



NACIONALNI INŠTITUT ZA BIOLOGIJO
NATIONAL INSTITUTE OF BIOLOGY



Morska biološka postaja Piran
Biotehnologija in sistemska biologija
Genetska toksikologija in biologija raka
Raziskave organizmov in ekosistemov
Infrastrukturni center NIB

Piran Marine Biology Station
Biotechnology and Systems Biology
Genetic Toxicology and Cancer Biology
Organism and Ecosystem Research
NIB Infrastructural Centre

nova spoznanja za trajnostni razvoj
new knowledge for sustainable development



Prof. Dr. Tamara Lah Turnšek,
direktorica /
Prof. Dr. Tamara Lah Turnšek
Director

Nacionalni inštitut za biologijo (NIB) je bil ustanovljen leta 1961 in je danes vodilni javni raziskovalni zavod na področju bioloških ved v Sloveniji z okoli 115 zaposlenimi. NIB deluje na dveh lokacijah v Sloveniji – v Biološkem središču v Ljubljani in na Morski biološki postaji Piran v Piranu.

V dejavnostih NIB-a se prepletajo temeljne in aplikativne biološke raziskave, ki pa se prepletajo še z drugimi naravoslovnimi vedami, kot so kemija, fizika, agronomija, ekologija in biomedicina. Raziskave pretežno podpirajo razpisi Javne agencije za raziskovalno dejavnost Republike Slovenije in drugih agencij.

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 ter preventivnega zdravstva. S pogodbenimi projekti sodelujemo tudi s poslovnim sektorjem, predvsem s podjetji v farmacevtski, prehranski ter drugih biotehnološko in okoljsko usmerjenih industrijah. To podpira delovanje Pisarne za prenos tehnologij, ki tesno sodeluje s Tehnološkim parkom Ljubljana, katerega soustanovitelj je NIB, in seveda s sorodnimi pisarnami v Sloveniji. Pisarna tudi podpira naraščajoče število mednarodnih projektov, pretežno v območju EU.

NIB je mednarodno priznana in zelo cenjena institucija, vpeta v mnoge projekte EU in mednarodne projekte. Zelo pomembna vzporedna dejavnost inštituta je izobraževanje mladih raziskovalcev; v proces usposabljanja je vključeno nekaj deset doktorandov.

Raziskave inštituta potekajo v štirih raziskovalnih oddelkih:

- 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 rastlin 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 – od bakterije do človeka in širšega področja ekologije ter varstva okolja. Ekološke raziskave vključujejo sladkovodne sisteme, kot so reke in jezera ter kraško območje, kopenske sisteme, kot so močvirja in gozdovi, ter morje. Temeljne in ekonomsko relevantne so fiziološke raziskave bakterijskih sistemov, rastlin, nevretenčarjev in višjih živali ter še posebej raziskave na področju biomedicine. Nova znanja genetike in genske tehnologije so pripeljala do ustanovitve visokotehnološkega in prvega odcepljenega podjetja NIB – **BioSistemika**. V okviru NIB-a deluje v Biološkem središču tudi **Biološka knjižnica**, ki 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 pa tudi onkraj njenih meja.

The National Institute of Biology (NIB) was founded in 1961. With around 115 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 Piran Marine Biology Station.

The main research activities at the NIB are closely intertwined with basic and applied research in the field of biology, which also overlaps with other disciplines such as chemistry, physics, agronomy, ecology and the biomedical sciences. Its research activities are supported mainly by the Slovenian Research Agency (ARRS) and other agencies.

The NIB's core mission is to advise various ministries by performing specific analyses and offering other services and expert consulting on various aspects of agriculture, environmental safety and human health protection. We work closely with the private sector, especially the pharmaceutical and food industries as well as biotechnological companies. This is supported by the Technology Transfer Office (TTO), which works closely with the Technological Park, co-funded by the NIB, and other TTOs in Slovenia. The TTO also supports an increasing number of international projects, most of which are located in the EU.

The NIB is an internationally recognised and highly ranked research institution that is engaged with EU and other international research activities. An important parallel activity at the institute is the education of young researchers, with tens of doctoral students in attendance.

