P.S., Marcé, R., Obrador, B. & Koschorreck, M. (2021), "Global carbon budget of reservoirs is overturned by the quantification of drawdown areas", *Nature Geoscience*, vol. 14, no. 6, pp. 402-408. IF= 16.908, Q1

Khan, H., Laas, A., Marcé, R., Sepp, M. & Obrador, B. (2021), "Eutrophication and geochemistry drive pelagic calcite precipitation in lakes", *Water*, vol. 13, no. 5. IF= 3.17, Q1

Köck-Schulmeyer, M., Ginebreda, A., Petrović, M., Giulivo, M., Aznar-Alemany, Ö., Eljarrat, E., Valle-Sistac, J., Molins-Delgado, D., Diaz-Cruz, M.S., Monllor-Alcaraz, L.S., Guillem-Argiles, N., Martínez, E., Miren, L.D.A., Llorca, M., Farré, M., Peña, J.M., Mandaric, L., Pérez, S., Majone, B., Bellin, A., Kalogianni, E., Skoulikidis, N.T., Milačić, R. & Barceló, D. (2021), "Priority and emerging organic microcontaminants in three Mediterranean river basins: Occurrence, spatial distribution, and identification of river basin specific pollutants", *Science of the Total Environment*, vol. 754. IF= 7.96, Q1

Koschorreck, M., Prairie, Y.T., Kim, J. & Marcé, R. (2021), "Technical note: CO₂ is not like CH₄ - Limits of and corrections to the headspace method to analyse pCO₂ in fresh water", *Biogeosciences*, vol. 18, no. 5, pp. 1619-1627. IF= 4.295, Q1

Kothawala, D.N., Kellerman, A.M., Catalán, N. & Tranvik, L.J. (2021), "Organic matter degradation across ecosystem boundaries: The need for a unified conceptualization", *Trends in Ecology and Evolution*, vol. 36, no. 2, pp. 113-122. IF= 10.035, Q1

Kumar, A., Škoro, N., Gernjak, W. & Puač, N. (2021), "Cold atmospheric plasma technology for removal of organic micropollutants from wastewater—a review", *The European Physical Journal D*, vol. 75, no. 11. IF= 4.131, Q3

Kumar, M., Dhangar, K., Thakur, A.K., Ram, B., Chaminda, T., Sharma, P., Kumar, A., Raval, N., Srivastava, V., Rinklebe, J., Kuroda, K., Sonne, C. & Barceló, D. (2021), "Antidrug resistance in the Indian ambient waters of Ahmedabad during the COVID-19 pandemic", *Journal of Hazardous Materials*, vol. 416. IF= 10.39, Q1

Kumar, M., Kuroda, K., Joshi, M., Bhattacharya, P. & Barceló, D. (2021), "First comparison of conventional activated sludge versus root-zone treatment for SARS-CoV-2 RNA removal from wastewaters: Statistical and temporal significance", *Chemical Engineering Journal*, vol. 425. IF= 13.07, Q1

Kumar, M., Kuroda, K., Barceló, D. & Furumai, H. (2022), "Monsoon dilutes the concurrence but increases the correlation of viruses and pharmaceuticals and personal care products (PPCPs) in the Urban Waters of Guwahati, India: The context of pandemic viruses", *Science of the Total Environment*, vol. 813, art. 152282, 1-15, IF= 7.96, Q1

Langergraber, G., Castellar, J.A.C., Andersen, T.R., Andreucci, M.B., Baganz, G.F.M., Buttiglieri, G., Canet-Martí, A., Carvalho, P.N., Finger, D.C., Griessler Bulc, T., Junge, R., Megyesi, B., Milošević, D., Oral, H.V., Pearlmutter, D., Pineda-Martos, R., Pucher, B., van Hullebusch, E.D. & Atanasova, N. (2021), "Towards a cross-sectoral view of nature-based solutions for enabling circular cities", *Water*, vol. 13, no. 17. IF= 3.17, Q1

Langergraber, G., Castellar, J.A.C., Pucher, B., Baganz, G.F.M., Milošević, D., Andreucci, M.B., Kearney, K., Pineda-Martos, R. & Atanasova, N. (2021), "A framework for addressing circularity challenges in cities with nature-based solutions", *Water*, vol. 13, no. 17. IF= 3.17, Q1

León-Muñoz, J., Aguayo, R., Marcé, R., Catalán, N., Woelfl, S., Nimptsch, J., Arismendi, I., Contreras, C., Soto, D. & Miranda, A. (2021), "Climate and land cover trends affecting freshwater inputs to a fjord in Northwestern Patagonia", *Frontiers in Marine Science*, vol. 8. IF= 4.435, Q1

Liñan-Vidriales, M.A., Peña-Rodríguez, A., Tovar-Ramírez, D., Elizondo-González, R., Barajas-Sandoval, D.R., Ponce-Gracia, E.I., Rodríguez-Jaramillo, C., Balcázar, J.L. & Quiroz-Guzmán, E. (2021), "Effect of rice bran fermented with 'Bacillus' and 'Lysinibacillus' species on dynamic microbial activity of Pacific white shrimp ('Penaeus vannamei')", *Aquaculture*, vol. 531. IF= 4.242, Q1

Llena, M., Batalla, R.J., Smith, M.W. & Vericat, D. (2021), "Do badlands (always) control sediment yield? Evidence from a small intermittent catchment", *Catena*, vol. 198. IF= 4.333, Q1

López-García, E., Mastroianni, N., Ponsà-Borau, N., Barceló, D., Postigo, C. & López de Alda, M. (2021), "Drugs of abuse and their metabolites in river sediments: Analysis, occurrence in four Spanish river basins and environmental risk assessment", *Journal of Hazardous Materials*, vol. 401. IF= 10.39, Q1

López-Pacheco, I.Y., Castillo-Vacas, E.I., Castañeda-Hernández, L., Gradiz-Menjivar, A., Rodas-Zuluaga, L.I., Castillo-Zacarias, C., Sosa-Hernández, J.E., Barceló, D., Iqbal, H.M.N. & Parra-Saldívar, R. (2021), "CO₂ biocapture by 'Scenedesmus' sp. grown in industrial wastewater", *Science of the Total Environment*, vol. 790. IF= 7.96, Q1

López-Pacheco, I.Y., Rodas-Zuluaga, L.I., Fuentes-Tristan, S., Castillo-Zacarias, C., Sosa-Hernández, J.E., Barceló, D., Iqbal, H.M.N. & Parra-Saldívar, R. (2021), "Phycocapture of CO₂ as an option to reduce greenhouse gases in cities: Carbon sinks in urban spaces", *Journal of CO₂ Utilization*, vol. 53.

López-Pacheco, I.Y., Silva-Núñez, A., García-Perez, J.S., Carrillo-Nieves, D., Salinas-Salazar, C., Castillo-Zacarias, C., Afewerki, S., Barceló, D., Iqbal, H.M.N. & Parra-Saldívar, R. (2021), "Phyco-remediation of swine wastewater as a sustainable model based on circular economy", *Journal of environmental management*, vol. 278. IF= 6.89, Q1

Maganha de Almeida Kumlien, A.C., Borrego, C.M. & Balcázar, J.L. (2021), "Antimicrobial resistance and bacteriophages: An overlooked intersection in water disinfection", *Trends in Microbiology*, vol. 29, no. 6, pp. 517-527. IF= 17.079, Q1

Maganha de Almeida Kumlien, A.C., González-Villalobos, E. & Balcázar, J.L. (2021), "Making waves: How does the emergence of antimicrobial resistance affect policymaking?", *Water Research*, vol. 206. IF= 11.236, Q1

Mannina, G., Alliet, M., Brepols, C., Comas, J., Harmand, J., Heran, M., Kalboussi, N., Makinia, J., Robles, Á., Rebouças, T.F., Ni, B.J., Rodriguez-Roda, I., Victoria Ruano, M., Bertanza, G. & Smets, I. (2021), "Integrated membrane bioreactors modelling: A review on new comprehensive modelling framework", *Bioresource Technology*, vol. 329. IF= 9.642, Q1

Marcé, R., Verdura, L. & Leung, N. (2021), "Dissolved organic matter spectroscopy reveals a hot spot of organic matter changes at the river-reservoir boundary", *Aquatic Sciences*, vol. 83, no. 4. IF= 2.744, Q1

Martínez Bueno, M.J., García Valverde, M., Gómez-Ramos, M.G., Salinas Andújar, J.A., Barceló, D. & Fernández-Alba, A.R. (2021), "Fate, modeling, and human health risk of organic contaminants present in tomato plants irrigated with reclaimed water under real-world field conditions", *Science of the Total Environment*, vol. 806, art. 150909, 1-12. IF= 7.96, Q1

Menger, F., Ahrens, L., Wiberg, K. & Gago-Ferrero, P. (2021), "Suspect screening based on market data of polar halogenated micropollutants in river water affected by wastewater", *Journal of Hazardous Materials*, vol. 401. IF= 10.39, Q1

Menger, F., Boström, G., Jonsson, O., Ahrens, L., Wiberg, K., Kreuger, J. & Gago-Ferrero, P. (2021), "Identification of pesticide transformation products in surface water using suspect screening combined with national monitoring data", *Environmental Science and Technology*, vol. 55, no. 15, pp. 10343-10353. IF= 9.028, Q1

Mercado-Bettín, D., Clayer, F., Shikhani, M., Moore, T.N., Frias, M.D., Jackson-Blake, L., Sample, J., Iturbide, M., Herrera, S., French, A.S., Norling, M.D., Rinke, K. & Marcé, R. (2021), "Forecasting water temperature in lakes and reservoirs using seasonal climate prediction", *Water Research*, vol. 201. IF= 11.236, Q1

Mino, E., Pueyo-Ros, J., Škerjanec, M., Castellar, J.A.C., Viljoen, A., Istenič, D., Atanasova, N., Bohn, K. & Comas, J. (2021), "Tools for edible cities: A review of tools for planning and assessing edible nature-based solutions", *Water*, vol. 13, no. 17. IF= 3.17, Q1

Mir-Tutusaus, J.A., Jaén-Gil, A., Barceló, D., Buttiglieri, G., Gonzalez-Olmos, R., Rodríguez-Mozaz, S., Caminal, G. & Sarrà, M. (2021), "Prospects on coupling UV/H₂O₂ with activated sludge or a fungal treatment for the removal of pharmaceutically active compounds in real hospital wastewater", *Science of the Total Environment*, vol. 773. IF= 7.96, Q1

Musacchio, A., Mas-Pla, J., Soana, E., Re, V. & Sacchi, E. (2021), "Governance and groundwater modelling: Hints to boost the implementation of the EU Nitrate Directive. The Lombardy Plain case, N Italy", *Science of the Total Environment*, vol. 782. IF= 7.96, Q1

Nagler, M., Praeg, N., Niedrist, G.H., Attermeyer, K., Catalán, N., Pilotto, F., Gutmann Roberts, C., Bors, C., Fenoglio, S., Colls, M., Cauvy-Fraunié, S., Doyle, B., Romero, F., Machalett, B., Fuss, T., Bednařík, A., Klaus, M., Gilbert, P., Lamonica, D., Nydahl, A.C., Romero González-Quijano, C., Thuile Bistarelli, L., Kenderov, L., Piano, E., Mor, J.R., Evtimova, V., deEyto, E., Freixa, A., Rulík, M., Pegg, J., Herrero Ortega, S., Steinle, L. & Bodmer, P. (2020), "Abundance and biogeography of methanogenic and methanotrophic microorganisms across European streams", *Journal of Biogeography*, vol. 48, no. 4, pp. 947-960. IF= 3.83, Q1

Narayanankutty, A., Kuttithodi, A.M., Alfarhan, A., Rajagopal R. & Barceló, D. (2021), "Chemical composition, insecticidal and mosquito larvicidal activities of allspice ('Pimenta dioica') essential oil", *Molecules*, vol. 26, art. 6698, 1-10. IF= 4.41, Q1

Norra, G.F. & Radjenovic, J. (2021), "Removal of persistent organic contaminants from wastewater using a hybrid electrochemical-granular activated carbon (GAC) system", *Journal of Hazardous Materials*, vol. 415. IF= 10.39, Q1

Oral, H.V., Radinja, M., Rizzo, A., Kearney, K., Andersen, T.R., Krzeminski, P., Buttiglieri, G., Ayrar-Cinar, D., Comas, J., Gajewska, M., Hartl, M., Finger, D.C., Kazak, J.K., Mattila, H., Vieira, P., Piro, P., Palermo, S.A., Turco, M., Pirouz, B., Stefanakis, A., Regelsberger, M., Ursino, N. & Carvalho, P.N. (2021), "Management of urban waters with nature-based solutions in circular cities—exemplified through seven urban circularity challenges", *Water*, vol. 13, no. 23. IF= 3.17, Q1

Ortega, L., Llorella, A., Esquivel, J.P., Mas-Pla, J. & Sabaté, N. (2021), "A printed and self-powered test strip for digital conductivity measurement of low volume liquid samples", *Flexible and Printed Electronics*, vol. 6, no. 4. IF= 3.588, Q1

Ortega, R.C.M.H., Tabugo, S.R.M., Martínez, J.G.T., Padasas, C.S., Balolong, M.P. & Balcázar, J.L. (2021), "High-throughput sequencing-based analysis of bacterial communities associated with Barbour's seahorses ('Hippocampus barbouri') from Surigao del Norte, Philippines", *Letters in Applied Microbiology*, vol. 73, no. 3, pp. 280-285. IF= 2.242, Q2

Ortmeyer, F., Mas-Pla, J., Wohnlich, S. & Banning, A. (2021), "Forecasting nitrate evolution in an alluvial aquifer under distinct environmental and climate change scenarios (Lower Rhine Embayment, Germany)", *Science of the Total Environment*, vol. 768. IF= 7.96, Q1

Palatsi, J., Ripoll, F., Benzal, A., Pijuan, M. & Romero-Güiza, M.S. (2021), "Enhancement of biological nutrient removal process with advanced process control tools in full-scale wastewater treatment plant", *Water Research*, vol. 200. IF= 11.236, Q1

Parra-Arroyo, L., González-González, R.B., Castillo-Zacarias, C., Melchor Martínez, E.M., Sosa-Hernández, J.E., Bilal, M., Iqbal, H.M.N., Barceló, D. & Parra-Saldívar, R. (2021), "Highly hazardous pesticides and related pollutants: Toxicological, regulatory, and analytical aspects", *Science of the Total Environment*, art. 151879, 1-16. IF= 7.96, Q1

Pastor, A., Manolaki, P., Freixa, A., Giménez-Grau, P., Romani, A.M. & Riis, T. (2021), "Temperature-induced changes in biofilm organic matter utilization in arctic streams (Disko Island, Greenland)", *Polar Biology*, vol. 44, no. 11, pp. 2177-2188. IF= 2.441, Q1

Pastorino, P., Pizzul, E., Barceló, D., Abete, M.C., Magara, G., Brizio, P., Avolio, R., Bertoli, M., Dondo, A., Prearo, M. & Elia, A.C. (2021), "Ecology of oxidative stress in the Danube barbel ('Barbus balcanicus') from a winegrowing district: Effects of water parameters, trace and rare earth elements on biochemical biomarkers", *Science of the Total Environment*, vol. 772. IF= 7.96, Q1

Patrício Silva, A.L., Prata, J.C., Duarte, A.C., Barceló, D. & Rocha-Santos, T. (2021), "An urgent call to think globally and act locally on landfill disposable plastics under and after COVID-19 pandemic: Pollution prevention and technological (Bio) remediation solutions", *Chemical Engineering Journal*, vol. 426. IF= 13.07, Q1

Patrício Silva, A.L., Prata, J.C., Mouneyrac, C., Barceló, D., Duarte, A.C. & Rocha-Santos, T. (2021), "Risks of COVID-19 face masks to wildlife: Present and future research needs", *Science of the Total Environment*, vol. 792. IF= 7.96, Q1

Patrício Silva, A.L., Prata, J.C., Walker, T.R., Duarte, A.C., Ouyang, W., Barceló, D. & Rocha-Santos, T. (2021), "Increased plastic pollution due to COVID-19 pandemic: Challenges and recommendations", *Chemical Engineering Journal*, vol. 405. IF= 13.07, Q1

