



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



MORSKA BIOLOŠKA POSTAJA PIRAN  
MARINE BIOLOGY STATION PIRAN

ODDELEK ZA BIOTEHNOLOGIJO IN SISTEMSKO BIOLOGIJO  
DEPARTMENT OF BIOTECHNOLOGY AND SYSTEMS BIOLOGY

ODDELEK ZA GENETSKO TOKSIKOLOGIJO IN BIOLOGIJO RAKA  
DEPARTMENT OF GENETIC TOXICOLOGY AND CANCER BIOLOGY

ODDELEK ZA RAZISKAVE ORGANIZMOV IN EKOSISTEMOV  
DEPARTMENT OF ORGANISMS AND ECOSYSTEMS RESEARCH

INFRASTRUKTURNI CENTER NIB  
NIB INFRASTRUCTURAL CENTRE

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**nova spoznanja za trajnostni razvoj**  
new knowledge for sustainable development

## NACIONALNI INŠTITUT ZA BIOLOGIJO



izr. prof. dr. Matjaž Kuntner, direktor  
Assoc. Prof. Dr Matjaž Kuntner, Director

Nacionalni inštitut za biologijo (NIB) je bil ustanovljen leta 1960 in je danes vodilni javni raziskovalni zavod na področju bioloških ved v Sloveniji z okoli 140 zaposlenimi. NIB deluje na dveh lokacijah v Sloveniji – v Biološkem središču v Ljubljani in na Morski biološki postaji Piran.

NIB izvaja temeljne in uporabne biološke raziskave, ki pa se prepletajo še z drugimi naravoslovnimi vedami, kot so kemija, fizika, agronomija, ekologija in biomedicina. Raziskave se financirajo s projekti pridobljenimi na razpisih Javne agencije za raziskovalno dejavnost Republike Slovenije, raznih ministrstev Republike Slovenije, Evropske unije in drugimi mednarodnimi projekti.

Pomembno poslanstvo NIB-a je svetovanje strokovnim službam ministrstev ter izvajanje analiz in ekspertiz v podporo politikam na več področjih kmetijstva, okolja in njegove varnosti, obrambe ter zdravstva in preventivnega zdravstva. Sodelujemo tudi s poslovnim sektorjem, predvsem s podjetji v farmacevtski, prehranski ter drugih biotehnoško in okoljsko usmerjenih industrijah. Tovrstno delovanje podpira Pisarna za prenos tehnologij, ki tesno sodeluje s sorodnimi pisarnami v Sloveniji. Nova znanja genetike in genske tehnologije so pripeljala do ustanovitve visokotehnoškega in prvega odcepljenega podjetja NIB – BioSistemika.

Pomembna vzporedna dejavnost inštituta je izobraževanje mladih raziskovalcev; v proces usposabljanja je vključeno nekaj deset doktorandov.



Raziskave inštituta potekajo v okviru štirih raziskovalnih oddelkov:

- Oddelek za biotehnologijo in sistemsko biologijo,
- Oddelek za genetsko toksikologijo in biologijo raka,
- Oddelek za raziskave organizmov in ekosistemov,
- Morska biološka postaja Piran.

V sklopu NIB deluje tudi Infrastrukturni center NIB, ki podpira smeri:

- biotehnologija in sistemska biologija v okviru Oddelka za biotehnologijo in sistemsko biologijo ter
- morske vede v okviru Morske biološke postaje Piran.

Vsebinsko dejavnosti inštituta pokrivajo širok spekter prepletajočih se raziskav. Raziskujemo biologijo organizmov: viruse, bakterije, rastline, nevretenčarje, vretenčarje in človeka. Pokrivamo področja bioloških znanosti: ekologijo, varstvo okolja, fiziologijo, biologijo celice in molekularno biologijo. Naše ekološke raziskave vključujejo sladkovodne, kopenske in morske ekosisteme. Naše aplikativne raziskave so uporabne v biomedicini in biotehnologiji.

V okviru NIB-a deluje v Biološkem središču tudi Biološka knjižnica, ki že desetletja hrani pomembne dokumente iz bioloških znanosti.

Naša vizija ostaja ustvarjati vrhunsko znanje in tehnologije na področju ved o življenju in okolju, ki bodo vpleteni v sodobno družbo in gospodarstvo v Sloveniji in tudi onkraj njenih meja.



## NATIONAL INSTITUTE OF BIOLOGY

The National Institute of Biology (NIB) was founded in 1960. With around 140 employees, it is one of the leading public research institutes in the biological sciences in Slovenia. The NIB operates in two different locations – the Biological Centre in Ljubljana, and the Marine Biology Station Piran, in Piran, on the Adriatic coast.



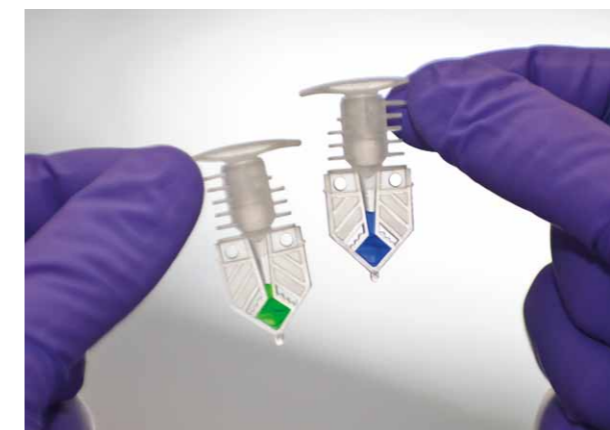
The NIB performs basic and applied biological research that is integrated with the other natural sciences, including chemistry, physics, agronomy, ecology and biomedical sciences. The research is supported by grants from the Slovenian Research Agency (ARRS) and various Ministries, as well as international funding, which is mainly as EU projects.

The core mission of the NIB is to provide advice for the various Government Ministries through specific analyses, and to offer other services and expert opinions on various aspects of agricultural, environmental, defence, and human-health protection. We work closely with the private sector, especially the pharmaceutical and food industries, and also with biotechnological companies. These operations are supported by the Office of Technology Transfer, which cooperates closely with similar offices across Slovenia. New knowledge from genetics and gene technology have resulted in the establishment of the first high-technology spin-off company at the NIB – BioSistemika.

An important parallel activity of the NIB is the education of young researchers. A good number of PhD students (generally around 20) are included in various research projects being carried out.

The research activities at the NIB are defined according to the four research Departments:

- Department of Biotechnology and Systems Biology;



- Department of Genetic Toxicology and Cancer Biology;
- Department of Organisms and Ecosystems Research;
- Marine Biology Station Piran.

An integral part of the NIB is the NIB Infrastructure Centre that supports the relevant Departments, particularly in terms of:

- Biotechnology and systems biology;
- Marine sciences.

A broad spectrum of interrelated research is covered across the activities of the NIB. We carry out research on the biology of organisms, such as viruses, bacteria, plants, non-vertebrates, vertebrates and human. We cover many fields across the biological sciences, including ecology, protection of the environment, physiology, biology of the cell, and molecular biology. Our ecological research includes freshwater, terrestrial and marine ecosystems. Our applied research is useful in the biomedical sciences and biotechnology.

The Central Biology Library that operates within the NIB at the Biological Centre has been compiling important documents from all areas within the biological sciences for decades.