The research activities at the NIB are performed by four research departments:

- Department of Biotechnology and Systems Biology,
- Department of Genetic Toxicology and Cancer Biology,
- Department of Organism and Ecosystem Research,
- Piran Marine Biology Station.

An integral part of the NIB is its **NIB Infrastructural Centre**, which operates within two departments and supports:

- plant biotechnology at the Department of Biotechnology and Systems Biology, and
- marine sciences at the Piran Marine Biology Station.

The activities carried out at the institute cover a wide range of research topics – from bacteria to humans – and broad areas of ecology and environmental protection. The ecological research comprises the sea, freshwater systems such as rivers and lakes as well as karst, terrestrial systems in wetlands and forests. The main economically relevant research areas include the physiology of bacterial systems, plants, invertebrates and animals of higher orders, and especially research in biomedical topics. New knowledge from genetics and gene technology resulted in the establishment of the first high-technology spin-off business at the NIB – **BioSistemika**. The **Central Biology Library**, which operates within the NIB at the Biological Centre, has been compiling important documents from the area of biological sciences for decades.

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



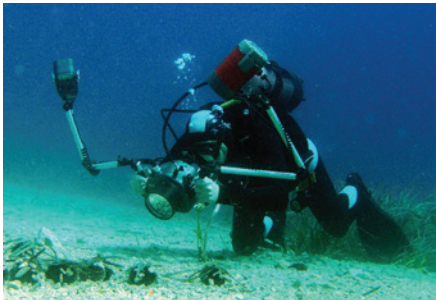
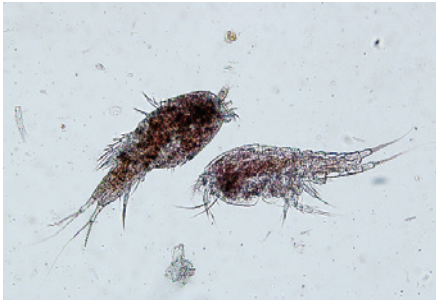


Doc. dr. Andreja Ramšak,
vodja oddelka /
Assist. Prof. Dr Andreja Ramšak
Head of Department

Morska biološka postaja Piran je osrednja enota v slovenskem prostoru, ki izvaja temeljne in uporabne multidisciplinarne 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 pelaškega 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 pelaških 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 se ovrednotijo antropogeni vplivi 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 prognoziranje 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

Razvejeno 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.

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

Basic research

- We study climate change and the characteristics of pelagic ecosystems, with an emphasis on plankton communities and the changes in those 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.
- Besides the ecologic characteristics of bacteria and archaea in different marine environments (in water columns, the seafloor, biofilms), we study their role in the transformation of organic matter



and the interactions between microbes and other organisms.

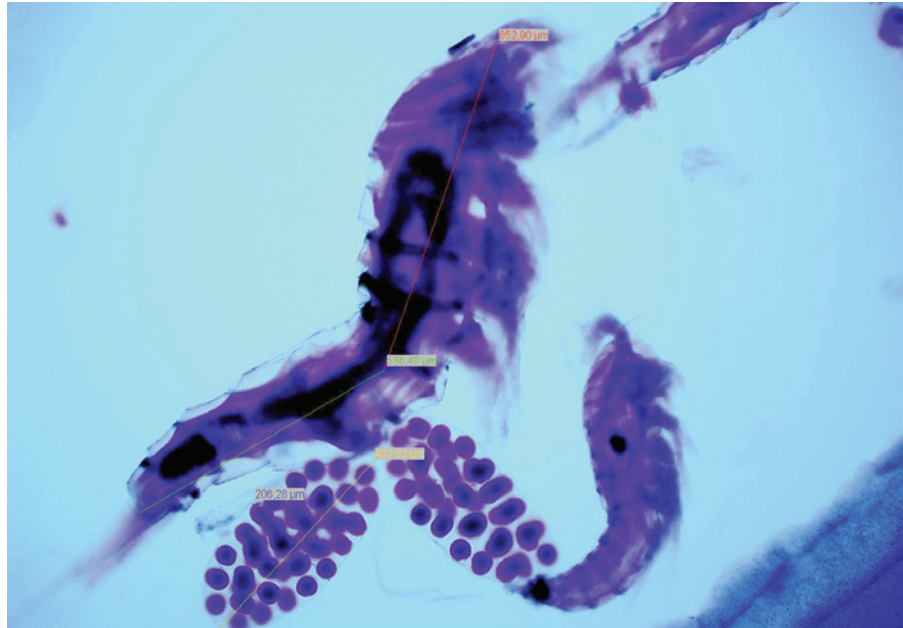
- We investigate the population dynamics of gelatinous plankton as well as phylogeography, dispersion and massive outbreaks in relation to oceanographic factors and anthropogenic impacts (e.g. constructions in the sea).
- We study the biodiversity of benthos (invertebrates, macroalgae, sea grass) and fish, surveillance over the introduction of alien species and we develop indices to assess the status of habitats in littoral and coastal waters.
- We conduct research on the biogeochemistry of water columns and marine sediment, mercury cycling and the degradation of organic matter and selected pollutants through photochemical and microbial processes. We apply biomarkers to study their effects on pollution.
- We conduct oceanographic observations and numerical simulations in order to study the dynamics related to the water mass and transport of re-suspended 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 manage the monitoring of the biotoxins in the marine organisms.
- Analyses of spreading contaminants, marine organisms and suspended sediments with currents, and forecasts of circulation are essential in the event that action needs to be taken for accidents and pollution at the sea.
- An estimate of the circulation properties and ecological potential in the marine environment, which is essential for the planning of artificial structures and their effects.