- Pearlmutter, D., Pucher, B., Calheiros, C.S.C., Hoffmann, K.A., Aicher, A., Pinho, P., Stracqualursi, A., Korolova, A., Pobric, A., Galvão, A., Tokuç, A., Bas, B., Theochari, D., Milošević, D., Giancola, E., Bertino, G., Castellar, J.A.C., Flaszynska, J., Onur, M., Mateo, M.C.G., Andreucci, M.B., Milousi, M., Fonseca, M., Di Lonardo, S., Gezik, V., Pitha, U. & Nehls, T. (2021), "Closing water cycles in the built environment through nature-based solutions: The contribution of vertical greening systems and green roofs", *Water*, vol. 13, no. 16. IF= 3.17, Q1
- Pereda, O., von Schiller, D., García-Baquero, G., Mor, J.R., Acuña, V., Sabater, S. & Elosegi, A. (2021), "Combined effects of urban pollution and hydrological stress on ecosystem functions of Mediterranean streams", *Science of the Total Environment*, vol. 753. IF= 7.96, Q1
- Perez-Lopez, C., Ginebreda, A., Carrascal, M., Barceló, D., Abian, J. & Tauler, R. (2021), "Non-target protein analysis of samples from wastewater treatment plants using the regions of interest-multivariate curve resolution (ROIMCR) chemometrics method", *Journal of Environmental Chemical Engineering*, vol. 9, no. 4. IF= 5.88, Q1
- Pérez-Sánchez, T., Mora-Sánchez, B., Jirón, W., Flores, B. & Balcázar, J.L. (2021), "Effect of a postbiotic on the histopathological features and expression levels of immune-related genes in farmed rainbow trout (*Oncorhynchus mykiss*)", *Aquaculture Research*, vol. 52, no. 11, pp. 5882-5885. IF= 4.242, Q1
- Perujo, N., Van den Brink, P.J., Segner, H., Mantyka-Pringle, C., Sabater, S., Birk, S., Bruder, A., Romero, F. & Acuña, V. (2021), "A guideline to frame stressor effects in freshwater ecosystems", *Science of the Total Environment*, vol. 777. IF= 7.96, Q1
- Piccardo, M., Bertoli, M., Pastorino, P., Barceló, D., Provenza, F., Lesa, D., Anselmi, S., Elia, A.C., Prearo, M., Pizzul, E. & Renzi, M. (2021), "Lethal and sublethal responses of 'Hydropsyche pellucidula' (Insecta, trichoptera) to commercial polypropylene microplastics after different preconditioning treatments", *Toxics*, vol. 9, no. 10. IF= 3.791, Q1
- Picó, Y. & Barceló, D. (2021), "Identification of biomarkers in wastewater-based epidemiology: Main approaches and analytical methods", *TrAC - Trends in Analytical Chemistry*, vol. 145. IF= 9.801, Q1
- Picó, Y. & Barceló, D. (2021), "Mass spectrometry in wastewater-based epidemiology for the determination of small and large molecules as biomarkers of exposure: toward a global view of environment and human health under the COVID-19 outbreak", *ACS Omega*, vol. 6, no. 46, pp. 30865-30872. IF= 3.512, Q1
- Picó, Y., Soursou, V., Alfarhan, A.H., El-Sheikh, M.A. & Barceló, D. (2021), "First evidence of microplastics occurrence in mixed surface and treated wastewater from two major Saudi Arabian cities and assessment of their ecological risk", *Journal of Hazardous Materials*, vol. 416. IF= 10.39, Q1
- Picó, Y., Campo, J., Alfarhan, A.H., El-Sheikh, M.A. & Barceló, D. (2021), "A reconnaissance study of pharmaceuticals, pesticides, perfluoroalkyl substances and organophosphorus flame retardants in the aquatic environment, wild plants and vegetables of two Saudi Arabia urban areas: Environmental and human health risk assessment", *Science of the Total Environment*, vol. 776, art. 145843, 1-12. IF= 7.96, Q1
- Postigo, C., Andersson, A., Harir, M., Bastviken, D., Gonsior, M., Schmitt-Kopplin, P., Gago-Ferrero, P., Ahrens, L., Ahrens, L. & Wiberg, K. (2021), "Unraveling the chemodiversity of halogenated disinfection by-products formed during drinking water treatment using target and non-target screening tools", *Journal of Hazardous Materials*, vol. 401. IF= 10.39, Q1
- Postigo, C., Ginebreda, A., Barbieri, M.V., Barceló, D., Martín-Alonso, J., De la Cal, A., Boleda, M.R., Otero, N., Carey, R., Solà, V., Queral, E., Isla, E., Casanovas, A., Frances, G. & López de Alda, M. (2021), "Investigative monitoring of pesticide and nitrogen pollution sources in a complex multi-stressed catchment: The lower Llobregat River basin case study (Barcelona, Spain)", *Science of the Total Environment*, vol. 755. IF= 7.96, Q1
- Previšić, A., Vilenica, M., Vučković, N., Petrović, M. & Rožman, M. (2021), "Aquatic insects transfer pharmaceuticals and endocrine disruptors from aquatic to terrestrial ecosystems", *Environmental Science and Technology*, vol. 55, no. 6, pp. 3736-3746. IF= 9.028, Q1
- Prosenc, F., Piechocka, J., Škufca, D., Heath, E., Griessler Bulc, T., Istenič, D. & Buttiglieri, G. (2021), "Microalgae-based removal of contaminants of emerging concern: Mechanisms in 'Chlorella vulgaris' and mixed algal-bacterial cultures", *Journal of Hazardous Materials*, vol. 418. IF= 10.39, Q1
- Qiao, M., Fu, L. & Barceló, D. (2021), "Removal of polycyclic aromatic hydrocarbons by g-C₃N₄ nanosheets under visible light irradiation and effect of typical co-existence substances in river water", *Process Safety and Environmental Protection*, 1-17. IF= 6.158, Q1
- Raposo, F. & Barceló, D. (2021), "Assessment of goodness-of-fit for the main analytical calibration models: Guidelines and case studies", *TrAC - Trends in Analytical Chemistry*, vol. 143. IF= 9.801, Q1
- Raposo, F. & Barceló, D. (2021), "Challenges and strategies of matrix effects using chromatography-mass spectrometry: An overview from research versus regulatory viewpoints", *TrAC - Trends in Analytical Chemistry*, vol. 134. IF= 9.801, Q1
- Ribalta, M., Mateu, C., Bejar, R., Rubión, E., Echeverría, L., Varela Alegre, F.J. & Corominas, L. (2021), "Sediment level prediction of a combined sewer system using spatial features", *Sustainability*, vol. 13, no. 7. IF= 3.251, Q1
- Rodríguez, E.A., Ramirez, D., Balcázar, J.L. & Jiménez, J.N. (2021), "Metagenomic analysis of urban wastewater resistome and mobilome: A support for antimicrobial resistance surveillance in an endemic country", *Environmental Pollution*, vol. 276. IF= 8.04, Q1
- Rusiñol, M., Zammit, I., Itarte, M., Forés, E., Martínez-Puchol, S., Girones, R., Borrego, C., Corominas, L. & Bofill-Mas, S. (2021), "Monitoring waves of the COVID-19 pandemic: Inferences from WWTPs of different sizes", *Science of the Total Environment*, vol. 787. IF= 7.96, Q1
- Sabater, S., Elosegi, A. & Ludwig, R. (2021), "Framing biophysical and societal implications of multiple stressor effects on river networks", *Science of the Total Environment*, vol. 753. IF= 7.96, Q1
- Sabater-Liesa, L., Montemurro, N., Ginebreda, A., Barceló, D. & Eichhorn, P. (2021), "Retrospective mass spectrometric analysis of wastewater-fed mesocosms to assess the degradation of drugs and their human metabolites", *Journal of Hazardous Materials*, vol. 408, art. 124984, 1-12. IF= 10.39, Q1
- Sagaya Jansi, R., Khusro, A., Agastian, P., Afarhan, A., Abdullah Al-Dhabi, N., Valan Arasu, M., Rajagopal, R., Barceló, D. & Al-Tamimi, A. (2021), "Emerging paradigms of viral diseases and paramount role of natural resources as antiviral agents", *Science of the Total Environment*, vol. 759, art. 143539, 1-24. IF= 7.96, Q1
- Sánchez-Aceves, L., Pérez-Alvarez, I., Gómez-Oliván, L.M., Islas-Flores, H. & Barceló, D. (2021), "Long-term exposure to environmentally relevant concentrations of ibuprofen and aluminum alters oxidative stress status on *Danio rerio*", *Comparative Biochemistry and Physiology, part C*, vol. 248, art. 109071, 1-18. IF= 3.28, Q1
- Sánchez-Aceves, L.M., Pérez-Alvarez, I., Gómez-Oliván, L.M., Islas-Flores, H. & Barceló, D. (2021), "Developmental alterations, teratogenic effects, and oxidative disruption induced by ibuprofen aluminum, and their binary mixture on *Danio rerio*", *Environmental Pollution*, vol. 291, art. 118078, 1-13. IF= 8.04, Q1
- Sanchís, J., Gernjak, W., Munné, A., Catalán, N., Petrović, M. & Farré, M.J. (2021), "Fate of N-nitrosodimethylamine and its precursors during a wastewater reuse trial in the Llobregat River (Spain)", *Journal of Hazardous Materials*, vol. 407. IF= 10.39, Q1
- Sanchís, J., Petrović, M. & Farré, M.J. (2021), "Emission of (chlorinated) reclaimed water into a Mediterranean River and its related effects to the dissolved organic matter fingerprint", *Science of the Total Environment*, vol. 760. IF= 7.96, Q1
- Sanchís, J., Petrović, M. & Farré, M.J. (2021), "Prediction of NDMA formation potential using non-target analysis data: A proof of concept", *Environmental Science: Water Research and Technology*, vol. 7, no. 12, pp. 2255-2267. IF= 4.251, Q1
- Schulze, B., van Herwerden, D., Allan, I., Bijlsma, L., Etxebarria, N., Hansen, M., Merel, S., Vrana, B., Aalizadeh, R., Bajema, B., Dubocq, F., Coppola, G., Fildier, A., Fialová, P., Frøkjær, E., Grabic, R., Gago-Ferrero, P., Gravert, T., Hollender, J., Huynh, N., Jacobs, G., Jonkers, T., Kaserzon, S., Lamoree, M., Le Roux, J., Mairinger, T., Margoum, C., Mascolo, G., Mebold, E., Menger, F., Miège, C., Meijer, J., Moilleron, R., Murgolo, S., Peruzzo, M., Pijnappels, M., Reid, M., Roscioli, C., Soulier, C., Valsecchi, S., Thomaidis, N., Vulliet, E., Young, R. & Samanipour, S. (2021), "Inter-laboratory mass spectrometry dataset based on passive sampling of drinking water for non-target analysis", *Scientific Data*, vol. 8, no. 1. IF= 5.541, Q1
- Sergienko, N. & Radjenovic, J. (2021), "Manganese oxide coated TiO₂ nanotube-based electrode for efficient and selective electrocatalytic sulfide oxidation to colloidal sulfur", *Applied Catalysis B: Environmental*, vol. 296. IF= 19.503, Q1
- Serra-Compte, A., Pikkemaat, M.G., Elferink, A., Almeida, D., Diogène, J., Campillo, J.A., Llorca, M., Álvarez-Muñoz, D., Barceló, D. & Rodríguez-Mozaz, S. (2021), "Combining an effect-based methodology with chemical analysis for antibiotics determination in wastewater and receiving freshwater and marine environment", *Environmental Pollution*, vol. 271. IF= 8.04, Q1
- Solaun, O., Germán Rodríguez, J., Menchaca, I., López-García, E., Martínez, E., Zonja, B., Postigo, C., López de Alda, M., Barceló, D., Borja, A., Manzanos A. & Larreta, J. (2021), "Contaminants of emerging concern in the Basque coast (N Spain): Occurrence and risk assessment for a better monitoring and management decisions", *Science of the Total Environment*, vol. 765, art. 142765, 1-12. IF= 7.96, Q1
- Söregård, M., Gago-Ferrero, P., B. Kleja, D. & Ahrens, L. (2021), "Laboratory-scale and pilot-scale stabilization and solidification (S/S) remediation of soil contaminated with per- and polyfluoroalkyl substances (PFASs)", *Journal of Hazardous Materials*, vol. 402. IF= 10.39, Q1
- Soria, M., Bonada, N., Ballester, A., Verkaik, I., Jordà-Capdevila, D., Solà, C., Munné, A., Jiménez-Argudo, S.M., Fortuño, P., Gallart, F., Vinyoles, D., Llorens, P., Latron, J., Estrella, T., Prat, N. & Cid, N. (2021), "Adapting participatory processes in temporary rivers management", *Environmental Science and Policy*, vol. 120, pp. 145-156. IF= 5.581, Q1
- Sunyer-Caldú, A., Peiró, A., Díaz, M., Ibáñez, L., Gago-Ferrero, P. & Silvia Diaz-Cruz, M. (2021), "Development of a sensitive analytical method for the simultaneous analysis of Benzophenone-type UV filters and paraben preservatives in umbilical cord blood", *MethodsX*, vol. 8. IF= 1.84, Q2
- Taylor, N.G., Grillas, P., Al Hreisha, H., Balkiz, Ö., Borie, M., Boutron, O., Catita, A., Champagnon, J., Cherif, S., Çiçek, K., Costa, L.T., Dakki, M., Fois, M., Galewski, T., Galli, A., Georgiadis, N.M., Green, A.J., Hermoso, V., Kapedani, R., Lange, M.A., Mateljak, Z., Osta, M., Papastergiadou, E., Papazoglou, C., Sabater, S., Samraoui, B., Samraoui, F., Bachir, A.S., Tankovic, E., Thévenet, M., Troya, A. & Sutherland, W.J. (2021), "The future for Mediterranean wetlands: 50 key issues and 50 important conservation research questions", *Regional Environmental Change*, vol. 21, no. 2. IF= 4.135, Q2
- Tena, Á., Vericat, D. & Batalla, R.J. (2021), "Sediment balance of the Ribarroja reservoir", *Geographical Research Letters*, vol. 47, no. 2, pp. 415-433. IF= 4.497, Q1
- Tkalec, Z., Negreira, N., López de Alda, M., Barceló, D. & Kosjek, T. (2021), "A novel workflow utilizing open-source software tools in the environmental fate studies: The example of imatinib biotransformation", *Science of the Total Environment*, vol. 497, art. 149063, 1-10. IF= 7.96, Q1
- Tornés, E., Colls, M., Acuña, V. & Sabater, S. (2021), "Duration of water flow interruption drives the structure and functional diversity of stream benthic diatoms", *Science of the Total Environment*, vol. 770. IF= 7.96, Q1

Torremorell, A., Hegoburu, C., Brandimarte, A.L., Rodrigues, E.H.C., Pompêo, M., da Silva, S.C., Moschini-Carlos, V., Caputo, L., Fierro, P., Mojica, J.I., Matta, Á.L.P., Donato, J.C., Jiménez-Pardo, P., Molinero, J., Ríos-Touma, B., Goyenola, G., Iglesias, C., López-Rodríguez, A., Meerhoff, M., Pacheco, J.P., De Mello, F.T., Rodríguez-Olarte, D., Gómez, M.B., Montoya, J.V., López-Doval, J.C. & Navarro, E. (2021), "Current and future threats for ecological quality management of South American freshwater ecosystems", *Inland Waters*, vol. 11, no. 2, pp. 125-140. IF= 2.299, Q2

Torres-Martínez, J.A, Mora, A., Mahlknecht, J., Kaown D. & Barceló, D. (2021), "Determining nitrate and sulfate pollution sources and transformations in a coastal aquifer impacted by seawater intrusion—A multi-isotopic approach combined with self-organizing maps and a Bayesian mixing model", *Journal of Hazardous Materials*, vol. 417, art. 126103, 1-12. IF= 10.39, Q1

Valdés, M.E., Santos, L.H.M.L.M., Rodríguez Castro, M.C., Giorgi, A., Barceló, D., Rodríguez-Mozaz, S. & Amé, M.V. (2021), "Distribution of antibiotics in water, sediments and biofilm in an urban river (Córdoba, Argentina, LA)", *Environmental Pollution*, vol. 269. IF= 8.04, Q1

Vander Vorste, R., Stubbington, R., Acuña, V., Bogan, M.T., Bonada, N., Cid, N., Datry, T., Storey, R., Wood, P.J. & Ruhí, A. (2021), "Climatic aridity increases temporal nestedness of invertebrate communities in naturally drying rivers", *Ecography*, vol. 44, no. 6, pp. 860-869. IF= 2.973, Q1

Vázquez-Tarrío, D., Piqué, G., Vericat, D. & Batalla, R.J. (2021), "The active layer in gravel-bed rivers: An empirical appraisal", *Earth Surface Processes and Landforms*, vol. 46, no. 2, pp. 323-343. IF= 4.133, Q1

Veyrand-Quirós, B., Guzmán-Villanueva, L.T., Reyes, A.G., Rodríguez-Jaramillo, C., Salas-Leiva, J.S., Tovar-Ramírez, D., Balcázar, J.L. & Quiroz-Guzman, E. (2021), "Assessment of bacteriophage vB_Pd_PDCC-1 on bacterial dynamics during ontogenetic development of the longfin yellowtail (*Seriola rivoliana*)", *Applied Microbiology and Biotechnology*, vol. 105, no. 7, pp. 2877-2887. IF= 4.70, Q1

Wang, F., Harindintwali, J.D., Yuan, Z., Wang, M., Wang, F., Li, S., Yin, Z., Huang, L., Fu, Y., Li, L., Chang, S.X., Zhang, L., Rinklebe, J., Yuan, Z., Zhu, Q., Xiang, L., Tsang, D.C.W., Xu, L., Jiang, X., Liu, J., Wei, N., Kästner, M., Zou, Y., Ok, Y.S., Shen, J., Peng, D., Zhang, W., Barceló, D., Zhou, Y., Bai, Z., Li, B., Zhang, B., Wei, K., Cao, H., Tan, Z., Zhao, L.B., He, X., Zheng, J., Bolan, N., Liu, X., Huang, C., Dietmann, S., Luo, M., Sun, N., Gong, J., Gong, Y., Brahushi, F., Zhang, T., Xiao, C., Li, X., Chen, W., Jiao, N., Lehmann, J., Zhu, Y.G., Jin, H., Schäffer, A., Tiedje, J.M. & Chen, J.M. (2021), "Technologies and perspectives for achieving carbon neutrality", *The Innovation*, vol. 2, no. 4. IF= 1.867, Q1

Wang, F., Wang, Y., Xiang, L., Redmile-Gordon, M., Gu, C., Yang, X., Jiang, X. & Barceló, D. (2021), "Perspectives on ecological risks of microplastics and phthalate acid esters in crop production systems", *Soil Ecology Letters*, IF= 9.492, Q1

Wear, S.L., Acuña, V., McDonald, R. & Font, C. (2021), "Sewage pollution, declining ecosystem health, and cross-sector collaboration", *Biological Conservation*, vol. 255. IF= 5.99, Q1

Woolway, R.I., Sharma, S., Weyhenmeyer, G.A., Debolskiy, A., Golub, M., Mercado-Bettin, D., Perroud, M., Stepanenko, V., Tan, Z., Grant, L., Ladwig, R., Mesman, J., Moore, T.N., Shatwell, T., Vanderkelen, I., Austin, J.A., DeGasperi, C.L., Dokulil, M., La Fuente, S., Mackay, E.B., Schladow, S.G., Watanabe, S., Marcé, R., Pierson, D.C., Thiery, W. & Jennings, E. (2021), "Phenological shifts in lake stratification under climate change", *Nature Communications*, vol. 12, no. 1. IF= 14.919, Q1

Yu, X., Sui, Q., Lyu, S., Zhao, W., Wu, D., Yu, G. & Barcelo, D. (2021), "Rainfall influences occurrence of pharmaceutical and personal care products in landfill leachates: Evidence from seasonal variations and extreme rainfall Episodes", *Environmental Science and Technology*, vol. 55, no. 8, pp. 4822-4830. IF= 9.028, Q1

Zahedi, S., Ferrari, F., Blandin, G., Balcazar, J.L. & Pijuan, M. (2021), "Enhancing biogas production from the anaerobic treatment of municipal wastewater by forward osmosis pretreatment", *Journal of Cleaner Production*, vol. 315. IF= 9.297, Q1

Zahedi, S., Gros, M., Balcazar, J.L., Petrović, M. & Pijuan, M. (2021), "Assessing the occurrence of pharmaceuticals and antibiotic resistance genes during the anaerobic treatment of slaughterhouse wastewater at different temperatures", *Science of the Total Environment*, vol. 789. IF= 7.96, Q1

Zahedi, S., Gros, M., Petrović, M., Balcazar, J.L. & Pijuan, M. (2021), "Anaerobic treatment of swine manure under mesophilic and thermophilic temperatures: Fate of veterinary drugs and resistance genes", *Science of the Total Environment*, IF= 7.96, Q1

Zelený, J., Mercado-Bettin, D. & Müller, F. (2021), "Towards the evaluation of regional ecosystem integrity using NDVI, brightness temperature and surface heterogeneity", *Science of the Total Environment*, vol. 796. IF= 7.96, Q1

Zhang, S., Bilal, M., Adeel, M., Barceló, D. & Iqbal, H.M.N. (2021), "MXene-based designer nanomaterials and their exploitation to mitigate hazardous pollutants from environmental matrices", *Chemosphere*, vol. 283. IF= 7.086, Q1

BOOKS PUBLISHED BOOKS (2)

Pérez Solsona, S., Montemurro, N., Chiron, S. & Barceló, D. (2021), *Interaction and Fate of Pharmaceuticals in Soil-Crop Systems: The Impact of Reclaimed Wastewater*, The Handbook of Environmental Chemistry, Heidelberg: Springer vol. 103, pp. 1-542.

Rodríguez-Mozaz, S., Blázquez Cano, P., Sarrà Adroguer, M. (Eds.) (2021), *Removal and Degradation of Pharmaceutically Active Compounds in Wastewater Treatment*, The Handbook of Environmental Chemistry, Heidelberg: Springer.

BOOKS CHAPTERS (10)

Bilal, M., Iqbal, H.M.N. & Barceló, D. (2021), "Perspectives on the feasibility of using enzymes for pharmaceutical removal in wastewater", in Rodríguez-Mozaz, S., Blázquez Cano, P. & Sarrà Adroguer, M. (Eds.), *Removal and Degradation of Pharmaceutically Active Compounds in Wastewater Treatment*, The Handbook of Environmental Chemistry, Heidelberg: Springer. doi: 10.1007/698_2020_661

Castaño-Trias, M., Brienza, M., Tomei, M.C. & Buttiglieri, G. (2021), "Fate and removal of pharmaceuticals in CAS for water and sewage sludge reuse", in Rodríguez-Mozaz, S., Blázquez Cano, P. & Sarrà Adroguer, M. (Eds.), *Removal and Degradation of Pharmaceutically Active Compounds in Wastewater Treatment*, The Handbook of Environmental Chemistry, Heidelberg: Springer, pp. 23-51.

Farré, M.J. & Gernjak, W. (2021), "Disinfection byproducts in potable reuse", in Manasfi, T., & Bodenne, J.L. (Eds.), *Analysis and Formation of Disinfection Byproducts in Drinking Water*, Comprehensive Analytical Chemistry, vol. 92, Amsterdam: Elsevier, pp. 135-137.

Feijóo, C., Sabater, S. & Cañedo-Argüelles, M. (2021), "Conservación de ecosistemas fluviales", in: Feijóo, C. (Ed.), *Conservación, manejo y restauración de sistemas fluviales. Una aproximación ecológica*, Buenos Aires: INEDES, pp 91-108.

Gago-Ferrero, P. (2021), "Suspect and non-target screening methodologies for the evaluation of the behavior of polar organic micropollutants and changes in the molecule fingerprint during water treatment", in Rodríguez-Mozaz, S., Blázquez Cano, P. & Sarrà Adroguer, M. (Eds.), *Removal and Degradation of Pharmaceutically Active Compounds in Wastewater Treatment*, The Handbook of Environmental Chemistry, Heidelberg: Springer, pp. 97-117. doi: 10.1007/698_2020_662

Ginebreda A., Barceló D., Rodríguez-Mozaz S. (2021), "Environmental risk assessment of pharmaceuticals in wastewater treatment", in Rodríguez-Mozaz, S., Blázquez Cano, P. & Sarrà Adroguer, M. (Eds.), *Removal and Degradation of Pharmaceutically Active Compounds in Wastewater Treatment*, The Handbook of Environmental Chemistry, Heidelberg: Springer. doi: https://doi.org/10.1007/698_2020_694

Guerrero Cruz, S., Pijuan, M. (2022), "Methanotrophic bacterial biorefineries: Resource recovery and GHG mitigation through the production of bacterial biopolymers", in An, A., Tyagi, V. Kumar, M., Cetecioglu, Z. (Eds.), *Clean Energy and Resource Recovery: Wastewater Treatment Plants as Biorefineries*. Amsterdam: Elsevier. ISBN: 978-0-323-90178-9

Parra-Saldivar, R., Castillo-Zacarias, C., Bilal, M., Iqbal, H.M.N. & Barceló, D. (2021), "Sources of pharmaceuticals in water", in Pérez Solsona, S., Montemurro, N., Chiron, S. & Barceló, D., *Interaction and Fate of Pharmaceuticals in Soil-Crop Systems: The Impact of Reclaimed Wastewater*, The Handbook of Environmental Chemistry, Heidelberg: Springer vol. 103. doi: https://doi.org/10.1007/698_2020_623

Radjenovic, J. & Baptista-Pires, L. (2021), "Advanced electrochemical processes for the elimination of pharmaceutical compounds in contaminated waters", in Rodríguez-Mozaz, S., Blázquez Cano, P. & Sarrà Adroguer, M. (Eds.), *Removal and Degradation of Pharmaceutically Active Compounds in Wastewater Treatment*, The Handbook of Environmental Chemistry, Heidelberg: Springer. doi: 10.1007/698_2020_689

Santos, L.H.M.L.M., Rodríguez-Mozaz, S., Barceló, D. (2021), "Sorption of pharmaceuticals on microplastics", in: Rocha-Santos, T., Costa, M.F., Mouneyrac, C. (Eds.), *Handbook of Microplastics in the Environment*. Heidelberg: Springer. doi: https://doi.org/10.1007/978-3-030-10618-8_14-1

OTHER BOOKS AND JOURNALS (11)

Agathokleous, E., Barceló, D., Fatta-Kassinos, D., Moore, M.N. & Calabrese, E.J. (2021), "Contaminants of emerging concern and aquatic organisms: the need to consider hermetic responses in effect evaluations", *Water Emerging Contaminants & Nanoplastics*, 1:2, 1-9.

