2021

HRZZ
Hrvatska zaklada za znanost

Annual report for 2021

Table of contents

Opening address by Executive Director

In February 2021, the Foundation reached the 1 billion HRK mark regarding funds disbursed for financing scientific research projects and young researchers' career development. As it took the Foundation 20 years to reach this landmark (2001-2021), we hope that our next billion HRK will be invested in scientific projects in a much shorter period of time.

Even though the pressure of the pandemic slightly eased down in 2021, primarily due to the vaccination coverage throughout the population, it was still a very demanding year for all aspects of our society, both in Croatia and across the globe. Apart from the pandemic, Croatia also faced the repair of the devastating consequences of the 2020 earthquakes in Zagreb and Banija.

As the pandemic developed and new issues arose that can only be tackled through scientific research, in November 2020 the Foundation launched an additional thematic Call related to the pandemic – "Health, economic and educational effects of the COVID-19 pandemic" (IP-CORONA-2020-12). Proposals submitted to this Call were evaluated in early 2021 and four projects were accepted for financing, which, together with the eleven projects funded through the first IP-CORONA-2020-04 Call, brings the total number of research teams exploring the biology and pathogenesis of the virus, more efficient diagnostic and treatment procedures and enhanced recovery and resilience of the society after the pandemic to fifteen.

In June 2021, the Croatian Parliament, acting on a proposal from the Government of the Republic of Croatia, adopted the Decision on the Dismissal of Board Members of the Croatian Science Foundation and the Decision on the Appointment of Board Members of the Croatian Science Foundation. The constitutive session of the fifth assembly of the Board was held on 17 June 2021, at which the Board members elected Professor Nikola Ružinski, PhD, as the new Board President. I would hereby like to thank once again all members of the previous assembly for all their work during their term, while hoping that the new Board members will be equally successful and will continue to improve the system of financing scientific activity.

The year 2021 had an additional significance for the Foundation as it marked the 20th anniversary of its establishment. The anniversary year started off with an important milestone. In February 2021, the Foundation reached the **1 billion HRK** mark regarding funds disbursed for financing scientific research projects and young researchers' career development. As it took the Foundation 20 years to reach this landmark (2001-2021), we hope that our next billion HRK will be invested in scientific projects in a much shorter period of time.

This jubilee made us conduct a thorough analysis of our work in the previous 20-year period. We released two publications – one giving an overview of all our funding programmes, while the edition Scholarly output and impact analyses bibliometric data on the outputs of our projects collected through Elsevier's Scopus database. The formal celebration of our 20th anniversary was planned to the last detail and was supposed to take place at the end of the year but was cancelled to avoid potential health issues. We believe that our 25th anniversary will be celebrated with the dignity it deserves.

As an additional activity to mark our 20th anniversary, we organised the Best Scientific Photo Competition, which was open to submission of photographs taken during any project we funded in the past 20 years. All photographs scattered across the present Report are photos submitted to the Photo Competition, all taken by Croatian scientists.

The Foundation's active participation in Science Europe continued in 2021 as well. In accordance with its Multi-annual Strategic and Action Plan (2021-2026), Science Europe established six new working groups responsible for the implementation of the Action Plan, acting in an advisory role for the Governing Board. The following working groups have been established: **Open Science, Research Culture, Horizon Europe, Green and Digital Transition, High-level Policy Network and Scientific Communication**. The Foundation nominated its representatives for each of the six working groups, which will enable it to actively contribute to the advancement of the system for financing science at the European level.

The coronavirus pandemic moved us to modify our day-to-day operations and to adjust to the virtual or hybrid mode of operation. We gave our employees the opportunity to work from home, when necessary, while the majority of meetings was held online. Some of these new modes will be retained even after we return to the pre-pandemic mode of operation.

Associate Professor, **Irena Martinović Klarić**, PhD

Opening address by Board President

In 2021, the Croatian Science Foundation disbursed a total of **HRK 228.14 million**, which were used to finance more than **780 scientific research projects** and the salaries of **more than 1,000 young researchers**. This is the highest amount ever disbursed by the Foundation in a single calendar year, exceeding the 2020 amount by almost HRK 43 million and beating the previous record year, 2019, by HRK 36 million. These numbers show that the positive trend of gradually increasing funding for competitive scientific projects and young researchers' careers is still present.

National funding of scientific research projects continued in 2021 through the "Research Projects" and "Installation Research Projects" programmes, which provide funding for fundamental research whose goal is creating new and enhancing existing knowledge in a certain area. Having in mind the challenges posed to the scientific community by the pandemic-induced crisis, in late 2020 the Foundation launched an additional thematic call as part of the "Research Projects" programme – "Health, economic and educational effects of the COVID-19 pandemic" (IP-CORONA-2020-12), which saw 63 project proposals evaluated. In 2021, the Foundation monitored 717 research and installation projects and 15 projects implemented through the Call IP-CORONA.

The Young Researchers' Career Development Project – Training New Doctoral Students saw 712 doctoral students funded in 2021 – of which 582 were funded from the State Budget and 130 from the European Social Fund. In addition, 267 young researchers (doctoral students and postdoctoral researchers) have been funded through research and installation projects, 35 were employed to work on projects of research collaboration with scientists in diaspora, 30 are involved with projects funded through the Swiss-Croatian Cooperation Programme, while 5 young researchers have been financed through the "Partnership in Research" programme.

The Foundation's Department for International Programmes and Funds continued with the implementation of two programmes under the auspices of the Swiss-Croatian Cooperation Programme: the Croatian-Swiss Research Programme 2017-2023 and Promoting Excellence in Higher Education – Tenure Track Pilot Programme. The **Croatian-Swiss Research Programme** is implemented in cooperation with the Swiss National Science Foundation (SNSF). The programme provides funding for 11 joint research projects of Croatian and Swiss scientists. The Promoting Excellence in Higher Education – Tenure Track Pilot Programme,

implemented by the Foundation in cooperation with École polytechnique fédérale de Lausanne (EPFL) as its Swiss partner, provides funding for three projects led by excellent young scientists in the area of Natural sciences. The implementation of 23 collaborative projects financed within the Collaboration Programme with Croatian Scientists in Diaspora "Research Cooperability", co-funded from the European Social Fund, also resumed in 2021.

Due to restrictions to researchers' mobility imposed by pandemic conditions, the Call "Support to Researchers for Applying to ERC Programmes" was launched slightly later than in previous years – in October 2021. This programme supports collaboration of Croatian researchers with Principal Investigators of projects funded by the European Research Council (ERC), which should be used for gaining experience for preparing their own project proposals for ERC's calls. The evaluation of applications is underway, and the visits are expected to take place in 2022.

In 2021, the Croatian Science Foundation disbursed a total of HRK 228.14 million, which were used to finance more than 780 scientific research projects and the salaries of more than 1,000 young researchers.

In 2021, the Foundation took part in various other activities aimed at increasing the inclusion of Croatian scientists and institutions into the European Research Area through the new cooperation mechanism Weave and programmes co-funded from the European Framework Programme (ERA-NET Cofund projects). Weave is an instrument whose intention is to simplify the application and selection procedure for joint project proposals which are submitted jointly by researchers from not more than three European countries or regions by conducting a single evaluation procedure. This instrument builds on the bilateral cooperation programme launched between the Croatian Science Foundation and the Slovenian Research Agency (ARRS) in 2019 and the Swiss National Science Foundation (SNSF) in 2020. Two calls were launched through this initiative in 2021, both with Switzerland and both with SNSF serving as the Lead Agency. By 2025, we plan to expand our collaboration network to other European organizations taking part in the Weave initiative.

In 2021, the Foundation took part in calls launched by three separate ERA-NET consortia: BlueBio (ERA-NET Cofund on Blue Bioeconomy – Unlocking the potential of aquatic bioresources), Quantera (ERA-NET Cofund in Quantum Technologies) and Chanse (Collaboration of Humanities and Social Sciences in Europe). In addition, the foundation also joined the Trans-Atlantic Platform for Social Sciences and Humanities (T-AP) and participated in the thematic Call "Recovery, Renewal and

Resilience in a Post-Pandemic World". The results of all these calls will be made public in early 2022 and we hope to see many Croatian research teams in the implementation of the most successful transnational projects.

In conclusion, the core tasks arising from the Foundation's mission statement have been achieved in 2021. The Foundation's numerous programmes extend to over seven thousand Principal Investigators and team members of research projects. We fund salaries of over one thousand young scientists at the doctoral and post-doctoral levels in all scientific disciplines. Through a strict selection process for proposed projects and careful monitoring and evaluation of funded research, we enhance the quality of scientific research in Croatia.

For the upcoming year 2022, I can introduce a new call for Research Projects and several calls to be financed through the National Recovery and Resilience Plan (NPOO). The Call for Research Projects will be launched through the Weave initiative, which means that it will be open not only to national teams but also to bilateral and even trilateral consortia comprising researchers from Slovenia and Switzerland. Programmes funded through the NPOO will include several mobility calls (mobility of doctoral students, outbound and inbound mobility of young researchers), new call within the Young Researchers Career Development Projects and two new programmes – Grant for Independent Career Establishment and Targeted Scientific Research. I believe another successful and intense year is ahead of us, in which we will see new records broken.

Professor **Nikola Ružinski**, PhD

Spherical alphabet, author: Ena Cegledi, University of Zagreb Faculty of Food Technology and Biotechnology, IP-2018-01-4924 (PlantBioPower)

The Foundation's organisational structure

Pursuant to the Act on the Amendments to the Croatian Science Foundation Act (Official Gazette 78/2012), the Foundation's bodies are the Board and Executive Director. Besides the Foundation's bodies, the work of the Foundation in 2021 also involved independent monitoring experts and evaluators as well as the Foundation's administrative office.

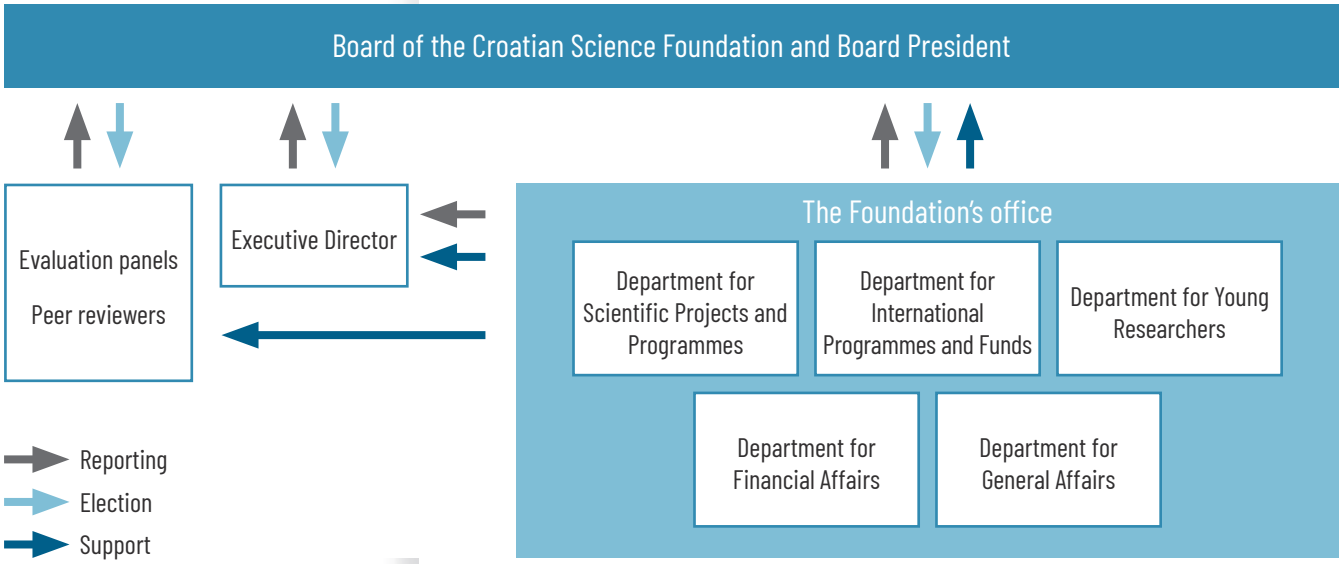


Figure 1. Organisational structure of the Croatian Science Foundation

Members of the fourth assembly of the Foundation's Board (until June 2022):

Professor **Dario Vretenar**, PhD, F.C.A.

Professor **Dean Ajduković**, PhD

Dr. **Smiljana Goreta Ban**, PhD

Professor **Stipan Jonjić**, PhD

Professor **Ljiljana Marks**, PhD

Professor **Dragan Poljak**, PhD

Professor **Pavao Rudan**, PhD, F.C.A.

The Board

Pursuant to the Act on the Croatian Science Foundation, the Board is the body that adopts the Foundation's legal acts and grant award decisions, manages and monitors the Foundation's activities, proposes the Foundation's strategic plan and conducts other activities pursuant to the Act and the Statute.

Board members are appointed from the pool of excellent Croatian scientists, especially those with results recognized at the international level, taking into account that all scientific areas are represented. They are appointed by the Croatian Parliament, upon nomination by the Government of the Republic of Croatia. The Government selects candidates for Board members upon nomination by scientific institutes, the Croatian Rectors' Conference, University Senates, the Croatian Academy of Sciences and Arts, the Croatian Chamber of Commerce, employers' associations, National Council for Science as well as individual

scientists and academia members, following a public call for nominations launched by the Ministry of Science and Education. Board members are elected to a five-year term, renewable once. The Croatian Parliament, at its 7th session, held on 2 June 2021, acting on a proposal from the Croatian Government, adopted the Decision on the Dismissal of Board Members of the Croatian Science Foundation in the Fourth Assembly and the Decision on the Appointment of Board Members of the Croatian Science Foundation in the Fifth Assembly. The constitutive session of the fifth assembly of the Board was held on 17 June 2021, at which the Board members elected Professor Nikola Ružinski, PhD, as the new Board President.

The fourth assembly of the Board held 11 sessions in 2021, 5 of which were sessions in person and 6 were electronic sessions. The fifth assembly of the Board held 15 sessions in 2021, 8 of which were sessions in person and 7 electronic sessions.

Members of the fifth assembly of the Foundation's Board:

Professor **Nikola Ružinski**, PhD, Board President

Professor **Željko Kaštelan**, PhD, F.C.A., Deputy President

Assoc. Prof. **Anna-Maria Getoš Kalac**, PhD, Deputy President

Professor **Srećko Kovač**, PhD

Professor **Milan Mesić**, PhD

Dr **Slavko Perica**, PhD

Professor **Dražen Vikić-Topić**, PhD

Executive Director

The Executive Director oversees the Foundation's operations and manages the work of the Foundation's Office. Pursuant to the provisions of the Act on the Amendments to the Croatian Science Foundation Act (Official Gazette No. 78/12), the Executive Director is selected through a public call to a five-year term and is appointed and released from duty by the Board.

At its 122nd session, held on 16 November 2018, the Board appointed Assoc. Prof. Irena Martinović Klarić, PhD, to the position of Executive Director, who assumed her office in January 2019 for a five-year term.