Scientific collaboration

Extensive international collaborations with researchers from many European countries, the USA, Japan, Russia and Israel and countries in South America. In Slovenia, we work with all universities and leading research institutes. Agencies are also important partners in applied projects and comprise many small to medium sized research companies.





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 organizmov in njihove vloge v okolju, od nevronalnih mehanizmov zaznavanja okolja in fizioloških odzivov nanj do medvrstnih interakcij v ekosistemi.

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, 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 varstvenega pomena in tako prispevamo k trajnostni rabi gozdnih virov.
- Z raziskavami ekologije opraševanja 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.

Znanstveno sodelovanje

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



Members of the Department of Organism and Ecosystem Research study biological processes, from the cellular to ecosystem levels. We create state-of-the art knowledge that is essential for a 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 the interspecific interactions in the ecosystems.

Basic research

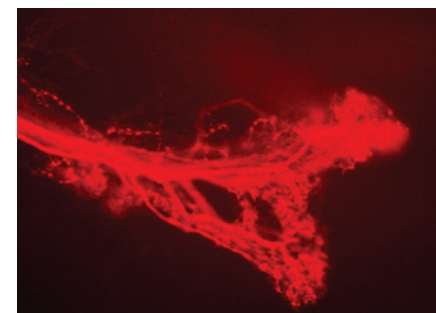
The integrative basic research carried at our department is crucial for understanding the mechanisms underlying the structure and function of natural and anthropogenic ecosystems. We link integrative taxonomy and research on reproductive isolation, communication networks and interspecific interactions in order 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, the sustainable use of natural resources and conservation biology are aimed at defining the waypoints of sustainable development, ensuring biodiversity conservation at different levels and the sustainable use of renewable natural resources. By integrating our knowledge into the different levels of biological organisation, we are paving the way for innovative solutions.



Relevance for application

Our interdisciplinary research is crucial for assessing the impacts of human activities on ecosystems and provides the state-of-the-art knowledge necessary for more efficient conservation and management policies. We are developing new methods and protocols for monitoring endangered species and are designing 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.
- By identifying the species-specific pheromones of saproxylic beetles, which are key elements in forest ecosystems, we enable the development of efficient monitoring strategies for conservation priority species, as well as contribute to the improvement of forest management schemes.
- Our insight into pollination ecology enables the agriculture sector to capitalise on the natural resources available.
- With the development of alternative approaches to managing 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.



Scientific collaboration

We work with several universities, research institutes and museums in Slovenia and the rest of the world (USA, Brazil) as well as enterprises, governmental and non-governmental organisations in applying the research results and identifying new research issues required for the sustainable development of society.



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, razvoj terapevtskih inhibitorjev proteaz ter razvoj novih medicinskih uporab matičnih celic, kot so novi sistemi za dostavo zdravil in regenerativna medicina.