Barocio, M.E., Hidalgo-Vázquez, E., Kim, Y., Rodas-Zuluaga, L.I., Chen, W.N., Barceló, D., Iqbal, H.N.M., Parra-Saldivar, R. & Castillo-Zacarias, C. (2021), "Portable microfluidic devices for in-field detection of pharmaceutical residues in water: Recent outcomes and current technological situation – A short review", *Case Studies in Chemical and Environmental Engineering*, vol. 3.

Batalla, R.J. (2021), *Contribució del transport de sorres en el balanç de sediment d'una conca granítica Mediterrània*, 200 p. (+ annexos). ISBN 978-84-123083-4-0

Batalla, R.J. (2021), "Reflexión sobre dinámica morfo-sedimentaria. Implicaciones para la gestión fluvial en un contexto de cambio global", *Cuadernos de Geografía*, no. 107, pp. 175-190. doi: 10.7203/CGUV.107.21372

Batalla, R.J. & Vericat, D. (2021), "Flow changes in a highly regulated river: the Ebro. A research example by the Fluvial Dynamics Research Group (RIUS)" in Vericat, D., Martínez Casanovas, J.A., Poch Claret, R.M., Vidalhuguet, C. & Querol, M. (Eds.), *Medi Ambient i Ciències del Sòl. Miscel·lània hom-enatge Jaume Porta*. Lleida: Institut d'Estudi Ilerdencs. ISBN 978-84-16452-71-2. 195-208

Buttiglieri, G. & Comas, J. (2021), "Soluciones basadas en la naturaleza para la transición hacia ciudades circulares", RETEMA. <https://www.retema.es/noticia/soluciones-basadas-en-la-naturaleza-para-la-transicion-hacia-ciudades-circulares-R2cY>

Evode, N., Qamar, S.A., Bilal, M., Barceló, D. & Iqbal, H.M.N. (2021), "Plastic waste and its management strategies for environmental sustainability", *Case Studies in Chemical and Environmental Engineering*, vol. 4.

Pereira, P., Bogunovic, I., Zhao, W. & Barceló, D. (2021), "Short-term effect of wildfires and prescribed fires on ecosystem services", *Current Opinion in Environmental Science and Health*, vol. 22.

Picó, Y. & Barceló, D. (2021), "Analysis of microplastics and nanoplastics: How green are the methodologies used?", *Current Opinion in Green and Sustainable Chemistry*, vol. 31.

Santos, L.H.M.L.M., Rodríguez-Mozaz, S. & Barceló, D. (2021), "Microplastics as vectors of pharmaceuticals in aquatic organisms – An overview of their environmental implications", *Case Studies in Chemical and Environmental Engineering*, vol. 3.

Silva, A.L.P., Prata, J.C., Duarte, A.C., Soares, A.M.V.M., Barceló, D. & Rocha-Santos, T. (2021), "Microplastics in landfill leachates: The need for reconnaissance studies and remediation technologies", *Case Studies in Chemical and Environmental Engineering*, vol. 3.

Petrović, M. - Advisory Board Member of Environmental Science and Technology, Water, ACS

Petrović, M. - Editor in Chief of Trends in Environmental Analytical Chemistry, Elsevier

Rafael Marcé - Associate Editor of *Limnetica*

Ramon J. Batalla - Associate Editor of *Water*

Ramon J. Batalla - Member of the Editorial Board *Zeitschrift für Geomorphologie*

S. Rodríguez-Mozaz - Editor of *Journal of Hazardous Materials* since September 2019

Sergi Sabater - Associate Editor of *Freshwater Science*, specialty section of "Frontiers in Environmental Science"

Sergi Sabater - Editorial Board Member and Associate Editor of *Science of the Total Environment*, Elsevier

Sergi Sabater - Editorial Board Member of *Acta Biológica Colombiana*

Damià Barceló - Contributing Editor of *TrAC - Trends in Analytical Chemistry* since 1990

Damià Barceló - Co-Editor-in-Chief of *Science of the Total Environment* since 2012

Damià Barceló - Editor-in-Chief of *Current Opinion in Environmental Science and Health*, since 2017, and Co-Editor-in-Chief of *Case Studies of Chemical and Environmental Engineering* since 2020, Elsevier

Damià Barceló - Editor of *MethodsX and Process Safety and Environmental Protection* since 2017

Damià Barceló - Editor of three book series: *Comprehensive Analytical Chemistry*, Elsevier, *Advances in Chemical Pollution and Environmental Management and Protection*, Academic Press - Elsevier and *The Handbook of Environmental Chemistry*, Springer

EDITORIAL BOARDS OF BOOKS AND SCIENTIFIC JOURNALS

Bond, T., Chu, W., von Gunten, U. & Farré, M.J. (2020), "Themed issue on drinking water oxidation and disinfection processes", *Environmental Science: Water Research & Technology*, no. 9, 2252-2256.

Farré, M.J. - Advisory Board Member of *Environmental Science: Water Research & Technology* since 2021

G. Buttiglieri - Guest Editor of the special issue "COVID-19: Wastewater-Based Epidemiology" from the *International Journal of Environmental Research and Public Health (IJERPH)*

J. Radjenovic - Associate Editor of *Journal of Hazardous Materials* (ranked 4th in the environmental engineering field) and Editor of *Journal of Hazardous Materials Letters* (new journal by Elsevier)

J.L. Balcázar - Associate Editor of *BMC Microbiology*, BioMed Central, since 2013 to present day

J.L. Balcázar - Member of the Advisory Board of *Ecological Indicators*, Elsevier, since 2020 to present day

J.L. Balcázar - Member of the Editorial Board of *Environmental Science and Pollution Research*, Springer, since 2016 to present day

J.L. Balcázar - Member of the Editorial Board of *Journal of Applied Microbiology*, Wiley, since 2016 to present day

J.L. Balcázar - Review Editor of *Frontiers in Microbiology*, Frontiers, since 2016 to present day

Josep Mas-Pla - Associate Editor of *Antibiotics*, Section Board of "Antibiotics Use and Antimicrobial Stewardship"

Josep Mas-Pla - Associate Editor of *Hydrogeology Journal*

Josep Mas-Pla - Associate Editor of *Water*

Josep Mas-Pla - Review Editor of *Frontiers in Water*, "Environmental Water Quality"

M. Pijuan - Associate Editor of *Case Studies in Chemical and Environmental Engineering*

M. Pijuan - Associate Editor of *Water Research*

PRESENTATIONS AT CONGRESSES

ORAL PRESENTATIONS (47)

Barceló, D. (January 2021), Macro- and micro-plastic litter and increased Covid-19 based plastic pollution, Zhejiang A&F University seminar, Hangzhou (China). (Virtual conference guest).

Barceló, D. (March 2021), Analysis of microplastics in water, Pittcon (US). Short course - SC 7764 - virtual event.

Barceló, D. (March 2021), Macro- and micro-plastic litter and increased COVID-19 based plastic pollution to be in your radar. Think global, act local, Second International Conference Cycle on the 50th Anniversary of the Chemistry Faculty of the Autonomous University of Mexico State. Virtual conference guest.

Barceló, D. (March 2021), Microplastics pollution in mixed surface and treated wastewaters from Saudi Arabia. Can organic contaminants be absorbed by microplastic particles?, 9th International Conference on Water Resources and Arid Environment, 9 ICWRAE, King Saud University, Riyadh. Virtual event. Virtual conference guest.

Barceló, D. (April 2021), Profiling the uptake, metabolism and translocation of emerging contaminants from water and soil to plants by LC-HRMS, American Chemical Society, Spring 2021 National Meeting and Exposition, Division of Environmental Chemistry, San Antonio (US). Virtual conference guest.

Barceló, D. (May 2021), Macro- and micro-plastic litter and increased COVID-19 based plastic pollution in waters. Environmental risk with focus on dose and threat to biodiversity, Mesoamerican Association of Ecotoxicology and Environmental Chemistry (Mexico). Virtual event. Virtual conference guest.

Barceló, D. (June 2021), Micropollutants in groundwater, EWA 40th Anniversary Water Online Conference on Micropollutants (Denmark). Virtual event.

Barceló, D. (June 2021), Analysis of microplastics in water: focus on sampling, sample preparation and green analytical protocols, EXTECH, Alicante (Spain). Virtual conference guest.

Barceló, D. (July 2021), Macro- and micro-plastic litter and increased COVID-19 based plastic pollution in the aquatic environment: analysis, effects, remediation and policy solutions, 27th National Meeting of the Portuguese Society of Chemistry Braga (Portugal). Virtual conference guest.

Barceló, D. (September 2021), Macro- and micro-plastic litter and increased COVID-19 based plastic pollution in waters: environmental risks with focus on low dose and threat to biodiversity, 17th International Conference on Environmental Science & Technology, Athens, (Greece). Face-to-face conference guest.

Barceló, D. (September 2021), Analysis of microplastics in water, Pittcon (US). Short course. Virtual event instructor.

Barceló, D. (September 2021), Emerging contaminants in European water resources, 1st DoSChem International Student Symposium, University of Vienna (Austria). Face-to-face conference guest.

Barceló, D. (September 2021), The EU globaqua project on multiple stressors on aquatic ecosystems under water scarcity. Fate, risks and remediation of emerging contaminants in surface waters and groundwaters of selected European rivers at global scale, Sustainability Cluster Lecture Series UPES, Dehradun (India). Virtual event conference guest.

Barceló, D. (October 2021), Mass Spectrometry in Wastewater-Based Epidemiology (WBE) for the determination of small and large molecules as biomarkers of exposure: Needs for COVID-19 testing with environmental proteomics (EP-WBE), 17th Annual Workshop on Emerging High-Resolution Mass Spectrometry (HRMS) LC-MS-MS Applications in Environmental Analysis and Food Safety, Ottawa (Canada). Virtual event conference guest.

Barceló, D. (October 2021), Membrane technologies, eco-friendly fungal treatment and AOPs for efficient removal of pharmaceuticals in urban and hospital wastewaters, The Hybrid 9th Jordan International Chemical Engineering Conference, Amman (Jordan). Virtual event conference guest.

Barceló, D. (October 2021), Assessment of treatment technologies (Membrane AOPs, and Eco-friendly solutions Fungal, CAS and Microalgae) for efficient removal of CECs, ARGs, MPs and SARS-CoV-2 in urban wastewaters and landfill leachates, Sharjah International Conference for Water, Energy & Climate Change, Sharjah (United Arab Emirates). Virtual conference guest.

Barceló, D. (November 2021), Assessment of treatment technologies such as AOPs, Biological and Constructed Wetlands for removal of pharmaceuticals in wastewaters, 4th International Caparica Conference on Pollutant Toxic Ions and Molecules, Caparica (Portugal). Face-to-face conference guest.

Barceló, D. (2021), Mass Spectrometry in Wastewater-Based Epidemiology (WBE) for the determination of small and large molecules as biomarkers of exposure: Needs for Covid-19 testing with environmental proteomics (EP-WBE). EBNet Working Group, Cranfield University (November 2021) Cranfield University, UK. Virtual event conference guest.

Barceló, D. (November 2021), How to write a great paper and get it accepted by a good environmental journal like 'STOTEN', 3rd International Symposium on Carbon Cycling, Sequestration and Emission Reduction in Agriculture and Forest Ecosystems, Zhejiang A&F University, Hangzhou (China). Virtual event conference guest.

Barceló, D. (November-December 2021), Wastewater-based epidemiology to monitor COVID-19 outbreak: Present and future diagnostic methods to be in your radar, CICTA, Blumenau (Brazil). Face-to-face conference guest.

Barceló, D. (December 2021), Assessment of treatment technologies (membrane AOPs, and eco-friendly solutions fungal, CAS and microalgae) for efficient removal of CECs, ARGs, MPs and SARS-CoV-2 in urban wastewaters and land-fill leachates, 7th International Water Industry Conference, Daegu (Korea). Virtual conference guest.

Barceló, D. (December 2021), Environmental proteomics in wastewater-based epidemiology: Challenges and opportunities of high resolution mass spectrometry, Advances in Applications of GC-MS and LC-MS-A Virtual Symposium from LCGC, (US). Virtual conference guest.

Barceló, D. (December 2021), Contaminants of emerging concern and microplastics in European seafood samples and coastal waters from ECSeafood and SmartPhone projects, Emerging Contaminants in the Environment: Behaviour and Screening Methodologies Web Talks, University of Aveiro (Portugal). Virtual conference guest.

Barceló, D. (December 2021), CECs and microplastics in European seafood samples and coastal waters from ECSeafood project and beyond: The marine environment and humans during the COVID-19 pandemic, Athens (Greece). Virtual event conference guest.

Barceló, D. (December 2021), Evaluation of different wastewater treatment trains for removal of pharmaceutically active compounds and transformation products. Combination of AOPs and biological treatment, Chemical Congress on Pacific Basin Societies (US). Virtual congress conference guest.

Batalla, R.J. & Vericat, D. (24-25 November 2021), Rehabilitación fluvial: balance de sedimentos, conectividad y flujos funcionales, Iberaqua-net, Red Nacional de Ecosistemas Fluviales: Retos y Estrategias de Futuro, online talk.

Bertagna Silva, D., Buttiglieri, G. & Babic, S. (1-5 October 2021), Design of experiments for photodegradation of pharmaceuticals in water: a case study, platform presentation by Bertagna Silva, D. at the 27th Croatian Meeting of Chemists and Chemical Engineers (27HSKIKI).

Bertagna Silva, D., Buttiglieri, G. & Babic, S. (1-4 September 2021), Investigation of variables affecting UV-LED photocatalytic degradation of antibiotics ciprofloxacin and sulfamethoxazole, platform presentation by Bertagna Silva, D. at the 17th International Conference on Environmental Science and Technology, Athens (Greece).

Buttiglieri, G. (21-25 June, 2021), Impacting the environment with innovation in wastewater treatment, IWA EcoSTP, Buttiglieri, G., chair of the session Contaminants of emerging concern 3 (CEC3), Milan (Italy), virtual conference.

Duinslaeger, N. & Radjenovic, J. (2021), Graphene sponge electrodes for electrochemical degradation of perfluoroalkyl substances, 12th European Symposium on Electrochemical Engineering (ESEE), Leeuwarden (the Netherlands), virtual platform presentation.

Marcé R. (2021), Co-convener, GLEON, virtual conference.

Mas-Pla, J. (19 October 2021), Afectacions als recursos hídrics a Catalunya, IV Congrés de l'Aigua a Catalunya. Reptes a la Gestió dels Recursos Hídrics davant l'Emergència Climàtica, Associació Catalana d'Amics de l'Aigua. Cosmocaixa. Face-to-face.

Mas-Pla, J. (5 May 2021), Aigua: Escassa, distribuïda de manera desigual i indispensable per a la vida, Caixaforum, Palma de Mallorca. Face-to-face.

Mas-Pla, J. (17-19 November 2021), Antibióticos en el agua subterránea: Origen, trayectoria, y ... ¿qué podemos decirle al receptor?, CIAS - Congreso Ibérico de Aguas Subterráneas, AIG-GE, Valencia, opening lecture. Face-to-face.

Mendoza, E., Blandin, G., Comas, J. & Buttiglieri, G. (2021), Fertilizer drawn forward osmosis for sustainable greywater reuse in touristic Mediterranean regions, platform presentation by Mendoza, E. at the 5th International Conference on Ecotechnologies for Wastewater Treatment - IWA EcoSTP, Milan (Italy).

Mendoza, E., Vosse, J., Castellar, J.A.C., Comas, J. & Buttiglieri, G. (2021), Hydroponic systems with edible plants for greywater treatment and organic micropollutant removal, platform presentation by Mendoza, E. at WETPOL - 9th International Symposium on Wetland Pollutant and Dynamics and Control.

Ormeño Cano N. & Radjenovic, J. (2021), Electrochemical degradation of antibiotics using flow-through graphene sponge electrodes, 72nd Annual Meeting of the International Society for Electrochemistry (ISE), Jeju (South Korea), platform presentation. (virtual)

Radjenovic, J. (2021), Graphene-enabled water treatment: main outcomes of the ERC StG ELECTRON₄WATER, IWA EcoSTP, Milan (Italy), virtual keynote.

Norra, G.F., Baptista-Pires, L., Borrego, C. & Radjenovic, J. (2021), Electrochemical disinfection of E. coli with reduced graphene oxide foam electrodes, 12th European Symposium on Electrochemical Engineering (ESEE), Leeuwarden (the Netherlands), virtual platform.

Radjenovic, J. (2021), Electrocatalytic remediation of contaminated water: will going nano be the technology enabler?, 1st Severo Ochoa Workshop on Environmental Monitoring and Remediation, Catalan Institute for Nanoscience and Nanotechnology, Barcelona (Spain), plenary talk.

Sabater, S. (March 2021), Potencialidades y limitaciones del uso de indicadores biológicos en el monitoreo de los ecosistemas acuáticos. La experiencia de la Directiva Marco Europea, Taller Internacional sobre Experiencias en Monitoreo y Seguimiento de Ecosistemas Acuáticos, Instituto de Hidrología, Meteorología y Estudios Ambientales - Ideam (Colombia).

Segués Codina, A. & Radjenovic, J. (2021), Chlorine-free disinfection of water using n-doped graphene-based sponge electrodes, 72nd Annual Meeting of the International Society for Electrochemistry (ISE), Jeju (South Korea), platform presentation. (virtual).

Vosse, J., Estelrich, M., Comas, J., Atanasova, N., Castellano Costa, J., Gattringer, H. & Buttiglieri, G. (2021), Vertical constructed wetland for greywater treatment and reuse in touristic resorts: feasibility study, 5th International Conference on Ecotechnologies for Wastewater Treatment - IWA EcoSTP, Milan (Italy), platform presentation by Vosse, J.

Vosse, J., Estelrich, M., Comas, J., Atanasova, N., Castellano Costa, J., Gattringer, H. & Buttiglieri, G. (2021), Vertical constructed wetland for greywater treatment and reuse: feasibility study in a touristic resort, II International Conference on Water and Sustainability - ICWS, Terrassa, Barcelona (Spain), platform presentation by Vosse, J., third prize for the Best Communication Award.

Vosse, J., Santos, L.H.M.L.M., Mendoza, E., Comas, J., Rodríguez-Mozaz, S. & Buttiglieri, G. (2021), Human health risk assessment for the ingestion of food crops irrigated with greywater - Feasibility study for water reuse, WETPOL, 9th International Symposium on Wetland Pollutant and Dynamics and Control, platform presentation by Vosse, J.

Zahedi, S., Ferrari, F., Blandin, G., Balcazar, J.L. & Pijuan, M. (5-8 September 2021), Enhancing biogas production from anaerobic treatment of municipal wastewater by forward osmosis pretreatment, 4th IWA Resource Recovery Conference, Istanbul. Virtual.

PATENTS/PILOT PLANTS

Spanish Patent: ES2490065

Title: System for monitoring overflows in pipe networks.

Application date: 27/02/2013 - Grant date: 09/06/2015

Holder: Catalan Institute for Water Research Foundation (ICRA)

Inventors: Oriol Gutiérrez García-Moreno; Lluís Corominas Tabares; Vicenç Acuña Salazar

European patent application: EP20382879

Patent Cooperation Treaty (PCT) application: PCT/EP2021/076930

Title: Method to prepare graphene coated sponges, sponges obtained thereof, electrodes obtained from such sponges and uses of the sponges for water treatment

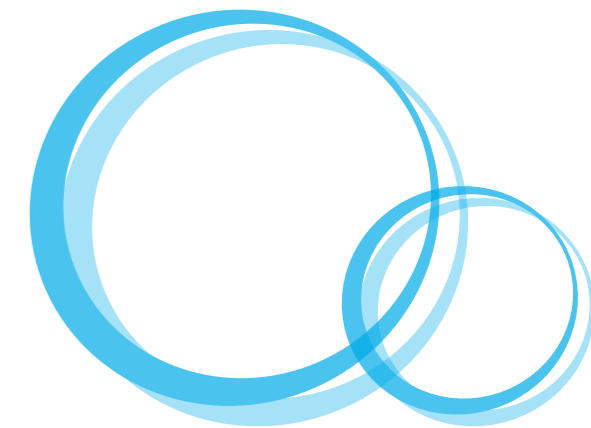
Application date: 02/10/2020 (EP), 30/09/2021 (PCT)

Holder: Catalan Institute for Water Research (ICRA) and Catalan Institution for Research and Advanced Studies (ICREA)

Inventors: Lluís Pires, Nick Diuslaeger, Florjan Norra and Jelena Radjenovic (ICRA-ICREA)

Zahedi, S., Gros, M., Petrović, M., Balcazar, J.L. & Pijuan, M. (5-8 September 2021), Exploring the effect of temperature in anaerobic digestion of slaughterhouse wastewater: bioenergy, pharmaceutical compounds and antibiotic resistance genes, 4th IWA Resource Recovery Conference, Istanbul. Virtual.

Zahedi, S., Gros, M., Petrović, M., Balcazar, J.L. & Pijuan, M. (21-25 June 2021), Waste to energy: anaerobic digestion of slaughterhouse wastewater for biorefinery, pharmaceutical compounds degradation and antibiotic resistance genes, 5th IWA International Conference on Ecotechnologies for Wastewater Treatment, Milan (Italy). Virtual.



European patent application: EP21382385

Title: Method to prepare an electrode with a manganese oxide coated titanium oxide nanotube array interlayer, electrode obtained thereof, and uses of the electrode

Application date: 30/04/2021

Holder: Catalan Institute for Water Research (ICRA) and Catalan Institution for Research and Advanced Studies (ICREA).