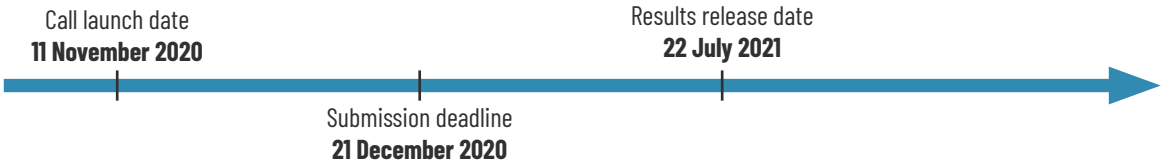
The Foundation's Office

The Foundation's office is divided into five departments: Department for Scientific Projects and Programmes, Department for Young Researchers, Department for International Programmes and Funds, Department for Financial Affairs and Department for General Affairs.

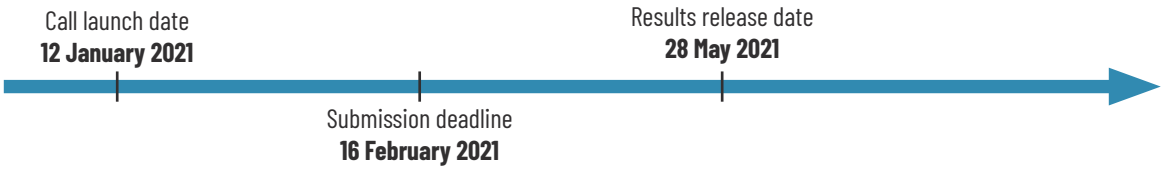
On 31 December 2021, the Foundation had 36 employees (of which 5 employees are funded from the European Social Fund). All the Foundation's employees have full-time contracts.

Activities in 2021

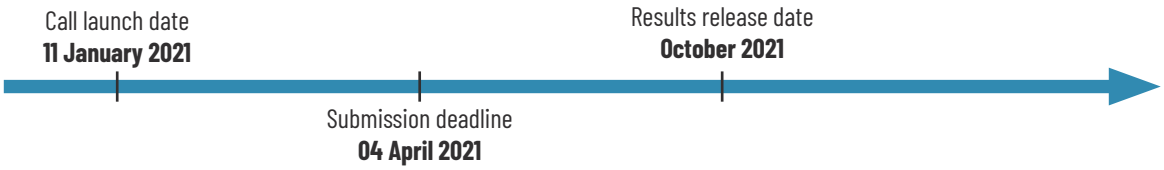
Call for Proposals "Health, economic and educational effects of the COVID-19 pandemic" (IP-CORONA-2020-12)



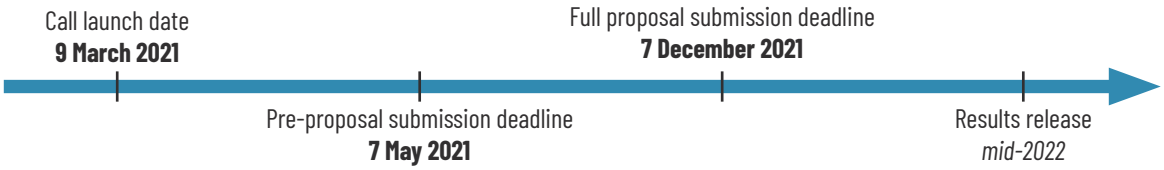
Young Researcher's Career Development Project – Training New Doctoral Students (DOK-2021-02)



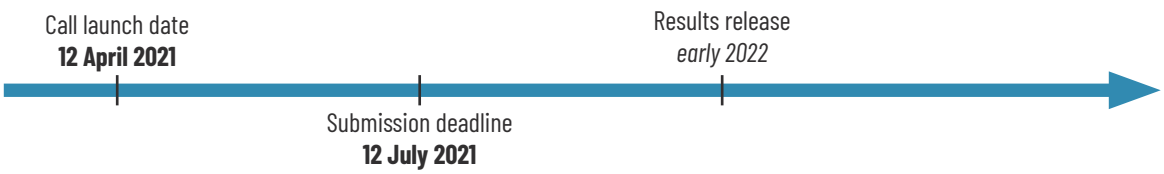
Research Projects – Swiss-Croatian Bilateral Projects (IPCH-2021-04)



Transformations: Social and Cultural Dynamics in the Digital Age – CHANSE

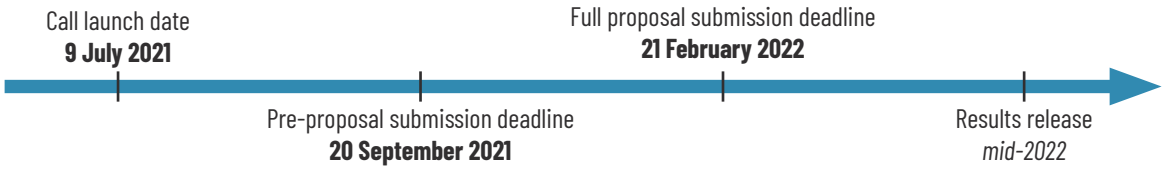


Trans-Atlantic Platform Call "Recovery, Renewal and Resilience in a Post-pandemic World" (TAP-2021)

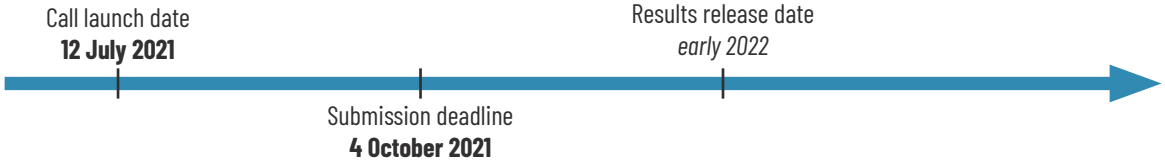


Call for Proposals in the area of Quantum Phenomena and Resources and Applied Quantum Science (QuantERA 2021)

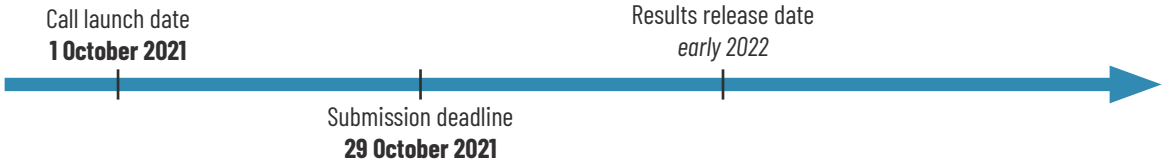
ERA-NET Cofund in Blue Bioeconomy (BlueBio)



Research Projects - Swiss-Croatian Bilateral Projects (IPCH-2021-10)



Support to Researchers for Applying to European Research Council Programmes



The Foundation's Board in 2021

The fifth assembly of the Board continued applying previously established best practice, while its intention is to further enhance the Foundation's operations. As part of this enhancement, the Board proposed the establishment of the Complaints Committee, which would improve the transparency of the Foundation's activities. In addition, to further improve the transparency of the project monitoring process and enhance its quality, the Foundation launched a public Call for the nomination of independent project monitoring experts. In 2021, the Board also worked on the proposal to simplify the process of financial monitoring of projects with the aim of reducing the administrative burden for the PIs.

The draft Act on the Croatian Science Foundation was sent to Parliamentary proceedings, while in July 2021 the Government of the Republic of Croatia adopted the National Recovery and Resilience Plan 2021–2026. Measures to be implemented by the Croatian Science Foundation are part of investment priorities C3.2. R2-I1 and C3.2. R3-I1. Within investment priority C3.2. R2-I1 "Developing a stimulating career advancement model for researchers and conducting leading scientific research in STEM and ICT", the Foundation will implement the Young Researchers' Career Development Programme, the Independent Career Establishment Programme and Mobility Programme. Within investment priority C3.2. R3-I1 "Introduction of a more functional programme framework for financing research, development and innovation", more emphasis will be placed on implementing more efficient programmes for financing development and innovative projects. The programme implemented by the Foundation within this investment priority will be called "Targeted Scientific Research" Programme.

The Board will keep enhancing the quality and efficiency of the Foundation's operation throughout its term. The launch of new calls for research projects and the adoption of the Strategic Plan will be aligned with the new legislative framework, National Recovery and Resilience Plan and the National Development Strategy of the Republic of Croatia until 2030, all of which will define the responsibilities of the Croatian Science Foundation.

Independent monitoring experts

In order to improve the transparency of the project monitoring process and enhance its quality, the Foundation's Board launched a public Call for the Nomination of Independent Experts for Monitoring Projects Financed by the Croatian Science Foundation.

Independent experts take part in monitoring the progress of funded projects, which entails evaluating the implementation of project activities, the distribution of allocated funds and compliance with contractual obligations. The independent monitoring experts are also responsible for nominating evaluators for each project and issuing a proposal to the Foundation's Board regarding the resumption of financing on the basis of the conducted evaluation.

The public call was launched on 24 September 2021 for independent monitoring experts in 22 scientific disciplines, while on 23 November 2021 an additional call was launched for experts in specific disciplines within the Social sciences and Humanities. Appointments of independent monitoring experts will be completed in early 2022.

Check this out, author: Kristina Krklec, University of Zagreb Faculty of Agriculture, IP-2018-01-7080 (KADEME)

The Foundation's programmes

NATIONAL FUNDING PROGRAMMES

- Research Projects (IP)
- Installation Research Projects (UIP)
- Research Projects – CORONA (IP-CORONA)
- Programme of Supporting Research and Development Activities in the Area of Climate Change (PKP)

YOUNG RESEARCHERS' CAREER DEVELOPMENT

- Training New Doctoral Students (DOK)

INTERNATIONAL PROGRAMMES

- Croatian-Swiss Research Programme (CSRP)
- Excellence in Higher Education – Tenure Track Pilot Programme (TTP)
- Cooperation Programme with Croatian Scientists in Diaspora "RESEARCH COOPERABILITY" (PZS)
- Bilateral and multilateral cooperation – WEAVE
- Trans-Atlantic Platform for Social Sciences and Humanities (T-AP)
- ERA-NET Cofund in Quantum Technologies (QuantERA)
- ERA-NET Cofund in Blue Bioeconomy (BlueBio)
- HERA-NORFACE ERA-NET Cofund (CHANSE)

MOBILITY

- Support to Researchers for Applying to European Research Council Programmes

BUILDING CROATIAN PROFESSIONAL TERMINOLOGY (STRUNA)

COLLABORATION WITH THE ECONOMIC SECTOR

- Partnership in Research (PAR)

The Foundation's programme funding in 2021

In 2021, the Foundation disbursed a total of **HRK 228.14 million** for financing scientific research projects and young researchers' salaries.

In sum, since its establishment in 2001 until the end of 2021, the Foundation disbursed **HRK 1,199,170,310 million** in total for projects and young researchers.

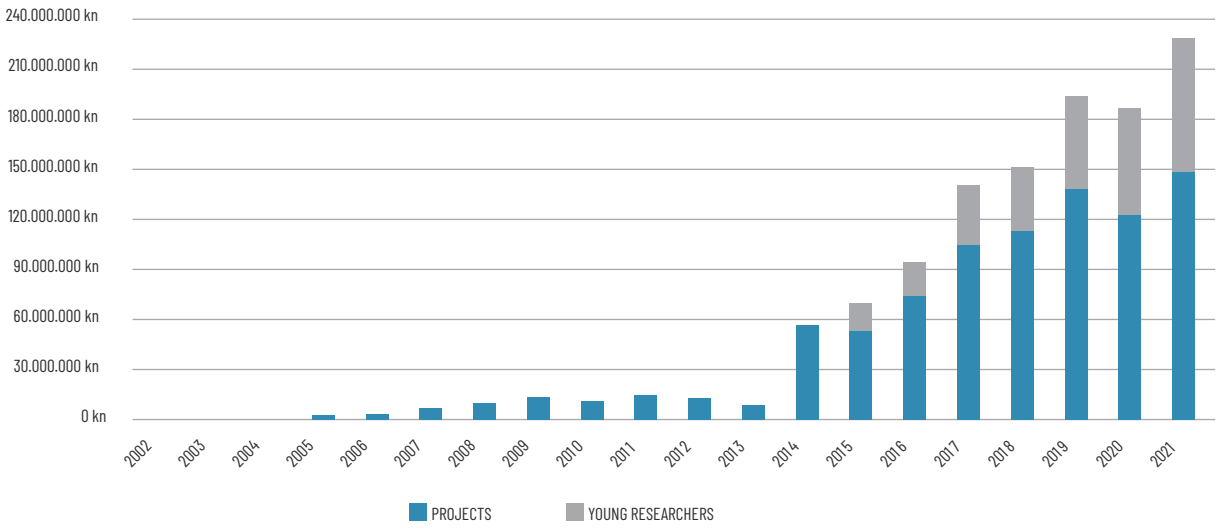


Figure 2. Annual amounts of funding for scientific research projects and young researchers in the period 2002-2021

As in previous years, the majority of funds disbursed in 2021 originated from the State Budget of the Republic of Croatia (84%), while other sources include ESI Funds and international collaboration (Swiss-Croatian Cooperation Programme).

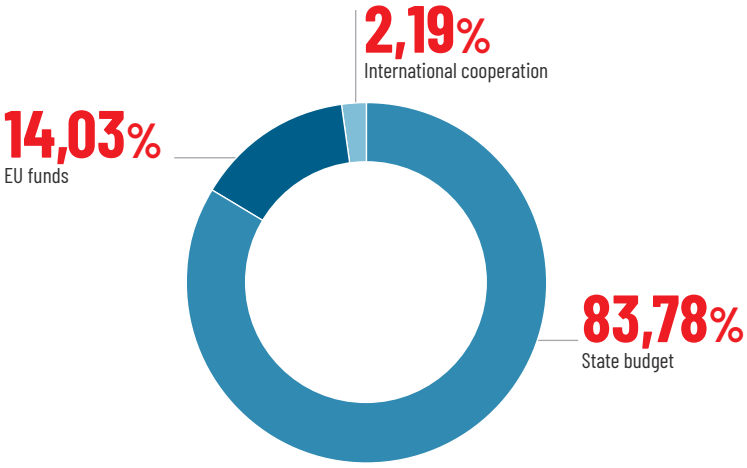


Figure 3. Funding sources in 2021

The six programmes implemented in 2021 saw a total of 780 projects and almost 1,000 young researchers funded. The largest part of funds was disbursed to research projects (HRK 87.16 million, or 38% of the Foundation's budget), young researchers (HRK 79.85 million, or 35% of the budget) and installation research projects (HRK 43.14 million, or 19% of the budget).

Floodplain woods in Lonjsko polje, author: Palma Orlović-Leko, Ruđer Bošković Institute, IP-2013-11-1205 (SPHERE)

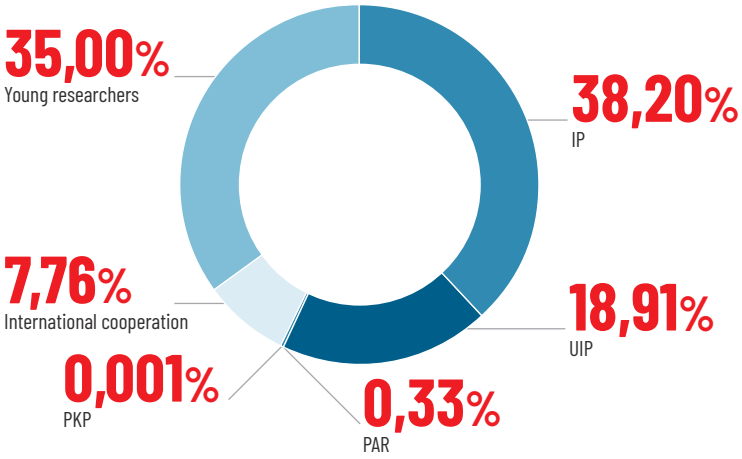


Figure 4. Programmes and projects funded in 2021

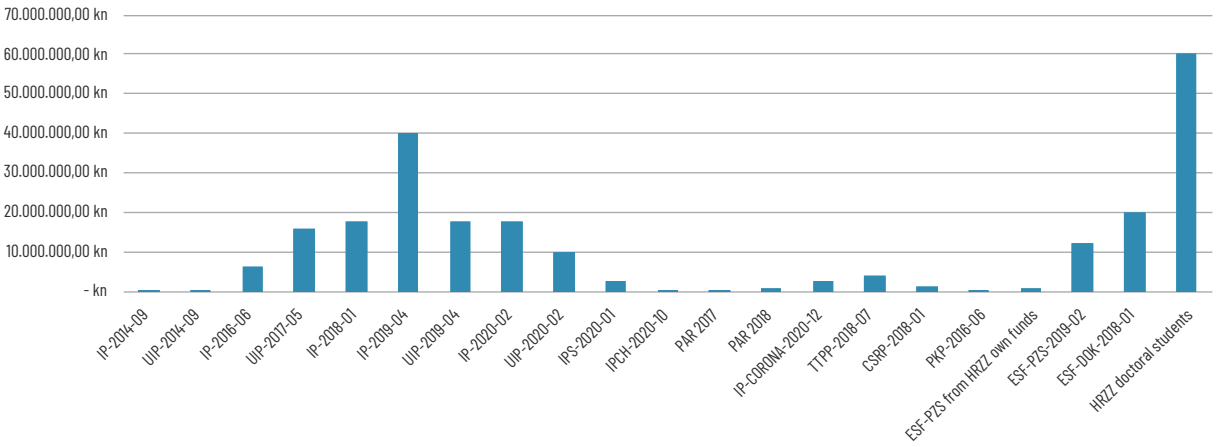


Figure 5. Programmes funded in 2021 broken down by individual calls

Young researchers are supported through the following programmes: "Young Researchers' Career Development Project – Training New Doctoral Students" (doctoral students), "Installation Research Projects" (doctoral students and post-doctoral researchers) and "Research Projects" (post-doctoral researchers). The Young Researchers' Career Development Project is financed from two sources – State Budget and European Social Fund. In 2021, the majority of funds disbursed through the "Young Researchers' Career Development Project" originated from the State Budget (75%), while the remaining 25% came from the European Social Fund.

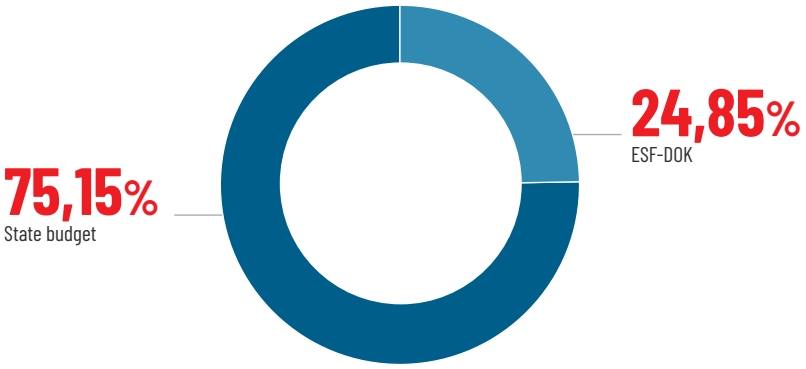


Figure 6. Young researchers funded in 2021 broken down by funding sources

Aspergillus flavus, author: Daniela Jakšić, University of Zagreb Faculty of Pharmacy and Biochemistry, IP-2014-09-5982 (MycotoxA)

Natural antibiotics, author: Tomislav Ivanković, University of Zagreb Faculty of Science, IP-2014-09-5656 (NATURACI)

NATIONAL FUNDING PROGRAMMES

Research Projects

The Programme "Research Projects" has been established for funding fundamental research whose goal is creating new and enhancing existing knowledge about a specific area as well as applied research that is conducted with clear technological, economic or social aims in mind. The research topic needs to be internationally recognisable and/or nationally relevant, while the applicant needs to have an excellent scientific track record. Research projects are based on strong research teams formed at Croatian scientific institutions and include integration of scientific organisations, research and equipment, development of research capacity and plan for the development of young researchers. The maximum duration of research projects is 48 months, while the maximum amount of funding is between HRK 1,000,000 and 1,500,000 (HRK 600,000 and 900,000 for projects in the Social sciences and Humanities).

In 2021, we monitored the implementation of 543 research projects to which we disbursed **HRK 87,158,413.67** following evaluations conducted by 728 scientists. More than 5,900 scientists are engaged in research projects (Principal Investigators and team members), including 120 post-doctoral researchers directly employed for the purpose of project implementation. The largest number of projects are funded in the Natural sciences (35%) and Biomedicine and Health sciences (19%) (Figure 7), while the institutions implementing the largest number of projects are Ruđer Bošković Institute (104 projects) and three faculties of the University of Zagreb – Faculty of Science (56), School of Medicine (29) and Faculty of Electrical Engineering and Computing (29).

Funds disbursed for Programme in 2021

HRK

87.16

million

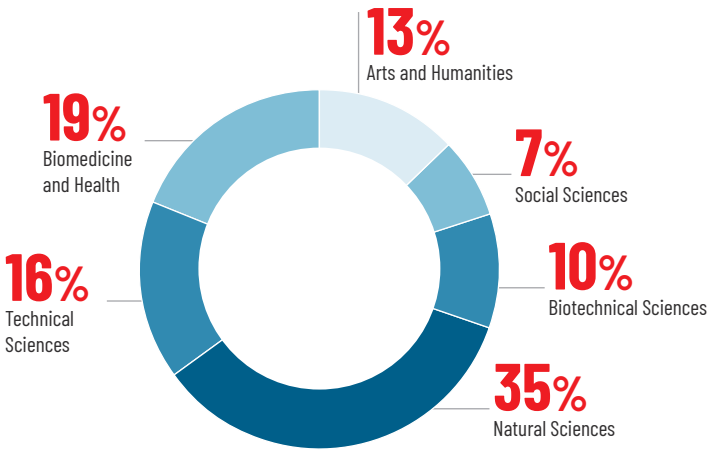


Figure 7. Number of funded and monitored projects through the Research Projects programme in 2021 broken down by areas of science

Outputs of the Research Projects in 2021, as extracted from the Croatian Scientific Bibliography (CROSBI), include: 16 books and 120 book chapters, 1,132 conference abstracts, 213 proceedings, 353 doctoral/master/graduation theses, 1,416 papers in academic journals, 56 other publications and 3 textbooks.

Funds disbursed for Programme in 2021

HRK

2.55

million

Research Projects – IP-CORONA thematic call

The thematic Call IP-CORONA is intended for financing fundamental and applied scientific research that creates new and improves existing knowledge on the COVID-19 pandemic and on the enhancement of resilience of society against crisis situations, with an emphasis on health preservation, sustainable economic recovery and the development of high-quality and inclusive educational system in the Republic of Croatia. Fifteen projects financed through this Call were in their implementation stage in 2021, receiving **HRK 2,549,332.76**.

Installation Research Projects

The goal of the Programme "Installation Research Projects" (UIP) is providing support to the establishment of new research groups of young scientists in order to accelerate the establishment of autonomous research careers after the acquisition of a doctoral degree. Scientists who were evaluated positively will have the opportunity to establish their own research groups that will engage in innovative research topics. Young scientists should use the funding provided by the Foundation in a five-year period to set up their research teams and labs by recruiting doctoral students and post-doctoral researchers as well covering research costs and acquiring scientific equipment. The research topic of these projects needs to be internationally recognisable and/or nationally relevant, while the applicant needs to have an excellent scientific track record. The maximum duration of installation research projects is 60 months, and the maximum amount of funding is between HRK 500,000.00 and 2,000,000.00 (or HRK 1,500,000.00 for projects in the Social sciences and Humanities).

Funds disbursed for Programme in 2021

HRK 43.14 million

In 2021, we monitored the implementation of 174 installation research projects to which we disbursed HRK 43,139,467.46 following evaluations conducted by 245 scientists. More than 1,100 scientists are engaged in research projects (Principal Investigators and team members), including 129 doctoral students and 18 post-doctoral researchers directly employed for the purpose of project implementation. The largest number of projects are funded in the Natural sciences (30%) and Technical sciences (28%) (Figure 8), while the institutions implementing the largest number of projects are the University of Zagreb Faculty of Science, Ruđer Bošković Institute and the Faculty of Electrical Engineering and Computing of the University of Zagreb.

Encounters, author: Klara Filek, University of Zagreb Faculty of Science, UIP-2017-05-5635 (TurtleBIOME)

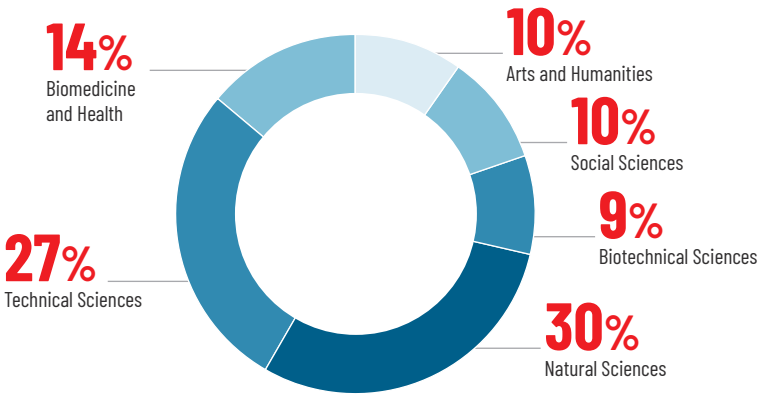


Figure 8. Number of funded and monitored projects through the Installation Research Projects programme in 2021 broken down by areas of science

Outputs of the Installation Research Projects in 2021, as extracted from the Croatian Scientific Bibliography (CROSBI), include: 3 books and 21 book chapters, 467 conference abstracts, 123 proceedings, 115 doctoral/master/graduation theses, 330 papers in academic journals, 17 other publications and 1 textbook.

Experiment with Micropterna nycterobia larvae, author: Marina Veseli, University of Zagreb Faculty of Science, PZS-2019-02-9479

Partnership in Research

The Programme supports research partnerships between public universities or public scientific institutes in Croatia and extra-budgetary sources of funding (not funded from the State Budget) from Croatia or from abroad: companies, local government units, foreign research funding agencies and foundations, foreign scientific organisations). The beneficiary of the grant is a researcher employed at a public scientific institution in Croatia, whose project partnership may establish or develop existing collaboration for the purpose of implementing scientific research whose results will be applicable in the economy or society. Research costs of the scientific institution are covered by the Foundation, while the partner organization (one or more) should provide at least 50% of the total project value. The overall amount is disbursed to the account of the public institution.

The Programme is intended to provide support to scientific research that is able to enhance the development of new and existing enterprises and attract representatives of partner organizations that would be able to substantially contribute to the economic, technological and social development of the Republic of Croatia. The specific objective of the Programme is to implement research partnership in order to: conduct research with potential for having a visible an relevant economic or social impact, enhance the link between Croatian public scientific institutions and the economy, enable the transfer of knowledge and connect with the users of research results.

There have not been any new calls launched in 2021 within this Programme. A total of HRK 742,744.95 was disbursed in 2021 to four projects still in implementation from previous calls. Four young researchers and one post-doctoral researcher have been recruited to these projects so far.

Funds disbursed for Programme in 2021

HRK

742,745

Young Researchers' Career Development Project – Training New Doctoral Students

Funds disbursed for Programme in 2021
HRK
79.85
million

One of the Foundation's strategic goals is funding career development of young researchers. Our objective is to fund between 200 and 250 new doctoral students every year, depending on the available funds from the State Budget, in order to reach the intended number of 1,000 doctoral students in the Foundation's grant system.

The programme provides stable funding for young researchers' career development and enables mentors to include research-oriented doctoral students into their projects, thus directing their careers toward top-notch science. The ultimate goal of these calls is to educate new PhDs, who would pursue a career in competitive research or industry. Funding includes doctoral students' annual gross salary, including commute costs and other social expenditures for employees. Applicants to the Call are mentor candidates – scientists permanently employed at Croatian scientific institutions who are Principal Investigators or team members of scientific projects funded by the Foundation, EU and other competitive sources. One generation of young researchers is funded from the European Social Fund (ESF) within the Operational Programme 10.II.3. Improving Conditions for Croatian Researchers with co-financing from the State Budget of the Republic of Croatia, while other generations are funded exclusively from the State Budget.