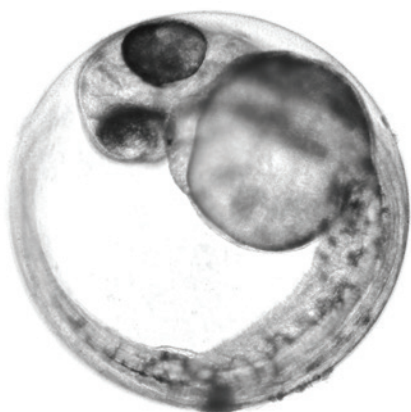
- Na področju ekotoksikologije raziskujemo regulacijo cianobakterijskih združb, dejavnikov, odgovornih za produkcijo cianobakterijskih toksinov, in vlogo teh toksinov pri vzdrževanju ravnovesja v vodnih ekosistemih. Na podlagi razumevanja teh procesov razvijamo nove metodologije za napovedovanje in karakterizacijo cianobakterijskih cvetov ter metode za njihovo preprečevanje.

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 podjetji, kot so Novartis-Lek-Sandoz, Radenska, Pivovarna Union, Pivovarna Laško, Costella, Cinkarna Celje, Medis, Biobanka, Educell, Medex, Arhel, Ekliptik, BIA, SAN.KO.M, ter z ministrstvi in agencijami na področjih varstva okolja in zdravja ljudi, prehrane pa tudi 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 in več državami Zvezne republike Brazilije.



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

Basic research

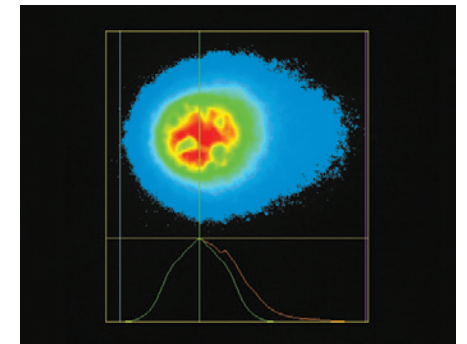
- In the field of genetic toxicology, we study the molecular mechanisms of genotoxicity for different types of environmental contaminants (i.e. foodborne carcinogens, natural toxins, metals, residues of pharmaceuticals, nanomaterials), as well as the mechanisms related to the cancer-preventive effects 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, especially the role of proteolytic systems, the tumour microenvironment and different types of stem cells. We are aiming to translate basic research into clinical applica-

tions such as the development of new diagnostic and prognostic markers of cancer development, the development of therapeutic protease inhibitors and the development of novel medical applications for stem cells such as novel drug delivery systems and regenerative medicine.

- In the field of ecotoxicology, we study the regulation of cyanobacterial communities, which are the factors responsible for the production of cyanobacterial toxins, and the role of these toxins in maintaining the balance of aquatic ecosystems. Based on an understanding of these processes, we are developing new methods for the prediction and characterisation of toxic cyanobacterial blooms and the methods for their prevention.

Relevance for application

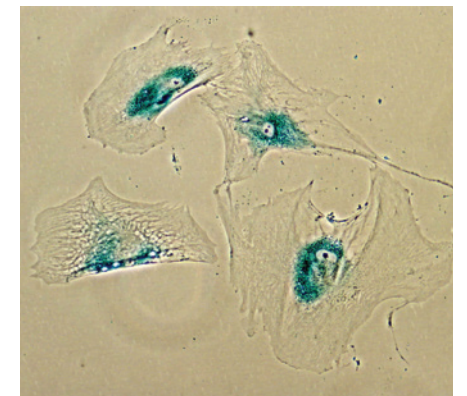
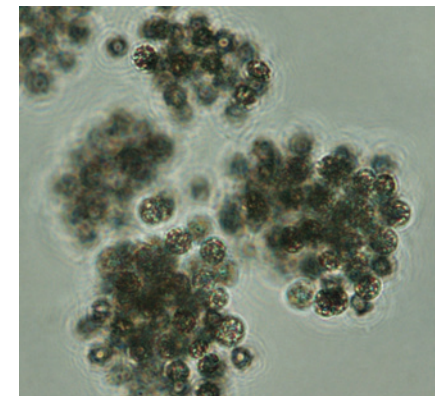
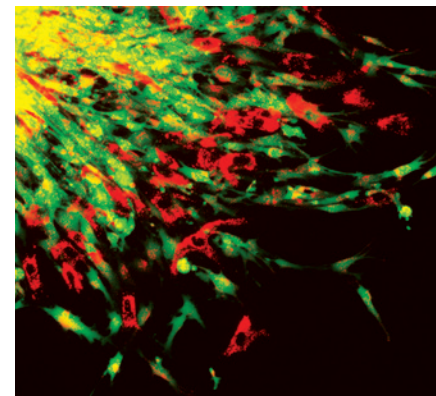
- In the field of toxicology, we are offering consultancy services as well as the toxicity and genotoxicity testing of compounds and products. We perform mutagenicity testing in accordance with the OECD Principles of Good Laboratory Practice.
- We provide custom-made services for the development of new diagnostic and therapeutic approaches in the stage 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.
- We collaborate with companies such as Novartis-Lek-Sandoz, Radenska Pivovarna Union, Pivovarna Laško, Costella, Cinkarna Celje, Medis, Biobanka, Educell, Medex, Arhel, Ekliptik, BIA, SAN.KO.M, and ministries and agencies in the fields of environmental and human health protection, food and nutrition, as well as civil defence.
- We also collaborate within certain Slovenian centres of excellences and national hubs, such as COBIK (Centre of Excellence for Biosensors, Instrumentation and Process Control) and the national hub for human biomonitoring.

Scientific collaboration

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





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

Naše raziskave zajemajo 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 biotehnološki, prehranski in farmacevtski industriji.

Temeljne raziskave

Naše temeljne raziskave se osredotočajo na:

- razumevanje odziva rastlin na stres (predvsem biotski) s pristopi sistemske biologije. Največ pozornosti namenjamo interakcijam krompir – krompirjev virus Y – koloradski hrošč in vinska trta – fitoplazme;
- poglobljanje znanja o biologiji mikrobov (predvsem povzročiteljev bolezni rastlin), da bi bolje razumeli njihovo raznolikost, patogenost in epidemiologijo ter njihovo vlogo v rastlinskih gostiteljih.

Cilje dosegamo z uporabo novih pristopov, kot so sistemska biologija, kvantitativna analiza nukleinskih kislin (kvantitativni in digitalni PCR), pomnoževanje nukleinskih kislin pri isti temperaturi (LAMP), sekveniranje nove generacije (NGS), metagenomika in mikroskopija. Za integracijo vseh podatkov o dinamičnih interakcijah med geni, molekulami RNA, proteini in metaboliti v večnivojski model razvijamo nove pristope in orodja za analizo in interpretacijo podatkov.

Uporabnost in pomen raziskav

Na podlagi pridobljenih rezultatov temeljnih raziskav razvijamo učinkovite in trajnostne metode za biotehnološki in biološki nadzor mikrobov ter nove strategije za varstvo rastlin, varno hrano in vodo. Hkrati razvijamo tehnološko platformo, ki podpi-

ra raziskave sistemske biologije in razvoj nove meroslovno naravnane tehnološke podpore ter učinkovitejših identifikacijskih in detekcijskih metod za mikroorganizme in gensko spremenjene organizme (GSO), 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 in okolje. Smo pooblaščen nacionalni referenčni laboratorij za določanje GSO v hrani, krmi in semenih in smo nosilec nacionalnega etalona za področje množične 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, odcepljenim podjetjem BioSistemika ter drugimi domačimi in tujimi podjetji s področja kmetijstva, biotehnologije in farmacije. Smo člani COBIK-a.

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. Vključeni smo v platformi EU za sistemsko biologijo in bioinformatiko ISBE in ELIXIR.

The Department of Biotechnology and Systems Biology conducts research across a broad range of disciplines in the biological sciences, with a special emphasis on plants, their pests and pathogens. Our research activities are included in the professional work of Slovene governmental organisations and various companies from the agronomy, environment, biotech, food and pharmaceutical sectors.

Basic research

The objectives of our basic research activities are:

- to understand plant responses to (mainly biotic) stress with a special emphasis on the potato – Potato virus Y – Colorado potato beetle and grapevine – phytoplasma interactions
- insight into the biology of microbes (primarily plant pathogens) in order to understand their diversity, pathogenicity and epidemiology

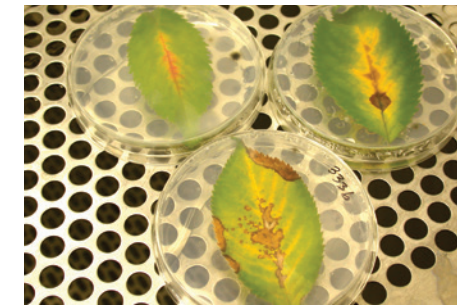
These goals are achieved by using state of the art methodologies such as systems biology, quantitative analysis of nucleic acids (quantitative and digital PCR), isothermal nucleic acid amplification (LAMP), next generation sequencing

(NGS), metagenomics and microscopy. In order to integrate the data for the dynamic interactions between genes, RNA molecules, proteins and metabolites into a multi-level model, we are developing new approaches and tools for data analysis and interpretation.

Relevance for application

Based on the outcomes of the basic research activities, we are developing efficient and sustainable strategies for biological and biotechnological plant protection and strategies for food and water safety. In parallel, we are developing a technological platform to support systems biology research, develop new metrologically sound technological support and more efficient identification and detection methods for microorganisms and GMOs which may be applicable 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 EPPO (European Plant Protection Organisation) and the ENGL (European Network of GMO Laboratories). We offer expert support and diagnostics for the Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection as authorised laboratories for the detection of GMOs in food feed and seeds and hold-



ers 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 by the Slovenian Accreditation (no. LP-028) for the 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, our spin-off company BioSistemika and other national and international companies from the agro, biotech and pharmaceutical sectors. We are members of the COBIK Centre of Excellence.

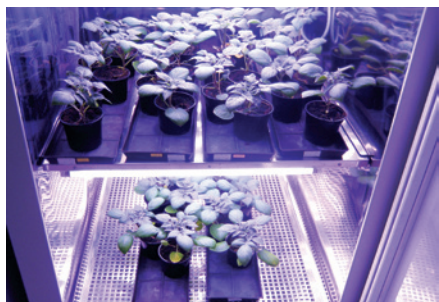
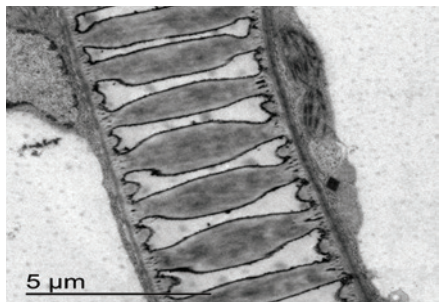
Scientific collaboration

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 platforms for systems biology (ISBE) and bioinformatics (ELIXIR).



Infrastrukturni center NIB

Infrastrukturni center NIB (IC NIB) sestavljata dva programsko in organizacijsko zaokrožena centra: infrastrukturni center Planta (IC Planta), ki deluje pod okriljem Oddelka za biotehnologijo in sistemsko biologijo, ter infrastrukturni center na Morski biološki postaji Piran (IC 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 PI-800 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, namenjeno manjšim in hitrim posegom na morju ter
- visoko frekvenčni radijski merilnik površinskih tokov in valov (HF Radar).

IC MBP služi kot podpora raziskovalni in aplikativni dejavnosti za ministrstva in druge državne organe ter izvajanju pedagoške dejavnosti MBP. Tehnološko napredna oprema omogoča najsodobnejše 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:

- presevni elektronski mikroskop (Philips CM100) s CCD-kamero, ki je v solastništvu Nacionalnega inštituta za biologijo in Oddelka za biologijo Biotehniške fakultete Univerze v Ljubljani,
- kriomikrotom (Leica EM FC6) in ultramikrotom (Leica),
- konfokalni stereomikroskop (Leica TCS LSI),
- aparature za PCR v realnem času (ABI 7900HT Fast, Roche Light Cycler 480 in ABI PRISM ViiA7),
- 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, ministrstvu, 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 tečaji za uporabo opreme, mogoča pa je tudi uporaba opreme v obliki storitev in naročil analiz.