Inventors: Natalia Sergienko and Jelena Radjenovic (ICRA-ICREA)

European patent application: EP20382065

Patent Cooperation Treaty (PCT) application: PCT/EP2021/052228

Title: Rend-cap device. Self-assembling membrane housing for low pressure water filtering application

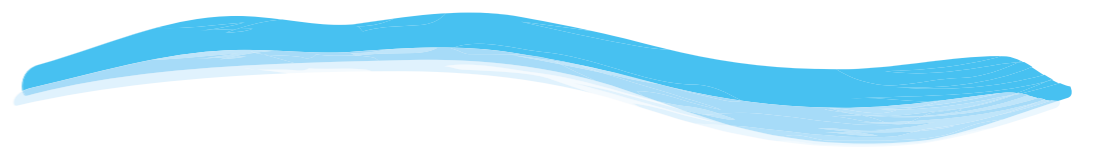
Application date: 31/01/2020 (EP) - 31/01/2021 (PCT)

Holder: University of Girona and Catalan Institute for Water Research (ICRA).

Inventors: Raquel García Pacheco (UdG) and Joaquim Comas Matas (UdG-ICRA)



06



PROJECTS

- RESOURCES AND ECOSYSTEMS RESEARCH AREA
- WATER QUALITY RESEARCH AREA
- TECHNOLOGIES AND EVALUATION RESEARCH AREA

RESOURCES AND ECOSYSTEMS RESEARCH AREA

PROJECT	
Intermitencia espacial y temporal del flujo en sistemas fluviales: efectos en la estructura, funcionamiento, y servicios ecosistémicos (Retos17_SPACESTREAM)	
Funding agency:	Ministerio de Economía y Competitividad (MINECO) and ERDF.
Duration:	2018-2021
Coordination:	Catalan Institute for Water Research (ICRA)
Leader researcher:	Vicenç Acuña Salazar
Amount for ICRA:	€96,800

PROJECT	
CLIMALERT Climate alert smart system for sustainable water and agricultura	
Funding agency:	Agencia Estatal de Investigación (AEI) - Ministerio de Economía y Competitividad (MINECO)
Duration:	2017-2021
Coordination:	University of Minho (Portugal)
Leader researcher:	Sergi Sabater
Amount for ICRA:	€97,445.00

PROJECT	
WATEXR: Integration of climate seasonal prediction and ecosystem impact modeling for an efficient adaptation of water resources management to increasing climate extreme events	
Funding agency:	Agencia Estatal de Investigación (AEI) - Ministerio de Economía y Competitividad (MINECO)
Duration:	2017-2021
Coordination:	ICRA
Leader researcher:	Rafael Marcé
Amount for ICRA:	€148,000.00

PROJECT	
MANTEL - Management of Climatic Extreme Events in Lakes Reservoirs for the Protection of Ecosystem	
Funding agency:	EUROPEAN COMMISSION
Duration:	2017-2021
Coordination:	Centre for Freshwater and Environmental Studies (IRL)
Leader researcher:	Rafael Marcé
Amount for ICRA:	€238.872,96

PROJECT	
C-HydroChange: Dinámica del carbono en lagos y embalses frente a una hidrología cambiante: implicaciones para el metabolismo del ecosistema, flujos de gases y sumideros sedimentarios	
Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia, Innovación y Universidades (MICIU) y el Fondo Europeo de Desarrollo Regional (FEDER)
Duration:	2018-2021
Coordination:	University of Málaga
Leader researcher:	Rafael Marcé
Amount for ICRA:	€48,400.00

PROJECT	
Ajuts per a la contractació de personal investigador JdCF 2017	
Funding agency:	Agencia Estatal de Investigación (AEI)
Duration:	2019-2021
Coordination:	ICRA
Leader researcher:	Sergi Sabater
Amount for ICRA:	€60,342.47

PROJECT	
Ajuts per a la contractació de personal investigador JdCF 2017	
Funding agency:	Agencia Estatal de Investigación (AEI)
Duration:	2019-2021
Coordination:	ICRA
Leader researcher:	Vicenç Acuña Salazar
Amount for ICRA:	€60,342.47

PROJECT	
GW-GEN: Antibióticos, genes de resistencia y riesgos asociados en el agua subterránea	
Funding agency:	Agencia Estatal de Investigación (AEI) y financiado por la Unión Europea NextGenerationEU/ PRTR
Duration:	2020-2022
Coordination:	ICRA
Leader researcher:	Mas Pla, Josep
Amount for ICRA:	€10,000

PROJECT	
Impacto de la contaminación de origen agrícola en la calidad hidroquímica (nitratos, antibióticos) y microbiológica (genes de resistencia)	
Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia, Innovación y Universidades (MICIU) y el Fondo Europeo de Desarrollo Regional (FEDER)
Duration:	2018-2022
Coordination:	Catalan Institute for Water Research (ICRA)
Leader researcher:	Josep Mas Pla
Amount for ICRA:	€104,665

PROJECT	
Integració d'estat ecològic i serveis ambientals per al disseny i prioritació de mesures de gestió (EESAM)	
Funding agency:	Catalan Water Agency
Duration:	2020-2022
Coordination:	Catalan Institute for Water Research (ICRA)
Leader researcher:	Vicenç Acuña
Amount for ICRA:	€127,422

PROJECT	
DRYVER - Securing biodiversity, functional integrity and ecosystem services in DRYing rivER networks	
Funding agency:	EUROPEAN COMMISSION
Duration:	2020-2024
Coordination:	Institut National de recherche pour l'agriculture, l'alimentation et l'environnement (Inrae) FR
Leader researcher:	Sergi Sabater
Amount for ICRA:	€136,541.25

PROJECT	
Inventive forecasting tools for adapting water quality management to a new climate (InventWater)	
Funding agency:	EUROPEAN COMMISSION
Duration:	2021-2025
Coordination:	ICRA
Leader researcher:	Rafael Marcé
Amount for ICRA:	€726,596.79

PROJECT	
Mainstreaming Ecological Restoration of freshwater-related ecosystems in a Landscape context: INnovation, upscaling and transformation (MERLIN)	
Funding agency:	EUROPEAN COMMISSION
Duration:	2021-2025
Coordination:	UNIVERSITAET DUISBURG- ESSEN
Leader researcher:	Vicenç Acuña
Amount for ICRA:	€90,000

PROJECT

Alteration of carbon sinks and sources in shrinking inland waters Alter-C

Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia e Innovación (MCIN)
Duration:	2021-2024
Coordination:	University of Barcelona
Leader researcher:	Rafael Marcé
Amount for ICRA:	€145,200

PROJECT

Impactos de múltiples estresores sobre los ríos: efectos sobre la biodiversidad y funciones del ecosistema (RIVSTRESS)

Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia e Innovación (MCIN)
Duration:	2021-2024
Coordination:	University of Barcelona
Leader researcher:	Sergi Sabater
Amount for ICRA:	€151,250

WATER QUALITY RESEARCH AREA

PROJECT

Qualitat, dinàmica i funció dels ecosistemes aquàtics continentals (ICRA-ENV)

Funding agency:	Agència de Gestió d'Ajuts Universitaris (AGAUR)
Duration:	2017-2021
Coordination:	Catalan Institute for Water Research (ICRA)
Leader researcher:	Mira Petrović
Amount for ICRA:	€60,216.00

PROJECT

EFLUCOMP: recerca de tecnologies cost-eficients basades en processos de separació, biològics i altres processos innovadors per al tractament d'efluents complexes.

Funding agency:	ACCIÓ/ RIS3CAT, Generalitat de Catalunya - Fondo Europeo de Desarrollo Regional (FEDER)
Duration:	2017-2021
Coordination:	Eurecat-CTM Technological Centre
Leader researcher:	Mira Petrović
Amount for ICRA:	€42,230.02

PROJECT

PLAS_MED: Microplásticos y microcontaminantes en la costa Mediterránea. Toxicidad e impacto ambiental y en la salud humana

Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia, Innovación y Universidades (MICIU) y el Fondo Europeo de Desarrollo Regional (FEDER)
Duration:	2018-2021
Coordination:	Catalan Institute for Water Research (ICRA)
Leader researcher:	Sara Rodríguez Mozaz
Amount for ICRA:	€159,720.00

PROJECT

REWATERGY - Sustainable Reactor Engineering for Applications on the Water-Energy Nexus

Funding agency:	EUROPEAN COMMISSION
Duration:	2019-2023
Coordination:	Rey Juan Carlos University
Leader researcher:	Sara Rodríguez
Amount for ICRA:	€0.00 (ICRA participates only as Partner Organisation)

PROJECT

SCHEME - Sewage chemical information mining - development of a novel concept for the assessment of human exposure to pollutants through wastewater analysis

Funding agency:	EUROPEAN COMMISSION H2020
Duration:	2019-2021
Coordination:	ICRA
Leader researcher:	Ivan Senta
Amount for ICRA:	€160,932.48

PROJECT

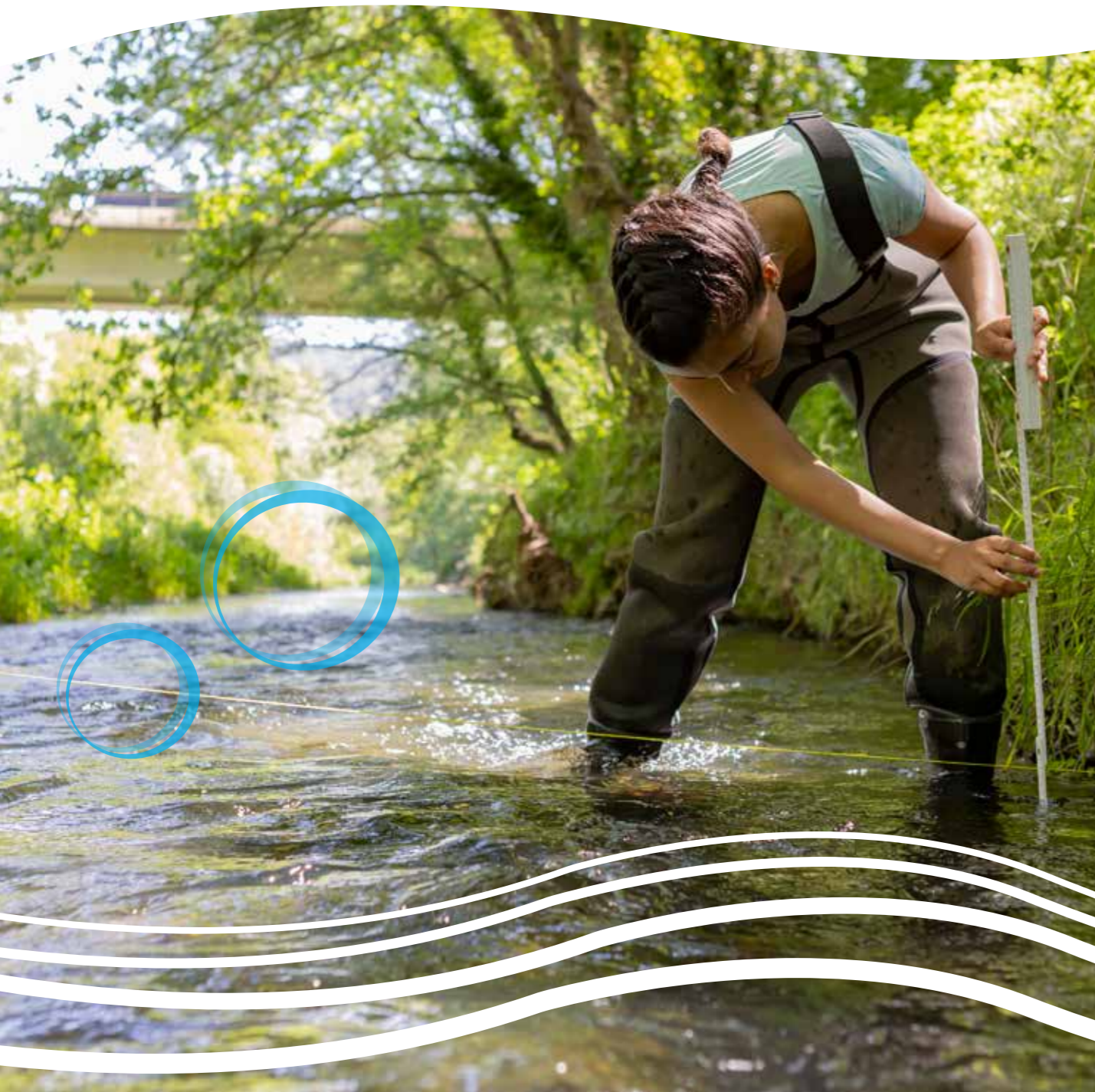
ENVIROSTOME - Exploring the contribution of bacteriophages to the emergence and spread of antibiotic resistance in environmental settings

Funding agency:	EUROPEAN COMMISSION (REA)
Duration:	2019-2022
Coordination:	ICRA
Leader researcher:	José Luís Balcázar
Amount for ICRA:	€170,121.60

PROJECT

BIOaccumulation of toxic contaminants in biofilms exposed to microPLASTics in aquatic mesocosms. (BioPlast)

Funding agency:	AGAUR
Duration:	2019-2021
Coordination:	ICRA
Leader researcher:	Sara Rodríguez Mozaz
Amount for ICRA:	€113,738.89



PROJECT
NOWELTIES: Joint PhD Laboratory for New Materials and Inventive Water Treatment Technologies. Harnessing resources effectively through innovation

Funding agency:	EUROPEAN COMMISSION
Duration:	2019-2023
Coordination:	ICRA
Leader researcher:	Mira Petrović
Amount for ICRA:	€862,334.64

PROJECT
Contribution of bacteriophages to the spread of antibiotic resistance in the environment (SfAM)

Funding agency:	Society for Applied Microbiology (SfAM)
Duration:	2020-2022
Coordination:	ICRA
Leader researcher:	José Luis Balcázar
Amount for ICRA:	€10,850.00

PROJECT
Ajuts per a la contractació de personal investigador novell FI 2020

Funding agency:	Agència de Gestió d'Ajuts Universitaris i de Recerca (AGAUR), Departament d'Universitats, Recerca i Societat de la Informació, Generalitat de Catalunya amb cofinançament del Fons Social Europeu (FSE)
Duration:	2020-2021
Coordination:	ICRA
Leader researcher:	Sara Rodríguez Mozaz
Amount for ICRA:	€20,774.97

PROJECT
EMERGE - Evaluation, control and Mitigation of the Environmental impacts of shipping Emissions

Funding agency:	EUROPEAN COMMISSION H2020
Duration:	2020-2024
Coordination:	ILMATIETEEN LAITOS, Finland
Leader researcher:	Mira Petrović
Amount for ICRA:	€399,968.75

PROJECT
Dissemination of Antibiotic Resistance by Aquatic Birds: disentangling the contribution of microbes, bird ecology and anthropogenic pollution (DARABi)

Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia, Innovación y Universidades (MICIU)
Duration:	2020-2023
Coordination:	University of Sevilla
Leader researcher:	Carles Borrego More
Amount for ICRA:	€159,720.00

PROJECT
Herramienta de escaneo de huellas moleculares de materia orgánica disuelta para la predicción de la formación de subproductos de desinfección durante el tratamiento del agua (Scan2DBP)

Funding agency:	Agencia Estatal de Investigación, Ministerio de Ciencia e Innovación/ y la Unión Europea NextGenerationEU/ PRTR
Duration:	2021-2023
Coordination:	ICRA
Leader researcher:	María José Farre Olalla
Amount for ICRA:	€126.500,00

PROJECT
EFLUCOMP: recerca en tecnologies cost-eficients basades en processos de separació, biològics i altres processos innovadors per al tractament d'efluents complexes

Funding agency:	ACCIÓ/ RIS3CAT, Generalitat de Catalunya - Fondo Europeo de Desarrollo Regional (FEDER)
Duration:	2017-2021
Coordination:	Eurecat-CTM Technological Centre
Leader researcher:	Mira Petrović
Amount for ICRA:	€42,230.02

PROJECT
REST-RESIST: Antibiotics of restricted use and corresponding resistant genes: tracking their emergence and fate in the environment and assessing natural and engineered attenuation processes to mitigate their spread

Funding agency:	AGAUR
Duration:	2021-2024
Coordination:	ICRA
Leader researcher:	Sara Rodríguez Mozaz
Amount for ICRA:	€144,300.00

PROJECT
Phage treatment and wetland technology as intervention strategy to prevent dissemination of antibiotic resistance in surface waters (PhageLand)

Funding agency:	Agencia Estatal de Investigación, Ministerio de Ciencia e Innovación/ y la Unión Europea NextGenerationEU/ PRTR
Duration:	2021-2024
Coordination:	ICRA
Leader researcher:	Carles Borrego
Amount for ICRA:	€264,270.00

PROJECT
ARENA - Antibiotic RESistaNce and Pathogenic Signature in Marine and Freshwater Aquaculture Systems

Funding agency:	Agencia Estatal de Investigación, Ministerio de Ciencia e Innovación/ y la Unión Europea NextGenerationEU/ PRTR
Duration:	2021-2024
Coordination:	National Research Council (CNR) Italy
Leader researcher:	Sara Rodriguez-Mozaz
Amount for ICRA:	€150,000

PROJECT
Small-molecule mass spectrometry fingerprinting as a diagnostic tool in water quality control and treatment optimization (waterDOM)

Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia e Innovación (MCIN)
Duration:	2021-2024
Coordination:	Consejo Superior de Investigaciones Científicas
Leader researcher:	María Jose Farre Olalla
Amount for ICRA:	€181,500

PROJECT
LIFE-RECYCLO- RECYCLing waste water from small and medium sized laundries with advanced Oxidation process.

Funding agency:	EUROPEAN COMMISSION
Duration:	2021-2024
Coordination:	TREEWATER SAS, France
Leader researcher:	Sara Rodriguez
Amount for ICRA:	€74,140

TECHNOLOGIES AND EVALUATION RESEARCH AREA

PROJECT	
Dl17_SCAN - Doctorat Industrial amb SCAN IBERIA (Mireia Plà Castellana)	
Funding agency:	AGAUR
Duration:	2017-2021
Coordination:	ICRA
Leader researcher:	Oriol Gutiérrez
Amount for ICRA:	€33,690.00

PROJECT	
ELECTRON ₄ WATER - Nanoelectrochemical systems (NES) for distributed water and wastewater treatment.	
Funding agency:	European Commission
Duration:	2017-2023
Coordination:	ICRA
Leader researcher:	Jelena Radjenovic
Amount for ICRA:	€1,493,733.13

PROJECT	
Tecnologies i avaluació del cicle integral de l'aigua (ICRA-TECH)	
Funding agency:	Agència de Gestió d'Ajuts Universitaris (AGAUR)
Duration:	2017-2021
Coordination:	ICRA
Leader researcher:	Ignasi Rodríguez-Roda Layret
Amount for ICRA:	€36,000.00

PROJECT	
Life NEWBIES - Nitrogen Extraction from Water By an Innovative Electrochemical System	
Funding agency:	LIFE programme of the European Union
Duration:	2018-2021
Coordination:	WETSUS
Leader researcher:	Maite Pijuan
Amount for ICRA:	€162,179.00

PROJECT	
SCOREwater: Smart City Observatories implement REsiliant Water Management	
Funding agency:	Call H2020-SC5-2018-2
Duration:	2019-2023
Coordination:	IVL (Sweden)
Leader researcher:	Lluís Corominas
Amount for ICRA:	€388,511.75

PROJECT	
DESENVOLUPAMENT D'EINES PER AL SUPORT EN LA IMPLEMENTACIÓ I GESTIÓ DE LA REUTILITZACIÓ (SUGGEREIX)	
Funding agency:	Catalan Water Agency (ACA)
Duration:	2020-2022
Coordination:	Eurecat (CTM)
Leader researcher:	Wolfgang Gernjak
Amount for ICRA:	€ 65,606.85

PROJECT	
Innovative WATER recoverY Solutions through recycling of heat, materials and water across multiple sectors (iWAYS)	
Funding agency:	EUROPEAN COMMISSION
Duration:	2020-2024
Coordination:	UNIVERSITA DEGLI STUDI DI MODENA E REGGIO EMILIA
Leader researcher:	Wolfgang Gernjak
Amount for ICRA:	€583,980.00

PROJECT	
Ajuts per a la contractació de personal investigador JdCF 2017	
Funding agency:	Agencia Estatal de Investigación (AEI)
Duration:	2018-2021
Coordination:	ICRA
Leader researcher:	Damià Barceló
Amount for ICRA:	€75,997.26

PROJECT	
Ajuts per a la contractació de personal investigador JdCF 2017	
Funding agency:	Agencia Estatal de Investigación (AEI)
Duration:	2019-2021
Coordination:	ICRA
Leader researcher:	Maite Pijuan
Amount for ICRA:	€64,000

PROJECT	
Ajuts per a la contractació de personal investigador novell FI 2020	
Funding agency:	Agència de Gestió d'Ajuts Universitaris i de Recerca (AGAUR), Departament d'Universitats, Recerca i Societat de la Informació, Generalitat de Catalunya amb cofinançament del Fons Social Europeu (FSE)
Duration:	2020-2021
Coordination:	ICRA
Leader researcher:	Gianluigi Buttiglieri
Amount for ICRA:	€23,774.97

PROJECT	
Ajuts per a la contractació de personal investigador novell FI 2020	
Funding agency:	Agència de Gestió d'Ajuts Universitaris i de Recerca (AGAUR), Departament d'Universitats, Recerca i Societat de la Informació, Generalitat de Catalunya amb cofinançament del Fons Social Europeu (FSE)
Duration:	2020-2021
Coordination:	ICRA
Leader researcher:	Joaquim Comas Matas
Amount for ICRA:	€23,774.97

PROJECT	
COST ACTION- Plasma applications for smart and sustainable agriculture (PIAgri)	
Funding agency:	EUROPEAN COMMISSION
Duration:	2020-2024
Coordination:	Institute of Physics Belgrade Serbia
Leader researcher:	Wolfgang Gernjak
Amount for ICRA:	€0 (COST Action covers only the networking activities expenses (travels) rather than research and as such and they are reimbursed directly to individual participants)

PROJECT	
WASTewater as a source of knowledge on SARS-CoV-2 and other potentially pandemic VIRuses: a One Health approach (VIRWASTE)	
Funding agency:	Agència de Gestió d'Ajuts Universitaris i de Recerca (AGAUR)
Duration:	2021-2022
Coordination:	University of Barcelona (UB), Laboratori de Virus Contaminants d'aigües i aliments.
Leader researcher:	Lluís Corominas Tabares
Amount for ICRA:	: €0 (The ICRA budget is allocated to UB. Expenses will be paid from there.)