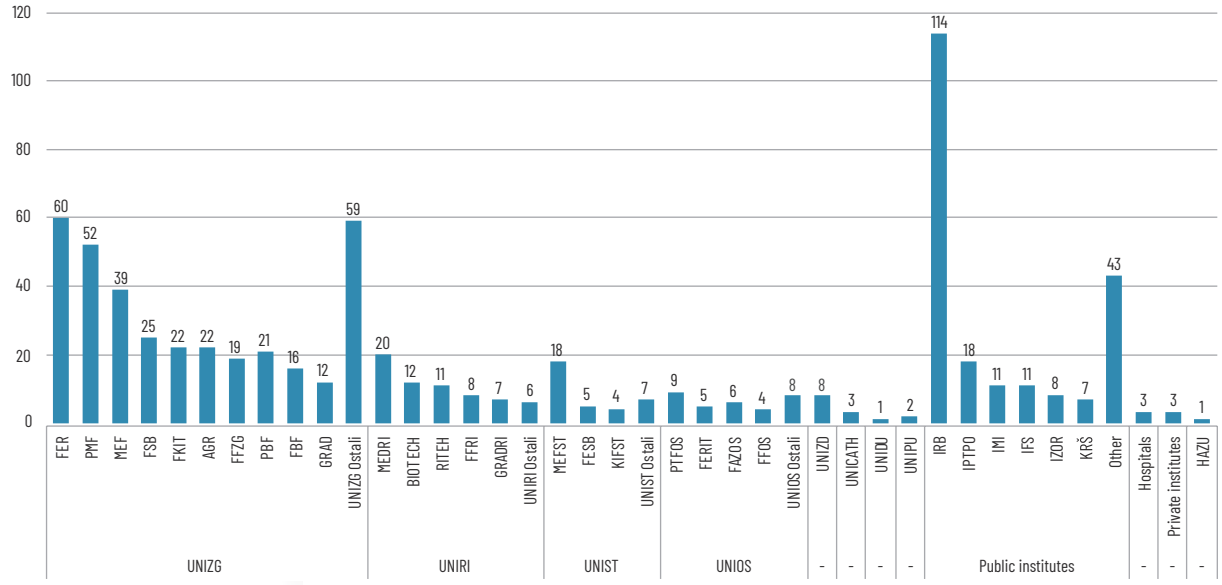


Figure 9. Number of doctoral students funded through the Young Researchers' Career Development Project in 2022 broken down by institution

The monitoring procedure entails the evaluation of doctoral students' progress reports. In accordance with the terms and conditions of the Call and their contractual obligations, mentors and doctoral students are obliged to submit periodic reports on the doctoral student's progress after 18 and 36 months respectively. Doctoral student's progress reports are an essential source of information to the Foundation regarding the progress of the young researcher, i.e. their achievements in both their doctoral studies and their research within the mentor's project. On 31 December 2021, the Young Researchers' Career Development Project included 712 doctoral students, 582 of which were funded from the State Budget and 130 from the ESF. The total cost of doctoral students' salaries in 2021 amounted to **HRK 79,848,669.01** (HRK 60,002,317.83 from the State Budget and HRK 19,846,351.18 from ESF). The monitoring procedure included 23 evaluators, who evaluated 235 reports in 2021.

In 2021, **62 doctoral students** obtained their doctoral degree – 48 funded from budgetary funds and 14 funded through the ESF.

February 2021 was the closing date of the Call **DOK-02-2021**. A total of 296 applications were submitted, the majority of them in Natural sciences (31%) and Technical sciences (26%). The evaluation procedure included 70 Croatian scientists scattered across 18 evaluation committees. 226 mentor applications were approved for funding. By the end of the year, 195 doctoral students started their career development plans. The remaining number will be employed in early 2022.

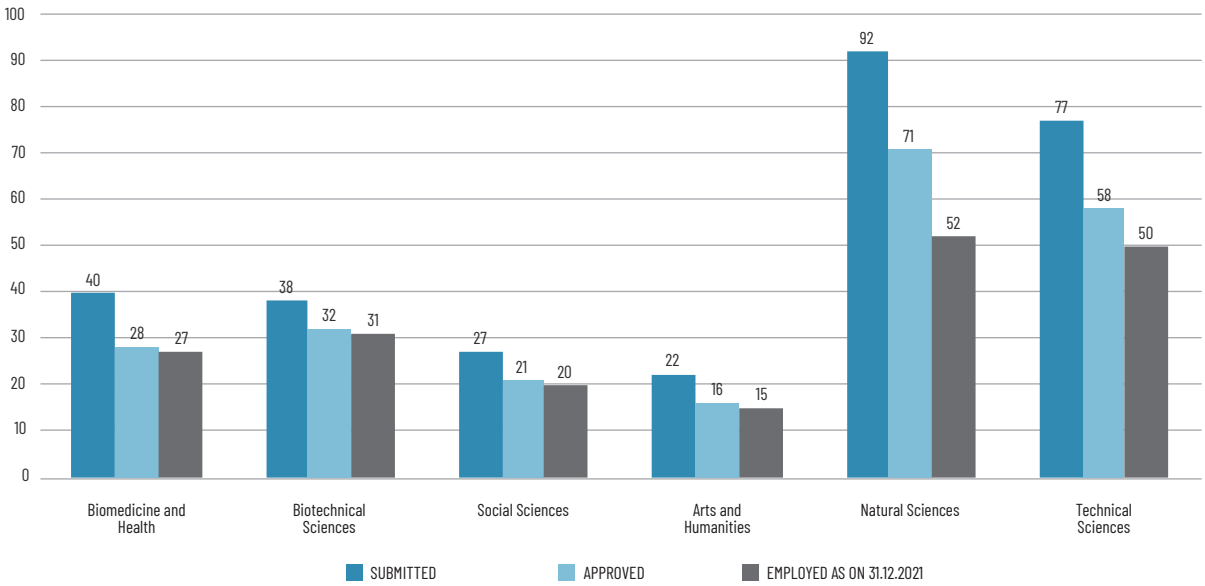


Figure 10. Call DOK-2021-02 statistics

Doctoral students in numbers

2021

195

new doctoral students recruited

62

doctoral theses defended

over

80

thesis topics defended

more than

200

publications with doctoral students listed as the first or only author

4

state prizes for science in the category of young researchers,

712

doctoral students monitored, in various stages of their doctoral studies

more than

600

published journal papers

over

500

conferences attended

1

scholarship "For Women in Science"

Floodplain in Lonjsko polje, author: Palma Orlović-Leko, Ruđer Bošković Institute, IP-2013-11-1205 (SPHERE)

INTERNATIONAL PROGRAMMES

WEAVE

Weave is an instrument whose intention is to simplify the application and selection procedure for joint project proposals, which are submitted jointly by researchers from not more than three European countries or regions, by conducting a single evaluation procedure. Weave was launched in 2021 not as a new, separate funding programme; rather, project proposals are submitted to existing national or regional funding programmes following the Lead Agency procedure. At the Croatian Science Foundation, Weave is implemented through the Research Projects programme. Weave enables researchers from two or more countries to submit a joint research project proposal to one of the funding agencies (the Lead Agency). This agency conducts the evaluation procedure according to its internal procedures. The funding recommendation is then forwarded to the other organizations (partner agencies) for their approval, without additional evaluation, pursuant to the Agreement on mutual recognition of evaluation procedures. This instrument builds on the bilateral cooperation programme launched between the Croatian Science Foundation and the Slovenian Research Agency (ARRS) in 2019 and the Swiss National Science Foundation (SNSF) in 2020. By 2025, we expect to expand our collaboration to other national European research funding organizations which are part of the Weave initiative.

2021 saw the implementation of four bilateral calls through the Weave instrument and four transnational calls – one through the Trans-Atlantic Platform for Social Sciences and Humanities (T-AP) and one through each of the three ERA-NETs the Foundation is a member of.

Research Projects – Slovenian-Croatian Bilateral Projects

Funds disbursed for Programme in 2021
HRK
2.58
million

Pursuant to the Bilateral Collaboration Agreement between the Slovenian Research Agency (ARRS) and the Croatian Science Foundation, in December 2019 the Foundation launched the Call for co-financing the Croatian part of Slovenian-Croatian joint research projects (IPS-2020-01). The Lead Agency for this Call, which conducted the evaluation of proposals, was ARRS. Eight projects were approved for financing through this Call, receiving HRK 2,578,595.26 of funds in 2021.

In late 2021, the Foundation launched another Call for co-financing the Croatian part of Slovenian-Croatian joint research projects with the submission deadline in February 2022 (IPS-2022-02). Results of the Call will be released in mid-2022.

Research Projects – Swiss-Croatian Bilateral Projects

Funds disbursed for Programme in 2021
HRK
422,450

Pursuant to the Multilateral Lead Agency Agreement (MLA) and its Annex and the Bilateral Agreement signed with the Swiss National Science Foundation (SNSF), in July 2020 the Croatian Science Foundation launched the Call for co-financing the Croatian part of Swiss-Croatian joint research projects (IPCH-2020-10). The Lead Agency for this Call, which conducted the evaluation of proposals, was SNSF. Five joint research project proposals were submitted to the Call, with two eventually being approved for financing. The two projects received funding in the amount of HRK 422,450.00 in 2021.

Two additional calls for co-financing the Croatian part of Swiss-Croatian joint research projects were launched in 2021, with the submission deadlines on 1 April (IPCH-2022-04) and 1 October (IPCH-2021-10) respectively. SNSF served as the Lead Agency in both these calls. Nine project proposals were submitted to the Call IPCH-2021-04; unfortunately, none of them were approved for financing. Results of the Call IPCH-2021-10 will be released in the first half of 2022.

Swiss-Croatian Cooperation Programme

In late 2021, stakeholders started preparing programmes to be funded within the second Swiss grant to Croatia. The Croatian Science Foundation will be involved with programmes in the area of research and innovation. The Swiss contribution to the European Union enlargement process is aimed at new EU Member States and is a token of Swiss solidarity with Europe by sharing the burden of actions taken to reduce economic and social disparities across the European Union.

Croatian-Swiss Research Programme (CSRP)

The Croatian-Swiss Research Programme is implemented by the Croatian Science Foundation in collaboration with the Swiss National Science Foundation. This programme funds 11 joint research projects implemented by Croatian and Swiss scientists in collaboration. A total of HRK 1,170,243.48 was disbursed for their implementation in 2021.

17 young researchers and 3 expert associates were recruited on these projects so far. The largest number of projects are funded in the Natural sciences (54.55%) and Biomedicine and Health sciences (27.2%), while the institution implementing the largest number of projects is the University of Zagreb Faculty of Science, which hosts 5 projects.

The outputs of Croatian-Swiss projects in 2021 include 11 publications, while Principal Investigators attended 7 conferences.

Funds disbursed for Programme in 2021

HRK

1.17

million

Promoting Excellence in Higher Education (TTP)

Funds disbursed for Programme in 2021

HRK

3.83

million

The Tenure Track Pilot Programme represents collaboration of the Croatian Science Foundation, Ministy of Science and Education and École polytechnique fédérale de Lausanne (EPFL), for the preparation of the tenure track model for the development of careers of excellent young researchers in Croatia. The goal of the programme is to offer young and talented researchers the possibility of long-term career in Croatia.

Three research groups are funded in the framework of the Programme for a five-year period. Two projects are implemented at the Ruđer Bošković Institute, one is implemented at the University of Zagreb Faculty of Science.

Apart from the three PIs, eleven young researchers have been recruited to work on the projects (five doctoral students and six post-doctoral researchers). The following results were achieved: more than 20 papers published in international papers, team members presented at more than 10 conferences and established more than 15 new informal collaborations with foreign institutions.

In late 2020, the Foundation launched the Call for the Extension of Project Activities within TTPP, which would enable the PIs to finance additional activities with the aim of increasing project quality and the results of research teams (e.g. recruiting additional members of the project team, short-term visits to mentors at EPFL, fees for accessing advanced infrastructure in Switzerland or other countries, further trainings for team members etc. plus additional overheads for their host institutions). The Call was launched to maximise the utilization of funds available on the Programme level. All three PIs submitted proposals to this Call and additional funds in the total amount of HRK 7,311,116.00 were contracted. Each TTP project now has close to HRK 10 million at its disposal.

Cooperation Programme with Croatian Scientists in Diaspora "Research Cooperability"

The Research Cooperability Programme is financed from the European Social Fund as part of Specific Objective 10.ii.3. "Improving the environment for Croatian researchers" within the Operational Programme Efficient Human Resources 2014-2020 and co-funded from the State Budget of the Republic of Croatia.

The aim of the Programme is transfer of knowledge and attracting investments into the Croatian science and technology system, and indirectly into the economy as well, through collaboration between Croatian-based scientists and scientists of Croatian origin who live and work abroad. Such collaboration would enhance the collaboration and networking potential of Croatian scientists in Croatia and the diaspora, with special emphasis on career development of early-career researchers. In addition, through the Programme they are set to develop and strengthen their capacities for participation in international calls.

Scientific projects funded through this Programme are expected to be implemented by 31 May 2023 at the latest, with the obligation to recruit two full-time young researchers per project. Individual funding is provided in the minimum amount of HRK 1,000,000.00 and a maximum of HRK 2,200,000.00.

The Research Cooperability Programme currently funds 23 projects which received a total of HRK 12,742,667.20 in funding in 2021. 32 young researchers and 11 post-doctoral researchers have been recruited to these projects so far.

The highest number of projects are funded at the University of Zagreb (12) and the Ruđer Bošković Institute (5). The largest number of projects are implemented in Biomedicine and Health (17.39%) and Biotechnical sciences and Social sciences (8.69% each).

Funds disbursed for Programme in 2021

HRK

12.74

million

ERA-NET programmes

The consortium of national RFOs taking part in an ERA-NET launches calls for transnational research projects which enable researchers from various countries to implement joint research projects.

The Croatian Science Foundation takes part in three ERA-NET consortia: BlueBio, Quantera i Chanse.

The European Union supports the coordination of national research programmes at the European level through ERA-NET programmes with participation of national research funding organizations (RFOs). The consortium of national RFOs taking part in an ERA-NET launches calls for transnational research projects which enable researchers from various countries to implement joint research projects. The European Commission, through the Horizon 2020 programme, co-funds these projects in the amount of up to 33% through the instrument recently renamed to ERA-NET COFUND.

The Croatian Science Foundation takes part in three ERA-NET consortia: BlueBio (ERA-NET Cofund on Blue Bioeconomy – Unlocking the potential of aquatic bioresources), QuantERA (ERA-NET Cofund in Quantum Technologies) and Chanse (Collaboration of Humanities and Social Sciences in Europe).

The BlueBio Network (ERA-NET Cofund in Blue Bioeconomy) gathers 28 partners from 17 European countries (Belgium, Denmark, Estonia, Finland, Croatia, Germany, Greece, Ireland, Iceland, Italy, Malta, Norway, Portugal, Romania, Spain and Sweden), whose objective is to secure sustainable and competitive blue economy in Europe, to develop knowledge on value chains in blue bioeconomy, to encourage the application of research results, innovations and demonstrations of bioproducts in production through a multi-shareholder approach. The BlueBio Project shall contribute to the production of safe, nutritious and quality bioproducts and services. In 2021, the BlueBio network launched an additional call – **BlueBio 2021**, which received 20 pre-proposals requesting funding in the amount of EUR 21 million. One submission did not meet the administrative criteria. After the first evaluation round, 19 teams were invited to submit full proposals. Since no pre-proposals in the first stage included partners from Croatia, the applicants were invited to include Croatian partners when drafting their full proposals. Results of the Call will be released in late May 2022.

The QuantERA network (ERA-NET Cofund in Quantum Technologies) was launched in 2016 and is currently the leading European network of public RFOs in the field of quantum technologies. The network gathers 38 organizations from 31 countries. The network secured over EUR 40 million of national contributions and additional EUR 15 million of European Commission co-financing for its new programme, QuantERA II. In 2021, QuantERA II implemented a transnational call with EC co-financing. 39 projects were approved for financing, all in the fields of quantum phenomena and resources and applied quantum science. One project consortium includes a Croatian partner. The overall funds requested by the Croatian partner equal EUR 199,998, of which EUR 38,400 will be co-financed by the European Commission.