NIB Infrastructural Centre

The Infrastructural Centre at the NIB comprises two integrated programmes, the Planta Infrastructural Centre (Planta IC), which is part of the Department of Biotechnology and Systems Biology, and the PMBS Infrastructural Centre (PMBS IC) as part of the Piran Marine Biology Station (PMBS). 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 PMBS IC consists of:

- a PI-800 Sagita research vessel, which is equipped with sophisticated navigation and marine research equipment,
- a Vida oceanographic buoy, which is equipped with meteorological and oceanographic instruments (a multiparametric CTD and current meter),
- a smaller vessel, suited for fast interventions at sea, and
- a high frequency radar (HF Radar).



The PMBS IC supports the research and applicative activities for ministries and other public institutions as well as the educational activities carried out at PMBS. The technologically advanced and sophisticated infrastructure in place enables state-of-the-art research activities to be conducted at sea and ranks the PMBS IC among the leading centres in the Mediterranean. The PMBS serves as the National Oceanographic Data Centre (NODC). The PMBS IC infrastructure ensures that the data on sea conditions is of high quality and that it is 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 (NIB) and the Department of Biology at the Biotechnical Faculty (BF) of the University of Ljubljana (UL),
- a cryo-ultramicrotome (Leica EM FC6) and ultramicrotome (Leica),
- a confocal stereomicroscope (Leica TCS LSI),
- real-time PCR instruments (ABI 7900HT Fast, Roche Light Cycler 480 and ABI PRISM ViiA7),
- digital PCR instruments (Biorad QX100, Biorad QX200 and Fluidigm BioMark HD),

- a robot for pipetting (Hamilton Microlab STARlet),
- growth chambers for plant and tissue culture breeding (Kambič),
- plant growth chambers for separate breeding (Kambič),
- two quarantine greenhouses, and
- supplementary equipment that is essential for the functioning of the large infrastructural equipment.

It is also possible to use:

- spectrofluorimeters (SynergyMx, BioTek) and
- a system for the identification of microorganisms using fatty acid methyl ester analysis by Gas Chromatography (Sherlock Microbial Identification System) that is currently located at the Biotechnical Faculty (BF) of the University of Ljubljana (UL).

Planta IC's equipment supports research activities, ministries and their inspection bodies, enterprises and educational activities. All of Planta IC's large equipment 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 to order analyses.

Spremljanje kakovosti morja in monitoring

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

Spremljanje (monitoring) in ocena okoljskega stanja morskega okolja glede na različne biološke, fizikalno-kemične 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 (<http://buoy.mbss.org>) in njena uporaba za napovedovanje cirkulacije.

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

Kontaktni podatki: dr. Andreja Ramšak, e-pošta: andreja.ramsak@nib.si

Detekcija patogenih 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 antibakterijskih 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).

Kontaktni podatki: 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 spremna ustrezna strokovna podpora in izobraževanje s področja kvantitativne analize nukleinskih kislin in metrologije. Razvito spletno orodje: GMOseek (<http://www.gmoseek.com/gmoseek>).

Kontaktni podatki: 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 in kontrola kakovosti). Ena od mogočih aplikacij teh študij je izboljšanje industrijskih proizvodnih sevov. Razviti spletni orodji: GoMapMan (www.gomapman.org), quantGenius (<http://quantgenius.nib.si>).

Kontaktni podatki: 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 cebraic (*Danio rerio*) (FET test) s pregledom učinkov glede na SIST ISO 7346-3:1998, 5667-16 ter ustrezno smernico OECD v osnutku 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 odplake) 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: dr. Metka Filipič, e-pošta: metka.filipic@nib.si

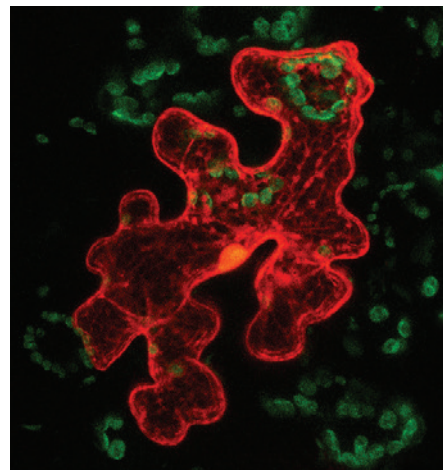
Storitve na področju predkliničnih in vitro raziskav in tehnologije matičnih celic

Ponujamo dvodimenzionalne in tridimenzionalne in vitro celične modele za raziskave mehanizmov delovanja, učinkovitosti in varnosti pri razvoju diagnostičnih in terapevtskih pristopov.