PROJECT	
INtegrated and adaptiVE management of river basins: developing STRategies for optimized investments in urban water infrastructure (INVEST)	
Funding agency:	Funding agency: Agencia Estatal de Investigación (AEI), Ministerio de Ciencia, Innovación y Universidades (MICIU) y el Fondo Europeo de Desarrollo Regional (FEDER)
Duration:	2019-2022
Coordination:	ICRA
Leader researcher:	Wolfgang Gernjak
Amount for ICRA:	€133,100

PROJECT

Analysis of antibiotic resistance and micropollutants biotransformation: bioRGO-enhanced anaerobic MBR and elucidation of degradation products (ANTARES)

Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia, Innovación y Universidades (MICIU)
Duration:	2020-2023
Coordination:	Universidade de Santiago
Leader researcher:	Jelena Radjenovic
Amount for ICRA:	€137,335.00

PROJECT

EdiCitNet - Edible City Solutions

Funding agency:	EUROPEAN COMMISSION
Duration:	2018-2023
Coordination:	Humboldt Universitaet
Leader researcher:	Joaquim Comas
Amount for ICRA:	€427,780

PROJECT

Demonstration of water loops with innovative regenerative business models for the Mediterranean region (HYDROUSA)

Funding agency:	EUROPEAN COMMISSION
Duration:	2018-2022
Coordination:	National Technical University of Athens
Leader researcher:	Gianluigi Buttiglieri
Amount for ICRA:	€474,300

PROJECT

Circular economy to facilitate urban water reuse in a touristic city: centralized or decentralized? (CLEAN-TOUR)

Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia, Innovación y Universidades (MICIU) y el Fondo Europeo de Desarrollo Regional (FEDER)
Duration:	2018-2021
Coordination:	Catalan Institute for Water Research (ICRA)
Leader researcher:	Joaquim Comas
Amount for ICRA:	€181,500.00

PROJECT

Cost Action: Implementing nature-based solutions for creating a resourceful circular city (Circular City Re.Solution)

Funding agency:	EUROPEAN COMMISSION
Duration:	2018-2022
Coordination:	Universität für Bodenkultur Wien (BOKU, Austria)
Leader researcher:	Gianluigi Buttiglieri
Amount for ICRA:	€0 (COST Action covers only the networking activities expenses (travels) rather than research and as such and they are reimbursed directly to individual participants)

PROJECT

DIGITAL-WATER.city - Leading urban water management to its digital future (DWC)

Funding agency:	EUROPEAN COMMISSION
Duration:	2019-2022
Coordination:	KWB KOMPENTENTZZENTRUM WASSER BERLIN GEMEINNUTZIGE GMBH (KWB), Germany
Leader researcher:	Oriol Gutierrez
Amount for ICRA:	€193,750

PROJECT

MICROWATER

Funding agency:	EUROPEAN COMMISSION
Duration:	2020-2023
Coordination:	ICRA
Leader researcher:	Maite Pijuan
Amount for ICRA:	€259,398.72

PROJECT

Avaluació de la propagació de la COVID-19 mitjançant epidemiologia de les aigües residuals: tipatge, cribatge comunitari i risc ocupacional (EPISARS).

Funding agency:	Fundació La marató de TV3. Código: 202103-31
Duration:	2021-2023
Coordination:	University of Barcelona
Leader researcher:	Lluís Corominas Tabares
Amount for ICRA:	€95,100.00

PROJECT

Water and Wastewater Companies for Climate Mitigation (WaCClIM): ECAM-GIZ

Funding agency:	Government of the Federal Republic of Germany, Federal Ministry for Environment, Nature, Conservation and Nuclear Safety
Duration:	2020-2021
Coordination:	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Leader researcher:	Lluís Corominas
Amount for ICRA:	€38,584.20

PROJECT

Spread Sewer Sensing for Sustainable Management (4SM)

Funding agency:	Agencia Estatal de Investigación, Ministerio de Ciencia e Innovación/ y la Unión Europea NextGenerationEU/PRTR
Duration:	2021-2024
Coordination:	ICRA
Leader researcher:	Oriol Gutiérrez Moreno
Amount for ICRA:	€299,999.39

PROJECT

ReUseMP3- Integrating nature-based water ReUse strategies with advanced Monitoring of the Presence and impact of MicroPollutants and MicroPlastics.

Funding agency:	Agencia Estatal de Investigación (AEI), Ministerio de Ciencia e Innovación (MCIN)
Duration:	2021-2024
Coordination:	ICRA
Leader researcher:	Gianluigi Buttiglieri
Amount for ICRA:	€174,240

PROJECT

ModULar Tools for Integrating enhanced natural treatment SOLUTIONS into Urban water CydEs (MULTISOURCE)

Funding agency:	EUROPEAN COMMISSION
Duration:	2021-2025
Coordination:	INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE, L'ALIMENTATION ET L'ENVIRONNEMENT, France
Leader researcher:	Joaquim Comas
Amount for ICRA:	€326,500

PROJECT

Twinning Western Balkans Special- TWINNING FOR SMART WATER- THINKING AND RETHINKING WASTEWATER MANAGEMENT IN CIRCULAR ECONOMY FRAME (SmartWaterTwin)

Funding agency:	EUROPEAN COMMISSION
Duration:	2022-2025
Coordination:	University of Novi Sad Faculty of Sciences
Leader researcher:	Jelena Radjenovic
Amount for ICRA:	€248,667

PROJECT

Sustainable water reuse practices improving safety in agriculture, food and environment (PCI2021_SAFE)

Funding agency:	Agencia Estatal de Investigación (AEI)
Duration:	2022-2025
Coordination:	Università degli Studi della Basilicata (UNIBAS)
Leader researcher:	Gianluigi Buttiglieri
Amount for ICRA:	€200,662





07

CONTRACTS

TOTAL AMOUNT OF CONTRACTS
AWARDED IN 2021:

€447,787.16€

CONTRACT:
EcoAdvisor - (EcoAdvisor for Wise Leadin Water Management)

Contracting Entity: Aigües de Catalunya

Duration: 2018-2021

Leader researcher: Lluís Corominas

CONTRACT:
NDMA_Licitacio (Servicios de investigación, presencia y eliminación de precursores de NDMA en ETAP)

Contracting Entity: Canal de Isabel II S.A.

Duration: 2019-2022

Leader researcher: Farre Olalla, Maria Jose

CONTRACT:
NEIKER_Antifungicos

Contracting Entity: NEIKER

Duration: 2019-2022

Leader researcher: Sabater Cortes, Sergi

CONTRACT:
TRAGSATEC_licitacio (Servicio de Asesoramiento Experto Senior en Limnología Aplicada Para La Revisión de Las Condiciones de Referencia de Las Masas de Agua de La Categoría Ríos y Lagos.)

Contracting Entity: TRAGSATEC

Duration: 2019-2023

Leader researcher: Sabater Cortes, Sergi

CONTRACT:
CTFC_Life_ALNUS. Projecte de transferencia CTFC tasques projecte Life_ALNUS

Contracting Entity: CTFC

Duration: 2020-2021

Leader researcher: Sergi Sabater Cortés

CONTRACT:
CEC_BESOSTORDERA. Consorci besos tordera CEC_BESOSTORDERA

Contracting Entity: Consorci Besós Tordera

Duration: 2020-2021

Leader researcher: Ignasi Rodriguez Roda Layret

CONTRACT:
ACA_TRAÇA. Traçabilitat de les fonts de contaminació de substancies prioritàries i contaminants emergents en trams fluvials rellevants, i mesures de millora en el sanejament urbà al Baix Llobregat

Contracting Entity: Catalan Water Agency (ACA)

Duration: 2020-2022

Leader researcher: Vicenç Acuña Salazar

CONTRACT:
Cetaqua_CARBOLOCKDOWN. Medición de emisiones directas de GEI en EDAR - CARBOLOCKDOWN

Contracting Entity: Cetaqua

Duration: 2020-2021

Leader researcher: Maite Pijuan Vilalta

CONTRACT:
Sanitation for and by Nature 2 NCEAS-SNAPP

Contracting Entity: National Center for Ecological Analysis and Synthesis (NCEAS)

Duration: 2020-2021

Leader researcher: Acuña Salazar, Vicenç

CONTRACT:
WETSUS_Analysis

Contracting Entity: WETSUS

Duration: 2021-2021

Leader researcher: Gernjak, Wolfgang

CONTRACT:
Licitacio_WBCSD-WIAT

Contracting Entity: World Business Council for Sustainable Development (WBCSD)

Duration: 2021-2022

Leader researcher: Acuña Salazar, Vicenç

CONTRACT:
ACCIONA_Olors-Ebre

Contracting Entity: ACCIONA Agua S.A.

Duration: 2021-2022

Leader researcher: Gutierrez Garcia Moreno, Oriol

CONTRACT:
UMinho_pharma

Contracting Entity: Universidade do Minho (Portugal)

Duration: 2021-2022

Leader researcher: Rodriguez Mozaz, Sara

CONTRACT:
CWP_aquifer

Contracting Entity: Universidade do Minho (Portugal)

Duration: 2021-2022

Leader researcher: Mas Pla, Josep

CONTRACT:
Xarxa_SARS-Aigua21-22

Contracting Entity: Ministry of Health - GENCAT

Duration: 2021-2023

Leader researcher: Borrego More, Carles

CONTRACT:
SENVES_Milano

Contracting Entity: Council for Scientific and Industrial Research (CSIR)

Duration: 2021-2023

Leader researcher: Petrović, Mira

CONTRACT:
Licitacio_CSIR

Contracting Entity: Gruppo CAP

Duration: 2021-2026

Leader researcher: Gutierrez Garcia Moreno, Oriol





08

AGREEMENTS

08/02/2021

FORAM UISCE - THE WATER FORUM (AFU)

Commitment of the Partner Organisation. InventWater Consortium project.

08/02/2021

DUBLIN CITY UNIVERSITY - DCU

Commitment of the Partner Organisation. InventWater Consortium project.

09/02/2021

AU, DKIT, UFZ.... All

Consortium Agreement for a Marie Skłodowska-Curie Innovative Training Network (ITN), European Training Network. This CA is based upon Regulation EU. inventWater Project (Inventive forecasting tools for adapting water quality management to a new climate). New forecasting tools to help manage water quality Long-term climate change, extreme phenomena and changes in meteorological patterns have a serious effect on the water quality of rivers, lakes and reservoirs. There is consequently an urgent need to develop instruments that can anticipate the effects of environmental changes and allow for a water management system that can maintain water quality in an effective way. Technological progress has produced new meteorological data products and innovative modelling instruments that allow us to obtain reliable forecasts for the water quality of rivers and lakes, at both a regional and worldwide level. The inventWater project, financed with European funding, will create a platform that offers advanced interdisciplinary training to the next generation of water specialists. The project will provide training in data and climate science.

15/02/2021

Institute for Climate Impact Research PIK

Commitment of the Partner Organisation. InventWater Consortium project.

22/02/2021

NIOO-KNAW

Commitment of the Partner Organisation. InventWater Consortium project.

09/03/2021

University of Girona - Parc Científic UdG

Modifications of services and economic conditions related to the agreement signed between ICRA, the University of Girona (UdG) and the University of Girona Science and Technology Pole (PCIT) in 2014, given ICRA's new status as a co-owner of a percentage of the H2O Building

10/03/2021

UPPSALA UNIVERSITY

Commitment of the Partner Organisation. InventWater Consortium project.

11/03/2021

VIRGINIA TECH

Commitment of the Partner Organisation. InventWater Consortium project.

11/03/2021

CLIMATE ANALYTICS

Commitment of the Partner Organisation. InventWater Consortium project.

11/03/2021

RUHRVERBAND

Commitment of the Partner Organisation. InventWater Consortium project.

11/03/2021

UNIVERSITY OF BARCELONA

Commitment of the Partner Organisation. InventWater Consortium project.

11/03/2021

UNIVERSITY OF UTRECHT

Commitment of the Partner Organisation. InventWater Consortium project.

22/03/2021

CWP

Contract for the renting of space in the H2O Building. Conditions and clauses.

22/04/2021

MARINE INSTITUTE

Commitment of the Partner Organisation. InventWater Consortium project.

22/04/2021

ACCIONA-AGUA

Contract and service conditions for waste water treatment plants at L'Ametlla de Mar and L'Ampolla

06/05/2021

INRAE

Consortium Agreement for a HORIZON 2020. This CA is based upon Regulation EU. MULTISOURCE Project. The main aim of MULTISOURCE is, together with local, national and international stakeholders, to demonstrate a variety of enhanced natural treatment solutions (ENTS) to treat a wide range of urban water types and to develop tools, methods and innovative commercial models to provide planning support for the whole city and long-term and maintenance operations for nature-based solutions for the treatment, storage and reuse of water in urban areas all over the world. MULTISOURCE will enable users to identify multiple sources for the local reuse of water, to promote greater access to nature-based solutions and to minimise the discharge of water that has not received adequate treatment. MULTISOURCE will provide new expertise related to ENTS and their ability to eliminate pollutants transmitted by water and will provide an effective reduction of the risk of chemical and biological hazards, together with its capacity to merge into the surrounding landscape and to contribute to the enhancement of urban habitats. The project includes seven pilot schemes that treat a wide range of urban water types. Two individual municipalities (Girona, Spain; Oslo, Norway), two metropolitan conurbations (Lyon, France; Milan, Italy) and international partners in Brazil, Vietnam and the United States. They will contribute to each of the main activities making up the project: ENTS pilot schemes, risk assessment, business models, the selection of technologies and the MULTISOURCE Planning Platform. The use of urban archetypes in the Planning Platform will enable users to rapidly classify regions (in both developed and developing countries) for the appropriate application of nature-based solutions for water treatment (NBSWT) and to compare scenarios both with and without NBSWT. This unique focus will encourage the development of expertise.

19/05/2021

WBCSD

Contract for scientific collaboration with the World Business Council for Sustainable Development and Earth Genome and with Future H2O-B.

19/05/2021

UNIVERSITY OF BELGRADE

Scientific collaboration in the framework of the Novelities (ITN-European Joint Doctorate) project, for the duration of the stay at ICRA of the visiting researcher Ajit Kumar

20/05/2021

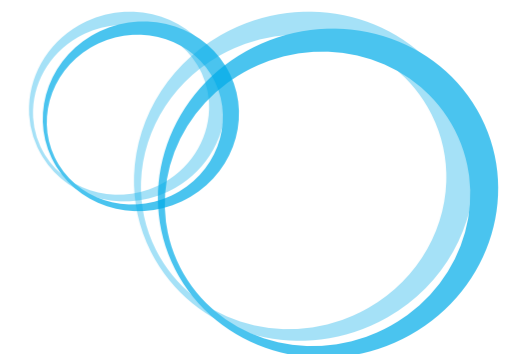
Altafulla City Council, L'Ampolla City Council, Rambla Prim Institute (Barcelona)

The aim of this collaboration agreement is to provide a coordinating framework for the operations of Altafulla City Council, L'Ampolla City Council, the Rambla Prim Institute in Barcelona, the Institut Escola del Treball (Institute of Employment) in Barcelona and the ICRA Foundation in terms of assessments, exchanges of information and project implementation in the field of research, education, preparation and analytical studies of marine microplastics, with samples taken using filter buoys, within the framework of the project entitled "Buoys for filtering marine microplastics".

05/08/2021

Ministry of Health - Generalitat de Catalunya (Government of Catalonia)

This management order forms part of the operations that need to be undertaken in order to implement a system to monitor the circulation of the SARS-CoV-2 virus in various regions, with a view to reinforcing clinical and epidemiological surveillance of COVID-19, by means of a temporary surveillance programme for the SARS-CoV-2 virus in wastewater in Catalonia. With regard to ICRA, the aim of the management order is to coordinate the project, which includes the coordination of all the participants concerned, in terms of the logistics regarding collecting and transporting samples from all the wastewater treatment stations to the laboratories, and also for the scientific coordination of the processes, including relative calibration tests for the participating laboratories, monitoring of analytical protocols, interpretation of the results and their transmission and dissemination. For the implementation of this order, ICRA undertakes to coordinate all the participants involved in the analysis of the genome of the virus in wastewater. Specifically, it will organise and supervise the logistical aspects of the collection and transporting of the samples from all the wastewater treatment stations to the laboratories, and will be responsible for the scientific coordination of the processes, including relative calibration testing of the participating laboratories, monitoring of analytical protocols, interpretation of the results and their transmission and dissemination.



24/06/2021

WETSUS

Scientific collaboration agreement between Wetsus (the European Centre of Excellence for Sustainable Water Technology) and ICRA in the framework of the project "Vacuum UV process for persistent micropollutants removal" for managing the stay of a visiting PhD student at ICRA within the framework of this project. ICRA Tutorship of Dr Wolfgang Gernjak

22/07/2021

University of Girona

Addenda to the agreement for the registration of the research carried out by the researcher Ignasi Rodríguez-Roda, in which the parties declare the early termination of the registration of the researcher.

05/08/2021

Ministry of Health - Generalitat de Catalunya (Government of Catalonia)

Management order issued by the Catalan Ministry of Health to the Catalan Institute for Water Research Foundation for the coordination of the surveillance programme of SARS-CoV-2 in wastewater in Catalonia for the years 2021 and 2022

A collaboration agreement the aim of which is to order the management of the operations that need to be undertaken in order to implement a system to monitor circulation of the SARS-CoV-2 virus in various regions, with a view to reinforcing clinical and epidemiological surveillance of COVID-19, by means of a temporary surveillance programme for the SARS-CoV-2 virus in wastewater in Catalonia.

With regard to ICRA, the aim of the management order is to coordinate the project, which includes the coordination of all the participants concerned, in terms of the logistics regarding collecting and transporting samples from all the wastewater treatment stations to the laboratories, and also for the scientific coordination of the processes, including relative calibration tests for the participating laboratories, monitoring of analytical protocols, interpretation of the results and their transmission and dissemination.

29/11/2021

Ministry of Health - Generalitat de Catalunya (Government of Catalonia)

The management order issued by the Catalan Ministry of Health to the Catalan Institute for Water Research Foundation for the extension of the temporary programme of surveillance of SARS-CoV-2 in wastewater in Catalonia for the years 2021 and 2022, with the monitoring of variants.

The aim of this management order is defined within the operations that need to be undertaken to detect and identify the genomic variants of concern or of interest (VOC/VOI) of the SARS-CoV-2 virus in wastewater from wastewater treatment stations (WTS) in Catalonia, for the purpose of providing additional information about the current status of the COVID-19 pandemic in Catalonia and detecting the possible entry and circulation within the region of new variants. With regard to ICRA, the aim of the management order is the development of IT systems for the checking and integration of the sequencing process, PCR testing and management of the results. This task will be conducted during the course of the year 2021.

10/12/2021

CERCA Institution - Participating Catalan Research Centres

Agreement for operations in the scientific and technological infrastructures of the CERCA system and for the development of a platform to access these infrastructures. The aim of the agreement is defined by the operations in the scientific and technological infrastructures of the CERCA system and the development of a platform to access these infrastructures for all the participating Catalan Research Centres.





09

OTHER DISSEMINATION ACTIVITIES

23/02/2021

ICRA coordinates a group of experts in water quality in order to improve the health of the persons within the buildings

Maria José Farré, a researcher from the Catalan Institute for Water Research (ICRA), is responsible for coordinating the Expert Working Group (EWG) of the Forum on Buildings and Health, which will analyse how water quality affects people's health within buildings.

The Forum on Buildings and Health is a project that was created through the collaboration between the Spanish Council of Technical Architects (CGATE), the Green Building Council Spain (GBCe) and the Spanish Efficient Habitat Cluster (AEICE). Its aim is to approach all aspects of buildings that affect the health of the people inside them, including air quality, ergonomics, acoustic comfort, lighting and water quality, among many others.

When each working period comes to an end, each group will present a technical report containing its conclusions, and these will in turn be used as a working guide for professionals working in this sector.