The HERA-NORFACE ERA-NET CO-FUND (Humanities in the European Research Area and New Opportunities for Research Funding Agency Cooperation in Europe) consortium comprises 27 organizations for funding research in the Social sciences and Humanities from 24 European countries. When applying for additional European Commission funding through Horizon 2020, this ERA-NET programme has been renamed to CHANSE. The consortium secured over EUR 26 million of national contributions and additional EUR 10 million of European Commission co-financing. March 2021 saw the launch of the transnational Call **Transformations: Social and Cultural Dynamics in the Digital Age**. Call results are expected to be released in May 2022.

Trans-Atlantic Platform for Social Sciences and Humanities (T-AP)

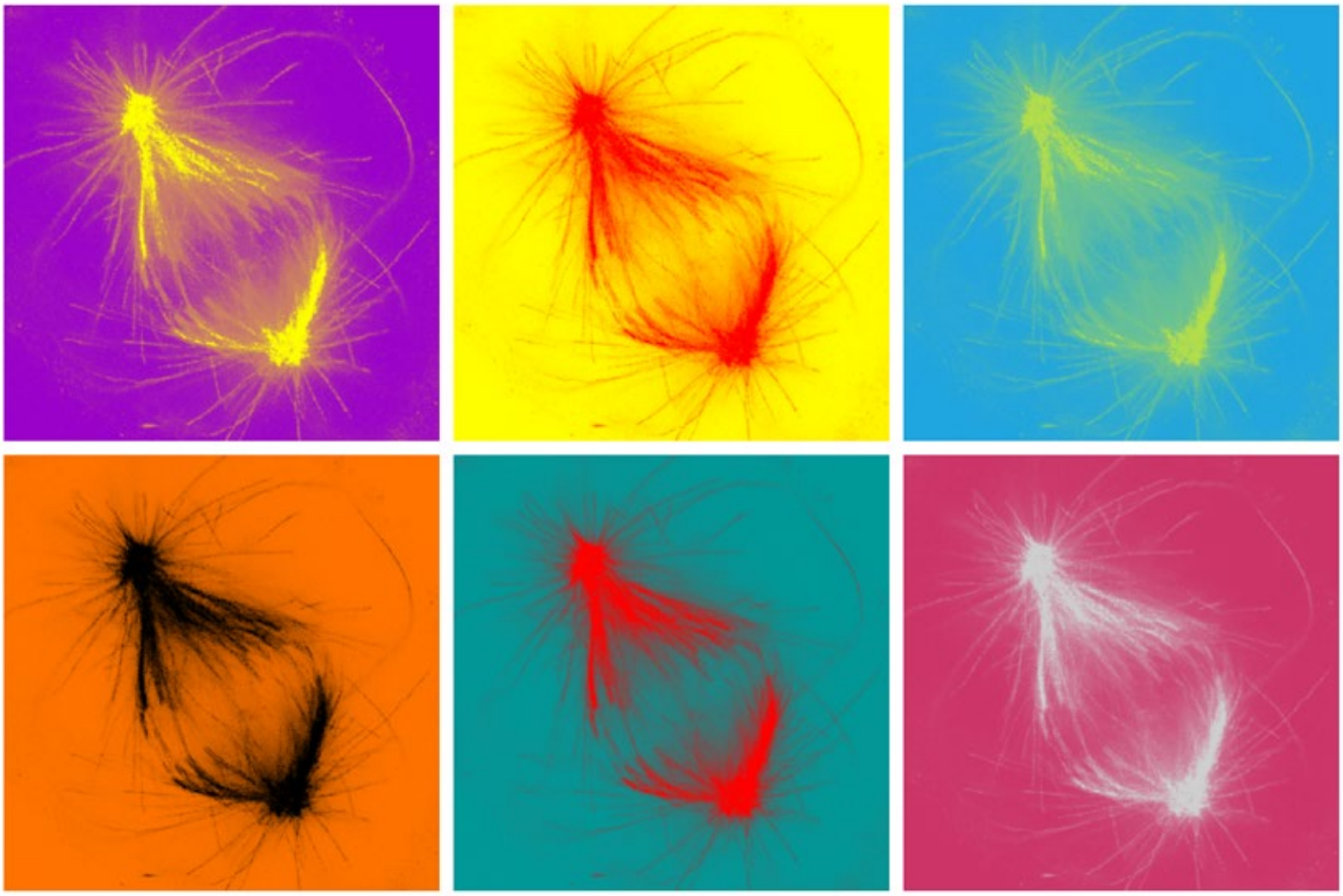
The Trans-Atlantic Platform for Social Sciences and Humanities (T-AP) is a network of research funding organizations from Europe and the Americas. The aim of this platform is to raise public awareness on the relevance of social sciences and humanities in the 21st century.

In early April 2021, Platform launched a thematic Call "Recovery, Renewal and Resilience in a Post-Pandemic World", in which the Croatian Science Foundation also took part. The Call was open for transnational project consortia, to be composed of at least three partners from three different participating countries and had to include partners from both sides of the Atlantic. The Call was open until 12 July 2021 and saw 310 transnational project proposals submitted. 24 of these consortia included research teams from Croatia. The administrative check conducted by the participating funding organizations saw the elimination of 60 submissions (including 5 with Croatian participation). The applications were evaluated following a two-step procedure: international peer review and evaluation panel. Results of the Call will be released in early 2022.

Support to Researchers for Applying to European Research Council Programmes

This Programme supports Croatian researchers (Visiting Researcher) in setting up collaboration with Principal Investigators of European Research Council (ERC) projects with the aim of gaining experience and preparing their own proposal for ERC calls.

In October 2021, the Foundation launched its fifth Call "Support to Researchers for Applying to ERC programmes". Four project proposals were submitted, two of which will be funded – one in the interdisciplinary area and the other in Technical sciences. The visits to ERC grantees will take place in 2022.



Pop art spindles, author: Iva Tolić, Ruđer Bošković Institute, PZS-2019-02-7653

2021 IN NUMBERS

63 project proposals evaluated

734 projects monitored

1.072 evaluators and independent experts involved in project monitoring

more than **1.000** young researchers funded

344 collections of papers

book chapters and books **143**

4
new projects accepted for financing through Call IP-CORONA-2020-12

83
Croatian panel members and international peer reviewers included in project proposal evaluation

7.370
Principal Investigators and team members

468
doctoral/master/ graduation theses

1.611
conference abstracts

1.758
papers in academic journals

MEET THE AUTHORS OF HIGHLY CITED PAPERS (2015-2020)

To mark the Foundation's 20th anniversary, we conducted an analysis of bibliometric data extracted from the Scopus database, managed by Elesevier. The analysis is presented in the publication Scholarly Output and Impact. Here we present the top cited papers published as outputs of research (IP) and installation (UIP) projects in the period from 2016 to 2020.

Publications were recognised as outputs of projects financed by the Croatian Science Foundation on the basis of the funding source statement in the paper itself. Below we present the highest cited paper for each scientific area. The selection criterion was the number of citations of the paper as of 23 August 2021 (the database included original scientific papers with up to 30 authors).

Scientific area: Social sciences

Self-Efficacy, Emotions and Work Engagement Among Teachers: A Two Wave Cross-Lagged Analysis, J. Happiness Stud., 19 (2018)

FIRST AUTHOR:
Associate Professor **Irena Burić**, PhD, University of Zadar
(31 citations)

In the last few years, most of my research interests have focused on a relatively unexplored area of teacher emotions. From 2014 to 2017, I was the Principal Investigator of an Installation Research Project dedicated to the study of emotions and emotional regulation in explaining the professional well-being and performance of teachers. The project was based on a combination of qualitative and quantitative research approach as well as both longitudinal and transversal design, and it resulted in a single database with answers from more than 4,000

teachers and 2,000 students. Since studies of this size and methodology are rare in the world, the project resulted in a series of invited lectures and communications at scientific and professional gatherings as well as more than 20 published original scientific papers indexed in the Web of Science and Scopus databases. Successful project implementation and quality dissemination of results have increased the international visibility of my scientific work and contributed to the establishment of continuous cooperation with world-renowned scientists in the field. Since 2020, I have been the Principal Investigator of a research project comprising an international team of scientists, which represents a continuation of the initiated research line with the ultimate aim of discovering dynamic, longitudinal relationships between personality, emotion and performance of teachers.

Based on a series of research combining qualitative and quantitative data, two multidimensional measuring instruments have been constructed – one intended to measure the most common and most important emotions in the work of teachers and the other intended to measure emotional regulation strategies in teachers – enabling us to research the relationship between emotional processes of teachers and other constructs of interest (e.g. motivation, quality of teaching, professional well-being). Also, through longitudinal monitoring of 3,010 teachers in three time points, reciprocal relations between teacher emotions, strategies for regulating them and a number of motivational constructs (e.g. self-efficiency, work involvement), or indicators of professional well-being of teachers (e.g. burn-out, job satisfaction) were tested for the first time. The results of these analyses provided an insight into the timeline of structures within the observed relationship.

Finally, the combination of data collected from teachers and their students enables the study of the relationship between teachers' personal characteristics and perceived quality of teaching and affective-motivational outcomes in pupils. For example, it was found that teachers who conceal, i.e. suppress, the perceived emotions in the class were assessed as providing lower-quality teaching, while students taught by teachers who spoke of more frequent acting of emotion (e.g. enthusiasm) assessed themselves as more motivated and satisfied in class. These results indicate the importance of using such strategies of emotional regulation that will achieve optimal effects both in the form of teacher performance and in the form of preserving their professional well-being.

The projects financed by the Croatian Science Foundation enabled me to implement complex drafts of research that are rare in the area concerned and consequently result in valuable data with high potential for scientific dissemination, as well as important practical insights about the factors that shape processes in a modern, dynamic educational system.

Scientific area: Biomedicine and Health

Phosphorylation of the mitochondrial autophagy receptor Nix enhances its interaction with LC3 proteins, Sci. Rep., 7: 1131 (2017)

CORRESPONDING AUTHOR:
Associate Professor **Ivana Novak Nakir**, PhD, University of Split School of Medicine (83 citations)

I am currently the Principal Investigator of a Research Project financed by the Croatian Science Foundation, which is a continuation of a previous three-year Installation Research Project, which had resulted in the publication of 5 scientific papers. Regular calls for research projects published by the Foundation enable me to continuously fund my scientific work and I consider it the only way to achieve quality in science. My scientific work includes studying the cell process of autophagy present in any eukaryotic cell, from a simple yeast to the complex man, and is an indispensable mechanism for cleaning and removing harmful, damaged or unnecessary cell parts. The focus of my research is mitophagy, i.e. the removal of mitochondria, cellular energy factories, through autophagy. Through the projects of the Croatian Science Foundation, my research group is trying to decipher the mechanisms governing mitophagy, which is very important for cell survival, since damaged mitochondria can lead to cell death. Autophagic activity slows aging, prevents the formation of tumours, inflammatory and neurodegenerative diseases because it removes harmful products from our cells, such as accumulated proteins in Parkinson's disease or it participates in the destruction of bacteria and viruses that attack our cells.

I continued my scientific journey in Croatia after my doctoral training in Sweden, and the projects of the Croatian Science Foundation enabled the beginning of my independent career. Employment of young doctoral and postdoctoral students, supported by the Croatian Science Foundation, is of immeasurable importance for the success and quality of scientific work. I try to convey enthusiasm to young scientists for science and to train them to conduct scientific research independently.

Scientific area: Biotechnical sciences

New perspective in extraction of plant biologically active compounds by green solvents, Food and Bioproducts Processing, 109 (2018)

CORRESPONDING AUTHOR:
Professor **Ivana Radojčić Redovniković**, PhD, University of Zagreb Faculty of Food Processing and Biotechnology (113 citations)

I run the NADES Design Research Group. Our research area are green technologies with special emphasis on green solvents. In the last 10 years, we have been intensively studying natural eutectic solvents (NADES), their preparation, characterization and application in the food, chemical, pharmaceutical and biotechnology industries. I received the Foundation's funding for my first project – "Green solvents for green technologies" – in 2014 as a young scientist, which allowed me to gather a team of scientists and launch systematic research in the field of green solvents. Through the project we have gained significant experience in the preparation and characterization of natural eutectic solvents, but also in the application of these solvents for the extraction of biologically active compounds from food industry waste, fuel purification and the implementation of biocatalysis. Also, the knowledge acquired through this project was an incentive to transfer knowledge to industry and based on the technology developed through the aforementioned project financed by the Foundation we applied and received a project with an industrial partner within the Operational Programme of the European Regional Development Fund.

I am currently the Principal Investigator of another project financed by the Foundation, through which we have expanded the application of natural eutectic solvents to the field of production and formulation of chiral medicines.

Furthermore, the possibility of employing young scientists through the Young Researchers' Career Development Project – Training New Doctoral Students is praiseworthy because it is our only possibility to plan and expand our research group. We employed three PhD students who contribute significantly to the further development of our research group, both at national and international level.

Scientific area: Technical sciences

Fast and accurate de novo genom assembly from long uncorrected reads, Genome Res., 5 (2017)

CORRESPONDING AUTHOR:
Professor **Mile Šikić**, PhD, University of Zagreb Faculty of Electrical Engineering and Computing (529 citations)

The scope of my group's research is to develop new algorithms and artificial intelligence methods for application in genomics. When I started my own group in the early 2010s, it was important to get initial funding. Part of the funding was provided by the Faculty of Electrical Engineering and Computing through grant programs to new Associate Professors and rewarding papers published in prestigious magazines. However, I received my first serious financing from the Croatian Science Foundation through the approval of an Installation Research Project. Soon afterwards, the funding of a doctoral student was also approved. This funding, together with domestic and foreign collaboration, enabled us to launch our research. The first results, successful completion of the project, and the defended doctoral theses opened the doors for new collaborations and encouraged us to write new project proposals in Croatia, the EU and Singapore. A significant percentage of proposals were approved, including the Foundation's Research Project; the experience from the Installation Research Project proved crucial in writing applications and managing projects. During my work on the Foundation's projects so far, I supervised three postdoctoral researchers and three doctoral students. After completing their doctoral studies and working on the project, these young researchers continued their academic career at prestigious institutions in Croatia and abroad or were given the opportunity to work in international corporations thanks to their results. When I look back on our career in the last ten years, I think the Foundation has helped very much on the scientific path both to young scientists I have supervised and to me.

Scientific area: Humanities

The moral bioenhancement of psychopaths, J. Med. Ethics, 43 (2017)

CO-AUTHOR:
Professor **Luca Malatesti**, University of Rijeka Faculty of Humanities and Social Sciences (8 citations)

As part of the interdisciplinary project "Classification and explanations of antisocial personality disorders and moral and criminal liability within the context of Croatian mental health law and care" (CEASCRO) (2014-2018), we investigated questions about ethical and legally appropriate social response in Croatia to a set of offenders classified with an antisocial personality disorder and psychopathy. For example, in the paper "The moral bioenhancement of psychopaths", we offer an argument that persons with psychopathic personality traits should be subjected to some form of moral improvement. The financing of the CEASCRO project by the Croatian Science Foundation was extremely important because it enabled us to fulfil three preconditions for interdisciplinary philosophical research. First, in order to answer research questions and draft an application for the CEASCRO project, we needed to establish an international interdisciplinary team covering philosophers, historians, psychiatrists and lawyers. Secondly, the financing enabled us to organise and participate in numerous conferences in Croatia and abroad during which ideas could be tested and improved through discussion with experts from different disciplines covered by the CEASCRO project. These ideas were finally presented in our noted international and domestic publications. Finally, the project enabled us to employ and/or direct research capacities of young researchers who participated in the project as doctoral students, and now, as employees of the University of Rijeka, they realize their own research within other international research projects.

Scientific area: Natural sciences

Synthesis, in vitro anticancer and antibacterial activities and in silico Studies of new 4-substituted 1,2,3-triazole-coumarin hybrids, Eur. J. Med. Chem., 124 (2016)

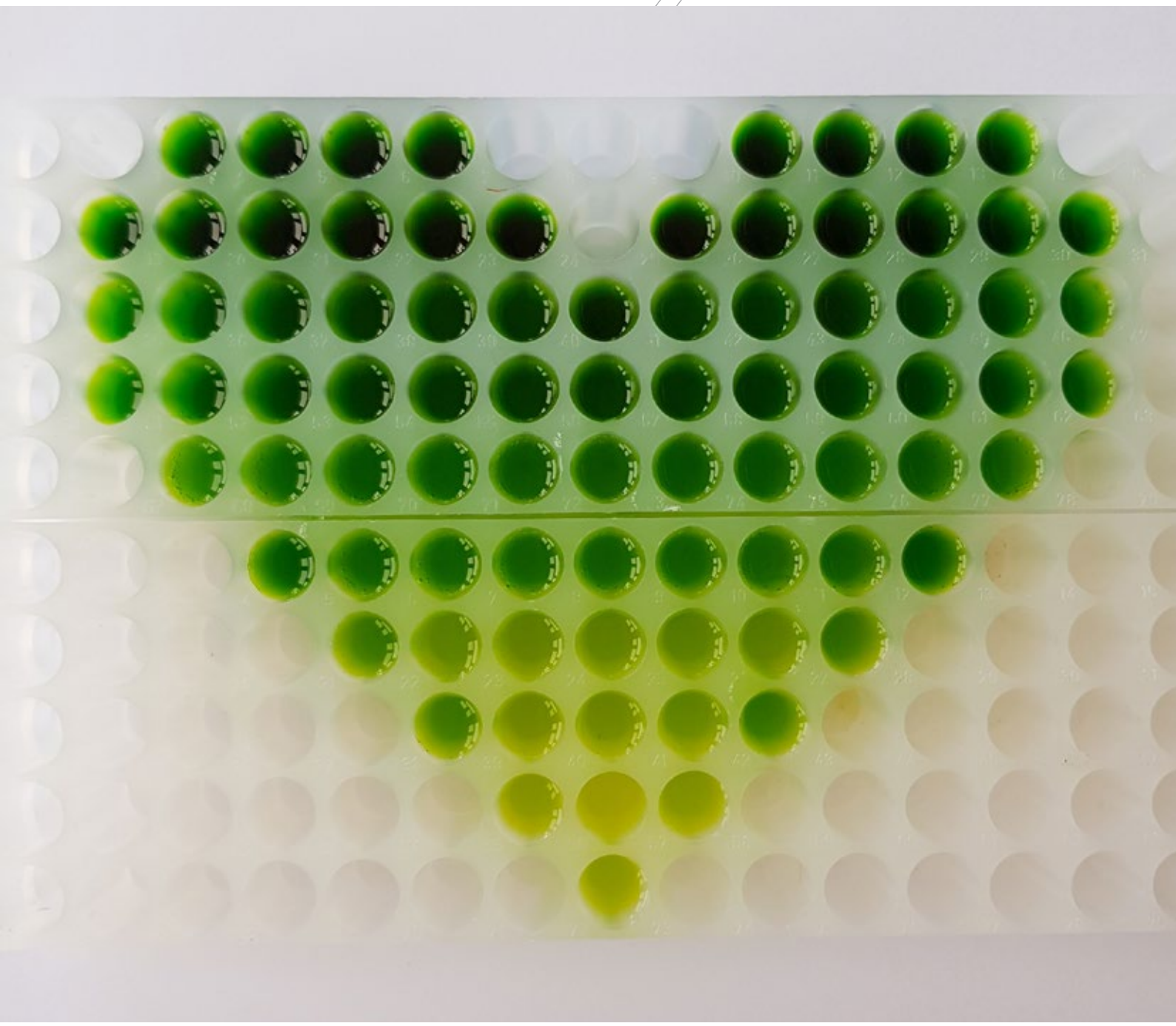
CORRESPONDING AUTHOR:
Professor **Silvana Raić-Malić**, PhD, University of Zagreb Faculty of Chemical Engineering and Technology (78 citations)

Within the project IP-2013-11-5596 financed by the Croatian Science Foundation, we carried out research aimed at the development of new nitrogen heterocyclic compounds with biological activity. In order to develop new chemical entities with strong and selective antitumor and antibacterial effects, coordinated synthesis and optimization of structures was carried out, together with methods of designing compounds and testing their biological effects.

The paper above describes ecologically acceptable synthesis of new compounds based on coumarin using microwave radiation. We observed the relationship between physical-chemical properties and biological activity of coumarin hybrids and heterocyclic compounds in which lipophilic compounds showed the best activity. The coumarin and benzimidazole hybrid is a leading structure with a strong and selective effect on liver cancer cells whose activity is associated with inhibition of 5-lipooxygenase activity and changes in the signalling of sphingolipids via intracellular acid ceramidase. Selected coumarin also showed activity against the clinical strain of Enterococcus faecium bacteria, which is resistant to the existing antibiotic.

The Foundation's financial support was a strong incentive to organic synthesis of biologically active compounds and enabled research groups in the fields of medical chemistry, biomedicine and bioinformatics to link their complementary skills.

The research contribution lies in the application of ecologically friendly synthesis of coumarin, significant natural compounds. The new coumarin derivative inhibited the clinical strain of Enterococcus faecium, which is resistant to the existing antibiotic. Since antimicrobial resistance is a global problem and represents one of the main priorities of public health, special importance of research is in the development of new compounds, related to natural coumarin, which would overcome the problem of bacterial resistance to antibiotics.



Green love, author: Ena Cegledi, University of Zagreb Faculty of Food Technology and Biotechnology, IP-2018-01-4924 (PlantBioPower)

Brain dissection, author: Franka Rigo, University of Rijeka Department of Biotechnology, IP-2018-01-2794

RESEARCH STORIES

Integrating refugee children in schools

The IRCiS project deals with the integration of refugee children into primary schools, but also with programmes to foster tolerance and prepare resident children for the reception of refugee children in schools where they are not yet included. The first year of the project was dedicated to examining the needs of all participants in the integration process – child refugees, their parents, their Croatian peers, teachers and professional associates in the selected schools. We used the information as guidelines for developing an intervention programme in schools, aimed at developing positive attitudes of resident children towards refugee children. Based on the feedback, we have prepared two types of intervention programmes: the preparatory programme is intended for work in schools where refugees are yet to arrive, so that the residential children would support and accept their newcomer peers. The integration program is intended for schools already attended by refugee students, in order to develop mutual learning strategies that will help both domestic and refugee children develop the habit of co-operation, positive attitudes towards each other, and enable more successful integration. In addition to Swiss partners who are experts in the field, teachers and professional associates of schools involved in the project have all participated in the drafting of the programme, in order to ensure the feasibility of the programmes in schools and their applicability to all children ages. One of the

PROJECT TITLE:
Integrating refugee children in schools: a mixed-method study on the efficacy of contact-in-school interventions for building positive intergroup relations among refugee and host-society children (IRCiS)

CALL:
CSRP-2018-01

PRINCIPAL INVESTIGATOR:
Assoc. Prof. Margareta Jelić, PhD

SWISS PRINCIPAL INVESTIGATOR:
Prof. Fabrizio Butera, University of Lausanne

INSTITUTION:
University of Zagreb Faculty of Humanities and Social Sciences

PROJECT DURATION:
01.09.2019. – 31.08.2022.

SCIENTIFIC AREA:
Social sciences

main challenges in the integration of refugee children is the language barrier, so the integration program has been designed in the form of workshops that do not require knowledge of the Croatian language, while materials have been prepared that visually explain the task. Training of teachers and professional associates for the implementation of intervention programmes in schools was also carried out. The developed programmes are currently being implemented in schools by means of a questionnaire survey that examines their efficiency before and after programme implementation. The questionnaire survey is also conducted in parallel schools in order to ensure that the expected effects, i.e. changes in the attitudes and behaviour of children, are actually attributable to the implemented programmes and not to the passage of time or other school activities. After the intervention, interviews and focus groups with children and teachers will also be conducted in order to check the effects of the programme qualitatively, and to examine the experience of participants in their application. It is expected that the project results will provide guidelines and concrete activities that can be implemented in schools attended by refugee children, as well as activities of preparing children in schools that are still being prepared for the reception of refugee children, both in Croatia and in other European countries. The designed model of connecting and integrating residential and refugee children was awarded the silver medal at the 19th International Innovation Exhibition ARCA.

Innovative functional lamb meat products

The risks of use and/or abuse of antibiotic growth promoters (AGP) in animal feed for human health have led to a ban on their use in the European Union (Regulation EC No. 1831/2003). Since 2006, European guidelines have limited the non-clinical use of antibiotic growth incentives (APR) in the production of animals intended for human consumption. Permanent health problems in controlled animal breeding were mainly addressed by adding sub-therapeutic doses of the APR to food in order to preventive/control disease and increase productivity. Adaptation to the withdrawal of the APR requires the establishment of relevant health criteria and the adoption of scientifically based alternative strategies. The consequences of the ban on the APR are reflected in the lower utilization rate of food and the reduction of production characteristics, including in the increased morbidity and mortality of animals. It is therefore really necessary to find alternative sustainable methods for controlling stress factors on animal health in appropriate feeding systems and joining European scientific trends in veterinary medicine in order to establish relevant health criteria as well as scientifically-based recommendations for the use of the APR in animal feed. In modern production of domestic animals, it is important to draw up recipes that would stimulate growth and at the same time be economically profitable. Such meals, apart from meeting the nutritional needs of animals depending on the species and breeding category, must be effective in modulating the selection of species/strains and microbiota development,

PROJECT TITLE:
Innovative functional lamb meat products

CALL:
IP-2016-06

PRINCIPAL INVESTIGATOR:
Professor Maja Popović, PhD

INSTITUTION:
University of Zagreb Faculty of Veterinary Medicine

PROJECT DURATION:
01.03.2018. – 28.02.2023.

SCIENTIFIC AREA:
Biomedicine and Health

stabilising commensal microorganisms, enhancing the function of the immune system and enhancing resistance to infectious diseases.Today's research increasingly recognizes the role of nutrient in creating and maintaining good health conditions in humans and animals with different effects on metabolism. Some of their beneficial effects include improved food intake, reduced oxidation stress, prevention of microorganism growth in food, modulation of the immune system, better digestibility and absorption of nutrients, and modification of the digestive system micro-population.

The aim of the research project is the production of lamb with lower fat and cholesterol contents and the production of functional healthy products from it, which are based on innovative solutions in technological production processes.

In addition, the aim is to verify the scientifically proven recommendations on the safe and effective introduction of a formulation of the Agaricus bisporus in the feed for monogastric animals on the model of polygastric animals, i.e. lamb of the Lička pramenka breed (which was unknown until the beginning of the project), while at the same time creating a new market product (lamb with lower fat and cholesterol content – project innovation). In the studies conducted in the previous two years, it has been established that in lambs of the Lička pramenka breed, the Agaricus bisporus formulation added to the feed improves the health status of animals (decreased glucose and cholesterol levels in serum and increased levels of T-lymphocytes and B-lymphocytes) and decreases fat and cholesterol content in lamb meat.

After the end of the contracted research period financed by the Croatian Science Foundation, new solutions will be offered for the establishment of uniform breeding systems without antibiotic stimulators of growth in food, which are environmentally friendly and beneficial for the welfare of lambs, i.e. all animals in production, which are at the same time compatible with EU regulations, economically justified and therefore acceptable for markets in the country and abroad – in public (consumers), public health (population) and agricultural sector (producers of lamb/fodder). Also, the results of the research will have a scientifically proven applicable value for Agaricus bisporus as a natural functional addition to a daily meal for lambs from which a new and innovative product in the form of functional food for man (lamb with lower fat and cholesterol content) will be presented to the market.

The Croatian Inventors' Association recognized the project as innovation in agriculture and awarded the project a silver medal for innovation in agriculture, food processing and agricultural mechanization at the 11th International Innovation Fair in Agriculture, Food Industry and Agricultural Mechanisation held in Karlovac from 25 to 27 April 2019.

ET TIBI DABO

PROJECT TITLE:
ET TIBI DABO: Commissions and Donors in Istria, Croatian Littoral and North Dalmatia from 1300 to 1800

CALL:
IP-2016-06

PRINCIPAL INVESTIGATOR:
Professor Nina Kudiš, PhD

INSTITUTION:
University of Rijeka Faculty of Humanities and Social Sciences

PROJECT DURATION:
20.03.2017. – 19.09.2021.

SCIENTIFIC AREA:
Humanities

Ever since Francis Haskell published his book Patrons and Painters: A Study in the Relation between Italian Art and Society in the Age of Baroque in 1963, the methodology of research in the history of art has experienced great changes, but the awareness of the need for a more thorough insight into the motivations and intentions of the client, in order to better understand the context of the creation, and even the stylistic characteristics of the works of art, has not changed. In accordance with the contemporary tendencies of combining different, sometimes even conflicting methodological approaches, this project uses the strategies of "social history of art", as well as those characteristic of stylistic analysis, attributionism and research of written sources. The objective of ET TIBI DABO project: Commissions and Donors in Istria, Croatian Littoral and North Dalmatia from 1300 to 1800 is to explore the influence of social elites and individuals on

the dissemination of certain artistic forms, styles and solutions. This process was partly created on the territory of Croatia by the most important representatives of European courts, such as the Habsburg emperors, Bavarian dukes, Venetian doges, Apostolic Nuncios and Cardinals. Insight into the reasons and characteristics of their orders enables a better understanding of the position and desire of local donors in the European context.

By applying the case study method, we strive to reach more general conclusions, applicable not only to the territory of the Adriatic Croatia, but also to the entire former territory of the Venetian Republic, as well as to the territory of the Apennine Peninsula and Central Europe.

In addition to the Principal Investigator, 11 researchers are participating in the project, in addition to two young researchers employed thanks to the grant by the Croatian Science Foundation. Most of the work on the project consists of field research conducted by the Principal Investigator and collaborators in Croatia and abroad, which includes the preparation of comprehensive photo-documentation and research in Croatian and foreign libraries and, in particular, archives.

The project has organised 3 scientific conferences so far, one of which was international. The project will end with a major international gathering. One of the important objectives of the project is dissemination of research results; this objective is conducted quite successfully through public lectures of researchers, presence in printed and electronic media, but especially through shorter dissemination texts that researchers systematically publish on the project's blog site.