Our vision remains to produce knowledge and technologies of the highest quality in the areas of the life sciences and the environment that can be integrated into modern society and the economy in Slovenia, and throughout the rest of the world.

## MORSKA BIOLOŠKA POSTAJA PIRAN



izr. prof. dr. Patricija Mozetič, vodja oddelka  
 Assoc. Prof. Dr Patricija Mozetič, Head of Department

Morska biološka postaja Piran (MBP) je osrednja enota v slovenskem prostoru, ki izvaja temeljne in uporabne multidisciplinarnе raziskave morskih in obalnih ekosistemov. Raziskujemo biodiverzitetu morskih organizmov, ekologijo planktona in bentosa, dinamiko prokariotskih mikroorganizmov, biogeokemijske procese, vplive onesnaženja in cirkulacijo obalnih morij.

### TEMELJNE RAZISKAVE

- Proučujemo značilnosti pelagičnega ekosistema s poudarkom na planktonskih združbah ter spremembe v združbah, ki jih izzovejo antropogeni dejavniki (npr. eutrofikacija, ladijski promet) in klimatske spremembe. Proučujemo tudi trofične povezave med funkcionalnimi skupinami planktona v pelagičnih prehranjevalnih verigah.
- Poleg ekoloških značilnosti bakterij in arhej v različnih morskih okoljih (v vodnem stolpcu, na morskem dnu, v biofilmih) podrobneje proučujemo tudi njihovo vlogo pri pretvorbah organske snovi različnega izvora in interakcije mikrobov z drugimi organizmi.
- Raziskujemo populacijsko dinamiko želatinoznega planktona, filogeografijo, disperzijo in masovno pojavljanje v povezavi z oceanografskimi razmerami in antropogenimi vplivi (npr. konstrukcije v morju).
- Proučujemo biodiverzitetu bentosa (nevretenčarji, makroalge, morske trave) in rib; spremljamo vnos tujerodnih vrst in razvijamo indekse za oceno stanja habitatnih tipov v obalnih vodah.
- Ukvarjamo se z biogeokemijo vodnega stolpca in sedimenta, proučujemo kroženje živega srebra, razgradnjo organske snovi in izbranih onesnažil s fotokemičnimi in mikrobnimi procesi ter analiziramo vplive onesnaženja na organizme z uporabo biomarkerjev.

- Z oceanografskimi opazovanji in numeričnimi simulacijami proučujemo dinamiko obalnih voda in transport sedimenta.

### UPORABNOST IN POMEN RAZISKAV

- Z monitoringom ekološkega stanja morja ocenjujemo antropogene vplive na morsko okolje. Uporabljamo standardizirane metode, ki so predpisane v slovenski in mednarodni zakonodaji s področja okolja.
- Ekološke raziskave škodljivega cvetenja alg se uporabljajo za načrtovanje nadzora nad biotoksini v morskih organizmih.
- Analize širjenja onesnaževal, morskih organizmov in suspendiranega sedimenta s tokovi ter napovedovanje cirkulacije so neizogibne pri ukrepanju v primeru nesreč in onesnaženj na morju.
- Opredelitev cirkulacijskih razmer in ekološkega potenciala v morskem prostoru je pomembna za načrtovanje umetnih struktur ter njihovega vpliva.

### ZNANSTVENO SODELOVANJE

Imamo razvejano mednarodno sodelovanje z raziskovalci iz številnih evropskih držav, ZDA, Južne Amerike, Japonske, Rusije in Izraela. V Sloveniji sodelujemo z vsemi univerzami in vodilnimi raziskovalnimi inštituti. Pomembni partnerji pri izvajanju uporabnih raziskav so agencije in številna manjša razvojna podjetja.

## MARINE BIOLOGY STATION PIRAN

The Marine Biology Station Piran is the central unit in Slovenia where both basic and applied multidisciplinary research into marine and coastal ecosystems is carried out. Its research comprises biodiversity of marine organisms, ecology of plankton and the benthos, dynamics of prokaryotic microorganisms, biogeochemical processes, effects of pollution, and circulation of the coastal waters.

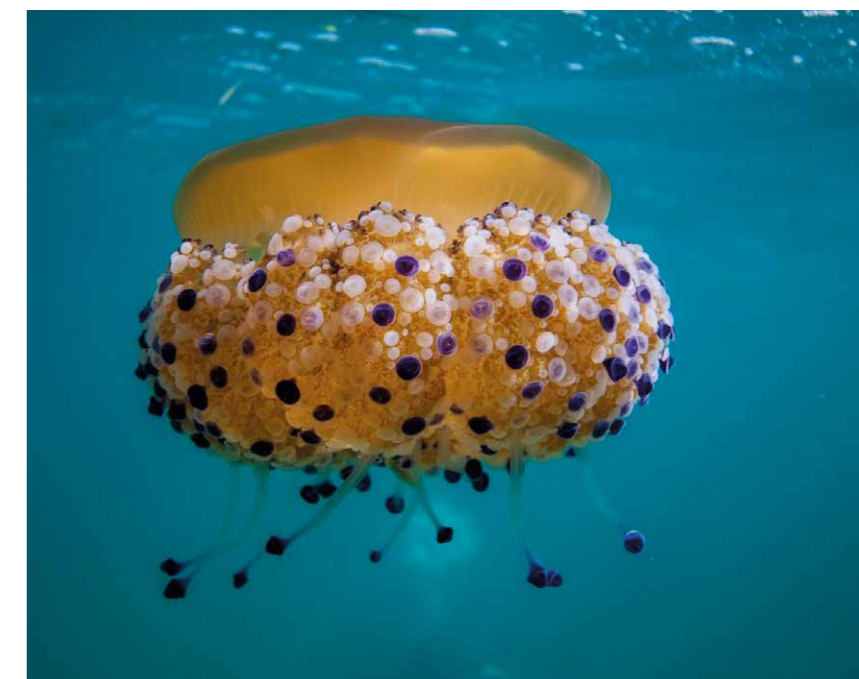


### BASIC RESEARCH

- We study climate change and the characteristics of pelagic ecosystems, with an emphasis on plankton communities and the changes in these communities that are triggered by anthropogenic factors (e.g., eutrophication, maritime transport). The trophic interactions are studied between functional groups of plankton in pelagic food chains.
- As well as studies on the ecological characteristics of bacteria and archaea in different marine environments (e.g., water columns, seafloor, biofilms), we investigate their roles in the transformation of organic matter and in the interactions between microbes and other organisms.
- We investigate the population dynamics of gelatinous plankton, as well as their phylogeography and dispersion, and the massive outbreaks that can occur in relation to oceanographic factors and anthropogenic impacts (e.g., constructions in the sea).
- We study the biodiversity of the benthos (e.g., invertebrates, macroalgae, seagrasses) and fish, and we carry out surveillance related to the introduction of alien species. We develop indices to assess the status of habitats in the littoral and coastal waters.
- We conduct research into the biogeochemistry of water column and marine sediment, mercury cycling, and degradation of organic matter and selected pollutants through photochemical and microbial processes. We apply biomarkers to study the effects of pollution.
- We conduct oceanographic observations and numerical simulations to study the dynamics related to the water mass and the transport of resuspended sediments.