02/03/2021

2021 Pittcon course: Analysis of microplastics in water

Speaker: Prof Dr Damià Barceló - Catalan Institute for Water Research-ICRA

The analysis of microplastic (MP) pollution in water has been identified as one of the main problems the world is currently facing. Currently, it is estimated that between 4 and 12 million tonnes of plastic go into the seas and oceans every year, and it is expected that by the year 2050 MPs will surpass the number of fish in the oceans. According to existing studies, the characterisation of MPs in water continues to constitute a challenge because they can easily be confused with organic or other kinds of material. There is consequently an urgent need to analyse MPs present in water. In this short course we will discuss the analysis of MPs using Raman and FT-IR spectroscopies and microscopies, gas chromatography by pyrolysis and thermal desorption, as well as liquid chromatography/mass spectrometry. This short course will also provide an overview and updated data concerning the sources and appearance, transporting and ultimate destination of the MPs found in aquatic ecosystems. Case studies from Europe, the US and China will be presented.

04/03/2021

Webinars focusing on the circular solutions proposed by the HYDROUSA project in three Mediterranean regions.

How can we develop long-term low-carbon solutions to deal with water stress in the Mediterranean regions? How can we advance towards a sustainable circular future?

A new year is a good time to take an in-depth look at the progress made by HYDROUSA.

A series of webinars focusing on the application of solutions in each Mediterranean region will start in early March and will continue until May.

The HYDROUSA 2021 series of webinars are designed by a community of water sector partners to introduce a mission leading to a viable circular economy scenario. We approach the challenges of water supply, wastewater and the loss of biodiversity, extracting water from unconventional sources by using cutting-edge nature-based technological innovation.

The online sessions include an introduction to the HYDROUSA project, its theoretical focus, methodology and practical implementation, with the support of interactive areas containing questions about the different in situ applications, with collective maps of the results and future stages of the webinar.

- WEBINAR A:
deals with the HYDROUSA applications on the island of Mykonos
Topics: #Collecting residential rainwater #Collecting underground rainwater
Date and time: 04/03/2021, 5.00 - 6.30 p.m.
- WEBINAR B:
deals with the HYDROUSA applications on the island of Tinos
Topics: #Desalination system #Greenhouse #Ecotourist water-loops
Date and time: 01/04/2021, 5.00 - 6.30 p.m.
- WEBINAR C:
deals with the applications on the island of Lesbos
Topics: #Wastewater treatment system #Agroforestry system
Date and time: 05/05/2021, 5.00 - 6.30 p.m.

The experts and key stakeholders will meet virtually to further explore the applications of our project, the different characteristics of the areas selected, the innovations and practices of the circular economy, from the initial conception of the applications to their completion.

Representatives of the National Technical University of Athens, Alchemia Nova, the Water Utility of Lesbos, the Municipalities of Tinos, Mykonos and Western Lesbos, PLANET, Delaros and Tinos Ecolodge will guide us through the vision, actions and technological innovations of the project in each location. We will discuss currently faced challenges, the evolution of the work undertaken in the pilot schemes and the solutions that will potentially lead to a more circular future.

Join us for an innovative webinar that offers a full vision of HYDROUSA and its implications for a more sustainable future.

22/03/2021

Lecture: Macro- and micro-plastic waste and how the increase in plastic pollution due to COVID-19 came to be on your radar. Think globally, act locally

Online talk

A lecture given by the director of the Catalan Institute for Water Research (ICRA), Dr Damià Barceló, as part of the Second Cycle of International Lectures of the Faculty of Chemistry of the Autonomous University of Mexico State.

Title: "Macro- and micro-plastic litter and increased COVID-19 based plastic pollution to be on your radar. Think global, act local"

24/03/2021

An explanatory talk on the SARS-CoV-2 Network of Surveillance in wastewater in Catalonia

On 23 March, the **Catalan Institute for Water Research (ICRA)** gave a talk to the students of the **Miquel Martí i Pol High School** in Cornellà de Llobregat (Barcelona) about the SARS-CoV-2 Network of Surveillance, the programme launched by the Catalan Public Health Agency and the Catalan Water Agency (ACA) which detects and monitors the presence of the virus in the wastewater of Catalonia.

A total of 24 persons, including both students and teaching staff from the Chemistry and Environmental Health Higher Level Training Cycles, were able to learn firsthand about the inspection methods and operations used at the 56 water treatment plants in the region that took part in the project.

The researchers **Neus Collado** and **Laura Guerrero** described the operations were carried out at ICRA, how the evolution of the virus was monitored and how useful information was provided to the authorities so they could determine the measures of control and prevention that were needed to manage the pandemic successfully.

The current situation meant that it was not possible to give the talk face-to-face. Nevertheless, at the end of the talk, a lively round of questions and answers was included, during which students had the opportunity to ask for further details and exercise their curiosity.

23/03/2021

Series of webinars: Innovation for SDGs: inspirational tools to tackle sustainability challenges

A session specifically dedicated to Water, Cities and Sustainable Communities and to Action for the Climate

Acting through its Sectoral Campuses, and with the collaboration of the Global University Network for Innovation, the University of Girona organised a cycle of talks dedicated to the 17 UN Sustainable Development Goals, on the following subject: "**Innovation for SDGs: inspirational tools towards sustainability challenges**". These talks will take place between 15 March and 25 March in virtual format, and we hope you will be able to take part in these events.

For the University of Girona, sustainability is a vital challenge and represents one of its key values. For this cycle of talks, we will be honoured by the participation of renowned local and international experts who will reflect on the need to establish a dialogue between science and society in order to attain the SDGs by the year 2030.

The cycle consists of eight sessions in total, with the first three being of a more generalist and introductory nature and the remaining five focusing on more specific thematic areas: social inequality in terms of healthcare; water management in an urban environment; regenerative tourism as a model for respectful social and environmental behaviour; the conservation of the natural world through the use of robotics, and the enhancement of sustainability in terms of food production.

Registration is free of charge and all sessions will be held exclusively in English. We hope this event will attract your interest, please don't hesitate to mention it to all your contacts!

On **23 March** a specific session was held by the Water Campus and the Natural and Cultural Heritage Campus: **Wise Water Management in Cities** from **11.00 a.m. to 1.00 p.m.** In this session, we will focus on how to improve water management in cities in order to make them more sustainable and resilient.

The session will start with a talk given by **Corinne Trommsdorff**, the CEO of the Water Citiesorganisation, and two examples of good practices explained by **Reginna Gnirss**, the Director of R+D at Berliner Wasserwerke and **Joana Castellar**, a researcher at ICRA.

The session will be presided over by **Joaquim Comas**, a professor at the University of Girona and researcher at ICRA.

26/03/2021

Doctoral thesis defence**Video conference**

Title: "Analysis and impact of antibiotics in marine organisms. Laboratory experiments and field studies"

By: Albert Serra Compte

Directors: Prof Damià Barceló, Dr Sara Rodríguez-Mozaz, Dr Diana Álvarez

Residues of antibiotics have been detected in the aquatic environment all over the planet, whether it be in rivers, lakes, underground water systems or sea-water. Various studies have also reported an accumulation of antibiotics in aquatic organisms that can produce ecotoxicological effects in the organisms concerned and alter the functioning of entire ecosystems. In addition, the bioaccumulation of antibiotics may be a cause of concern for human health when the latter accumulate in animals destined for human consumption, such as varieties of seafood. Furthermore, antibiotic pollution may contribute to the development and propagation of resistance to antibiotics in the surrounding environment, which is thus a further cause of concern due to this added risk for human health.

The main aim of this thesis was to investigate the ultimate limits to which residues of antibiotics could be traced and their impact on the environment, with a special emphasis on the marine ecosystem. The bioaccumulation of antibiotics in marine organisms was evaluated both in controlled conditions and through the analysis of aquatic organisms originating from both aquaculture and natural environments. Exposure-based experiments were also used to characterise the ecotoxicological effects of the antibiotics and to evaluate their contribution to the propagation of antibiotic-resisting genes.

The first part was dedicated to the development of analytical methods to determine the appearance of residues of antibiotics in marine organisms and water samples. Two different methodologies were explored in this part. On the one hand, an analytical method was developed based on the QuEChERS extraction technique followed by liquid chromatography combined with mass spectrometry analysis (LC-MS/MS) for the identification and quantification of 23 antibiotics in samples of fish, mussels and clams. On the other hand, a methodology was perfected that was based on inhibiting microbial growth for the screening of the four families of antibiotics in biofluids and water samples of the organism concerned. Both methodologies were applied for the determination of residues of antibiotics in samples of organisms and water on the basis of a relevant monitoring campaign.

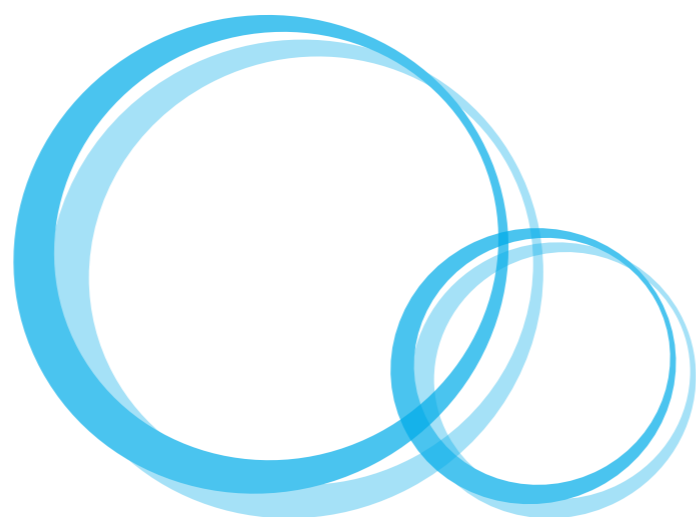
The second part evaluated the environmental impact of the pollution of marine organisms by antibiotics. Three different sets of exposure-based experiments were conducted in order to evaluate the bioaccumulation of antibiotics, the ecotoxicological effects and the propagation of antibiotic resistance in marine mussels. The first study evaluated the alterations in the bioaccumulation of antibiotics caused by the expected conditions induced by climate change in the marine environment, such as rises in water temperature and in levels of acidity. The second study evaluated exhaustively the ecotoxicological effects of exposure to sulfamethoxazole in marine mussels through the characterisation of enzymatic activities and the observation of changes in the metabolism by applying untargeted metabolomics. Finally, the third study determined the effects of the pollution of water by antibiotics on the abundance of antibiotic-resistant genes produced in bacteria located in the gastrointestinal tracts of mussels.

29/03/2021

9th International Conference on Water Resources and Arid Environments (29-31 March)

The ICWRAE is an international scientific conference held once every two years. It is organised by the King Saud University (KSU); the Prince Sultan Institute for Environmental, Water and Desert Research; the Prince Sultan bin Abdulaziz International Prize for Water (PSIPW); and the Saudi Arabian Ministry for the Environment, Water and Agriculture. As a result of COVID-19, this year's special virtual edition will only include invited speakers, focusing on the winners of the PSIPW from the 1st award-winner (2004) to the 9th award-winner (2020).

Participation in virtual attendance of the conference will be open to all stakeholders from all over the world.



21/04/2021

Holding of the biennial meeting of ICRA's Scientific Assessment Council

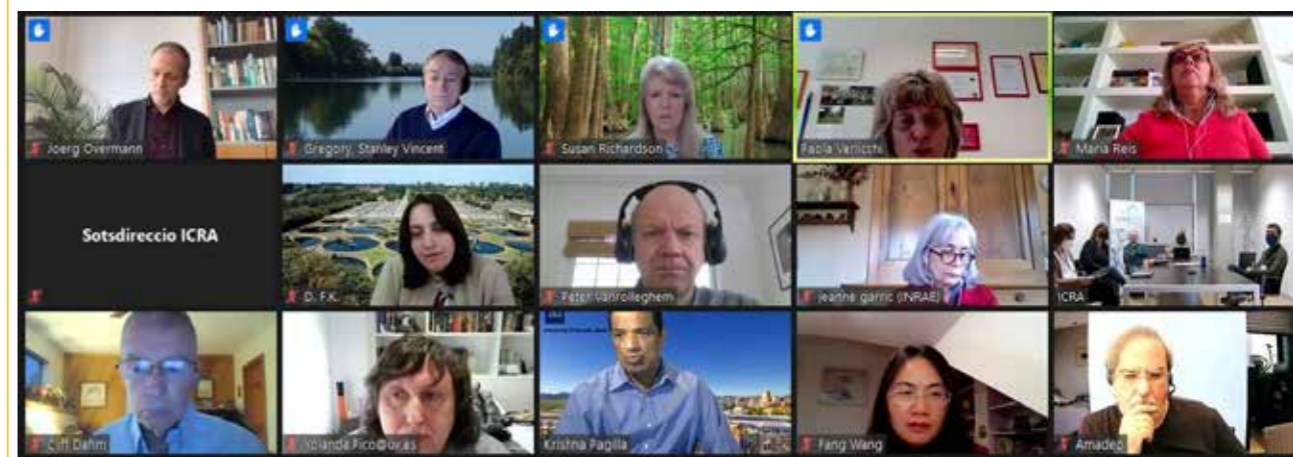
The **Catalan Institute for Water Research (ICRA)** held on 21-22 April the biennial meeting of its Scientific Assessment Council, after the cancellation of last year's meeting due to the pandemic. The Council is made up of **14 international scientists** of recognised prestige and competence, especially in the field of water studies and related scientific disciplines.

Damià Barceló, the Director of ICRA, and **Bernd Bilitewski**, the Chairman of the Council, welcomed those attending, including **Despo Fatta-Kassinos**, **Fang Wang**, **Krishna Pagilla** and **Yolanda Picó**, who were occupying their positions as members of the Council for the first time.

During the two-day session a review was conducted of ICRA's achievements to date in the different areas

of research, and some of the unique projects currently being carried out were presented, such as the coordination of the temporary programme for surveillance of **SARS-CoV-2** in wastewater in Catalonia, which helped the Catalan authorities to monitor the virus, the projects **Electron4water** and **Water Reuse**.

Those attending welcomed the increase in the number of SCI and PhD articles and theses published during the year 2020 compared with previous years, and hailed the financing obtained this year and that foreseen up to the end of 2025. During the meeting ICRA's **Strategic Plan** was also unveiled for the next few years (from 2021 to 2030), during which various research, financial and administrative strategies will be put in place with the aim of continuing to encourage ICRA's growth.



28/04/2021

We take part in an expert session on pollutants in the integrated water cycle of the Barcelona Metropolitan Area

On 24 April, three ICRA researchers, Gianluigi Buttiglieri, Maria José Farré and Meritxell Gros, participated in "Expert Session: Emerging, hazardous, priority and preferential pollutants in the Barcelona Metropolitan Area." This meeting formed part of a campaign for the opening of the Strategic Master Plan for the Integrated Water Cycle for the Barcelona Metropolitan Area, and aimed to bring together expert knowledge concerning specific topics with a view to sharing expertise, experiences and visions of the future with specific reference to the Barcelona Metropolitan Area (AMB).

A prior study ordered by the AMB and conducted by Barcelona Regional had shown the need to pay more attention to the evaluation of the presence of emerging, hazardous, priority and preferential pollutants in order to establish new priorities for extending our knowledge

of the subject and applying future measures to enable the water volumes of the metropolitan region can attain a positive ecological condition. To this end, during the session discussions took place concerning different causes of concern with regard to the management of pollutants in the integrated water cycle.

03/05/2021

SETAC EUROPE 31st ANNUAL MEETING

3-6 May - Virtual conference

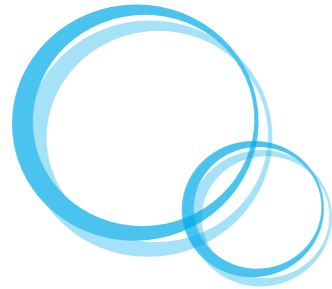
Damià Barceló, the Director of ICRA and a member of the Scientific Commission, attended the annual meeting of SETAC, which was organised virtually from Seville. This is a 4-day international virtual scientific conference that offers a variety of opportunities for learning, networking and training in toxicology and environmental chemistry.

12/05/2021

SIDISA 2021 webinars: Damià Barceló (Director of ICRA)

Title of the conference: "Macro-and micro-plastic litter and increased COVID-19 based plastic pollution in the aquatic environment: analysis, effects, remediation and policy solutions"

This presentation will cover, in the first part, different aspects of microplastics (MPs) and macroplastic litter pollution in coastal waters, wastewaters, rivers, sediments and lakes. Case studies of MP pollution in several coastal environments, sediments and catchment areas in China, Saudi Arabia, India, Mexico, Europe and Australia will be reported. The second part will be devoted to plastic litter and its increased use as a result of the COVID-19 outbreak. This is related to an excessive use and consumption of single-use plastics, including personal protective equipment, masks and gloves. This presentation aims to provide an integrated and insightful overview of the effects of COVID-19 on MP pollution and its potential implications for the environment and human health. Lastly, remediation strategies and policy solutions to mitigate the global MP pollution problem will be addressed.



28/05/2021

Doctoral thesis defence

Video conference

Title: "Removal of pharmaceuticals in wastewater combining different treatment technologies: Suspect screening identification and risk assessment of transformation products"

By: Adrian Jaén Gil

Directors: Dr Sara Rodríguez Mozaz and Dr Damià Barceló Cullerés

The low level of efficiency of wastewater treatment plants for achieving the total elimination of micro-pollutants, including pharmaceutical products, has encouraged the development of alternative water technologies to improve efficiency, sustainability and operational costs. Nevertheless, even when the total elimination of these pollutants is achieved, they can be transformed into new, unknown intermediate materials that can be more persistent and toxic than the original compounds. This doctoral thesis proposes the development of advanced methodologies for the screening of suspicious materials in order to identify the transformation products generated during the course of biological, physical and/or chemical treatments. In addition, their potential environmental effects were evaluated using in silico methods and in vitro bioassays on treated effluents. Finally, their efficiency of elimination was investigated with regard to combined water treatment technologies. This doctoral thesis shows that a multidisciplinary investigation is required to evaluate appropriately the best water treatment technology that should be used.

07/06/2021

The MEP Jordi Solé visits ICRA

Jordi Solé, a Member of the European Parliament and the spokesman for international affairs for the Republican Left of Catalonia (ERC) party, came to ICRA on 4 June, as part of the programme of visits proposed by the Catalan research system with a view to providing a general overview of the activities and research undertaken by ICRA. Mr Solé emphasised ICRA's role as a benchmark institution for the study of water cycles in the Mediterranean region.

The Director of ICRA, **Damià Barceló**, and his Deputy Director, **Sergi Sabater**, welcomed Jordi Solé and had the opportunity to talk with him about European funding, specifically the Horizon Europe funds, and the European Parliament's resolution concerning the European Research Area. Mr Solé also talked about his activity at the European Parliament and as a member of the Committee on ITRE (Industry, Research and Energy), which has the responsibility of legislating on some of the most important political aspects of the European

Union, including industry, research and innovation, energy and the application of new technologies.

The meeting finished with a visit to the experimental rivers room, located in the Centre's basement, and to the L06 Pilot Plants Laboratory.



18/06/2021

The Girona Biomedical Research Institute (IDIBGI) visits ICRA



This week we were pleased to be visited by the management team of the Girona Biomedical Research Institute (IDIBGI), including the Director, Marga Nadal; the General Manager, Anna Ribas; and the Assistant Director, Miriam Gironès.

This meeting, held with the Director of ICRA, Damià Barceló; the Deputy Director, Sergi Sabater; and the General Manager, Ivan Sánchez, enabled us to present the work undertaken by ICRA and to seek synergies for collaboration in the scientific and management fields.

IDIBGI belongs to the CERCA network of research centres of the Government of Catalonia, the aim of which is to promote, develop, manage, transfer and disseminate biomedical research, scientific and technological expertise, teaching and training in the field of the life and health sciences, focused mainly on the Girona region. The centre has 21 research groups, over 400 researchers and currently has 563 ongoing clinical trials.

18/06/2021

ICRA fosters the training of young water professionals from South-East Asia as a partner of INOWASIA

ICRA participates as a partner of **INOWASIA**, an Erasmus+ project, coordinated by the University of Girona, as part of the programme of **Cooperation for innovation and the exchange of good practices**, with a consortium of 11 partners in Cambodia, Laos, Vietnam, France and Spain, and a total budget of €1 million.

INOWASIA aims to train a new generation of young water professionals from South-East Asia with a solid, multidisciplinary training in sustainable water management, including a global vision of the sector's current and future challenges, together with a very specific focus on local requirements and the personal skills needed to cooperate in and provide leadership in the complex world of the water sector. Among other activities, INOWASIA has the following aims:

- 1) To provide innovative courses on water technology as part of the existing Masters courses at the universities in Cambodia, Laos and Vietnam. These courses will combine online training with learning based on case studies, a student-oriented educational methodology that favours the development of personal skills.
- 2) To build up a network of "living labs" to produce areas of joint-creation and to demonstrate the various aspects of the world of water, which will provide practical high-level training and will also attract companies, individual citizens and other stakeholders.
- 3) To create an international water resources network consisting of students, academics, professional operators and interest groups so as to stimulate cross-the-board collaboration that can provide new, creative solutions to all the potential challenges facing the water sector.

23/06/2021

Damià Barceló, the Director of ICRA and newly-elected honorary doctor of the University of Lleida, warns of the increase in plastics deriving from COVID-19

- By 2050 there will be more plastic than fish

It is calculated that by the year 2050 there will be more plastic than fish. This is one of the conclusions reached by the new honorary doctor of the University of Lleida (UdL), **Damià Barceló Cullerés**, the Director of the Catalan Institute for Water Research (**ICRA**), in his investment speech. Mr Barceló, who has a doctorate in

analytical chemistry, warned about the volume of production and consumption of plastic all over the world, figures that have worsened considerably as a result of COVID-19, due to the massive use of face-masks, gloves and medical material, among others.