NATURe as an ALLY

PROJECT TITLE:
NATURe as an ALLY: Alien invasive plants as phytopharmaceuticals - NATURALLY

CALL:
IP-2020-02

PRINCIPAL INVESTIGATOR:
Dr Danijela Poljuha, PhD

INSTITUTION:
Institute for Agriculture and Tourism Poreč

PROJECT DURATION:
29.01.2021. – 28.01.2025.

SCIENTIFIC AREA:
Biotechnical sciences

It all started in the 18th century when the tree of heaven (Ailanthus altissima (Mill.) Swingle) was imported into Europe as an ornamental tree. Once an exotic addition to high society, the garden has now started spreading like a wildfire which needs to be controlled. We know that the best way to stop a fire is to take advantage of its attributes – to fight fire with fire- and that's what our research plans on doing; taking advantage of the plants' natural abilities to make them an asset. And this is where our NATURALLY story begins.

Invasive species pose a global threat to biodiversity. Imported species can affect ecosystem processes, disrupt ecosystem service delivery, and cause significant economic losses. However, all organisms can and do contribute to these factors in surprisingly beneficial ways. Alien species have become a fact of life in our globalized landscape and thus the continuous changes of our ecosystems. Now we are faced with the challenging task of achieving and maintaining balance in the so-called "novel ecosystems", "the new normal". This can also mean finding new ways to benefit from our unwanted visitors and building new alliances with them – that is the goal of NATURALLY.

The general objective of this project is to explore the phytopharmaceutical potential of natural extracts of four invasive alien plant species (IAPS): black locust, Jerusalem artichoke, Canada goldenrod, and tree of heaven. Our specific objectives are: to perform chemical profiling of IAPS extracts by liquid chromatography-mass spectrometry (LC-MS); determine the antioxidative, antimicrobial, antiproliferative, genotoxic and cytotoxic properties of IAPS extracts

and isolated specific fractions by functional tests; propose the model for exploring new IAPS ecosystem services to mitigate the adverse effects of alien invasive species on the environment. We will pay special attention to disseminating results, especially to science communication and raising awareness of the importance of monitoring and controlling invasive species in the context of evident climate change. The implementation of the project will lead to new collaborations between seven research teams based in several countries.

These are ambitious goals, but we believe in them, and we believe in ourselves! The project started this year, but we already have something to be proud of. A postdoctoral student has been employed on the project, and the recruitment of a doctoral student is in progress. We are looking forward to their arrival to our team because the right measure of youth and experience, energy and knowledge is the key to success! New equipment has been purchased as a prerequisite for high-quality research, and we are currently engaged in field sampling.

We still have a lot of learning, challenges, and new questions ahead of us, but we also hope for the right answers. You can find our new visual identity and all information about the project on our website and social networks. Every initiative of yours, collaboration proposal, or every constructive idea that will help us be even better, our team will gladly accept!

Development of Reinforced Concrete Elements and Systems with Waste Tire Powder

PROJECT TITLE:
Development of Reinforced Concrete Elements and Systems with Waste Tire Powder - ReCoTiP

CALL:
UIP-2017-05

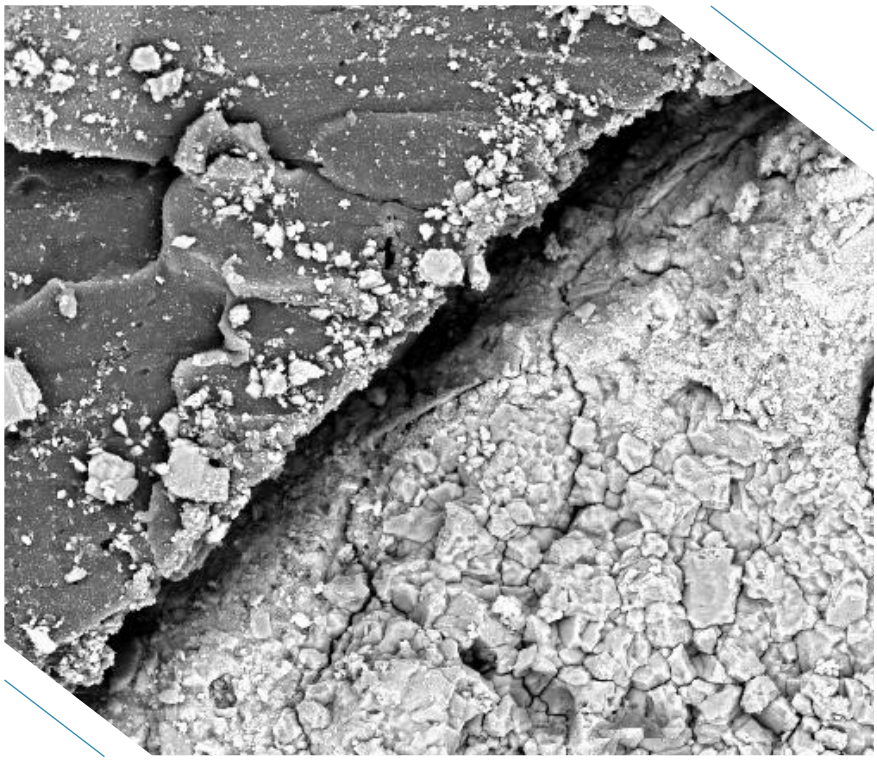
PRINCIPAL INVESTIGATOR:
Asst. Prof. Ivana Miličević, PhD

INSTITUTION:
Josipa Juraj Strossmayer University of Osijek, Faculty of Civil Engineering Osijek

PROJECT DURATION:
01.01.2018. – 31.12.2022.

SCIENTIFIC AREA:
Technical sciences

The main objective of the ReCoTiP project is the development of new material to be applied in load-bearing reinforced concrete structures with improved seismic resistance. The defined objective will be achieved by establishing a new international research group of young scientists in order to accelerate the process of developing independent research careers after obtaining doctoral degrees. The new research group, with strong support from the organization, will conduct scientific research and prove the set hypotheses through experimental and numerical methods. The application of waste powder and fine grains of recycled automobile tyres in self-consolidating concrete (SCC) will be demonstrated, structural elements (beams and columns) of equal mechanical and durability properties compared to ordinary SCCs will be constructed and tested, and a new type/form of reinforced concrete framework with improved seismic resistance will be developed. The ReCoTip project will further strengthen scientific and organizational capacities through two defended doctoral dissertations, a series of graduate/final papers and one postdoctoral training. This guarantees the implementation of the organisation's strategic objectives such as career development of young researchers and participation in international competitive



calls for project proposals throughout the RecoTiP project cycle. After the completion of the proposed research on the ReCoTiP project, concrete recommendations for the use and application of powder and fine grains of recycled waste automobile tyres and a key direction of further research area will be defined, given the results obtained from the project.

The project started in 2018 and is expected to last for a total of five years. The closure of the project is scheduled for the end of 2022. In the period from 2018 to 2020, nine students were included in the project, who completed their graduate and final theses within the framework of the project. Students are involved primarily in experimental work/tests in the Laboratory for Materials and Structures, all within the activities provided for in the work plan on the project.

Cooperation with economic operators from Croatia and abroad was established within the framework of the project (Gumiimpex d.d., BT3 Betontechnik GmbH, Našiceecement d.d., Velički kamen d.o.o.).

Middle Adriatic Upwelling and Downwelling

PROJECT TITLE:
Middle Adriatic Upwelling and Downwelling (MAUD)

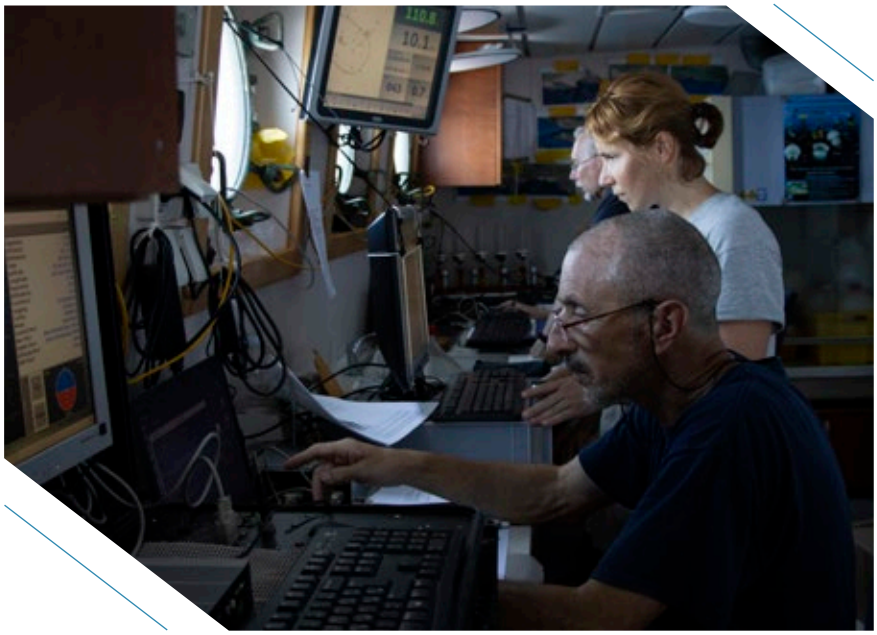
CALL:
IP-2018-01

PRINCIPAL INVESTIGATOR:
Professor Mirko Orlić, PhD, F.C.A.

INSTITUTION:
University of Zagreb Faculty of Science

PROJECT DURATION:
01.11.2018. – 31.10.2022.

SCIENTIFIC AREA:
Natural sciences



The MAUD project primarily deals with the process of emergence (upwelling) in the middle Adriatic. This process is extremely important for primary production in the sea, because upwelling brings nutrients from larger depths to the surface where solar radiation enables the creation of phytoplankton and thus other participants in the marine food chain. Twenty-three project associates, working in two Zagreb and two Split institutions, deal with various aspects of the process – physical, chemical and biological. They combine two research methods. One is collecting data on research cruises and on permanent measuring stations, as shown in a film made during experimental work available on the project's Youtube page.

The second research method relies on the development of numerical models, and – although it is not as visually attractive as the experimental method – it is no less challenging or useful because it enables the reproduction of natural processes using electronic computers. The compatibility of measurement and modelling results means that the natural process is not only described but also explained. The results achieved so far within the framework of the MAUD project show that in the area between the islands of Blitvenica and Jabuka, not only coastal upwelling is at work, but also upwelling on the open sea, which is a new finding for this area. In addition, project collaborators have developed an original method that allows the two types of upwelling to be distinguished and could prove useful in research in other seas. This would achieve the highest possible objective of geophysical and oceanographic research - namely, the study of a regional phenomenon leading to a scientific finding that crosses the borders of that region.

Life in an anaerobic chamber, author: Lorena Selak, Ruđer Bošković Institute, DOK-2018-09

YOUNG RESEARCHERS

In this section we present young researchers employed through the Young Researchers' Career Development Project who obtained their doctoral degree in 2021.

Dr **Ana Babić Perhoč**, PhD

DOCTORAL STUDENT:
Dr Ana Babić Perhoč, PhD

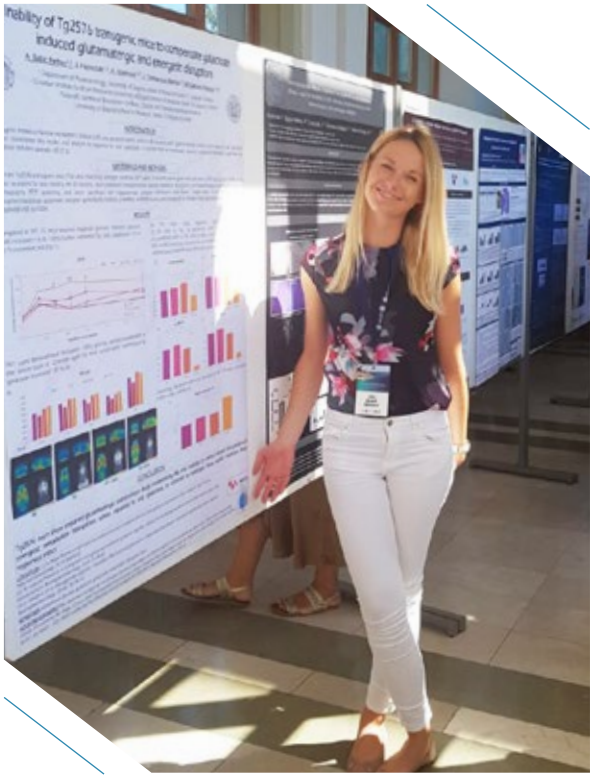
DISSERTATION TITLE:
Therapeutic potential of orally administered galactose on cognitive and metabolic changes in two experimental models of Alzheimer's disease

MENTOR:
Professor Melita Šalković-Petrišić, PhD, MD

INSTITUTION:
University of Zagreb School of Medicine

CALL:
DOK-2015-10

Alzheimer's disease is the most common neurodegenerative disorder in humans associated with progressive memory loss affecting 47 million people worldwide and 80,000 in Croatia. Recent studies show that Alzheimer's disease is a condition associated with insulin resistance in the brain and glucose hypometabolism already present in earlier stages of the disease. The available therapy for Alzheimer's disease is exclusively symptomatic and new therapeutic strategies are needed to slow down and/or stop the progression of neurodegeneration and dementia. Substances that could affect reduced levels of glucose in the brain and brain insulin resistance are investigated as potential therapy for Alzheimer's disease.



The aim of this study is to investigate oral galactose as a new therapeutic approach in the experimental model of sporadic Alzheimer's disease (a model caused by intracerebroventricular use of streptozotocin toxins; STZ-icv rat model) and familial Alzheimer's disease (Tg2576 transgenic mouse model with overexpressed beta-amyloid). Preliminary experiments with oral galactose have shown that it successfully prevents the development of cognitive deficit in the STZ-icv model, and this study will investigate the therapeutic effects of oral galactose in models of sporadic and familial Alzheimer's disease in the early and late stages of the disease with already developed cognitive and other features of Alzheimer's disease. Possible mechanisms of therapeutic effect at the level of glucose metabolism in the brain and stimulation of glucagon-like peptide 1 activity will be investigated. The results of this research will provide new knowledge about the metabolic aspects of pathophysiology of Alzheimer's disease. In view of the unsuccessful development of new medicinal products targeting amyloid or tau pathology, the results will also contribute to the research of a new approach to the treatment of this disease based on a multimodal substance; a nutrient that targets multiple points.

Dr **Katarina Batur**, PhD

DOCTORAL STUDENT:
Dr Katarina Batur, PhD

DISSERTATION TITLE:
Production, trade and maritime transport of colouring materials based on Early Modern Gnalić shipwreck finds

MENTOR:
Asst. Prof. Irena Radić Rossi, PhD

INSTITUTION:
University of Zadar

CALL:
DOK-2015-10

The southern entrance to the Pašman Channel, near the islet of Gnalić, is the venue of a unique archaeological site – the sunken ship Gagliana Grossa from the late Renaissance period. Loaded with precious products from European workshops, Gagliana Grossa sailed from Venice to Constantinople in 1583, sailing along the usual maritime route. A significant part of the cargo comprised paint-making raw materials packaged in heavy and massive barrels into the ship's deck, or, in the case of more valuable materials, wrapped in leather or textiles and placed on the upper decks.