### RELEVANCE FOR APPLICATION

- Assessment of the ecological and environmental status of the sea and the prevailing impacts, according to national, European and international legislation.
- Ecological studies of harmful algal blooms, to support monitoring of the biotoxins in marine organisms.
- Analyses of the spread of contaminants, marine organisms and suspended sediments, in terms of currents and forecasts of circulation, which are essential for when action



needs to be taken should there be accidents and pollution of the sea.

- An estimate of the circulation properties and ecological potential in the marine environment, which is essential for planning of artificial structures and analysis of their effects.

### SCIENTIFIC COLLABORATION

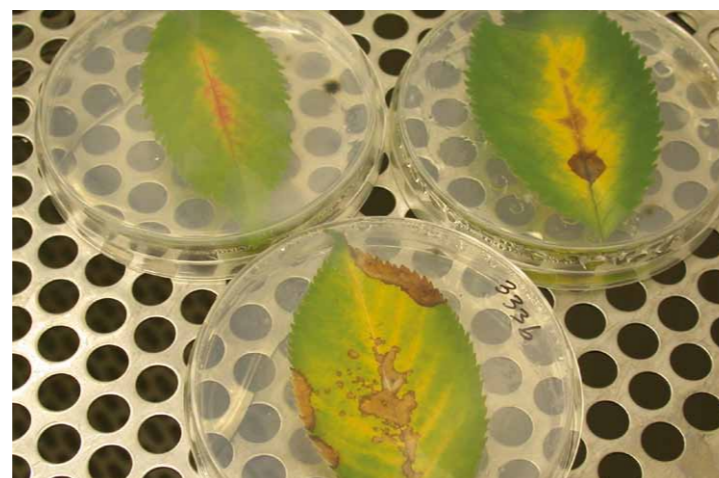
The NIB researchers at Marine Biology Station Piran have extensive international collaborations with other researchers from many European countries, and from the USA, Japan, Russia, Israel, and the countries in South America. In Slovenia, we work with all of the universities and the leading research institutes. Agencies are also important partners in applied projects, and these comprise many small-to-medium-sized research enterprises.

## ODDELEK ZA BIOTEHNOLOGIJO IN SISTEMSKO BIOLOGIJO



prof. dr. Maja Ravnikar, vodja oddelka  
Prof. Dr Maja Ravnikar, Head of Department

Naše raziskave vključujejo širok spekter bioloških znanosti s poudarkom na proučevanju rastlin, njihovih škodljivcev in mikroorganizmov. Raziskave omogočajo strokovno delo slovenskim vladnim organizacijam in različnim podjetjem, ki so povezana s kmetijstvom, okoljem in varno hrano, ter biotehnoški, prehranski in farmacevtski industriji.



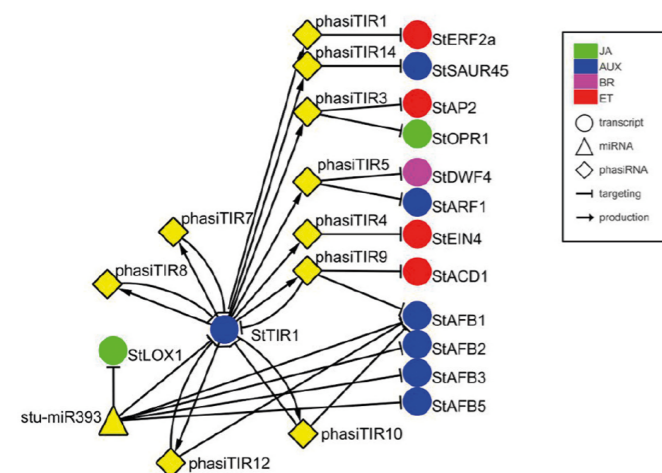
učinkovitejših identifikacijskih in detekcijskih metod za mikroorganizme in gensko spremenjene organizme (GSO), vključno s terapevtskimi virusi, ki so uporabljene tudi na področjih farmacije, človekovega zdravja in zdravja živali ter okolja.

Naše raziskave omogočajo podporo podjetjem in slovenskim vladnim službam, ki jih zastopamo v mednarodnih organizacijah, kot so EPPO (Evropska organizacija za varstvo rastlin) in ENGL (Evropska mreža laboratorijev za določanje GSO). Zagotavljamo strokovno podporo in diagnostiko Upravi za varno hrano, veterinarstvo in varstvo rastlin pri Ministrstvu za kmetijstvo, gozdarstvo in prehrano. S strani Evropske unije smo imenovani partnerji v dveh Evropskih referenčnih laboratorijih za področje virologije in fitoplazem ter bakteriologije.

Smo pooblaščen nacionalni referenčni laboratorij za določanje GSO v hrani, krmi in semenih ter za rastlinsko bakteriologijo in fitoplazme. Smo nosilec nacionalnega etalona za področje množina snovi/bioanalize nukleinskih kislin, zlasti na področju GSO in mikroorganizmov v bioloških in drugih materialih (Urad Republike Slovenije za meroslovje). Oddelek je akreditiran po ISO 17025 pri Slovenski akreditaciji s št. akreditacije LP-028 na področju preskušanja za določanje GSO in mikroorganizmov – povzročiteljev bolezni rastlin. Na ravni CEN in ISO smo vključeni v razvoj standardov za detekcijo dovoljenih in nedovoljenih GSO ter mikroorganizmov. Tesno sodelujemo s podjetji Lek, BiaSeparations, Omega, AveXis, odcepljenim podjetjem BioSistemika ter drugimi domačimi in tujimi podjetji s področja kmetijstva, biotehnologije in farmacije.

## ZNANSTVENO SODELOVANJE

Sodelujemo v številnih mednarodnih projektih s področja biologije rastlin, mikrobiologije, bioinformatike in meroslovja. Znanja iz kvantitativne molekulske biologije in sistemske biologije prenašamo tudi na področja medicine, farmacije in ekotoksikologije. Smo del infrastrukture EU za sistemske biologijo in bioinformatiko ISBE in ELIXIR.



## DEPARTMENT OF BIOTECHNOLOGY AND SYSTEMS BIOLOGY

The Department of Biotechnology and Systems Biology conducts research across a broad range of disciplines in the biological sciences, with special emphasis on plants and their pests, and microorganisms. Our research activities support the professional work of Slovene Governmental organisations and various companies from the agronomic, environmental, biotechnological, food and pharmaceutical sectors.



## BASIC RESEARCH

The objectives of our basic research activities are:

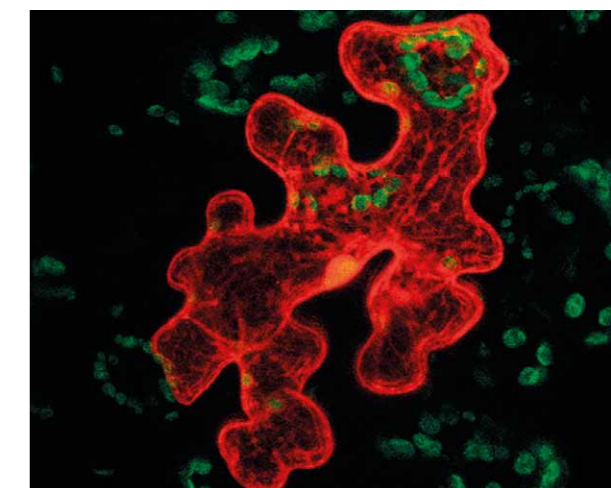
1. To understand plant responses to (mainly biotic) stress, with particular emphasis on the potato (i.e., *Potato virus Y*; Colorado potato beetle) and grapevine–phytoplasma interactions.
2. To provide insight into the biology of microbes (primarily plant pathogens), to understand their diversity, pathogenicity and epidemiology.

