

National Institute of Biology Biotechnology Hub



**BIOTECHNOLOGY
HUB**
NATIONAL INSTITUTE
OF BIOLOGY



REPUBLIC OF SLOVENIA
**MINISTRY OF HIGHER EDUCATION,
SCIENCE AND INNOVATION**



NACIONALNI INŠTITUT ZA **BILOGIJO**
NATIONAL INSTITUTE OF **BIOLOGY**



EUROPEAN UNION
EUROPEAN REGIONAL
DEVELOPMENT FUND

The investment is co-financed by the Republic of Slovenia and the European Union from the European Fund for Regional Development.

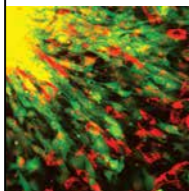
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BTS-NIB
 By moving to the newly constructed Biotechnology Hub the NIB has acquired the appropriate conditions for cutting-edge research.



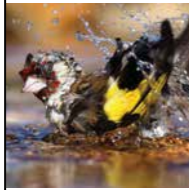
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Department of Biotechnology and Systems Biology
 A wide spectrum of research, emphasising the study of plants, their pests, and their microorganisms, enables professional work for Slovenian governmental organisations and private sector companies.



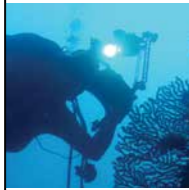
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Department of Genetic Toxicology and Cancer Biology
 We conduct research in several interconnected fields: ecotoxicology, genetic toxicology and cancer biology, as well as immunology and cellular immunotherapy.



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Department of Organisms and Ecosystems Research
 We study biological processes from the level of the cell to ecosystems. As a result, we create the knowledge necessary for a holistic understanding of biodiversity and the functioning of organisms, and their role in the environment.



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Marine Biology Station Piran
 A central Slovenian institution that performs research into marine and coastal ecosystems.



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NIB Infrastructural Centres
 This consists of the infrastructural centre Planta in Ljubljana (IC Planta) and the infrastructural centre of the Marine Biology Station in Piran (IC MBP).



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Knowledge transfer and business opportunities
 Our goal is the effective transfer of research results to the public and private sectors, both in Slovenia and globally.



The operations of the **NATIONAL INSTITUTE OF BIOLOGY** include many fields, including both the study of animals, such as the charming emperor dragonfly (*Anax imperator*) in the video, and research that expands knowledge about cancer and genotoxic substances in the environment.



PROF. DR. MAJA RAVNIKAR
 THE DIRECTOR

Our history began in 1960 when the University of Ljubljana founded the Institute of Biology. At that time, the research work began. The research work had its next important turning point in 1969 when research began on the fauna and flora of the northern Adriatic at the unit in Portorož, where the Marine Biology Station also began to operate. From humble beginnings, through the successful work of generations of dedicated researchers, the National Institute of Biology has developed into what it is today – the leading research institute in the field of biological sciences in Slovenia. **The institute now operates in the newly constructed Biological Hub in Ljubljana and the Marine Biology Station in Piran.**

Our activities are strongly embedded in the Slovenian and universal scientific space because we connect and cooperate with research institutions worldwide. We

are particularly closely connected with various institutions in the European Union. We conduct both basic and applied biological research, which is closely intertwined with chemistry, physics, agronomy, medicine, computer science, and other natural sciences.

The institute carries out a wide range of interconnected and complementary research. We research the biology of viruses, bacteria, plants, animals, and humans. We carry out research work in the field of biological sciences – molecular biology, systems biology, ecology, and environmental and nature protection. Ecological research covers inland waters, terrestrial, and marine ecosystems. Our applied research is aimed at applications in biotechnology, biomedicine, agriculture, forestry, nature protection, maritime industry, and geographical positioning.

An important part of our activity is consulting for professional services and Slovenian public administration bodies. We also prepare analyses and expert reports that enable the adoption of policies in different fields of agriculture, environment, health, infrastructure, and defence. We cooperate with the private sector, especially with pharmaceutical, food, biotechnology, and environmentally oriented companies. We also take care of the education of young researchers. Therefore, the training of dozens of doctoral students annually is included in our operations. Also noteworthy is our biology library, which has been collecting and storing important documents in the field of biological sciences for decades.

Our view of the future is the continuation of what we have always been committed to – developing superior knowledge and technologies in the field of life sciences and the environment and thereby contributing to successfully tackling the challenges of the future of human society. **The relocation to the new Biotechnology Hub, equipped with state-of-the-art research infrastructure, which was completed in autumn 2023, brought about improved research opportunities and a new drive for the researchers of our Institute.**



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 EXECUTIVE EDITOR: Marjan Žiberna
 Ljubljana, November 2023

NIB Biotechnology Hub

In autumn 2023, the relocation of the National Institute of Biology (NIB) to the Biotechnology Hub (BTS-NIB) was completed. This marks the realisation of a 15-year-long effort to provide the NIB with a building equipped with state-of-the-art research equipment and infrastructure, and thus with the appropriate conditions for cutting-edge research work.

The NIB has shared the premises with the Department of Biology of the Biotechnical Faculty at the University of Ljubljana since 1995. However, the then-new building of the Biological Centre on Večna pot in Ljubljana soon became too small due to the expansion of both institutions. The NIB gradually converted the auxiliary rooms and garages of the Biological Centre into laboratories, and containers were installed for this purpose. The solution was meant to be temporary but the premises where NIB carried out more than half of its research work remained in use until 2021. Researchers have been working in extremely difficult conditions in recent years.

In the summer of 2021, after years of effort, construction of the BTS-NIB started on the site. The first phase of construction was completed in autumn 2022, when the Department of Biotechnology and Systems Biology and the Department of Genetic Toxicology and

Cancer Biology moved into the building. In autumn 2023, when the construction and fitting-out of the building was fully completed, the Department of Organisms and Ecosystems Research and Shared Services moved in. The premises and research equipment of the BTS-NIB are also available to the Marine Biological Station Piran, which opens up new dimensions for marine ecosystem research. The two-phase relocation was very challenging for the construction and fit-out contractors as well as for the researchers, as the Institute's research work had to run smoothly at all times.

The available space at the BTS-NIB has been used extremely rationally. The laboratories, offices, lecture rooms, Shared Services offices and departmental offices are located on the ground and first floors. In addition to the machine installations, a research apiary (the so-called apiarium) and a quarantine greenhouse are located on the roof of the building.

FINANCING
Total investment value:
about EUR 36 million
Sources of financing:
80% EU cohesion funds
20% budget of the Republic of Slovenia

**NUCLEIC ACID
QUANTIFICATION
METHODS** are performed
in laboratories.



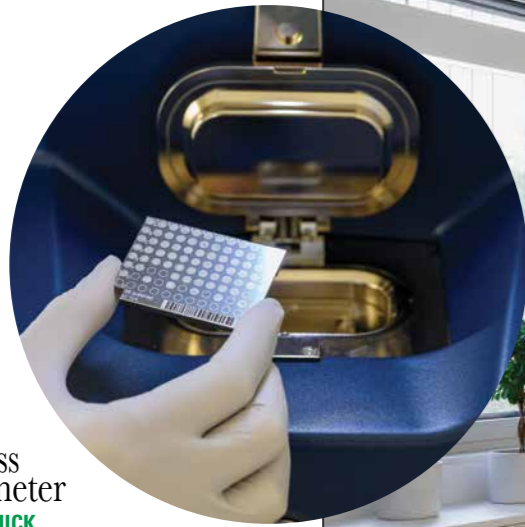
BTS-NIB
Head of the construction at NIB: **Majda Gostinčar**
Conceptual solution and project documentation:
David Mišič, Styria Arhitektura, d. o. o.
Construction, craft and installation work:
Kolektor Koling, d. o. o.
Construction supervision: **Elea iC, d. o. o.**
Consulting engineering: **Savaprojekt, d. d.**

The investment is co-financed by the Republic of Slovenia and the European Union from the European Fund for Regional Development.

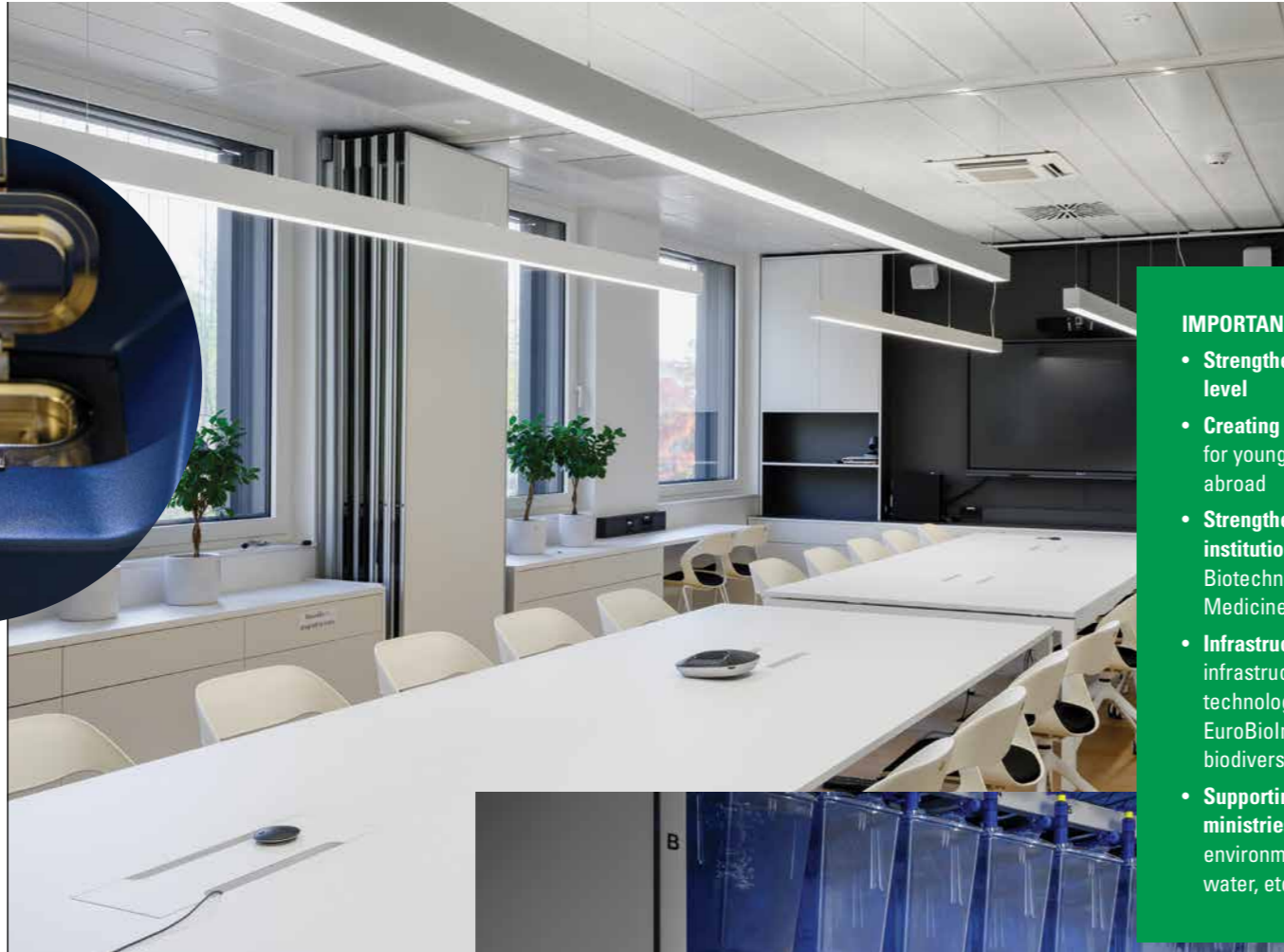
Plant clinic:
**THE QUARANTINE
GREENHOUSE**
is used for biological
testing of pathogenicity
of microbes isolated
from plant samples.

**MOLECULAR
BIOLOGY** methods
are carried out **IN
THE NEW
FACILITIES.**

The apiary is dedicated to the rearing and research of bumblebees and solitary bees, important but poorly studied wild pollinators of plants. The greenhouse consists of a series of quarantine chambers for studying plants in simulated and carefully controlled conditions. The basic structure of the building has been designed in such a way that adaptations can be made without major investments.



The mass spectrometer allows for **QUICK IDENTIFICATION OF BACTERIA** in different samples.



CONFERENCE ROOM, space for meetings, opinion exchanges, educational activities, etc.

IMPORTANCE OF BTS-NIB

- **Strengthening scientific excellence at the international level**
- **Creating an innovative environment**, particularly attractive for young Slovenian researchers and researchers from abroad
- **Strengthening cooperation with other Slovenian research institutions** (Jožef Stefan Institute, Institute of Chemistry, Biotechnical Faculty, Faculty of Pharmacy, Faculty of Medicine, etc.)
- **Infrastructure upgrading** (ELIXIR – European life science infrastructure for biological information for imaging technology in biological and biomedical sciences EuroBioImaging, for e-science and technology for biodiversity and ecosystem research LifeWatch)
- **Supporting national monitoring programmes and ministries** with state-of-the-art expertise (monitoring of the environment, GMOs, plant pathogens, SARS-CoV-2 in waste water, etc.)

The architectural design of the building is modular, with multiple sectors and individual entrances to the departments. Internal communication within the building is limited due to controlled access and clean pathways. The interior of the building meets all the criteria for scientific research, teaching and laboratory work processes. The external layout follows the principles of sustainability and integration into the surroundings, as the building is located in the Tivoli, Rožnik and Šišenski hrib Landscape Park. In the architectural design of the building and its construction, particular attention was paid to its location at the edge of the forest, next to a stand of black alder trees, and to the preservation of a grove of Japanese cherry trees, a gift from Japan to the Republic of Slovenia. The extent of paved areas is limited, with priority being given to shrubs, a new tree

BUILDING

- Floor dimensions: **152.80m x 23.50 m**
- Three floors: **ground floor, first floor and technical floor**
- Total area: **6593 m² net**
- Laboratory area: **2566 m²** (including quarantine greenhouse and research apiary)
- Area of offices and lecture rooms: **1741 m²**
- Other areas (communications, toilets, archives, etc.): **2286 m²**



A system **FOR FARMING AND MAINTAINING ZEBRAFISH** (*Danio rerio*) broods used mainly in **ECOTOXICOLOGICAL RESEARCH**.

plantation, and grassed areas. The eastern façade contains elements of environmentally sustainable greenery, the building is passively shaded by a grove of climbing plants, and the roof is also partly greened.

In addition to research, the new facilities and laboratories also allow for the organisation of specialised training courses at international level. As the NIB cooperates with many domestic and foreign research and educational institutions and companies, the BTS-NIB is an asset also for them and for the Slovenian scientific community as a whole. The BTS-NIB allows for the expansion of research areas and significantly improves the conditions for research activities, focusing on the environment, pollution, climate changes, biotechnology, and provision of healthy and safe food, as well as plant, animal, and human health. The BTS-NIB has been recognised by the European Commission as a model project – a state-of-the-art scientific infrastructure that will enable the NIB to accelerate its development at home and in the region. The BTS-NIB will enable the Institute to pursue its mission – to create knowledge that improves the quality of life for people and preserves nature – even more consistently.

MULTIPLIER EFFECTS OF BTS-NIB ON THE ECONOMY

- **Establishing a training centre** for further training of junior researchers and collaborators from companies
- **Providing research infrastructure for start-ups**
- **Expanding university and business education** at doctoral and post-doctoral level and functional training for the needs of the economy.

Department of Biotechnology and Systems Biology

HEAD OF THE DEPARTMENT
 PROF. DR. KRISTINA GRUDEN

The broad spectrum of our research, with an emphasis on the study of plants, their pests, and microorganisms, enables professional work for Slovenian government organisations and companies related to agriculture, the environment, and safe food, as well as domestic and foreign biotechnology, food, and pharmaceutical industries. We are a world leader in the field of nucleic acid quantification and the introduction of models to the study of plant function.

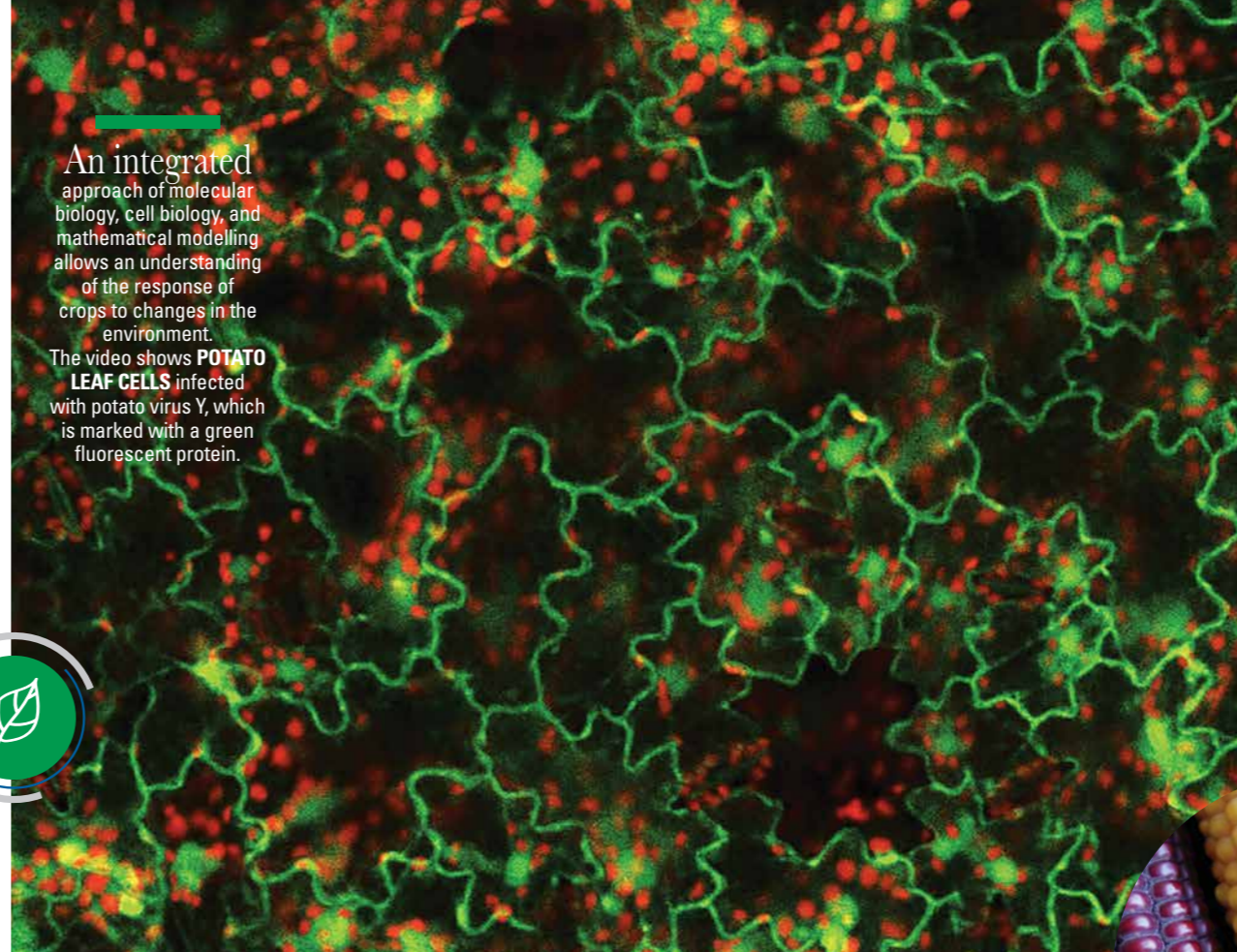
What does our **fundamental research** consist of? We focus a great deal of effort on understanding the response of plants to stress, especially biotic stress. In connection with that, we study interactions between plants and their pathogens and pests, as well as interactions with beneficial organisms. In the process, we use a systemic approach and attempt to understand organisms as a whole. Through modelling, we simulate responses and plan further experiments on this basis. In the case of plant disease agents, we research their diversity, pathogenicity, epidemiology, and role in plant hosts. We also research the presence of microbes, especially viruses, in various environments (water, air, soil, etc.) and their importance for human and plant health.

We achieve our goals using new approaches, such as systems biology, quantitative nucleic acid analysis, high-throughput sequencing, metagenomics, and microscopy. To integrate all data, we develop new approaches to visualisation, machine learning, and mathematical modelling of processes.

Among the many activities carried out by the Department of Biotechnology and Systems Biology is the study of viruses in different environments. Among them, there is the **TRACKING OF COVID-19 IN WASTEWATER**



An integrated approach of molecular biology, cell biology, and mathematical modelling allows an understanding of the response of crops to changes in the environment. The video shows **POTATO LEAF CELLS** infected with potato virus Y, which is marked with a green fluorescent protein.



What is the **practical value** of our research work? Based on the results of basic research, we develop effective, sustainable methods for biotechnological and biological control of microbes, new strategies for plant protection, safe food and water, and methods for characterising viruses in biomedical production processes. At the same time, we develop a technological platform that supports systems biology research and the development of new, metrology-oriented technological support and more effective identification and detection methods for microorganisms and genetically modified organisms (GMOs), including therapeutic viruses. These methods are also in use in the fields of pharmacy, human and animal health, and the environment.



Monitoring GENETICALLY MODIFIED ORGANISMS, the cultivation of which in Slovenia is precisely defined by regulations.

Our research enables support for companies and Slovenian governmental services, which we represent in international organisations, such as the European Plant Protection Organization (EPPO) and the European Network of GMO Laboratories (ENGL). We are an authorised national reference laboratory for the determination of GMOs and plant pathogenic bacteria. We provide professional support and diagnostics to the Administration for Food Safety, Veterinary Sector and Plant Protection of the Republic of Slovenia. We are also partners in two European reference laboratories: for the fields of virology and phytoplasmata, and bacteriology.

We are involved in the development of standards for the detection of GMOs and microorganisms at the European (CEN) and global (ISO) levels. We work closely with domestic and foreign companies in the fields of agriculture, biotechnology, and pharmaceuticals, including Lek, BIA Separations, Omega, BioSistemika, and others.

We participate in numerous **national and international scientific research** projects in the fields of plant biology, microbiology, bioinformatics, and metrology. We also transfer knowledge from quantitative molecular biology and systems biology to the fields of medicine, pharmacy, and ecotoxicology.

Department of Genetic Toxicology and Cancer Biology

HEAD OF THE DEPARTMENT
ASSOC. PROF. DR. **BOJANA ŽEGURA**

We conduct research in several interconnected fields: ecotoxicology, genetic toxicology, and cancer biology, as well as immunology and cellular immunotherapy. In the process, we use molecular, biochemical, biological, immunological, and toxicological methods in combination with the most modern 'omics' approaches.

What does our **fundamental research** consist of? In the field of genetic toxicology, we research the molecular mechanisms of the genotoxic action of different environmental pollutants (e.g. dietary carcinogens, natural toxins, pesticides, metals, drug residues, and nanomaterials) and the mechanisms of the protective action of natural substances (e.g. xanthohumol, rosmarinic acid, and essential oils) against cancer and other sicknesses. We study the mechanisms of cancer development, especially the role of proteolytic systems, tumour microenvironment, and different types of stem cells.

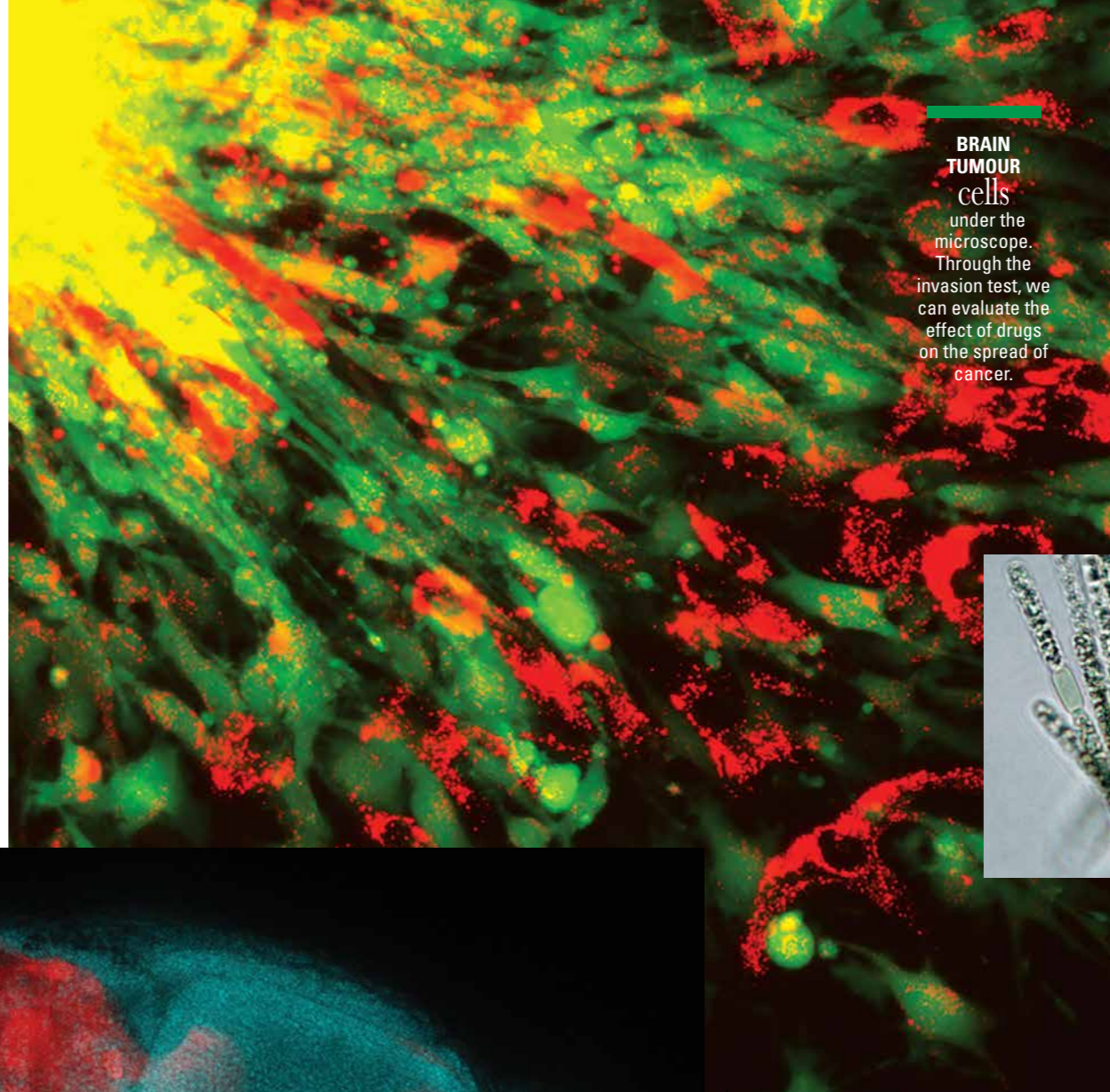
In the field of ecotoxicology, we develop new models and tools to assess the ecotoxicological and ecological

characteristics of the polluted aquatic environment and its impact on biodiversity.

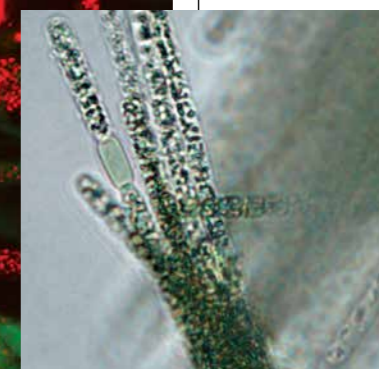
In the ecological monitoring of biodiversity, we are introducing modern genetic methods that will replace traditional taxonomic methods. To reduce and replace the use of experimental animals, we are developing new cell models, such as three-dimensional cell and organoid cultures that have improved properties compared to traditional two-dimensional in vitro systems and are, therefore, more relevant for the study of processes taking place in the human body. For this purpose, we are also developing a test system with zebrafish embryos.



A model OF ZEBRA FISH EMBRYOS used to study cancer. OBSERVATION OF BRAIN TUMOUR GROWTH in zebra brains under a confocal microscope.



BRAIN TUMOUR cells under the microscope. Through the invasion test, we can evaluate the effect of drugs on the spread of cancer.



Filamentous CYANOBACTERIA. Cyanobacteria that **CAN BE TOXIC** also live in our waters. Therefore, we develop fast and accurate methods for their identification.

In immunology and cellular immunotherapy, we establish substantive and infrastructural research platforms for the detailed study of cellular and molecular mechanisms involved in the antitumor function of the immune system, cancer resistance to therapies, autoimmunity, and responses to infections.

What is the **practical value** of our work? In the field of toxicology, we offer consulting and testing for the biological compatibility, toxicity, and genotoxicity of compounds and products. Mutagenicity testing is performed according to the principles of good laboratory practice following OECD guidelines.

We provide integrated services for companies in the development of new diagnostic and therapeutic approaches in the phase of preclinical in vitro efficacy and safety research. We carry out ecological monitoring of surface waters and prepare risk assessments of environmental interventions for clients. We cooperate with many domestic and foreign companies, as well as with ministries and agencies, in the fields of environmental protection and human health, nutrition, and civil protection.

Our findings regarding genetic toxicology contribute to the formulation of measures to prevent and reduce the impact of genotoxic environmental pollutants on human health and other organisms in the environment. Together with our partners, we are establishing a brain tumour bank, within which we collect tumour tissues, tumour cells, and blood from patients with these types of tumours. In the field of immunology and cellular immunotherapy, we research and develop approaches to the treatment of disease states, such as cancer and autoimmune and infectious diseases. An example is CAR T cell immunotherapy, a state-of-the-art cancer treatment approach using genetically modified T cells.

As collaborators and coordinators of national, European, and other international projects, **we cooperate with several research groups** from Europe, the USA, China, Argentina, Brazil, and South Africa.

Department of Organisms and Ecosystems Research

HEAD OF THE DEPARTMENT
DR. NATAŠA MORI

We study biological processes from the level of a cell to ecosystems. We develop the knowledge necessary for an integral understanding of biodiversity and the functioning of organisms and their function in the environment, from communication mechanisms and physiological responses to evolutionary processes and interspecies interactions in ecosystems.

What does our **fundamental research** consist of? Integrative basic research is key to understanding the mechanisms that shape the structure and function of natural and anthropogenic ecosystems. The purpose of the research in the fields of systematics and evolution, biogeography, communication networks, functional diversity, and interspecies interactions is to reveal key evolutionary and ecological mechanisms that shape patterns of morphological, genetic, physiological, ecological, and behavioural diversity.

Through research in the field of ecosystem services, biological resources, biomonitoring, and conservation biology, we study the effects of human intervention, pollution, and climate change on biotic diversity. On this basis, we formulate guidelines for sustainable development that will preserve biotic diversity at all levels and ensure the sustainable use of renewable resources. By connecting knowledge through different levels of biological organisation, we pave the way for innovative solutions.



There is **NO FOOD SECURITY** without **POLLINATORS**. For reliable pollination in agriculture, it is crucial to maintain sufficiently strong populations of **WILD POLLINATORS**, especially bumblebees and solitary bees.



Unpolluted water is extremely important for the preservation of **BIODIVERSITY**. The **GOLDFINCH** (*Carduelis carduelis*), like many other birds, needs it for drinking, and it also uses it to clean its feathers to keep them in a suitable condition for flight.



The European **stag beetle** is a species of European conservation importance within the **NATURA 2000** network, for which the NIB has been conducting the longest population monitoring in Europe.

Our research on pollinators helps to protect one of the key ecosystem services for agriculture and ensure food security. Identifying the response of organisms, populations, and ecosystems to climate change contributes to another of the key goals for the protection of biodiversity at the national, European, and global levels. By developing state-of-the-art biomonitoring approaches, including advanced technologies based on environmental DNA detection, we provide much-needed tools for conservation biology and relevant data on the state of biodiversity needed in decision-making and other societal processes. In the practical application of research findings and the definition of new areas of research necessary for the sustainable development of society, we are strongly connected with various companies and governmental and non-governmental organisations.

Our department **cooperates scientifically** with many universities, research institutes, and museums in Slovenia, Europe, and elsewhere in the world (USA, Brazil, China, South Korea, and Taiwan).

What is **the useful value** of our work? Our fundamental and applied interdisciplinary research is the basis for more sustainable interventions in nature and enables its more effective protection and management. We develop advanced methods and protocols for monitoring biodiversity and endangered species, as well as species that cause economic damage, and new approaches for their conservation and control. With an integral understanding of the interactions between human impacts, biodiversity, and ecosystem services, we contribute to natural solutions that ensure more sustainable use of water resources and the preservation of biotic diversity in agricultural and forest landscapes. We work to make Slovenia an example of biodiversity conservation and the sustainable management of renewable natural resources.

Marine Biology Station Piran

HEAD OF MARINE BIOLOGY STATION PIRAN
DR. BORUT MAVRIČ

For more than five decades, we have been conducting interdisciplinary basic and applied research on marine and coastal ecosystems. We research the biodiversity of marine organisms and their biotechnological potential, the ecology of plankton and benthos, biogeochemical processes, the effects of pollution and the circulation of coastal seas, and similar topics.



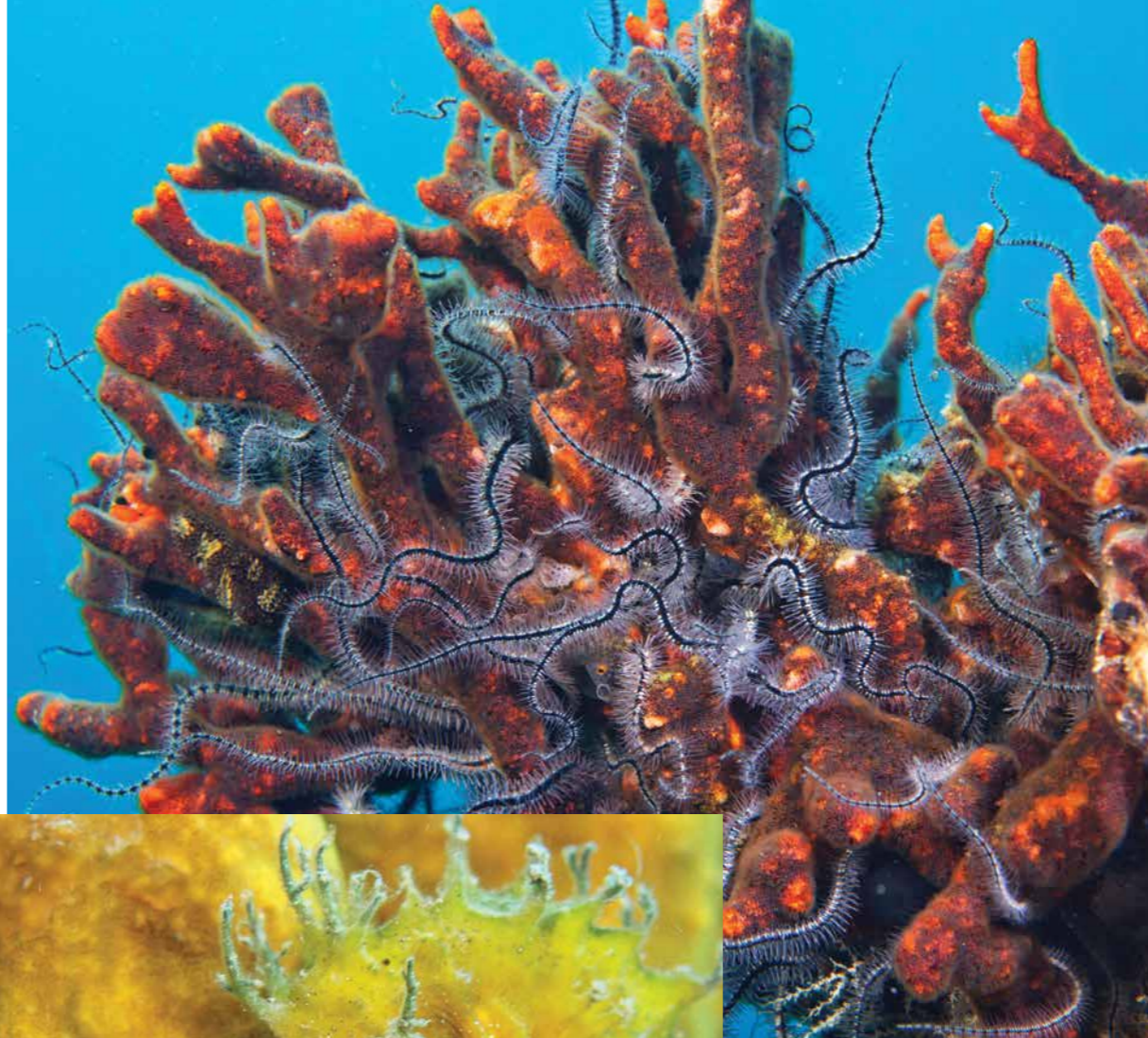
The direct

PRESENCE IN WATER is of exceptional importance for the study of the benthos, the community of organisms living on the seabed. Therefore, the Marine Biology Station has developed a strong scientific-diving team. A diver photographs the **COLOURFUL WORLD OF CORALIGEN**.

What does our **fundamental research** consist of? The focus is on knowledge of the biodiversity of pelagic and benthic communities and their variability in time and space. We are particularly interested in change as a result of climate change and other anthropogenic factors (e.g. pollution and urbanisation). In addition to the diversity and ecological characteristics of eukaryotic (microalgae) and prokaryotic microorganisms (bacteria and archaea) in different marine environments (in the water column, on the seabed, and in biofilms), we also study, in greater detail, their role in the carbon cycle and the conversion of organic matter of different origins, and interactions microbes with other organisms. We research the mass occurrence of gelatinous plankton and its population dynamics and phylogeography. We include comparative genomics and evolutionary aspects in biodiversity research and study processes in addition to the structure.



Concealment is an important strategy for avoiding predators. It is also used by the **EUROPEAN LONG-SNOUDED SEAHORSE** (*Hippocampus guttulatus*) **IN THE SAFE SHELTER OF THE GOLD SPONGE** (*Aplysina aerophoba*).



The benthic flora

(in the picture: *Schizoporella errata* and **BRITTLE STAR** *Ophiotrix fragilis*) is a **SEAWATER CLEANER** because it represents an important sink of organic matter from the water column.

What is the **practical value** of our research work? By monitoring the ecological state of the sea, we assess anthropogenic impacts on the marine environment. Research on harmful algal blooms is used to design controls for biotoxins in marine organisms. Our research provides guidelines for the development of marine biotechnology in the region and for the prevention of its infiltration into the production of food from the sea. Analyses of the spread of pollutants, marine organisms, and suspended sediment by marine currents and circulation prediction are essential for efficient response to disasters and pollution at sea. Defining the circulation conditions and ecological potential in marine space is necessary for designing artificial structures and predicting the spread of pathogens in the sea.

We study the biodiversity of the benthos (invertebrates, macroalgae, and seagrass) and fish, monitor the introduction of non-native species, plan measures for the conservation and restoration of endangered species and habitats, and develop indices to assess the environmental and ecological state of the sea. We deal with the biogeochemistry of the water column and sediment. We study the issue of water pollution with microplastics and the decomposition of organic matter and selected pollutants by photochemical and microbial processes. We analyse the effects of pollution on organisms using biomarkers. With oceanographic observations and numerical simulations, we study the dynamics of coastal and open waters and sediment transport. We strengthen the development of observational and information infrastructure at sea.

We have **extensive international cooperation** with researchers from many European countries, the USA, South America, Japan, Russia, and Israel. In Slovenia, we cooperate with all universities and leading research institutes. Important partners in the implementation of applied research are government agencies and public institutions, local communities, and larger companies (e.g. Luka Koper), as well as smaller development companies.

The Marine Biology Station Piran is fully integrated into the international scientific community; through its research activity, it offers knowledge for action that can lead to the improvement of the health of the oceans, which is especially important in light of climate change and other anthropogenic pressures.

NIB Infrastructural Centre

The infrastructural centre Planta in Ljubljana (IC Planta) and the infrastructural CENTRE of the Marine Biology Station in Piran (IC MBP) comprise the NIB Infrastructural Centre. They offer their services and use of equipment to NIB researchers and other public and private sectors, thereby enabling research, diagnostic, and teaching activities.

The topics of research and analyses for which IC NIB's large infrastructure equipment is used highly very diverse. Up to 130 programmes and projects are carried out with it annually. Almost a third of them are from other Slovenian research organisations. Therefore, the equipment is very well used.

IC MBP in Piran supports the research and application activities of Slovenian ministries (the Ministry of the Environment, Climate and Energy, the Ministry of Agriculture, Forestry and Food, and the Ministry of Education), agencies and institutes (the Slovenian Environment Agency and the Institute for Water of the Republic of Slovenia), administrations (Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection, Slovenian Maritime Administration), the Institute of the Republic of Slovenia for Nature Conservation, and coastal municipalities. It enables the education of young researchers and the implementation of certain courses at the universities in Ljubljana, of Primorska and in Maribor. The infrastructural equipment and

The foundation of the NIB **INFRASTRUCTURAL CENTRE** is up-to-date research equipment.



The large infrastructure equipment of the IC MBP consists of the following:

- the research vessel Sagita is equipped with modern navigation and research equipment, different samplers, an acoustic current, and a modern multiparametric probe
- the oceanographic buoy Vida with meteorological measuring instruments, multiparametric probes, and acoustic current meter
- a smaller vessel: Carolina
- Wera high-frequency radar
- line electron microscope – SEM (Tescan MIRA LMU)
- FTIR microscope (PerkinElmer Spotlight 200i)
- apparatus for DNA amplification in real time (Thermo Fisher QuantiStudio 3) SPARK multi-modular microtiter plate reader (Tecan)
- High Performance High Pressure Liquid Chromatograph (Agilent Technologies)
- Segmented-flow analyser (SFA) for seawater samples (Seal Analytical QuAAtro 39)



The research EQUIPMENT of the **NIB INFRASTRUCTURAL CENTRE** supports marine research and plant research with an emphasis on **MOLECULAR BIOLOGY** and **ELECTRON AND CONFOCAL MICROSCOPY**.

the top-notch knowledge of the employees enable state-of-the-art research at sea and place the centre among the leaders in the Mediterranean. IC MBP is a UNESCO/IODE National Oceanographic Data Committee (NODC).

IC Planta enables research activities and serves as support to Slovenian ministries (the Ministry of the Environment and Spatial Planning, the Ministry of Agriculture, Forestry and Food, the Ministry of Education, and the Ministry of Health), inspectorates (for agriculture, forestry, and food, etc.) and other state authorities (Administration of the

IC Plant's large infrastructure equipment consists of the following:

- quarantine greenhouse (Rastlinjaki Gajšek and CMF),
- chambers for growing plants and tissue cultures and chambers for separate growing plants (PSI and Kambič),
- Plant Phenotyping System (PSI)
- two scanning electron microscopes (Talos L120C and Philips CM100) with CCD cameras and all necessary equipment for sample preparation
- Plant imaging device (Vilber Newton 7.0 BIO),
- a confocal microscope (Leica Stellaris 5) and a confocal stereomicroscope (Leica TCS LSI)
- plant imaging equipment (Vilber Newton 7.0 BIO)
- apparatuses for real-time PCR (Roche Light Cycler 480, ABI 7900HT Fast, ABI PRISM ViiA7, ABI QuantStudio7 Flex, ABI QuantStudio7 Pro)
- apparatuses for digital PCR (Biorad QX200, Biorad QXone, Stilla naica and Fluidigm BioMark HD)
- pipetting robot (Hamilton Microlab STARlet)
- ultracentrifuge (Beckman Coulter Optima XPN-90)
- a system for rapid preparation and concentration of biological samples with the possibility of biological analyses on culture media
- desktop mass spectrometer for automatic identification of microorganisms (Bruker MALDI TOF Biotyper)

It is also possible to use spectrofluorimeters (SynergyMx and BioTek) and a system for the identification of bacteria with the analysis of cellular fatty acids by gas chromatography (Sherlock Microbial Identification System).

Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection, National Laboratory of Health, Environment and Food, etc.), and Slovenian (BIA Separations, Cobik, Žito, etc.) and international pharmaceutical companies working in the field of drug development for gene therapy. It also plays an important role in the education of many young researchers and the implementation of specific courses in cooperation with the universities of Ljubljana and Nova Gorica and the Jožef Stefan International Postgraduate School. For frequent users of our large infrastructure equipment, which is very up-to-date and professionally maintained, we organise training sessions for its use. We provide services and analyses on it for different clients.

Knowledge transfer and business opportunities

At the NIB, we are also focused on research that meets the current needs of society and industry. Our goal is to effectively transfer the results of this research to the public and the private spheres, both in Slovenia and globally. We offer different types of cooperation to partners for jointly solving development challenges – from joint development and research projects to the transfer of knowledge in the form of licence agreements or through the establishment of spin-off companies.

Monitoring of the ecological and environmental state of the sea

We carry out monitoring to assess the ecological state of the sea based on biological quality elements (phytoplankton, macroalgae, and benthic invertebrates) and supporting quality elements following the Water Framework Directive (WFD 2000/60/EC).

We develop methods for assessing the environmental state of the sea in terms of various biological, physical, and chemical elements, as well as indicators of anthropogenic pressures and impacts following the Framework Strategy on the Marine Directive (MSFD 2008/56/EC).

We monitor the occurrence of toxic microalgae in seawater.

With data from observation systems (oceanographic buoy Vida and HF radar), we enable operational oceanography and circulation forecasting in the Gulf of Trieste.

We advise and professionally support decision-makers in the fields of environmental policies and the sustainable blue economy.

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Detection, Characterisation and Quantification of Micro-organisms

We perform detection of plant bacteria, viruses and phytoplasmas, as well as other bacteria and viruses, using conventional and state-of-the-art methods in accordance with ISO17025 and other applicable international standards. Bacteria are identified by mass spectrometry over a few minutes and characterised by growth parameter determination and comparative genomic tools. High-throughput sequencing is used for non-targeted detection of viruses in

different sample types. We develop and validate specific tests for the quantification of micro-organisms in the laboratory (qPCR, dPCR) or in the field (LAMP). We provide services for the organisation of international qualification tests, comparative tests, and diagnostic training. We concentrate viruses from water samples using CIM technology and perform virus purification for various applications. We determine the efficacy of antimicrobial substances and bacteriophages and perform scanning electron microscopy analyses on request: localisation of biomolecules and cells, immunolocalisation, negative and positive contrasting of samples, observation of viruses, bacteria, and fungi (including macrophages and virus-like proteins).

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The NIB is a **KEY MEMBER** of the Slovenian and international **INNOVATION AND DEVELOPMENT ENVIRONMENT** in the fields of inland and marine biology, biotechnology and systems biology, microbiology, genetic toxicology, and cancer biology.

Services Using Advanced Molecular Biology Techniques in Biotechnology

We perform process studies in industrially or agronomically relevant organisms using different quantitative biology techniques such as high-throughput sequencing, quantitative PCR (qPCR), and digital PCR, including data analysis and integration. Applications of these studies include the improvement of industrial production organisms and processes in biopharmaceuticals and biotechnology, and support for plant breeding and adaptation of agronomic practices. We prepare samples from different biological systems (homogenisation, nucleic acid isolation). We develop approaches for the integration of multi-level omics data (e.g. transcriptomics, proteomics, and metabolomics), knowledge networks of molecular biological processes, and dynamic computational

models to interpret experimental data. To this end, we have developed a number of internationally recognised tools such as the generally applicable quantGenius (<http://quantgenius.nib.si>) and DiNAR (<https://nib-si.shinyapps.io/DiNAR/>), and the specialised plant data analysis tools GoMapMan (<https://gomapman.nib.si/>) and StressKnowledgeMap (<https://skm.nib.si/>). We use a combination of different techniques (molecular, serological, microscopy) to characterise viral vectors used for vaccines or gene therapy.

CONTACT DETAILS:
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Detection of Genetically Modified Organisms (GMOs) and Quality Assurance (QA)

We perform GMO detection, functional analysis, and other GMO-related studies. We develop protocols and work schemes and develop and validate methods following the ISO/IEC 17025 and ISO 900 standards.

We establish molecular and bacteriological laboratories, prepare expertise in metrology, and offer professional support and training for the quantitative analysis of nucleic acids and metrology.

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Dr. **David Dobnik**
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Toxicological analyses

We perform genotoxicity tests *in vitro*. They are necessary to satisfy various regulations: the bacterial reverse mutation test (Ames test), the micronucleus test *in vitro* on mammalian cells, the gene mutation test *in vitro* on mammalian cells, and the comet test *in vitro* on mammalian cells. Mutagenicity testing is carried out under

the principles of Good Laboratory Practice (GLP), following OECD guidelines.