Raw materials for making paint, found in the cargo of the ship sunk near the islet of Gnalić, are studied systematically, with the aim of bringing together the results of archaeological and historical research and archaeometric analyses, in order to improve the understanding of the production, trade and maritime transport of raw materials in the late Renaissance period.

Samples collected from the sunken ship are analysed using X-ray fluorescence (XRF), X-ray diffraction (XRD), electron microscope scanning (SEM-EDX), Raman spectroscopy, transformed infrared Fourier spectroscopy (FTIR) and high-performance liquid chromatography (HPLC). The associated contemporary and late Renaissance terminology is then joined with the identified colours. The data obtained will enrich the knowledge about Venetian production and export capacities, diversity of colour supply, but also about the needs of the Eastern Mediterranean market.

By combining historical data, the results of archaeological research and the above-mentioned archaeometric analyses, the research has an innovative approach to the study of the problem of colour trade. Raw paint-making material can rarely be found at archaeological sites; therefore, the doctoral dissertation will be an example of how to document, sample, analyse and interpret colours at an archaeological site.

Thanks to this exceptionally preserved shipwreck and cargo, we are able to visualize objects that used to be known only from historical sources. The true value of the site is in a precise dating process; by collecting the results of the analysis, a database of accurately dated minerals will be formed, which is extremely important for comparative studies in art history, geology, conservation and restoration.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Dr **Josip Karuc**, PhD

DOCTORAL STUDENT:
Dr Josip Karuc, PhD

DISSERTATION TITLE:
Quality of movement patterns in different groups of urban adolescents

MENTOR:
Assoc. Prof. Maroje Sorić, PhD, MD

INSTITUTION:
University of Zagreb Faculty of Kinesiology

CALL:
DOK-2018-01

The importance of the quality of basic movement patterns in adolescent populations is the topic of the doctoral research. In his work, Josip focuses primarily on determining the relations between the quality of movement patterns and the nutrition status, the level of physical activity and the frequency of injuries in adolescents.

The quality of movement patterns is fundamentally important for the optimal function and health of the locomotive system and is assessed by means of the Functional Movement Screen diagnostic instrument (FMS™). Three scientific papers will be published as part of the dissertation whose primary objectives are: (1) determine whether there are differences in functional movement between adolescents suffering from overweight and normally nourished adolescents; (2) establish the link between the functional movement and the level of physical activity; and (3) establish the predictive value of the FMS™ diagnostic instrument for the occurrence of injuries in a one-year period using artificial intelligence and machine learning methods. Until now, as part of his dissertation, he published an article "Movement quality in adolescence depends on the level and type of physical activity" in the eminent journal Physical Therapy in Sport, while two other studies are under review.

By analysing the predictive value of the FMSTM diagnostic instrument using artificial intelligence methods in identifying the risk of injury, the value of introducing such tests into regular school curriculum will be examined. Furthermore, by describing the correlation between the quality of movement and the level of physical activity and nutrition status, this dissertation will highlight groups at risk which should be the target group of efforts aimed at correcting dysfunctional movement patterns and consequently preventing injuries and postural deficits in adolescents.

Dr **Barbara Štimac Tumara**, PhD

DOCTORAL STUDENT:
Dr Barbara Štimac Tumara, PhD

DISSERTATION TITLE:
Numerical modelling of nonideal detonation of ANFO explosive using Wood-Kirkwood's theory

MENTOR:
Dr Muhamed Sućeska, PhD

INSTITUTION:
University of Zagreb Faculty of Mining, Geology and Petroleum Engineering

CALL:
DOK-2015-10

The phenomenon of non-ideal detonation (i.e. deviation from the detonation theory applicable to highly-brisant military explosives) is extremely important in the field of industry explosives, but also in the field of improvised explosives (home-made explosives).

The non-ideal behaviour of explosives is the result of the relationship between the velocities of two processes: the speed of the radial expansion of products in the detonation reaction zone and the speed of chemical reactions in the zone – the greater the radial expansion, the greater the deviation from the ideal. The non-ideal behaviour of explosives is manifested through the following:

1. a curved shock wave front,
2. the non-linear dependence of detonation speed on the initial density of explosives;
3. dependence of detonation parameters on the diameter of charge and coating;
4. a great critical diameter
5. chemical reactions even after the so-called sonic point, i.e. the release of heat energy in the phase of product expansion.

The doctoral research will investigate the influence of the diameter of the explosive charge on detonation parameters (detonation velocity and pressure, width of detonation reaction zone, radius of curvature of detonation wave, etc.) of the economic explosive of the ANFO type by using experimental methods. In addition, in order to numerically model non-ideal detonation, the thermochemical computer program EXPLO5 will integrate the Wood-Kirkwood theory and the detonation theory that describes the behaviour of non-ideal explosives because it takes into account the speed of chemical reactions and the speed of expansion of products. The focus of the research is precisely on these two processes. Direct and indirect methods for experimentally determining the model of the speed of chemical reactions will be used, as well as indirect methods for defining the model of radial expansion of products.

Dr **Domagoj Trlin**, PhD

DOCTORAL STUDENT:
Dr Domagoj Trlin, PhD

DISSERTATION TITLE:
Impact of climate change on dynamics of floodplain ecosystems in Croatia

MENTOR:
Professor Stjepan Mikac, PhD

INSTITUTION:
University of Zagreb, Faculty of Forestry and Wood Technology

CALL:
DOK-2015-10

The basis of the research is the monitoring of forest ecosystems considering changed habitat and climate conditions. The aim of this research is to understand the impact of climate change on the dynamics of forests in Croatia, with special emphasis on lowland forests of common oak and narrow-leaved ash trees which, as hydrologically sensitive ecosystems, are under great threat from present climate changes. The research method is based on dendrochronology. This is a discipline that can reveal the impact of climate and other factors influencing their growth from the tree rings. It is also possible to find out how this influence changed during the tree's lifetime, or how the climate changed. Wood samples are taken on the field from each tree by using a Pressler drill. Further preparation of samples is done in the laboratory as well as reading and analysis of obtained data. The knowledge obtained helps to understand the natural restoration of lowland oak and ash forests and should help plan economic interventions in forests affected by drought and dying.

Dr **Dario Vrdoljak**, PhD

DOCTORAL STUDENT:
Dr Dario Vrdoljak, PhD

DISSERTATION TITLE:
Elemental composition of otoliths: challenges and opportunities for reconstructing ecological links between habitats and species

MENTOR:
Dr Sanja Matić Skoko, PhD

INSTITUTION:
Institute of Oceanography and Fisheries

CALL:
Natječajni rok: DOK-2018-01

Dario Vrdoljak was a doctoral student at the project "Coastal nursery habitats: Patterns and processes of demographic variability in marine fish species along the eastern Adriatic coast" (NurseFish), who was focused on quantifying the demographic rates of Sparidae by special habitats, influence on their population dynamics and complementing the biological knowledge of these target species. The main objectives are to establish: the spatial-temporal use of growing sites by species, the boundaries of the geographical distribution of "settlers", the settlement rates and recruitment levels, the long-term variability in the intensity of annual classes and their connection, the elementary impressions of the otoliths of individual growing sites, the contribution of essential habitats to adult populations, the connection between transitional and marine environments, potential bioindicators of the structure of communities of juvenile fish and the effect of habitat transformation due to climatic and anthropogenic changes. Intra-annual and multi-annual differences in density, length frequencies and biomass will be determined by using univariate statistics according to different habitats. Apart from the identification of essential habitats, the response of the distribution of each species to environment-related predictor variables will be investigated. Prepared otoliths will be treated with laser ablation in order to quantify elementary concentrations in the otoliths to establish the correlation between juvenile and adult populations, the relative contribution of essential nursery and the time consistency of this contribution. Multivariate analysis of spatial-temporal changes in the structure of communities, using linear regression analysis, will be used to determine whether the observed differences correspond to clear long-term time trends. The doctoral student will apply biological and geochemical methods to the investigation of essential habitats, specific demographic rates and structural changes of coastal fish communities. Doctoral research will strengthen the research capacities of the project group, and the results will be applicable in fisheries management and conservation of biodiversity in the Adriatic.

Benthos in a Rogoznica Lake cavern, author: Irena Ciglenečki-Jušić, Ruđer Bošković Institute, IP-2018-01-1717 (MARRES)

THE FOUNDATION'S ACTIVITIES AND SCIENCE POPULARIZATION

PhD Café

PhD Café is an activity intended for the promotion of young Croatian scientists funded through the "Young Researchers' Career Development Project – Training New Doctoral Students". At each event several doctoral students present their doctoral research and obtained results in an informal environment. The activity was launched in early 2020 and by the end of that year eight events were held (four in Zagreb, two in Osijek and one in Split and Rijeka each). During the pandemic period, they took place on a less frequent basis. In 2021, a total of seven PhD Café events were held in Zagreb (several of them in open-air form) and one in Rijeka. A total of 30 doctoral students presented their research at these events. The list of all previous PhD Café events is available at: https://hrzz.hr/phd-cafe/.

We expect social gatherings to go back to normal in 2022, which would enable PhD Café to be held on a monthly basis in Zagreb and several times a year in Split, Rijeka and Osijek.

Zagreb PhD Café #7, 23 June 2021

Zagreb PhD Café #10, 12 November 2021

Zagreb PhD Café #11, 09 December 2021

Rijeka PhD Café #2, 13 September 2021

Career Path

Career Path is a series of webinars jointly organised by the Croatian Science Foundation and the Association of Croatian-American Professionals (ACAP). These webinars feature Croatian scientists, both from Croatia and abroad, who, by presenting their career paths, want to inspire young researchers and direct them at their own paths. Webinars are held once a month via Zoom. A total of nine webinars were held in 2021, which featured 28 Croatian scientists from various parts of the world. Each webinar was attended by around 50 participants, mostly young researchers. The list of all previous Career Path webinars is available at: https://hrzz.hr/seminar-karijerni-putevi/. This activity will resume in 2022 with equal frequency.

Best Scientific Photo Competition

To mark its 20th anniversary, the Croatian Science Foundation launched the Best Scientific Photo Competition in 2021. The aim of the competition was to introduce Croatian scientists, present their work environments and promote the importance of photos and visualization in modern science. The Call was open from 30 June 2021 to 14 September 2021. A total of 66 authors submitted 230 photographs divided into five categories – Research subject, Scientists up close, Field research, Science in society, Collage/Video.

The photographs were marked by the expert jury comprising three members: Dr Sandra Križić Roban, PhD, scientific advisor at the Institute of Art History and Principal Investigator of project IP-2019-04-1772 "Themes and Aspects of Croatian Photography from the 19th Century until Today", Professor Vladimir Mrša, PhD, professor at the Faculty of Food Processing and Biotechnology and President of the Croatian Association for Scientific Communication (ZNAK), and Mr Marko Knežević, a professional freelance photographer.

The first prize in the amount of HRK 5,000 was awarded to the photograph "View through a flask" taken by Dr Alen Bjelopetrović, PhD, from Ruđer Bošković Institute. Winners in each of the five categories were awarded HRK 2,000, while the jury awarded a special award for the best series of photographs by a single author. This award, not accompanied by a monetary prize, was awarded to Palma Orlović Leko for five photographs taken during field research in Lonjsko polje. The list of all winners and a digital exhibition of submitted photographs will be permanently available on the Foundation's website: https://hrzz.hr/najbolja-znanstvena-fotografija/.

First prize: photo "View through a flask", author: Dr Alen Bjelopetrović, PhD.

Stuck at work, author: Silvija Maračić, University of Zagreb Faculty of Chemical Engineering and Technology, IP-2018-01-4682

ACTS OF THE FOUNDATION

The Board of the Croatian Science Foundation, at the 3rd session of the fifth assembly held on 20 July 2021, adopted the draft amendment to Article 44 of the Statute of the Croatian Science Foundation. Pursuant to Article 6(2) of the Act on the Croatian Science Foundation, the amended Statute should be delivered to the Ministry of Science and Education for prior approval. Having obtained consent from the competent Ministry, the Board, at its 8th session held on 11 October 2021, adopted the amendment to Article 44 of the Statute and pursuant to the Act on Foundations (Official Gazette 106/18, 98/19), the Foundation submitted a request to the competent administrative authority to register the changes into the Registry of Foundations. The amendment to the Statute came into force upon decision by the Zagreb City Office for General Administration, which means that the Foundation met the recommendation by the State Audit Office issued in 2019 to align the provisions of its Statute and the Regulation on Internal Organization.

Plan of activities in 2022

As of 01 January 2022, the Croatian Science Foundation will acquire the status of budgetary user of the State Budget. This means that 2022 will be full of challenges and many new procedures will need to be introduced in order to switch from non-profit bookkeeping to budgetary bookkeeping.

The Government of the Republic of Croatia submitted the draft of the new Act on the Croatian Science Foundation, which should be adopted in the first half of 2022, after which the Foundation will be required to align all of its general and internal acts with the new Act. The Foundation's Board will draft the Foundation's Strategic Plan for the upcoming five-year period and submit it to the Croatian Parliament.

The Foundation has been included in activities of the National Recovery and Resilience Plan and will be responsible for new programme packages to be implemented in the period 2021–2026. This would extend the scope of the Foundation's activities, which also entails an expansion of human resources in all departments. The following programmes are to be implemented through the National Recovery and Resilience Plan: Young Researchers Programme, Independent Career Establishment Programme, Mobility Programme and Focused Scientific Research Programme.

Calls within the Foundation's national programmes – Research Projects (IP), Installation Research Projects (UIP), Young Researchers' Career Development Project - Training New Doctoral Students (DOK), Young Researchers' Training

Programme – Post-doctoral Researchers (PDOK) as well as bilateral calls for joint proposals with Slovenian and Swiss scientists with the Foundation in the capacity of Lead Agency – will be launched depending on the available funds in the State Budget. The Foundation will join the new cycle of calls for bilateral research projects as partner to the Swiss National Science Foundation and the Slovenian Research Agency.

In order to align our procedures with best practices in Europe, in the first half of 2022 we intend to introduce the Research Data Management Plan (DMP) in the implementation stage of IP and UIP projects.

The Foundation will continue its participation in international organizations – Science Europe, Global Research Council, three ERA-NETs and the Trans-Atlantic Platform. The Ministry of Regional Development and EU Funds started the negotiation procedure for the second Swiss-Croatian Cooperation Programme, where the Foundation is expected to manage one or two programmes.

The Foundation will resume its science popularization activities – PhD Café and Career Path seminars – in 2022, while all programme-related information and new calls will be published on its website and social media.

Interstellar dance in the third loop of the Milky Way, author: Vibor Jelić, Ruđer Bošković Institute, IP-2018-01-2889

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