These goals are achieved using state-of-the-art methodologies, such as systems biology, quantitative analysis of nucleic acids (quantitative and digital PCR, LAMP), high-throughput sequencing (HTS), metagenomics, and microscopy. To integrate the data for the dynamic interactions between genes, RNA molecules, proteins and metabolites into a multi-level model, we develop new approaches and tools for data analysis and interpretation.

## RELEVANCE FOR APPLICATION

On the basis of the results arising through our basic research, we have developed efficient and sustainable methods for biotechnological and biological control of microbes, and new strategies for plant protection and for safe food and water, and methods for characterisation of viruses in biomedical production processes. In parallel, we have developed a technological platform to support systems biology research, new metrological sound technology support, and more efficient identification and detection methods for microorganisms and genetically modified organisms (GMOs). This has included the development of therapeutic viruses that can be applied in the fields of pharmaceuticals, human and animal health, and the environment.

Our research activities provide support to industry and national Governmental organisations, which we represent at international organisations, such as the European Plant Protection Organisation (EPPO) and the European Network of GMO Laboratories (ENGL). We ensure professional support and diagnostics for the Food Safety Authorities, veterinary medicine, and plant protection at the Ministry of Agriculture, Forestry and Food. We are nominated partners with the European Union for European Reference Laboratories in the fields of virology, phytoplasmas and bacteriology.



We are operating as national reference laboratories for the detection of GMOs in food, feed and seeds, as well as plant bacteria and phytoplasmas, and holders of the national measuring standard for the amounts of substance/nucleic acid bioanalysis, especially in the fields of GMO and microorganisms in biological and other materials (Metrology Institute of the Republic of Slovenia). The Department is accredited according to ISO 17025 through the Slovenian Accreditation system (N°. LP-028), for detection of GMOs and plant pathogens. We participated in the development of the CEN and ISO standards for the detection of unauthorised GMOs and microorganisms. We work closely with companies such as Lek, BiaSeparations, Omega, AveXis, our spin-off company BioSistemika, and other national and international companies from the agronomic, biotechnological and pharmaceutical sectors.

## SCIENTIFIC COLLABORATION

We are involved in numerous national and international projects in the fields of plant biology, microbiology, bioinformatics and metrology. Our expertise in quantitative molecular biology and systems biology transfers to the fields of medicine, pharmaceuticals and ecotoxicology. We are also members of the EU infrastructures for systems biology (ISBE) and bioinformatics (ELIXIR).

## ODDELEK ZA GENETSKO TOKSIKOLOGIJO IN BIOLOGIJO RAKA

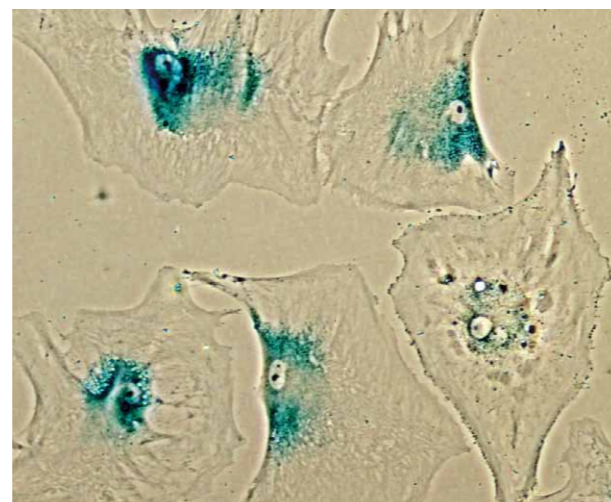


prof. dr. Metka Filipič, vodja oddelka  
Prof. Dr Metka Filipič, Head of Department

Naše raziskave potekajo na treh med seboj povezanih področjih: genetski toksikologiji, biologiji raka in ekotoksikologiji. Da bi dobili vpogled v kompleksne biološke sisteme, ki jih proučujemo, uporabljamo različne biokemijske, biološke in toksikološke metode v kombinaciji z najsodobnejšimi »omskimi« pristopi.

## TEMELJNE RAZISKAVE

- Na področju genetske toksikologije raziskujemo molekularne mehanizme genotoksičnega delovanja različnih onesnaževal okolja (npr. prehranski karcinogeni, naravni toksini, pesticidi, kovine, ostanki zdravil, nanomateriali) kot tudi mehanizme zaščitnega delovanja naravnih snovi (npr. ksantohumol, eterična olja) proti raku. Pridobljena nova spoznanja prispevajo k oblikovanju ustreznih ukrepov za preprečevanje in zmanjševanje vpliva genotoksičnih onesnaževal okolja na zdravje ljudi in druge organizme v okolju.
- Temeljne raziskave na področju biologije raka so usmerjene v proučevanje mehanizmov razvoja raka, predvsem v proučevanje vloge proteolitičnih sistemov, mikrookolja tumorjev in različnih vrst matičnih celic. Naš namen je prenos izsledkov temeljnih raziskav v klinično uporabo, kot je razvoj novih diagnostičnih in prognostičnih pokazateljev razvoja raka ter razvoj novih personaliziranih pristopov zdravljenja raka.
- Na področju ekotoksikologije razvijamo nove modele in orodja za oceno ekotoksikoloških in ekoloških značilnosti onesnaženega vodnega okolja in vpliva na biotsko raznovrstnost. Na področju ekološkega monitoringa biotske raznovrstnosti uvajamo sodobne genetske metode, ki bodo nadomestile tradicionalne taksonomske.



- Za zmanjševanje in nadomeščanje uporabe testnih živali (princip 3R) razvijamo nove metodologije, kot so tridimenzionalne celične in organoidne kulture ter testni sistemi z zarodki rib cebric.

## UPORABNOST IN POMEN RAZISKAV

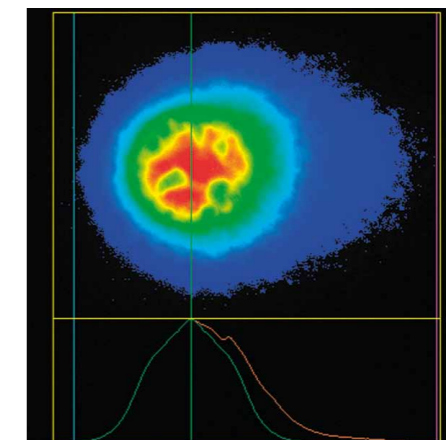
- Na področju toksikologije ponujamo svetovanje ter testiranje toksičnosti in genotoksičnosti spojin in proizvodov. Testiranje mutagenosti izvajamo po načelih Dobre laboratorijske prakse OECD.
- Za podjetja opravljamo celostne storitve pri razvoju novih diagnostičnih in terapevtskih pristopov v fazi predkliničnih *in vitro* raziskav učinkovanja in varnosti.
- Izvajamo ekološki monitoring površinskih voda in za naročnike pripravljamo ocene tveganja posegov v okolje.
- S svojimi znanji sodelujemo s številnimi domačimi in tujimi podjetji ter z ministrstvi in agencijami na področjih varstva okolja in zdravja ljudi, prehrane ter civilne zaščite.
- Povezujemo se z delom slovenskih centrov odličnosti in nacionalnih vozlišč, kot sta COBIK in nacionalno vozlišče za humani biomonitoring.

## ZNANSTVENO SODELOVANJE

Kot sodelavci in koordinatorji nacionalnih, evropskih in drugih mednarodnih projektov sodelujemo z vrsto raziskovalnih skupin iz Evrope, Kitajske, ZDA in Brazilije.

## DEPARTMENT OF GENETIC TOXICOLOGY AND CANCER BIOLOGY

Our research is conducted in three interrelated fields: genetic toxicology, cancer biology and ecotoxicology. To gain better insight into the complex biological systems we investigate, we use diverse biochemical, biological and toxicological methods, in combination with systems biology approaches, such as various state-of-the-art "-omic" approaches.

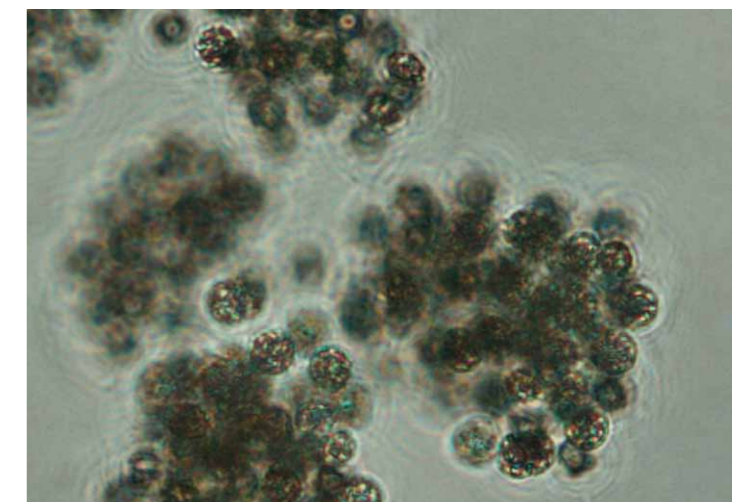


## BASIC RESEARCH

- In the field of genetic toxicology, we study the molecular mechanisms of genotoxicity for different types of environmental contaminants (i.e., foodborne carcinogens, natural toxins, metals, residues of pharmaceuticals, nanomaterials), as well as the mechanisms related to cancer-preventive effects of natural substances. This new knowledge contributes to the development of preventive and protective measures for reducing the impact of genotoxic environmental contaminants on humans and other organisms.
- The basic research in the field of cancer biology is focused on the mechanisms of cancer development, including especially the role of proteolytic systems, the tumour micro-environment, and different types of stem cells. Our purpose is to transfer the results of basic research into clinical use, such as development of new diagnostic and prognostic indicators of cancer development, and development of new personalised approaches to the treatment of cancers.
- In the field of ecotoxicology, we develop new models and tools for estimation of ecotoxicological and ecological characteristics of polluted water environments and the influence on biodiversity. In the field of ecological monitoring of biodiversity, we have introduced modern genetic methods to replace traditional taxonomical methods.
- To diminish and replace the use of test animals (the '3R' principle), we have developed new methodologies, such as tridimensional cellular and organoid cultures, and testing systems based around zebrafish embryos.

## RELEVANCE FOR APPLICATION

- In the field of toxicology, we offer consultancy services as well as toxicity and genotoxicity testing of compounds and products. We perform mutagenicity testing in accordance with the OECD Principles of Good Laboratory Practice.
- We provide custom-made services for the development of new diagnostic and therapeutic approaches at the level of preclinical *in-vitro* studies, on efficiency and safety.
- We conduct ecological monitoring of inland waters and offer assessments on the consequences of environmental interventions.



- Through our knowledge, we cooperate with numerous domestic and foreign companies and Ministries and Agencies in the fields of environmental protection and human health and nutrition, and for civil contingency planning.
- We also collaborate with other Slovenian centres of excellence and national hubs, such as the Centre of Excellence for Biosensors, Instrumentation and Process Control (CO-BIK), and the national hub for human biomonitoring.

## SCIENTIFIC COLLABORATION

As partners and coordinators of national and EU projects, we have many international links. We collaborate with research groups from other European countries, and from the USA, China, and several states in Brazil.



## ODDELEK ZA RAZISKAVE ORGANIZMOV IN EKOSISTEMOV



doc. dr. Meta Virant-Doberlet, vodja oddelka  
Assist. Prof. Dr Meta Virant-Doberlet, Head of Department

Na Oddelku za raziskave organizmov in ekosistemov proučujemo biološke procese od nivoja celice do ekosistemov. Ustvarjamo vrhunsko znanje, potrebno za celostno razumevanje delovanja organizmov in njihove vloge v okolju, od nevronalnih mehanizmov zaznavanja okolja in fizioloških odzivov nanj do medvrstnih interakcij v ekosistemih.



## TEMELJNE RAZISKAVE

Integrativne temeljne raziskave, ki jih izvajamo, so ključne za razumevanje mehanizmov, ki oblikujejo strukturo in usmerjajo funkcije naravnih in antropogenih ekosistemov. Namen raziskav na področjih integrativne taksonomije, filogenetske sistematike, biogeografije, reproduktivne izolacije, komunikacijskih omrežij in medvrstnih interakcij je razkriti ključne evolucijske in ekološke mehanizme, ki oblikujejo vzorce morfološke, genetske, fiziološke, ekološke in vedenjske pestrosti. Z raziskavami na področju invazivnih vrst, ekosistemskih storitev, trajnostne rabe naravnih virov in varstvene biologije pa oblikujemo smernice za trajnostni razvoj, ki bo ohranjal biotsko pestrost na vseh nivojih in zagotavljal trajnostno rabo obnovljivih virov. S povezovanjem znanja prek različnih ravni biološke organizacije odpiramo pot inovativnim rešitvam.

## UPORABNOST IN POMEN RAZISKAV

Naše temeljne in aplikativne interdisciplinarne raziskave so osnova za bolj trajnostne posege v okolje ter omogočajo učinkovitejše varovanje in upravljanje okolja. Razvijamo nove metode in protokole monitoringa ogroženih vrst ter nove in naprednejše pristope nadzora škodljivih vrst žuželk.

- S celostnim ekološkim razumevanjem interakcij med površinskimi in podzemnimi vodami prispevamo k izboljšanju trajnostne rabe vodnih virov.
- Z identifikacijo feromonov ciljnih saproksilnih hroščev, ki so ključni element gozdnih ekosistemov, omogočamo razvoj učinkovitih metod za spremljanje vrst evropskega varstvenege pomena in tako prispevamo k trajnostni rabi gozdnih virov.
- Z raziskavami opraševalcev kmetijstvu omogočamo boljše izkoriščanje dostopnih naravnih virov.
- Z razvojem alternativnih pristopov varstva rastlin, ki temeljijo na uporabi vibracijskih signalov, uvajamo nove, do okolja prijazne pristope za obvladovanje žuželčnih škodljivcev.
- Z empiričnimi podatki omogočamo učinkovitejše rešitve za ohranjanje biotske pestrosti v kmetijski krajini.
- Z novimi pristopi v sistematski biologiji prispevamo k poznavanju komponent biodiverzitete.

## ZNANSTVENO SODELOVANJE

Sodelujemo s številnimi univerzami, raziskovalnimi inštituti in muzeji tako v Sloveniji kot v Evropi in drugje po svetu (ZDA, Brazilija, Kitajska, Tajvan). Sodelujemo tudi s podjetji, vladnimi in nevladnimi organizacijami pri praktični uporabi izsledkov raziskav in pri definiranju novih področij raziskav, potrebnih za trajnostni razvoj družbe.

## DEPARTMENT OF ORGANISMS AND ECOSYSTEMS RESEARCH

Members of the Department of Organisms and Ecosystems Research study biological processes, from the cellular to ecosystems levels. We create state-of-the-art knowledge that is essential for holistic understanding of organisms and their role in the environment, from the neural mechanisms involved in sensing the environment and the physiological responses to it, to interspecies interactions in ecosystems.

## BASIC RESEARCH

The integrative basic research carried out in our Department is crucial for an understanding of the mechanisms underlying the structure and function of natural and anthropogenic ecosystems. We link integrative taxonomy and research on phylogenetic systematics, biogeography, reproductive isolation, communication networks and interspecies interactions, to unravel the key evolutionary and ecological mechanisms that form the patterns of morphological, genetic, physiological, ecological and behavioural diversity. Research activities on invasive species, ecosystem services, sustainable use of natural resources, and conservation biology are aimed to define the road to sustainable development, to ensure conservation of biodiversity at different levels, and the sustainable use of renewable natural resources. By integrating our knowledge into the different levels of biological organisation, we pave the way for innovative solutions.

## RELEVANCE FOR APPLICATION

Our interdisciplinary research is crucial to assess the impacts of human activities on ecosystems, and provides state-of-the-art knowledge that is necessary for more efficient conservation and management policies. We develop new methods and protocols for monitoring endangered species, and design novel and advanced approaches for managing insect pests.

- We contribute to the improved sustainable use of water resources, by providing a holistic understanding of how surface-groundwater interactions influence the ecology of both systems.
- Through the identification of species-specific pheromones of saproxylic beetles, which are key elements in forest ecosystems, we enable the development of efficient monitoring strategies for conservation of priority species, while also contributing to the improvement of forest management schemes.
- In our research on pollinators, we enable better use of accessible natural resources in agronomy.
- With the development of alternative approaches to the management of insect pests based on the exploitation of



vibrational signals, we introduce new environmentally friendly plant protection strategies.

- Based on empirical data, we propose more efficient solutions for biodiversity conservation in farmlands.
- Using innovative approaches in systems biology, we contribute to the understanding of biodiversity components.

## SCIENTIFIC COLLABORATION

We work with several universities, research institutes and museums in Slovenia and across the rest of the world (e.g., the USA, Brazil, China, Taiwan) as well as with enterprises and governmental and non-governmental organisations, to apply the results of our research and to identify new research issues that are essential for sustainable development of society.

## INFRASTRUKTURNI CENTER NIB

Infrastrukturni center NIB (IC NIB) sestavljata dva programska in organizacijsko zaokrožena centra: infrastrukturni center Planta (IC Planta), ki deluje pod okriljem Oddelka za biotehnologijo in sistemsko biologijo, ter infrastrukturni center MBP (IC MBP) na Morski biološki postaji Piran (MBP). IC NIB sofinancira Javna agencija za raziskovalno dejavnost prek infrastrukturnega programa NIB (IP NIB). Vsak del IC NIB ponuja uporabo opreme in storitve javnemu in zasebnemu sektorju.

Veliko infrastrukturno opremo IC MBP sestavljajo:

- raziskovalno plovilo Sagita s sodobno navigacijsko in raziskovalno opremo, različnimi vzorčevalniki, akustičnim tokomerom in sodobno multiparametrično sondo,
- oceanografska boja Vida z meteorološkimi merilnimi instrumenti, multiparametričnimi sondami in akustičnim tokomerom,
- manjše plovilo Carolina ter
- visoko frekvenčni radijski oddajnik.

IC MBP služi kot podpora raziskovalni in aplikativni dejavnosti za ministrstva in druge državne organe ter izvajanju pedagoške dejavnosti MBP. Tehnološko napredna oprema omogoča najodobnejše raziskave na morju in uvršča IC MBP med vodilne raziskovalne centre v Sredozemlju. MBP je tudi Nacionalni podatkovni center za morske podatke (NODC). Infrastruktura IC MBP zagotavlja visoko kakovost podatkov o stanju na morju, ki so na voljo v skoraj realnem času.

Veliko infrastrukturno opremo IC Planta sestavljajo:

- presevalni elektronski mikroskop (Philips CM100) s CCD-kamero v solastništvu Nacionalnega inštituta za biologijo in Oddelka za biologijo Biotehniške fakultete Univerze v Ljubljani ter Thermo scientific Talos L120C, ki je v solastništvu Nacionalnega inštituta za biologijo, Kemijskega inštituta in Oddelka za biologijo Biotehniške fakultete Univerze v Ljubljani,

- konfokalni stereomikroskop (Leica TCS LSI),
- aparature za PCR v realnem času (ABI 7900HT Fast, ABI PRISM ViiA7, ABI QuantStudio7 in Roche Light Cycler 480),
- aparature za digitalni PCR (Biorad QX100, Biorad QX200 in Fluidigm BioMark HD),
- robot za pipetiranje (Hamilton Microlab STARlet),
- komore za gojenje rastlin in tkivnih kultur (Kambič),
- komore za ločeno gojenje rastlin (Kambič) ter
- dva karantenska rastlinjaka.

Poleg tega je mogoča uporaba tudi:

- spektrofotometrov (SynergyMx, BioTek) in
- sistema za identifikacijo bakterij z analizo celičnih maščobnih kislin s plinsko kromatografijo (Sherlock Microbial Identification System), ki je trenutno na Biotehniški fakulteti Univerze v Ljubljani.

IC Planta služi kot podpora raziskovalni dejavnosti, ministrstvom, inšpektoratom in drugim državnim organom, podjetjem in pedagoški dejavnosti. Vsa velika infrastrukturna oprema IC Planta je tehnološko izjemno zahtevna ter skrbno, redno in strokovno vzdrževana. Veliko infrastrukturno opremo IC Planta uporabljajo tudi druge organizacije. Za pogoste uporabnike so organizirani tečajji za uporabo opreme. Mogoča je tudi uporaba opreme v obliki storitev in naročil analiz.



## NIB INFRASTRUCTURAL CENTRE

The Infrastructural Centre at the NIB comprises two integrated centres: the Planta Infrastructural Centre (Planta IC), which is part of the Department of Biotechnology and Systems Biology; and the MBS Infrastructural Centre (MBS IC), as part of the Marine Biology Station Piran (MBS). The NIB Infrastructural Centre is co-financed by the Slovenian Research Agency (ARRS) through the NIB Infrastructural Programme (NIB IP). Each part of the NIB IC offers services and equipment to the public and private sectors.

The large infrastructural equipment of the MBS IC consists of:

- research vessel Sagita, which is equipped with sophisticated navigation and marine research equipment;
- oceanographic buoy Vida, which is equipped with meteorological and oceanographic instruments (e.g., multiparametric CTD and current meter);
- the smaller vessel Carolina;
- a high-frequency radar system.

The MBS IC supports the research and applicative activities of Government Ministries and other public institutions, as well as the educational activities carried out at the MBS. The technologically advanced and sophisticated infrastructure in place enables state-of-the-art research activities to be conducted at sea, which ranks the MBS IC among the leading centres in the Mediterranean. The MBS serves as the National Oceanographic Data Centre (NODC). The MBS IC infrastructure ensures that the data on sea conditions is of high quality and that it can be provided at close to real time.

The large infrastructural equipment of Planta IC consists of:

- a transmission electron microscope (Philips CM100) with a CCD camera, co-owned by the National Institute of Biology and the Department of Biology at the Biotechnical Faculty of the University of Ljubljana, and Thermo scientific Talos L120C, co-owned by the National Institute of Biology, National Institute of Chemistry and the Department of Biology at the Biotechnical Faculty of the University of Ljubljana,
- a confocal stereomicroscope (Leica TCS LSI);
- real-time PCR instruments (ABI 7900HT Fast, ABI PRISM ViiA7, ABI QuantStudio7 in Roche Light Cycler 480);
- digital PCR instruments (Biorad QX100, Biorad QX200, Fluidigm BioMark HD);
- a robotics station for pipetting (Hamilton Microlab STARlet);
- growth chambers for plant breeding and tissue culture (Kambič);
- plant growth chambers for separate breeding (Kambič);
- two quarantine greenhouses;
- supplementary equipment that is essential for functioning of the large infrastructural equipment.

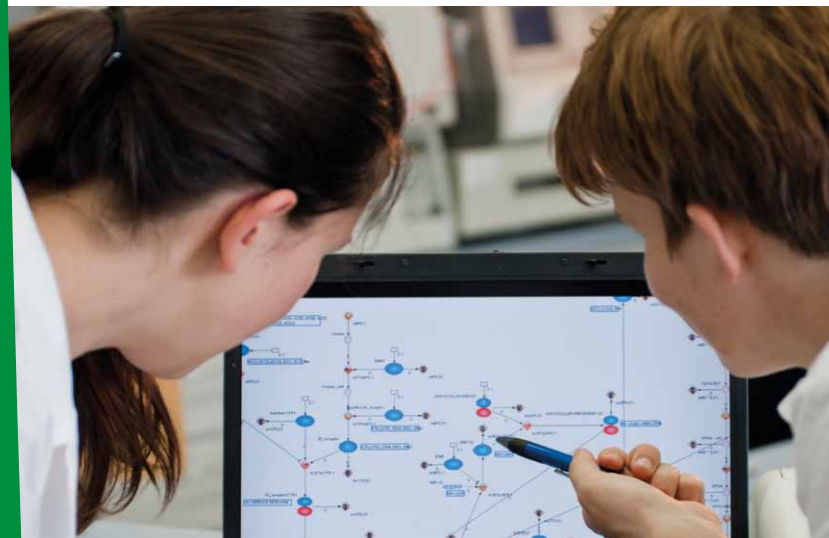
It is also possible to use:

- spectrofluorimeters (SynergyMx, BioTek);
- a system for identification of microorganisms using fatty acid methyl ester analysis with gas chromatography (Sherlock Microbial Identification System), which is currently located at the Biotechnical Faculty of the University of Ljubljana.



The equipment of Planta IC supports the research activities, Ministries and their inspection bodies, various enterprises, and educational activities. All of the large pieces of equipment of Planta IC is technologically advanced and carefully, regularly and professionally maintained. This large equipment is also used by other organisations. Training courses are arranged for frequent users, and services on the large equipment are offered to those preferring analyses to order.

## PRENOS ZNANJA IN POSLOVNE PRILOŽNOSTI



### SPREMLJANJE KAKOVOSTI MORJA IN MONITORING

Monitoring in ocena ekološkega stanja morja na podlagi bioloških elementov kakovosti (fitoplankton, makroalge in bentoški nevretenčarji) in podpornih fizikalnih ter kemijskih elementov kakovosti v skladu z Vodno direktivo (WFD 2000/60/EC).

Spremljanje (monitoring) in ocena okoljskega stanja morskega okolja glede na različne biološke, fizikalne in kemijske elemente in kazalnike antropoloških pritiskov v skladu z Okvirno strategijo o morski direktivi (MSFD 2008/56/EC).

Spremljanje pojavljanja toksičnih alg v morski vodi.

Operativna oceanografija: oceanografska boja Vida in njena uporaba za napovedovanje cirkulacije.

Strokovna podpora in svetovanje odločevalcem pri prenosu evropskih direktiv v nacionalno zakonodajo na področju okoljskih politik.

**Kontaktni podatki:**

izr. prof. dr. Patricija Mozetič, e-pošta: patricija.mozetic@nib.si

### DETEKCIJA MIKROORGANIZMOV IN DRUGE APLIKACIJE V BIOTEHNOLOGIJI

Detekcija rastlinskih virusov, bakterij in fitoplazem z uporabo konvencionalnih metod in novih molekularnih metod v skladu s standardoma ISO/IEC 17025 in ISO 9001 ter protokoli EPPO (Evropska organizacija za varstvo rastlin), koncentriranje virusov iz vodnih vzorcev z uporabo tehnologije CIM, čiščenje virusov za različne aplikacije, prirejen razvoj novih metod po naročilu (qPCR, dPCR, LAMP). Po naročilu opravljamo tudi ugotavljanje učinkovitosti antimikrobnih substanc, bakteriofagov ter analize z uporabo elektronske mikroskopije: lokalizacija biomolekul in celic, imunolokalizacija, negativno in pozitivno kontrastiranje vzorcev, opazovanje virusov, bakterij in gliv (tudi makrofagov in virusom podobnih proteinov). S kombinacijo različnih tehnik (molekularne, serološke, mikroskopija) okarakteriziramo virusne vektorje, uporabljene za cepiva ali gensko terapijo.

**Kontaktni podatki:**

prof. dr. Maja Ravnikar, e-pošta: maja.ravnikar@nib.si

### DETEKCIJA GENSKO SPREMENJENIH ORGANIZMOV (GSO) IN ZAGOTAVLJANJE KAKOVOSTI (QA)

Detekcija gensko spremenjenih organizmov (GSO), funkcionalne analize in druge študije, povezane z GSO. Razvoj protokolov in delovnih shem ter razvoj in validacija metod v skladu s standardoma ISO/IEC 17025 in ISO 9001, postavljanje molekularnih in bakterioloških laboratorijev, ekspertize v meroslovju ter spretna ustrezna strokovna podpora in izobraževanje s področja kvantitativne analize nukleinskih kislin in meroslovja.

**Kontaktni podatki:**

izr. prof. dr. Jana Žel, e-pošta: jana.zel@nib.si

### STORITVE Z UPORABO NAPREDNIH MOLEKULARNO BIOLOŠKIH TEHNIK

Izvajamo študije z uporabo različnih tehnik kvantitativne biologije, kot so sekvenciranje nove generacije, mikromreže, kvantitativni PCR (qPCR) in digitalni PCR, vključno z analizo in integracijo podatkov. Pripravljamo vzorce iz različnih bioloških sistemov (homogenizacija, izolacija nukleinskih kislin). Ena od aplikacij teh študij je izboljšanje industrijskih proizvodnih organizmov in procesov v biofarmaceutiki in biotehnologiji. Razvita spletna orodja: GoMapMan ([www.gomapman.org](http://www.gomapman.org)), quantGenius (<http://quantgenius.nib.si>), DiNAR (<https://nib-si.shinyapps.io/DiNAR/>).