Obvladujemo postopke izolacije in svetujemo pri pripravi mezenhimskih matičnih celic MSC iz človeških tkiv za različne raziskovalne namene.

Ponujamo ekspertna znanja s področja tumorskih biomarkerjev in njihove klinične uporabe.

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



Assessment of Marine Quality and Monitoring

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

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

Operational oceanography: the Vida buoy (<http://buoy.mbss.org>), and its use for circulation forecasting.

Offering professional support and advice to stakeholders regarding the implementation of European directives regarding environmental policies into national legislation.

Contact details: Dr Andreja Ramšak; email: andreja.ramsak@nib.si

Detection of Pathogens and Other Applications in Biotechnology

The detection of plant viruses, bacteria and phytoplasmas using conventional methods and new molecular methods in accordance with the ISO/IEC 17025 and ISO 9001 standards and the EPPO (European Plant Protection Organization) protocols; concentration of viruses from water samples using CIM technology, purification of viruses for various applications; and the customised development of new detection methods on demand (qPCR, dPCR, LAMP). We also offer services such as screening for antibacterial substances and various electron microscopy analyses: localisation of biomolecules in cells, immunolocalisation, negative and positive contrasting of samples and the ob-

servation of viruses, bacteria, and fungi (including bacteriophages and virus-like proteins).

Contact details: Dr Maja Ravnikar; email: maja.ravnikar@nib.si

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

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

Contact details: Dr Jana Žel; email: jana.zel@nib.si

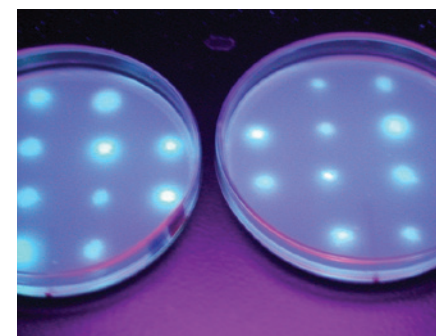
Services Using Advanced Molecular Biology Techniques

We offer studies using different quantitative biology approaches such as next generation sequencing (NGS), microarrays, quantitative and digital PCR including data analysis and integration. We prepare samples (homogenisation, nucleic acid isolation and quality control) from different biological systems. Services also include industrial production strain improvement. Developed web application: GoMapMan (www.gomapman.org), quantGenius (<http://quantgenius.nib.si>).

Contact details: Dr Kristina Gruden; email: kristina.gruden@nib.si

Toxicological Analyses

In vitro genotoxicity testing, as required by various regulatory documents: a bacterial reverse mutation (Ames) assay, an in vitro mammalian cell micronucleus assay, an in vitro mammalian cell gene mutation assay, and an in vitro mammalian cell com-



et assay. Bacterial mutagenicity tests are performed in compliance with OECD Good Laboratory Practice.

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

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 test with *Salmonella typhimurium* TA1535/pSK1002, Ames MPF™ 98/100 Aqua assay, and FET test).

Contact details: Dr Metka Filipič; email: metka.filipic@nib.si

Services in Preclinical In Vitro Studies and Stem Cell Technologies

We offer 2D and 3D in vitro cell models for mechanistic, efficiency and safety studies regarding the development of new diagnostic and therapeutic approaches and products.

We carry out characterisation and consultancy services for procedures related to the isolation and expansion of mesenchymal stem cells (MSC) from human tissue which are customised for a wide range of experimental purposes.

We provide expertise in tumour biomarkers and their clinical applications.

Contact details: Dr Tamara Lah Turnšek; email: tamara.lah@nib.si



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