"We all know that the virus is detected by qPCR, but what we don't know is that each measurement generated 37 grammes of plastic. Thus, 15,000 tonnes of plastic had been generated all over the world by August 2020 just because of PCRs alone," he explained. Mr Barceló said that the solution involved eliminating plastics that were used once only, producing more biodegradable plastics, developing more legislation in this field, involving both society as a whole and NGOs, and repeating numerous programmes of surveillance against microplastics. Specifically, programmes of environmental surveillance with professional operators from different fields (chemistry, ecology, ecotoxicology, hydrology, hydromorphology, etc.) that renew their technology will enable us to identify new pollutants such as nanomaterials, the key element for water quality, although without forgetting the need for an improvement in the treatment of wastewater, he declared. "The reuse of water is becoming more and more vital everywhere, and takes on more importance with each passing day, especially in a scenario of water shortages."

In this sense, the Director of ICRA also referred to the negative effects of climate change, since "not everything that happens in water, especially the effects caused in organisms, is caused by chemistry." The reduction of the volume of water due to drought and the rise in temperatures will make pollution more common in rivers, "by the simple factor of the effect concerning the greater concentration of pollutants in water." These include pesticides, one of the components that involve the highest risk of toxicity. In his talk: "Pollutants and water quality: the urgent challenge of finding both a global and a local vision," the Director of ICRA reviewed his own scientific career focused on the identification and the effects of new pollutants and on the evaluation of technologies to reduce this contamination.

Damià Barceló Cullerés, a native of Menàrguens and the brother of the writer **Joan Barceló**, was sponsored by the Professor of Geography of the UdL, **Ramon Batalla**, who acclaimed the work carried out jointly by Barceló with the Fluvial Dynamics Research Group (**RIUS**) of the UdL on projects such as **SCARCE** dealing with the effects of climate change on the rivers of the Iberian Peninsula. He underlined his multidisciplinary spirit: "Thanks to researchers like him, who have sought new knowledge at the boundaries of their own scientific field with other disciplines, leaving their own comfort zone, we now have a better knowledge of the complex systems governing our rivers," declared Mr Batalla.

A research professor at the Institute of Environmental Assessment and Water Studies of the Spanish National Research Council (CSIC) in Barcelona, and also a professor at the King Saud University in Saudi Arabia, Barceló was awarded the Jaume I Prize for Environmental Protection (2007), the Prince Sultan bin Abdulaziz of Saudi Arabia International Prize for Water (2012) and the Recipharm International Environmental Award (2012), and is an Honorary Doctor of the University of Ioannina, Greece. His career as a researcher has focused on water quality, particularly in the development of methods to monitor the organic pollution of the so-called emerging pollutants (pesticides, detergents, endocrine disruptors, drugs, antibiotics and other pharmaceutical products) in water of natural origin and in wastewater, and since 2010 he has been one of the most frequently cited scientists at an international level.

These are some of the aspects of Barceló's professional career that the Rector of UdL, **Jaume Puy**, outlined in his comments on the new Honorary Doctor. Mr Puy praised not only the importance and soundness of his analytical work, which has disturbed the economic interests of big companies "that do all they can to preserve their own business interests", but also its aspect of acting in the public interest, such as the European Directive 91/271 that made it obligatory to treat urban wastewater, while making it possible to develop public health studies on the basis of the data for pollutants in wastewater. In this sense, the Rector declared that "his work is also showing its usefulness for monitoring the incidence of SARS-CoV-2."

In his address, Mr Puy also referred to the subject of water, "one of humanity's greatest concerns" and warned that overexploitation, pollution and climate change will cause serious problems of a shortage of water, especially in the countries of the South, due to the unequal distribution of water on our planet. "It has been calculated that by 2025 more than two thirds of humanity will suffer from some form of stress due to a shortage of water," the Rector declared. Mr Puy, who like Mr Barceló is a chemist by training, appealed to the responsibility of all concerned in order to preserve our water supplies, and observed that we need to focus on recycling water "because it is more viable and easier to recycle soft water than salt water, reusing it and cleaning it for different uses."

30/06/2021

ExTech 2021 Scientific Programme

Damià Barceló, the Director of ICRA, attended the 23rd edition of ExTech, the International Symposium on Advances in Extraction Technologies.

The following subjects were discussed at this event:

Theoretical and fundamental aspects of extraction technologies; New extraction phases; New extraction

technologies; Emerging pollutants and current problems; environmental sampling and analysis; Teledetection; In vivo analysis; Preparation of biological samples; Microfluidics/Lab-on-a-chip: new instruments and techniques; New strategies and innovation for genomics, proteomics and metabolomics; New developments in sensors and assays; Automated analytical systems including flow systems and robotic configurations; Monitoring and analysis of foods; Industrial applications; Natural products, analyses of tastes and fragrances; Forensic analysis; Determination of pharmaceutical and personal healthcare products; Tools for diagnoses; Commercial developments and markets.

During the full session of the symposium, master conferences and oral conferences, presentations of posters, workshops and industrial exhibitions were also planned. Contributions to ExTech 2021 were published in a special issue of *Analytica Chimica Acta*, *Talanta* and *JCA*.

06/07/2021

The impact of organic and emerging pollutants on the aquatic and terrestrial environment

Dialogue on the transfer of knowledge, organised by the chambers of commerce of Girona, Lleida, Andorra, Pyrénées Orientales and Occitanie.

Session conducted by **Damià Barceló Cullerés**, Research Professor at IDAEA-CSIC (Institute of Environmental Assessment and Water Research - Spanish National Research Council) and Director of ICRA; **Marius Fina**, farmer and manager of Mas Gorgot Farm; and **Joan Carles Massot**, the President of the Catalan Association of Young Farmers (JARC).

07/07/2021

The "EXPLORE the water all around you" course

On 7-8 July, **Laura Guerrero**, a post-doctorate researcher in the Water Quality Area of ICRA, will take part as a professional specialist in the course "**EXPLORE the water all around you**" at the **Catalan Summer University of Nature (UCEN)**.

Those attending the course will be given tools accessible to all so as to be able to identify the state of the water around us, from surface water to the nearest underground water supplies. Workshops will be conducted so as to identify the key indicators of water quality and questions will be examined to enable us to become aware of how through our personal habits we can help to reduce water consumption in our daily lives, so as to conserve this resource which has such a key role in attenuating climate change.

The course also combines theoretical classes with excursions into the countryside, visiting La Riera de Metge, Font del Guiu and Font de l'Alou.

14/07/2021

Invitation from the Portuguese Chemical Society (Braga, Portugal)

Damià Barceló participated in the National Meeting on 14-16 July 2021 at the University of Minho, Portugal, and its presentation discussed the question of plastic pollution in relation to the outbreak of the COVID-19 virus. The title was: "Macro- and Micro-Plastic Litter and Increased COVID-19 Based Plastic Pollution in the Aquatic Environment and Landfills: Treatment, Environmental Risks and Policy Solutions"

This meeting takes place once every two years and brings together the community of researchers from different fields of chemistry, including both older and younger scientists, to discuss and share their latest achievements, with a scientific programme that includes both domestic speakers and foreign speakers of recognised prestige.

16/07/2021

Seminar on bacteriophages: Are they allies or enemies in terms of resistance to antibiotics?

A seminar organised by the **University of Girona Institute of Aquatic Ecology (IEA-UdG)**, coordinated by **Édgar González Villalobos**, a researcher at the Catalan Institute for Water Research (ICRA).

19/07/2021

Meeting of the ICRA Business Council

The Business Council is the organ for the participation of the business community in the ICRA Foundation. The Council may be consulted by the Board of Trustees and by the director, and may include in its duties the role of collaborating in the detection of sectoral needs, making specific proposals, promoting participation in joint research projects, facilitating the Foundation's access to public and private resources, and collaborating in the creation of spin-offs.

The Council conducted an online meeting in July in order to welcome new members and ICRA management and researchers took part in a general presentation of ICRA. At the close of the event, a brainstorming session took place on topics of interest contributed by members of the Council, and which will be discussed at the next executive meeting for 2022.

01/09/2021

CEST 2021 International Conference on Environmental Science & Technology

On 01-04 September 2021 the CEST 2021 International Conference on Environmental Science & Technology was held in Athens, Greece

The European Commission recently adopted a new, more ambitious EU strategy concerning the need to adapt to climate change in order to reinforce the effort to be made in terms of climate protection, the building up of resilience, prevention and preparation, thus ensuring that companies, cities and private citizens can incorporate climate change into their practices of risk management.

To achieve a transition towards a climatically neutral society will require major investment in research and innovation, new methods of production and consumption, and changes in our way of working and living together. Societies will need to be involved and to have a leading role in this process. In order to achieve climate neutrality in the whole economy, it is not possible to rely exclusively on the elimination of carbon dioxide. All the routes to climate neutrality require a significant reduction in emissions, i.e. adaptation to a lifestyle for modern societies that is more efficient in its use of resources.

This round table discussion will discuss the challenges and opportunities posed by the European Green Deal to foster the efficient use of resources by means of a cleaner, greener economy achieved by investing in technologies that are environment-friendly and by supporting innovative research.

13/10/2021

Doctoral thesis defence

Doctoral thesis defence: **Electrochemical control and minimization of hydrogen sulfide formation in anaerobic systems**

By: Natalia Sergienko

Directors: Dr Jelena Radjenovic and Dr Oriol Gutierrez

The formation of hydrogen sulphide represents a significant challenge for the functioning of wastewater collection systems. Hydrogen sulphide is a foul-smelling, toxic gas that causes corrosion in pipes, wells and structures, and therefore harms the structural integrity of collection systems and significantly reduces their useful life. The control of the formation, accumulation

and emission of hydrogen sulphide is normally managed through the dosage of chemical products to control the residues, which involves operational costs and considerable risks relating to the transporting, storage and handling of chemical products.

Electrochemical treatment is an attractive alternative to existing technologies for controlling sulphur, since it offers the direct elimination of sulphurs in situ and avoids the costs and risks associated with the use of chemical products. Nevertheless, implementation of this method is often limited in practice due to its major disadvantages, such as the lack of efficient, selective and low-cost anode material, and the passivation of the electrode with elementary sulphur, the final product of electrochemical oxidation of the sulphur. Consequently, the main aim of this thesis was to approach these restrictions by proposing a system of electrochemical treatment that would be capable of the long-term oxidation of sulphur. With this aim, the performance was evaluated of types of felt based on low-cost carbon and applied for the oxidation of sulphur. New electrode materials were also used.

Graphite felt was developed with MnO₂ or catalytically active Ti plaque with a layer of TiO₂ nanotubes covered with MnO₂ inserted, and applied for the oxidation of sulphur. Finally, the problem of the passivation of sulphur was also approached by trying different regeneration strategies and focuses.

Bearing in mind its small print, low cost, stability, high efficiency and selectivity, the system of electrochemical treatment developed in this study may potentially evolve into a technology of significant desulphurisation for wastewater or other types of currents of residues.

14/10/2021

17Th HRMS and LC-MS/MS Workshop (14-15 October), Canada

Guest speaker:

Prof Damià Barceló Cullerès (IDAEA-CSIC, ICRA, Barcelona, Spain)

"Mass spectrometry in wastewater-based epidemiology (WBE) for the determination of small and large molecules as biomarkers of exposure. Needs for COVID-19 tests with environmental proteomics (EP-WBE)."

15/10/2021

Samuel Reyes, the new Director of the Catalan Water Agency, visits ICRA

The new Director of the **Catalan Water Agency (ACA)**, **Samuel Reyes**, also accompanied by its new General Manager, **Mar León**, made their first visit on Friday to the **Catalan Institute for Water Research (ICRA)**, as senior representatives of their entity, in order to learn at first hand about the research projects that are currently being undertaken at the Institute and to explore the possibility of new methods of collaboration.

The meeting started with a guided visit through the ICRA laboratories, where they saw the functioning of the L06 Pilot Plants Laboratory for the treatment of wastewater, together with the Laboratories of the Scientific and Technical Services (STS), which provide highly qualified scientific support for research and technology transfer projects; the Experimental Streams Facility, which simulates the response of river ecosystems, and the Curator's Space, for the conservation and classification of samples.

This was followed by a meeting with the management team of ICRA, its Director, **Damià Barceló**, Deputy Director, **Sergi Sabater**, and General Manager, **Ivan Sánchez**, which gave the opportunity to exchange impressions about the role of the ACA as Owner of ICRA and its contribution to the facilities and the research that takes place there. The management of the Institute emphasised the value of the collaboration that has been maintained for many years between the two entities. There was also discussion of the joint projects, of both a competitive and non-competitive nature, such as the Water Framework Directive for Catalonia and the SARS-CoV-2 Surveillance Network, a programme coordinated by ICRA, which was fostered on an urgent basis by the Catalan Ministry of Health and ACA, and which pioneered in Europe the detection of the circulation of the virus by checking and analysing wastewater.

In this sense, **Damià Barceló** recalled the following: "ICRA is part of the infrastructure of the country—referring to the fact that it forms part of the National Pact for Research and Innovation (PNRI)—and we maintain the wish to direct our resources and research team for the service of society and of the transfer of knowledge. For this reason we have always been prepared to coordinate with ACA in all that is required, and our intention is to ensure that this collaboration increases even further in the coming years."

For his part, **Samuel Reyes** explained as follows: "For the period 2022-2027, ACA plans to send us €3.5 million in aid to foster research, innovation and development in the field of water studies, a figure that nearly triples the amount allocated in this field in the current planning cycle, which was €1.3 million."

The meeting came to an end with the signature by the Director of the Catalan Water Agency in ICRA's Visitors' Book, and a photograph was taken of the group outside the Institute's trademark H₂O Building.

19/10/2021

ICRA Seminar conducted by Xavier García: Resources and Ecosystems

Title: Evaluation of the ecosystem services in order to improve the management and conservation of aquatic ecosystems

Xavier García spoke about the importance of evaluating ecosystem services. He explained that through the viewpoint of ecosystem services we can see how good management and conservation of aquatic ecosystems often makes good economic sense. In addition, the evaluation of ecosystem services can support the evaluation of conflicts and the participation of stakeholders in the management of the ecosystems. He also talked about the evaluation of the economic viability of the renovation of a river: The River Yargon, among other subjects.

25/10/2021

Visit by the Yachiyo Engineering Co. to ICRA's facilities to learn about the SARSAIGUA programme

On Monday 25 October 2021 at 11.00 a.m. ICRA welcomed three technical consultants from the Yachiyo Engineering Co. (Hajime Watanabe, Kimiko Tamotsu and Takashi Toyoda). The aim of the visit was to make a preparatory study for the installation of a wastewater epidemiology system in the countries of the Association of Southeast Asian Nations (ASEAN) ordered by the Japanese Ministry of Land, Infrastructure, Transport and Tourism.

The team will make two other visits in Spain: The Isabel II Canal in Madrid, and Labaqua in Alicante province.

The SARSAIGUA network was presented in terms of its configuration, structure and operational functioning, in addition to its data management system (for online forms) and online platform.

- Questions/Queries about which they requested further information:

- They asked how the activity is coordinated with the managing treatment plants
- How Health information has been used, and what perspective the Network governance has kept in this respect
- The future of the analysis of other pollutants
- Forecast models that incorporate wastewater data with other data such as mobility
- Projects related to SMARTcities (including Barcelona)

31/10/2021

4th Caparica 2021 International Conference on pollutant toxic ions and molecules

31/10 - 4/11 Caparica - Portugal

Conference Speakers

Damià Barceló, PhD

Registration: Catalan Institute for Water Research (ICRA), H2O Building, Girona, Spain; Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain.

Title: Evaluation of treatment technologies such as AOPs, Biological Systems and Wetlands constructed through the elimination of pharmaceutical products in wastewater.

Irene M. C. Lo, PhD

Affiliation: Institute of Advanced Study (IAS), Hong Kong University of Science and Technology, China

Title: Current development and challenges in the process of advanced oxidation for the degradation of emerging pollutants, bacterial disinfection and production of energy for the treatment of wastewater.

Julia Y. Ljubimova, PhD

Affiliation: Terasaki Institute, Los Angeles, California, U.S.A.

Title: Genomic/proteomic changes in the brains of rats/mice after chronic exposure to air particles from the Los Angeles Basin. Correlation with human pathologies.

José Luis Gómez Ariza, PhD

Affiliation: University of Huelva (Spain)

Title: Omics for the study of pollution in terms of ageing and neuro-degenerative effects

10/11/2021

7th Cycle of Creative Intelligence

Girona- Roses

Cycle of conferences organised by Girona Provincial Council and Roses City Council, with the participation of Dr Mira Petrović and **Dr Natalia Sergienko of ICRA Creative Intelligence 7**

Cycle coordinator: Juan Jesús Aznar

The seventh cycle of scientific dissemination conferences on the subject of "Creative Intelligence" will take place, as usual, at the Casa de Cultura (Cultural Institute) of the Girona Provincial Council, although on this occasion there will be a second session held in the town of Roses.

Most of the world's water resources (three quarters of the total) are located in the oceans. The rest is fresh

water, of which only 0.3% flows through rivers and is available for consumption in lakes or reservoirs.

Water is truly a scarce commodity. In large European cities there are problems for the daily provision of drinking water for human consumption, and of clean water for domestic use, for industry or for irrigation. Our habits of consumption favour the appearance of new water pollutants: perfumes, drugs, hormones, cosmetics, domestic cleaning or gardening products, and other substances.

For all these reasons, we dedicate this cycle to this vital asset that gives us life: water.

3 November 2021 at 7.30 p.m. at the Casa de Cultura, Girona (Girona Provincial Council); 4 November 2021 at 12.00 noon, at the Roses Municipal Theatre

Water determines the climate and our health, with Joan O. Grimalt

This presentation will show how water is a vital element of Earth's climate, and how the variations in the flows of the marine currents are affecting the climate. It will also be shown how water is used in different countries all over the world and how it is a vector for the transmission of disease when it is not managed correctly.

Joan O. Grimalt has a doctorate in Chemical Sciences (Autonomous University of Barcelona, 1983) and has been a research professor at the Spanish National Research Council (CSIC) since 1992 and a full member of the Institute for Catalan Studies (IEC) since 2013. He is an environmental organic geo-chemist dedicated to the study of natural and man-made organic compounds as indicators of climate change and of the state of health of ecosystems and organisms (including humans).

10 November 2021 at 7.30 p.m. at the Casa de Cultura, Girona (Girona Provincial Council); 11 November 2021 at 12.00 noon, at the Roses Municipal Theatre

Anthropogenic pollutants in water. Sources and impacts on the aquatic environment and on human health, with Mira Petrović

Chemical products form part of our daily life. Human activity emits a large quantity of chemical products into the environment and the result is a continuous exposure to the complex chemical mixtures that affect ecosystems and human beings alike. The water from rivers and lakes or underground water are often polluted by these chemical products, to which we are exposed through drinking water.

Mira Petrović has been a research professor at the Catalan Institution for Research and Advanced Studies (ICREA) since 2005. She has a doctorate in Chemistry from the Faculty of Chemical Engineering and Technologies of the University of Zagreb, Croatia. She is currently a senior researcher at the Catalan Institute for Water Research (ICRA), where she is Head of the Water Quality Area and responsible for the line of research into pollutants in water treatment processes.

17 November 2021 at 7.30 p.m. at the Casa de Cultura, Girona (Girona Provincial Council); 18 November 2021 at 12.00 noon, at the Roses Municipal Theatre

Underground water. Concepts, definitions and basic criteria, and examples of technical management and governance in Catalonia, with Enric Vázquez-Suñé

In this conference the main concepts and definitions will be described in relation to underground water, together with its environmental and socio-economic importance. Reference will also be made to the process of planning and management of underground waters derived from the Water Framework Directive of the European Union and the groundwater directives, and examples of their application in Catalonia will be shown.

Enric Vázquez-Suñé is the Vice-Rector of the Institute of Environmental Assessment and Water Studies (IDAEA) of the Spanish National Research Council (CSIC). He has a bachelor's degree in Geology from the University of Barcelona and a doctorate in Hydrography from the Higher Technical School of Civil Engineering of the Polytechnic University of Catalonia (UPC). He is currently a professor and member of the teaching committee of the International Course on Underground Hydrology and the director of the professional Master's Degree in Underground Hydrology.

24 November 2021 at 7.30 p.m. at the Casa de Cultura, Girona (Girona Provincial Council); 25 November 2021 at 12.00 noon, at the Roses Municipal Theatre

Current challenges in wastewater management, with Natalia Sergienko

The volume and composition of wastewater is an important matter of concern for human and environmental health and, for this reason, wastewater management has represented a constant challenge since ancient times. This presentation will offer a general overview of the technologies of wastewater treatment. It will also examine the technological and social challenges associated with water management.

Natalia Sergienko has a bachelor's degree (2013) from the Faculty of Civil Engineering of the State Technical University of Saratov (Russia). Her research currently focuses on the development of an electrochemical treatment unit capable of oxidising and eliminating efficiently sulphur from wastewater.

1 December 2021 at 7.30 p.m. at the Casa de Cultura, Girona (Girona Provincial Council); 2 December 2021 at 12.00 noon, at the Roses Municipal Theatre

The world of dams. The need for a new policy for sediments, with Josep Joan Segarra

The ageing of dams, the increasing lack of security and the retention of sediments by barrages are problems that affect most of the world's hydrological basins and especially river deltas, which depend on their rivers being in good condition and the existence of appropriate liquid

and solid ecological volumes. This talk will build a portrait of the issues concerned, from the techniques for managing sediment to the lapsing of concessionaires' agreements and the application of environmental regulations.