We perform a toxicity test on the embryos of zebrafish (*Danio rerio*) (FET test) with an examination of the effects according to ISO 7346-3:1998, 5667-16 and relevant OECD guidelines and recommendations. We can also evaluate additional toxicological effects: sublethal effects and genotoxicity (comet test).

We evaluate the toxicological properties of complex environmental samples (e.g. industrial and municipal sewage) using specialised tests (e.g. SOS/umu test with the bacterial strain *Salmonella typhimurium* TA1535/pSK1002, Ames MPF™ 98/100 Aqua test, and FET test).

We perform tests of the biological compatibility of medical devices *in vitro*. They are necessary to ensure the adequacy of medical devices according to the ISO 10993-1:2020 standard. The tests are performed on mouse fibroblast cells following the ISO 10993-5:2009 standard.

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Services for preclinical *in vitro* research and stem cell technology

We produce two-dimensional and three-dimensional *in vitro* cell models for research into mechanisms of action, efficacy, and safety in the development of diagnostic and therapeutic approaches for cancer treatment.

We perform isolation procedures and advise on the preparation of mesenchymal stem cells from human tissues for various research purposes.

We offer expert knowledge regarding tumour biomarkers and their pre-clinical use.

CONTACT DETAILS:
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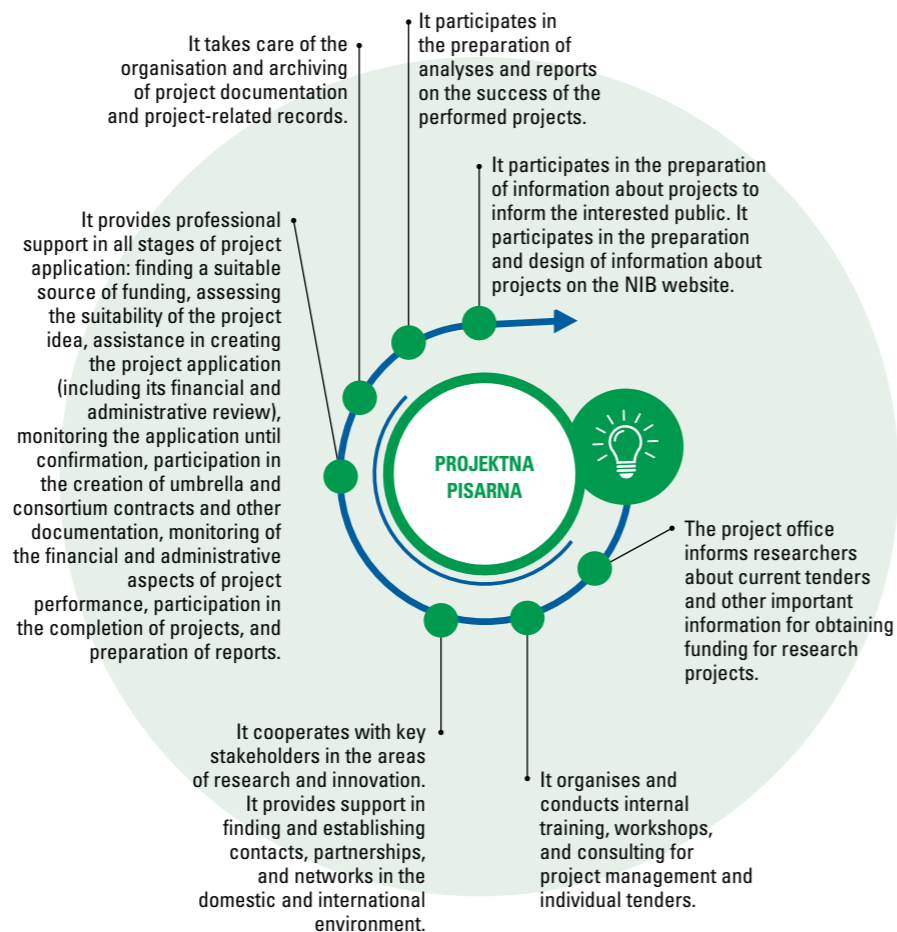
Project Office

HEAD OF THE PROJECT OFFICE
DR. DAMJANA MIKLIČ MILEK

The project office is the central point of comprehensive information, advisory, and administrative support for the institute's researchers in the planning, applications, implementation, and monitoring of numerous national and international projects. The office was established in 2021.

The project office offers professional support to researchers, from the initial concept for the performance of a process or an experiment to the publication of new knowledge or discoveries. As part of the project work, at least three activities are carried out at the same time – application and search for the financing of new projects, the performance of current projects, and publication and dissemination of the results of completed projects.

Good knowledge of scientific and professional findings, the contribution of its knowledge, ongoing monitoring of challenges that require changes in legislation and technical guidelines, involvement in European and international networks, and flexibility and responsiveness enable the NIB to cooperate superbly with the public sector, as well as to respond to the needs of the public administration regarding current environmental and social challenges.



NIB researchers participate actively in various networks, consortia, forums, associations, organisations, platforms, and partnerships in Slovenia and internationally.

Research infrastructure	Description
LIFEWATCH-SI	The NIB is involved in the Slovenian LifeWatch-SI consortium and through it in the e-Science and Technology Infrastructure for Biodiversity and Ecosystem Research LifeWatch-ERIC, also contributing marine data and participating in the consortium's joint actions.
eLTER-SI	The NIB is a member of the Slovenian eLTER-SI consortium with the aim of promoting research activities in the field of ecosystems and critical zones and their socio-ecological research and to be included in eLTER ESFRI as soon as possible.
ELIXIR	The NIB is a member of ELIXIR, the European Research Infrastructure for Life Sciences and Biological Information, which supports life sciences research and its translation into medicine, agriculture, bioindustries, and society. Within the Slovenian ELIXIR NIB node, the NIB leads content on systems biology and systems medicine.
METROFOOD-RI	The NIB is a member of METROFOOD-RI, the European research infrastructure for the promotion of metrology in food and nutrition.
SiMBioN	With its large electron and confocal microscopy infrastructure, NIB is a member of the Slovenian SiMBioN node as part of the EURO-BIOIMAGING (EuBI) European Research Infrastructure in the field of biological, biomolecular, biochemical and medical imaging, and related technologies.
Instruct.si	The NIB, with its large electron microscopy infrastructure, has also joined the Slovenian consortium Instruct.SI, through which Slovenia is part of the European research infrastructure in structural biology Instruct-ERIC.

National projects implemented by the NIB and mostly financially supported by the Slovenian Research Agency include infrastructure and research programmes, basic and applied projects, postdoctoral projects, young researchers, targeted research programmes, bilateral research projects, and other international cooperation.

The NIB performs international projects within the framework of centralised EU tenders and schemes, such as H2020, HEU, Erasmus+, EU4H, EDF, EMFAF, LIFE, and other tenders of directorates-general and partnerships, as well as decentralised tenders, such as European territorial cooperation (e.g. Interreg projects) and decentralised tenders arising from cohesion policy.

The NIB also responds to the needs of the market and participates in projects for domestic and foreign clients of services (business companies, state institutions, public institutions, etc.).





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Dislocirana enota
Dislocated Unit

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EUROPEAN UNION
EUROPEAN REGIONAL
DEVELOPMENT FUND

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