**Kontaktni podatki:**

prof. dr. Kristina Gruden, e-pošta: kristina.gruden@nib.si

### TOKSIKOLOŠKE ANALIZE

Testi genotoksičnosti *in vitro*, ki so potrebni za zadovoljevanje različnih regulativ: bakterijski test povratnih mutacij (Ames test), mikronukleus test *in vitro* na celicah sesalcev, test genskih mutacij *in vitro* na celicah sesalcev ter kometni test *in vitro* na celicah sesalcev. Testiranje mutagenosti izvajamo v skladu z zahtevami Dobre laboratorijske prakse OECD.

Test strupenosti na zarodkih rib cebric (*Danio rerio*) (FET test) v skladu s SIST ISO 7346-3:1998, 5667-16 ter ustrezno smernico OECD in njena priporočila. Ovrednotimo lahko tudi dodatne toksikološke učinke: subletalne učinke in genotoksičnost (kometni test).

Ocena toksikoloških lastnosti kompleksnih okoljskih vzorcev (npr. industrijske in komunalne odpadke) z uporabo specializiranih testov (npr. SOS/umu test z bakterijskim sevom *Salmonella typhimurium* TA1535/pSK1002, Ames MPF™ 98/100 Aqua test ter FET test).

**Kontaktni podatki:**

prof. dr. Metka Filipič, e-pošta: metka.filipic@nib.si

### STORITVE NA PODROČJU PREDKLINIČNIH *IN VITRO* RAZISKAV IN TEHNOLOGIJE MATIČNIH CELIC

Izdelava dvodimenzionalnih in tridimenzionalnih *in vitro* celičnih modelov za raziskave mehanizmov delovanja, učinkovitosti in varnosti pri razvoju diagnostičnih in terapevtskih pristopov. Obvladovanje postopkov izolacije in svetovanje pri pripravi mezenhimske matične celice MSC iz človeških tkiv za različne raziskovalne namene.

Ponudba ekspertnih znanj s področja tumorskih biomarkerjev in njihove klinične uporabe.

**Kontaktni podatki:**

prof. dr. Tamara Lah Turnšek, e-pošta: tamara.lah@nib.si

## KNOWLEDGE TRANSFER AND BUSINESS OPPORTUNITIES

### MARINE QUALITY MONITORING AND ASSESSMENT

Monitoring and assessment of the ecological status of the sea based on the biological elements of quality (i.e., phytoplankton, macroalgae, benthic invertebrates) and of the additional physical and chemical elements of quality according to the Water Framework Directive (WFD 2000/60/EC).

Surveillance (monitoring) and assessment of the marine environment according to a variety of biological, physical and chemical elements and indicators of anthropogenic pressures, in compliance with the Marine Strategy Framework Directive (MSFD 2008/56/EC).

Operational oceanography, with the Vida buoy and its use for circulation forecasting.

Offers of professional support and advice to stakeholders for the implementation of European Directives regarding environmental policies into national legislation.

**Contact details:**

Assoc. Prof. Dr. Patricija Mozetič, email: patricija.mozetic@nib.si

### DETECTION OF PATHOGENS AND OTHER APPLICATIONS IN BIOTECHNOLOGY

The detection of plant viruses, bacteria and phytoplasmas using conventional methods and using the new molecular methods, according to the ISO/IEC 17025 and ISO 9001 standards and the European Plant Protection Organisation (EPPO) protocols; concentration of viruses from water samples using CIM technology, and purification of viruses for various applications; customised development of new detection methods on demand (e.g., qPCR, dPCR, LAMP). We also offer services such as screening for antibacterial substances and various electron microscopy analyses, which include localisation of biomolecules in cells, immunolocalisation, negative and positive contrast for samples, and observation of viruses, bacteria and fungi (including bacteriophages, virus-like proteins). We characterise viral vectors used for vaccines or genetic therapies, by combinations of various techniques (e.g., molecular, serological, microscopy).

**Contact details:**

Prof. Dr. Maja Ravnikar, email: maja.ravnikar@nib.si

### DETECTION OF GENETICALLY MODIFIED ORGANISMS AND QUALITY ASSURANCE

Detection of genetically modified organisms (GMOs), study of functional genomics, and other studies related to GMOs. We offer services, such as development of protocols and workflows, that are compliant with ISO/IEC 17025 and ISO 9001, development and validation of various methodologies, and a molecular and bacteriological laboratory set-up, including professional support and training on nucleic-acids quantification methods and metrology. Developed web application: GMOseek (<http://www.gmoseek.com/gmoseek>).

**Contact details:**

Assoc. Prof. Dr. Jana Žel, email: jana.zel@nib.si

### SERVICES USING ADVANCED MOLECULAR BIOLOGY TECHNIQUES

We offer studies using different quantitative biology approaches, such as next-generation sequencing, microarrays, and quantitative and digital PCR, including data analysis and integration. We prepare samples (homogenisation, nucleic acid isolation,

quality control) from different biological systems. One of the applications of these studies is improvement of the industrial production of organisms and processes in biopharmacy and biotechnology. Developed web tools: GoMapMan ([www.gomapman.org](http://www.gomapman.org)); quantGenius (<http://quantgenius.nib.si>); DiNAR (<https://nib-si.shinyapps.io/DiNAR/>).

**Contact details:**

Prof. Dr. Kristina Gruden, email: kristina.gruden@nib.si

### TOXICOLOGICAL ANALYSES

*In-vitro* genotoxicity testing, as required by various regulatory requirements, comprising bacterial reverse mutation (Ames) assays, *in-vitro* mammalian cell micronucleus assays, *in-vitro* mammalian cell gene mutation assays, and *in-vitro* mammalian cell comet assays. Bacterial mutagenicity tests are performed in compliance with OECD Good Laboratory Practice.

Zebrafish (*Danio rerio*) embryo toxicity tests according to SIST ISO 7346-3:1998, 5667-16 and the corresponding OECD draft guideline recommendations. As per demand, additional toxicological endpoints can be evaluated, such as sublethal effects and genotoxicity (comet assays).

Assessment of the toxicological properties in complex environmental samples (i.e., industrial and municipal waste waters) by means of specialised assays (i.e., SOS/umu tests with *Salmonella typhimurium* TA1535/pSK1002; Ames MPF™ 98/100 Aqua assays; FET tests).

**Contact details:**

Prof. Dr. Metka Filipič, email: metka.filipic@nib.si

### SERVICES IN PRECLINICAL *IN-VITRO* STUDIES AND STEM-CELL TECHNOLOGIES

We offer two-dimensional and three-dimensional *in-vitro* cell models for mechanistic, efficiency and safety studies in the development of new diagnostic and therapeutic approaches and products.

We carry out characterisation and consultancy services for procedures related to isolation and expansion of mesenchymal stem cells from human tissues, which can be customised for a wide range of experimental purposes.

We provide expertise in tumour biomarkers and their clinical applications.

**Contact details:**

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REPUBLIKA SLOVENIJA  
**MINISTRSTVO ZA IZOBRAŽEVANJE,  
ZNANOST IN ŠPORT**



**EVROPSKA UNIJA**  
EVROPSKI SKLAD ZA  
REGIONALNI RAZVOJ

KONZORCIJ ZA PRENOS TEHNOLOGIJ  
IZ JRO V GOSPODARSTVO

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