Josep Juan Segarra has a Bachelor's Degree in Journalism (2007) and in Social and Cultural Anthropology (2021) from the University of Rovira i Virgili in Tarragona. Since the year 2000 he has participated in various organisations and social movements in defence of the River Ebro and its Delta. Since 2015 he has coordinated the Campaign for Sediments. He is a founder member of the Sediment Association, a maker of audio-visual material, a poet and the manager of the Poesia Surf i Kaiak entity. He also carries out research and practical work in the field of bioconstruction.

11/11/2021

Webinar: Mass spectrometry in wastewater-based epidemiology for the determination of small and large molecules as biomarkers of exposure. Needs for COVID-19 tests with environmental proteomics

Thursday 11 November at 12.00 noon

A talk given by Damià Barceló, the Director of ICRA, and a research professor at the Institute of Environmental Assessment and Water Studies (IDAEA) of the Spanish National Research Council (CSIC)

Wastewater-based epidemiology (WBE) estimates the collective consumption or exposure to chemical or pathogenic substances through the monitoring of the substances excreted from the population's wastewater. WBE is generally applied through mass spectrometry (MS) and provides a fingerprint of the risks for the health, habits and lifestyle of the population served by a wastewater treatment plant.

This presentation describes three applications of WBE using MS: 1) Detection of small molecules as biomarkers; 2) Detection of large molecules as biomarkers; and 3) Detection of viral proteins of SARS-CoV-2 using high-resolution MS (HR-MS) and MALDI-TOF-MS.



18/11/2021

Online Event for the European Antibiotic Awareness Day: National Plan against Antibiotic Resistance (PRAN) 2022-2024

Every year since 2008 the European Antibiotic Awareness Day has been celebrated, an initiative promoted by the European Centre for Disease Prevention and Control (ECDC). Its aim is to raise awareness about the risks associated with the undue use of antibiotics and to call for responsible consumption, in terms of both human and animal welfare, to prevent the appearance and development of resistance to antibiotics.

Carles Borrego, a research professor at ICRA and a member of the committee responsible for drawing up the National Plan against Antibiotic Resistance, was invited to the online event of the European Antibiotic Awareness Day 2021 and to give a talk on the environmental aspect of resistance to antibiotics.

19/11/2021

Workshop on disinfection by-products in water: current challenges in need of research

A working symposium on the current challenges in the field of disinfection by-products. A meeting point between various disciplines.

The ICRA researcher Maria José Farré participated with her lecture: "Prediction of disinfection byproduct formation during water treatment from characterization of dissolved organic matter with non-target".

24/11/2021

IBERAQUA-NET CONFERENCE. National network of river ecosystems: future challenges and strategies

ONLINE 24-25 November 2021

ORGANISERS: IDAEA-CSIC (Institute of Environmental Assessment and Water Research - Spanish National Research Council), ICRA (Catalan Institute for Water Research), University of Barcelona (UB), University Rovira i Virgili (URV), University of Lleida (UdL), University of València (UVEG), IMDEA Water Institute, UPV-EHU (University of the Basque Country/Euskal Herriko Unibertsitatea), ICMAN (Institute of Marine Sciences of Andalusia)

IBERAQUA-NET is a multidisciplinary network with long experience in the evaluation of pollution risks and of the overall change in Iberian river systems. The aim of the network is to generate synergies between

different sectors, and especially between academia and researchers and the managers directly involved in dealing with the environmental challenges imposed by global change. IBERAQUA-NET brings together a group of researchers around the topics of water and the environment, including experts in analytical chemistry (CSIC-IDAEA, UVEG, CSIC-ICMAN), ecology, ecotoxicology, hydrology and geomorphology (ICRA, UB, CSIC-ICMAN, UPV/EHU, IMDEA, UdL), modelling and digital techniques (URV, ICRA) and water management (ICRA, IMDEA). On the basis of the scientific knowledge generated by this platform, the aim is to collaborate with managers for the proposal and transfer of measures and recommendations with a view to improving the management of rivers in the face of the challenges related to global change.

Open proposal of TOPICS for interaction between confederations and agencies

1. Climate emergency and extreme events - implications for the management of river systems. Mitigation of climate change: prolonged periods of drought and views of the management and use of dams and barrages. Environmental consequences derived from the new construction of hydraulic structures.

Consequences of the climate emergency with a view to achieving the best ecological conditions: adapting indicators; establishment of invasive species.

2. Demographic and territorial aspects of the global environmental change. Implications of rural depopulation and rampant urbanisation. Regional changes in land use: implications in terms of flow, sediment dynamics and the occurrence of pollutants, both preferential and emergent.

3. Adaptation to the new quality standards promoted by the EU and which affect chemical and biological quality. Updates of the Water Framework Directive (WFD). Relation between good ecological and chemical conditions. Implementation of new ecotoxicological indicators (biomarkers, antibiotic-resistant genes, etc.). Ecotoxicity of mixtures of pollutants. New pollutants: micro- and nano-plastics. Relation between hydrology, geomorphology and pollution (transporting of pollutants associated with sediments). Combined effects of pollution, scarcity of water and climate change. Another legislation of interest existing or in preparation and the interaction with the WFD. Directive for reuse (at an advanced stage of preparation). Directive for viewpoints and risks of flooding (Floods Directive). Directive for droughts (in preparation). Directive for habitats - REACH Regulations.

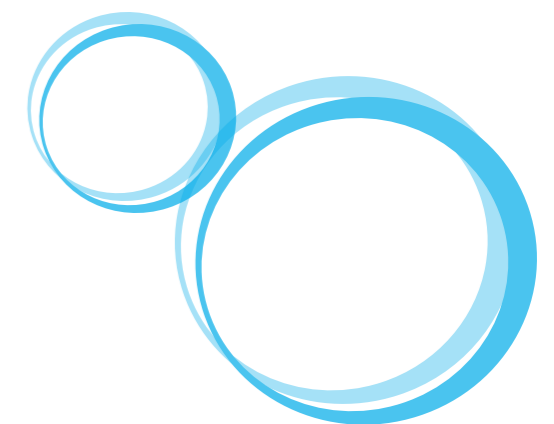
4. Implications of the climate emergency for economic activity. Correct estimation and distribution of usage costs, distribution, treatment and monitoring: institutional division of costs, calculation of environmental costs, "whoever uses and pollutes should pay?", application of the precautionary principle to the environment. Efficiency in the use of resources: changes in provisioning, losses in the network, reuse. Calculation of the cost-effectiveness of the new environmental measures and policies, including the proposals for the updating of the WFD.

For practical reasons, this conference, to be held in virtual format in Barcelona on 24-25 November 2021, is structured into guests' talks lasting 15 minutes each, corresponding to the following parts: i) Physics (sediments, hydromorphology); ii) Pollutants (emerging, preferential cases, nutrients, pathogens and microplastics); iii) Biological section (indicators, invasive species; and iv) Integrating section (global change and multiple stressors).

After each section discussions will be initiated between scientists and representatives of the different hydrographic basins. It is thus anticipated that there will be a presentation of posters with specific examples or "case studies" occurring in the different hydrographic basins. Each poster will be recorded beforehand on video and will last for five minutes. Summaries for presentations in the form of posters may be sent to the conference secretariat up to 15 October.

Finally, the conference will close with an executive summary and recommendations, which will be distributed both to the representatives of the hydrographic confederations and to the conference's scientists, to the press and to the social networks.

We hope that this virtual conference will awaken the interest of you all and we will meet again virtually soon in Barcelona in late November 2021!

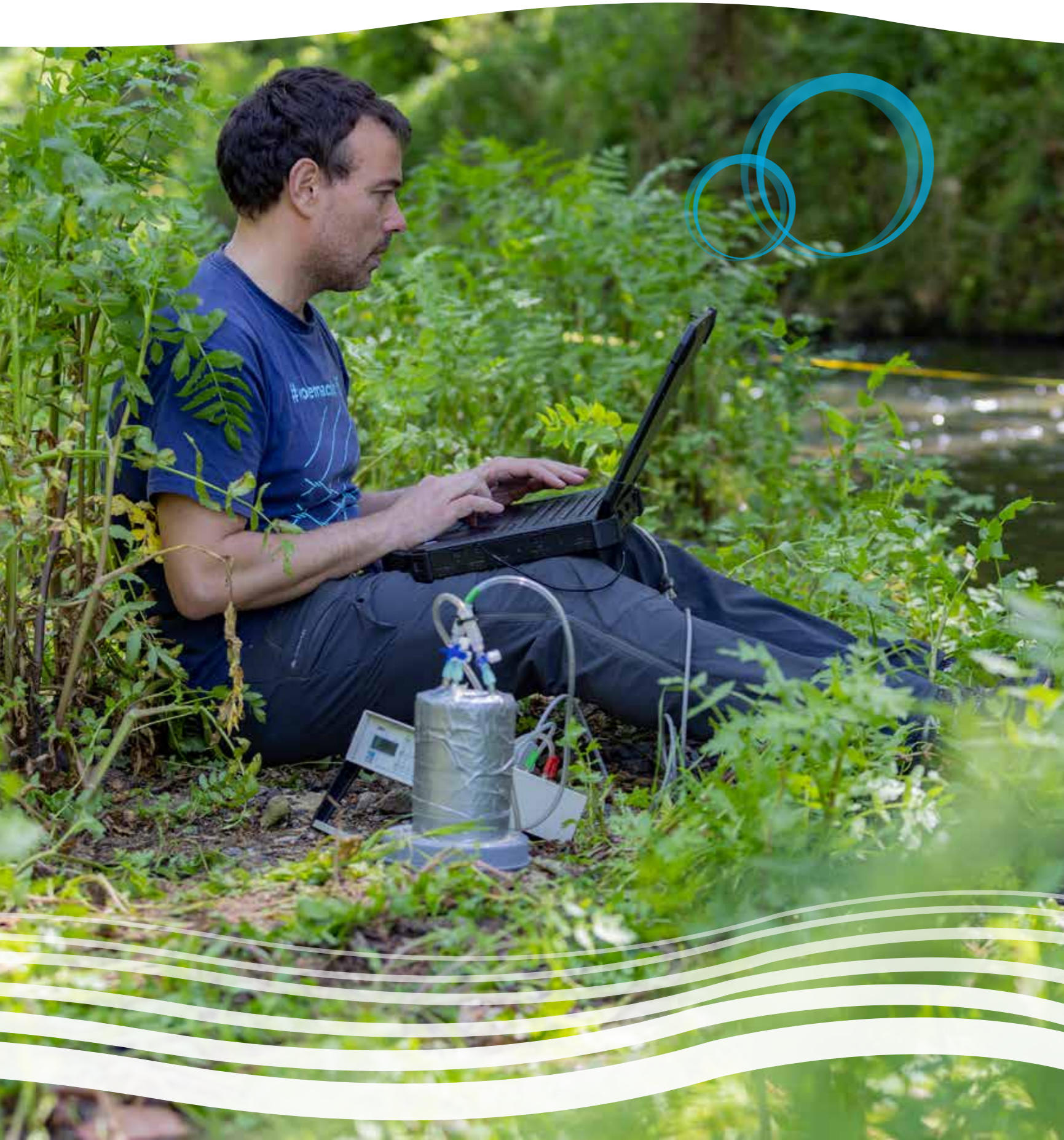




10

AWARDS

- Radjenovic, J. National Research Award for Young Talent 2021
Catalan Foundation for Research and Innovation (FCRI)
- Prosenč, F., Justyna Piechocka, J., Škufca, D., Heath, E., Griessler Bulc, T., Istenič, D. & Buttiglieri, G. Attainment prize. Best investigation
University of Ljubljana for: "Modern organic pollutants - how can we control them with algae?"
- Vosse, J., Estelrich, M., Comas, J., Atanasova, N., Castellano Costa, J., Gattringer, H. & Buttiglieri, G. (2021). Third Prize for the Best Communication at the 2nd II International Conference on Water and Sustainability
ICWS, Terrassa, Barcelona (Spain).
- Humboldt-Caldas Medal 2021 for the discussion "Historical legacies and contemporary processes shape beta diversity in Neotropical montane streams", by González-Trujillo, Juan; Saito, Víctor; Petsch, Danielle; Muñoz, Isabel; Sabater, Sergi, published in the Journal of Biogeography 48,1: 101-117. Under the responsibility of the Colombian Academy of Exact, Physical and Natural Sciences.



11

FINANCING

Contribution of the Regional Government of Catalonia

Ministry of Research and Universities - Gencat (Trustee)	€1,901,325.00
Catalan Water Agency (ACA) (Trustee)	€600,000.00
Competitive projects	
Regional Government of Catalonia	€225,485.93
Spanish Ministry	€462,718.60
European Union	€1.200.601,30
Transfer projects	
Knowledge Transfer Technology (KTT)	€429,330.90
Financial income	€9.32
Other income	€16,920.54
TOTAL INCOME	€4,836,391.59

As ICRA Trustee, **University of Girona** annually consolidates its non-monetary contribution to ICRA from the transfer of the researchers assigned to its investigation, which is financially measured by the UdG in the amount of €294,803.05 for 2021.



12



□ ICRA IN THE NEWS & PRESS

Although the pandemic situation continued during the course of 2021, last year ICRA's external communications reactivated its activity. The issuing of press releases concerning the work undertaken by the ICRA scientific community nearly quintupled with regard to the previous year, and a total of 11 press releases were distributed in two languages (Catalan and Spanish).

PRESS RELEASES

The press releases issued were about:

18/03/2021

Publicat el diagnòstic d'experts internacionals sobre el coronavirus en aigües residuals que lideren la Universitat de Salerno i l'ICRA

<https://press.clipmedia.cat/notas/publicat-el-diagnostic-dexperts-internacionals-sobre-el-coronavirus-en-aigues-residuals-que-lideren-la-universita-de-salerno-i-l-icra/>

Publicado el diagnóstico de expertos internacionales sobre el coronavirus en aguas residuales que lideran la Universidad de Salerno y el ICRA

<https://press.clipmedia.cat/notas/publicado-el-diagnostico-de-expertos-internacionales-sobre-el-coronavirus-en-aguas-residuales-que-lideran-la-universita-de-salerno-y-el-icra/>



23/06/2021

El 2050 hi haurà més plàstic que peixos

<https://press.clipmedia.cat/notas/al-2050-hi-haura-mes-plastic-que-peixos/>

En 2050 habrá más plástico que peces

<https://press.clipmedia.cat/notas/en-2050-habra-mas-plastico-que-peces/>



30/06/2021

Un estudi amb participació ICRA reflecteix amb mesures reals la contribució d'Europa a les escombraries marines

<https://press.clipmedia.cat/notas/un-estudi-amb-participacio-icra-reflecteix-amb-mesures-reals-la-contribucio-deuropa-a-les-escombraries-marines/>

Un estudio con participación ICRA refleja con medidas reales la contribución de Europa a la basura marina

<https://press.clipmedia.cat/notas/un-estudio-con-participacion-icra-refleja-con-medidas-reales-la-contribucion-de-europa-a-la-basura-marina/>



29/03/2021

Un mapa interactiu desenvolupat per l'ICRA connecta iniciatives alimentàries urbanes de 23 països

<https://press.clipmedia.cat/notas/un-mapa-interactiu-desenvolupat-per-licra-connecta-iniciatives-alimentaries-urbanes-de-23-paisos/>

Un mapa interactivo desarrollado por el ICRA conecta iniciativas alimentarias urbanas de 23 países

<https://press.clipmedia.cat/notas/un-mapa-interactivo-desarrollado-por-el-icra-conecta-iniciativas-alimentarias-urbanas-de-23-paises/>



27/07/2021

Girona es convertirà en el 'hub' europeu de la recerca de l'aigua amb el congrés internacional EcoSTP

<https://press.clipmedia.cat/notas/girona-es-convertira-en-el-hub-europeu-de-la-recerca-de-laigua-amb-el-congres-internacional-ecostp/>

Girona se convertirá en el 'hub' europeo de la investigación del agua con el congreso internacional EcoSTP

<https://press.clipmedia.cat/notas/girona-se-convertira-en-el-hub-europeo-de-la-investigacion-del-agua-con-el-congreso-internacional-ecostp/>



19/04/2021

El canvi climàtic altera el batec de llacs i embassaments

<https://press.clipmedia.cat/notas/el-canvi-climatic-altera-el-batec-de-llacs-i-embassaments/>

El cambio climático altera el latido de lagos y embalses

<https://press.clipmedia.cat/notas/el-cambio-climatico-altera-el-latido-de-lagos-y-embalses/>



28/09/2021

Un estudi del Centre Tecnològic BETA de la UVic-UCC i l'ICRA ajuda el sector ramader a reduir els antibiòtics en els purins

<https://press.clipmedia.cat/notas/un-estudi-del-centre-tecnologico-beta-de-la-uvic-ucc-i-licra-ajuda-el-sector-ramadera-reducir-els-antibioticos-en-els-purins/>

Un estudio del Centro Tecnológico BETA de la UVic-UCC y el ICRA ayuda al sector ganadero a reducir los antibióticos en los purines

<https://press.clipmedia.cat/notas/un-estudio-del-centro-tecnologico-beta-de-la-uvic-ucc-y-el-icra-ayuda-al-sector-ganadero-a-reducir-los-antibioticos-en-los-purines/>



06/10/2021
Europa busca solucions naturals contra les inundacions amb el projecte internacional MERLIN

https://press.clipmedia.cat/notas/europa-busca-solucions-naturals-contra-les-inundacions-amb-el-projecte-internacional-merlin/

Europa busca soluciones naturales contra las inundaciones con el proyecto internacional MERLIN

https://press.clipmedia.cat/notas/europa-busca-soluciones-naturales-contra-las-inundaciones-con-el-proyecto-internacional-merlin/



15/10/2021
Samuel Reyes, director de l'ACA: "Tripliquem els ajuts en matèria de recerca, innovació i desenvolupament en el cicle de l'aigua"

https://press.clipmedia.cat/notas/samuel-reyes-director-aca-tripliquem-els-ajuts-en-materia-de-recerca-innovacio-i-desenvolupament-en-el-cicle-de-laigua/

Samuel Reyes, director de la ACA: "Tripliquemos las ayudas en materia de investigación, innovación y desarrollo en el ciclo del agua"

https://press.clipmedia.cat/notas/samuel-reyes-director-aca-tripliquemos-las-ayudas-en-materia-de-investigacion-innovacion-y-desarrollo-en-el-ciclo-del-agua/



18/10/2021
El canvi climàtic dels darrers 40 anys ha augmentat en mig grau la temperatura dels llacs de tot el planeta

https://press.clipmedia.cat/notas/el-canvi-climatic-dels-darrers-40-anys-ha-augmentat-en-mig-grau-la-temperatura-dels-llacs-de-tot-el-planeta/

El cambio climático de los últimos 40 años ha aumentado en medio grado la temperatura de los lagos de todo el planeta

https://press.clipmedia.cat/notas/el-cambio-climatico-de-los-ultimos-40-anos-ha-aumentado-en-medio-grado-la-temperatura-de-los-lagos-de-todo-el-planeta



09/11/2021
La tecnologia SENVES+ de l'ICRA presentada al COP26 com a solució per a una gestió sostenible de l'aigua urbana

https://press.clipmedia.cat/notas/la-tecnologia-senves-de-licra-presentada-al-cop26-com-a-solucio-per-a-una-gestio-sostenible-de-laigua-urbana/

La tecnología SENVES+ del ICRA presentada en el COP26 como solución para una gestión sostenible del agua urbana

https://press.clipmedia.cat/notas/la-tecnologia-senves-del-icra-presentada-en-el-cop26-como-solucion-para-una-gestion-sostenible-del-agua-urbana/



The volume of impacts on the media came to a total of 329: 306 in digital media, 15 in print media, 3 on television, 4 on radio, and 1 podcast. This was made possible by the commitment and availability of ICRA's research team in order to deal with requests for collaboration, interviews and statements requested by the media.

In 2021 ICRA also continued to favour distribution in the social networks and networks such as Twitter maintained sustained growth. Thus, in December 2021 the Twitter account (@icrawater) had 369 more followers than in the previous year to reach a total of 2173 followers, and its posts were viewed a total of 554 times a day.

During the course of 2021 the publication was maintained of the ICRA News electronic bulletin. The new bulletin is intended to publicise the activities and research carried on by ICRA. It will come out quarterly in three languages: Catalan, Spanish and English.

As a novelty in 2021, we started to work on the generation of new audiovisual material, required by the different ICRA canals such as Press, Social Networks, Annual Report, website, etc. Specifically, three videos were recorded and produced for the SARS-Covid-2 Network coordinated by ICRA.

Girona



www.icra.cat

Catalan Institute for Water Research

H₂O Building
Scientific and Technological Park
of the University of Girona

Emili Grahit, 101
17003 Girona (Spain)
(+34) 972 18 33 80
info@icra.cat



Parc científic
i tecnològic



Riu Onyar





Institut Català
de Recerca de l'Aigua

Instituto Catalán
de Investigación del Agua

Catalan Institute
for Water Research

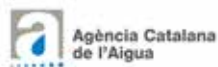
www.icra.cat

Catalan Institute for Water Research

**H2O Building
Scientific and Technological Park
of the University of Girona**

Emili Grahit, 101
17003 Girona (Spain)
(+34) 972 18 33 80
info@icra.cat

Trustees:



Supported by:

