PhD SDC
SUSTAINABLE DEVELOPMENT
AND CLIMATE CHANGE

Scholarship code

CU6.01

Curriculum: 6. Health and Ecosystems

Is human well-being enhanced by exposure to high biodiversity

Reference Person: Bertorelle Giorgio (ggb@unife.it)

Host University/Institute: University of Ferrara

Research Keywords:	Biodiversity loss and climate change
	Human wellbeing
	Biological evolution and -omics
Reference ERCs:	LS8_2
	LS8_5
	SH4_3
Reference SDGs:	GOAL 3: Good Health and Well-being, GOAL 15: Life on Land

Description of the research topic

Climate change is modifying levels and patterns of biodiversity. In particular, increased temperatures, modifications in physical-chemical parameters, and extreme meteorological events, produce either extinction, migration, or adaptation in many animal and plant species. Recent studies suggest that biodiversity plays an important role not only in ecosystems stability and services, but it may also produce psychological benefits to humans. Human well-being is enhanced by exposure to nature, but it is not well understood if this effect is higher in more biodiverse natural or urban habitats (e.G., areas with higher species richness). Understanding this relationship is important to better evaluate the effects of biodiversity loss due to global warming on human health, and to help planning urban green-spaces. This research project will investigate using public surveys the "feel-good factor" as a function of biodiversity levels in different environmental contexts. The possible evolutionary explanation that may justify the preference for more biodiverse habitat will be experimentally tested using animal models. In particular, fish models will be analyzed in choice experiments (biodiverse versus homogeneous settings), and the relationship between polymorphisms in the preference traits and its genetic determinants will be analyzed using genomic and transcriptomic data.

Research team and environment

The selected student will work at the Department of Life Sciences and Biotechnology of the University of Ferrara. The main responsible of the project will be Professor Giorgio Bertorelle, the evolutionary biologist head of the population genetics and genomics group (www.ls.Gd/popgg). Members of the team have an established experience in evolutionary

studies and biodiversity conservation, using DNA and RNA data. Co-supervisors of the project will be the Prof. Tyron Lucato Xiccon (expert in evolution and behavior studies in animal models). The research environment is strongly interdisciplinary, interdepartmental, and international thanks to the activities of the PhD programme in Environmental Sustainability and Wellbeing (Giorgio Bertorelle is vice-coordinator of this PhD programme).

Suggested skills for this research topic

Candidates should have basic knowledge in evolutionary biology and genetics, and be familiar with the scientific method. Additional skills in statistics and the analysis of interviews data are welcome.

Type of scholarship and obligations

The type of this scholarship is: Ricerca PNRR (PNRR Research). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT
AND CLIMATE CHANGE

Scholarship code

CU6.02

Curriculum: 6. Health and Ecosystems

Forecasting the consequences of glacier extinction for ecosystem functioning

Reference Person: Caccianiga Marco (marco.caccianiga@unimi.it)

Host University/Institute: Università degli Studi di Milano

Research Keywords:	Global Change Ecology
	Biodiversity, Ecosystem Functions and Services
	Ecological Networks
Reference ERCs:	LS8_1
	LS8_5
	PE10_4
Reference SDGs:	GOAL 13: Climate Action, GOAL 15: Life on Land

Description of the research topic

An iconic sign of global warming is the retreat and extinction of glaciers worldwide. As glaciers are retreating, new terrain is continuously exposed to colonization by diverse organisms, prompting distribution shifts and changes in the functioning of ecosystems. But glacier extinction will also be followed by

The loss of species from local communities, with the inherent impoverishment of ecosystem functions. However, lack of comprehensive system-level studies impairs our ability to predict the fate of biodiversity and the functioning of ecosystems on forelands of retreating glaciers. An integrative understanding of ecosystem functioning following glacier retreat is therefore of paramount importance to biodiversity maintenance, environmental health and human well-being.

To address such challenges, it is crucial to go beyond the traditional approach of examining individual species or ecosystem components in isolation and overcoming the difficulties associated with addressing complex biogeochemical cycles. Using cutting-edge analytical techniques, we plan to investigate ecosystem functioning in environments ranging from recently ice-free terrains to late stages of development on six Italian and Swiss glacier forelands. Our objective is to (1) Understand the evolution of biophysical soil and vegetation functions including productivity, biodiversity, carbon sequestration, nutrient and water retention; (2) Develop predictive models of ecosystem functioning response to glacier extinction, and (3) Design systemic nature-based interventions for mitigating the risk of ecosystem functioning collapse.

Combining traditional sampling with robotic measuring and cutting-edge analytical techniques, we will investigate ecological network dynamics in environments ranging from recently ice-free terrains to late stages of development on five glacier forelands in the Italian Alps. We will reconstruct interactions among multiple ecological communities (fungi, plants, pollinators, herbivores, and predators) by means of DNA metabarcoding. This novel aspect will allow us to unveil cryptic species and hidden interactions, and analyze the assembly, structure, and dynamics of ecological networks at unprecedented resolution. Furthermore, we will use state-of-the-art biogeoscience methods (eg. CHN analyzer, Leco TruSpec). Soil and ecological network functionality will be analyzed together with environmental and biological data by means of structural equation modeling. This will allow us to understand the interactions among ecological processes and devise recommendations for managing ecosystems. The contribution this project will provide is crucial to predicting the fate of ecosystem functioning and anticipating the consequences of global warming on mountain environments.

The ambitious work proposed here will be feasible thanks to the following points: (i) the applicants (Prof. Caccianiga as Reference Person and Dr. Losapio as Direct Supervisor) have matured expertise and advanced skills in alpine ecosystems, biogeochemical cycles, data analysis, and computational modeling, spanning plant–environment interactions and ecological network models; (ii) the field sites are already studied by glaciologists, geomorphologists and other ecologists, offering a wealth of geochronological and environmental information; (iii) Università degli Studi di Milano hosts outstanding facilities offering lab instrumentation, expert staff, and specialized scientific services.

Research team and environment

The Research Team links the expertise in alpine botany of the Reference Person (Prof. Marco Caccianiga) with the research experience in biodiversity and ecosystem functioning of the Direct Supervisor (Dr. Gianalberto Losapio). Furthermore, it matches with the long-standing studies of the host institution in climate change and mountain environments. The PhD student will develop their own research project while working in a multicultural, diverse, collaborative, and dynamic environment. We provide great opportunities for academic and professional training as well as acquisition of transversal skills. We offer stimuli for developing critical thinking and to become an independent scientist. In all, we are both professional and empathic. We select motivated, experienced, self-organized and passionate students. As we start, we clarify reciprocal expectations and set achievable goals. The student will be guided through the graduate school, will be trained and assigned to specific research subjects with diverse and achievable tasks. They will receive individualized attention and will be advised from the beginning (i.E., from the pilot study and planning data collection) and throughout the whole process (analyzing samples, implementing models, presenting results and writing publications). The PhD student will have many opportunities to develop close collegial relationships with fellow students (two ongoing PhD students), recruited Bachelor and Master students from different courses as well as different collaborator faculties (Prof. Ficetola and Prof. Trombino; Prof. Guisan and Prof. Grand at

University of Lausanne; Prof. Schmid and Prof. Bascompte at University of Zurich; Prof. Dirzo at Stanford University).

Suggested skills for this research topic

We are looking for a highly motivated PhD candidate with particular interests in biodiversity, ecosystem functioning and global change ecology. The ideal candidate is a highly motivated, enthusiastic, and independent person with a passion for science and nature. Talented students with a degree in biodiversity, ecology, conservation biology, environmental sciences or related fields interested in taking an integrative approach are particularly encouraged to apply. Applicants are expected to have research experience with field work (hiking at high-altitude), lab work (e.G., DNA metabarcoding, soil functionality, carbon sequestration), good quantitative skills (i.E., knowledge of R or gis), and be keen to learn experimental and computational techniques. A high level of written and spoken English proficiency is required.

Type of scholarship and obligations

The type of this scholarship is: Transizioni Digitali ed Ambientali (Digital and Environmental Transitions). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.03

Curriculum: 6. Health and Ecosystems

Pollution and health: exploiting geolocalized Emergency Medical Services data, ground monitoring and Earth observation

Reference Person: Caiani Enrico Gianluca (enrico.caiani@polimi.it)

Host University/Institute: Politecnico Di Milano

Research Keywords:	Health Geomatics and Earth observation
	Emergency medical Services
	Pollution measurement and risk prediction
Reference ERCs:	LS7_14
	SH7_6
	LS7_9
Reference SDGs:	GOAL 3: Good Health and Well-being, GOAL 11: Sustainable Cities and Communities, GOAL 13: Climate Action

Description of the research topic

Our current society is developing at expenses of the environment, with increased land consumption and pollutants emission due to anthropic activities, with an impact on our health by relevant environmental risk exposure. Air pollution constitutes the fourth largest risk factor for global mortality, of which >50% deaths are attributable to cardiovascular (CV) causes. Health Geomatics (HG) refers to the process of gathering, storing, processing, and delivering geographic information relevant to health through a Geographical Information System (GIS). HG techniques have the potential to evidence spatio-temporal correlations in diverse geolocalized information available for a specific territory. Emergency Medical Services (EMS) are managed in Italy at regional level by specific Agencies (in Lombardy, AREU is in charge): these services represent the first evidence of a suspected disease-related event on the territory, with the capability of geolocalization of the patient through the caller phone cell when the 112/118 emergency number is reached. Data gathered during this process is able to potentially indicate insurgence of communicable diseases (as we showed applied to COVID-19) as well as to evidence the spatial and temporal map of events relevant also to non-communicable diseases. These information can be linked with those relevant to the air pollutant concentration. measured through ground stations or derived from satellite images, in order to provide industry and policy makers with new tools and information to support their decisions on sustainable development, including preserving health. A case scenario will be represented by the Lombardy region, the most polluted in Italy, with possible focus on CV and respiratory diseases, as well as on COVID-19 diffusion, by taking into account also mobility

data and land use. Risk prediction mapping for different diseases will be produced on the basis of retrospective data, to highlight possible links with pollutants exposure and spatio-temporal effects on a given territory. Decision support tools for policy makers will be proposed based on the predicted models in order to simulate in advance possible benefits of mitigation actions and related costs, that could span from mitigating emissions to reorganizing the medical services to better cope with the geographical distribution of the observed phenomena.

Research team and environment

The research team is multidisciplinary: Ass. Prof. Caiani, biomedical engineer with 1 post-doc and 1 PhD in Data Science; Prof. Brovelli, environmental engineer and her team at GISGeoLab. A strong collaboration with AREU allows access to EMS data, as well as feedback from stakeholders. In addition, possible links with the ESC advocacy committee and its reach to WHO will complement the exploitation phase.

For this scholarship it is planned a period of internship at *Agenzia Regionale Emergenza Urgenza (AREU)*

Suggested skills for this research topic

Data science methods, Python programming skills, basic knowledge in GIS and Earth observation data analysis, interest in multidisciplinary research, basic knowledge of Italian language

Type of scholarship and obligations

The type of this scholarship is: Pubblica Amministrazione (Public Administration). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT
AND CLIMATE CHANGE

Scholarship code

CU6.04

Curriculum: 6. Health and Ecosystems

Impact of atmospheric pollutant on human health: from mouth to lungs

Reference Person: Di Carlo Piero (piero.dicarlo@unich.it)

Host University/Institute: University 'G. D'Annunzio' of Chiti-Pescara

Research Keywords: Air pollution
Health
Climate change

Reference ERCs: PE10_3
PE10_1
LS7_6

Reference SDGs: GOAL 3: Good Health and Well-being, GOAL 13: Climate Action

Description of the research topic

The proposed research is focused on the analysis of the impact of atmospheric pollutant and meteorological parameters on human health focusing on the genotoxicity on mouth and lungs tissues. The study includes in vitro analysis using different levels and chemical composition of particles and atmospheric trace gases under different levels of temperature and unidity.

Research team and environment

The research team includs a full professor of atmospheric physics, an assistant professor of dentistry, 2 assistant professors and a post doc.

Suggested skills for this research topic

Candidates with good skills in programming and data analysis are appreciated. Background in medicine, dentistry, biology, engineering, environmental science, chemistry is desirable.

Type of scholarship and obligations

The type of this scholarship is: Ricerca PNRR (PNRR Research). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and

Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.05

Curriculum: 6. Health and Ecosystems

Conserving the evolutionary potential of endemic species under global changes

Reference Person: Ficetola Gentile Francesco (francesco.ficetola@unimi.it)

Host University/Institute: Università degli Studi di Milano

Research Keywords:	Genetic diversity
	Cliamte change
	Species distribution models
Reference ERCs:	LS8_5 Biological aspects of environmental change, including climate change
	LS8_2 Biodiversity
	LS8_4 Population biology, population dynamics, population genetics
Reference SDGs:	GOAL 15: Life on Land

Description of the research topic

Environmental change is rapidly accelerating, and many species will need to adapt to survive. However, animal species are not homogeneous entities, as they often comprise multiple populations, each of which evolved local adaptations to specific local conditions. Local adaptations are extremely important, as they constitute the intra-specific genetic diversity and allow each species to have high fitness in specific habitats. Genetic variation strongly impacts population performance, and this can influence their response to global changes: (i) high genetic diversity populations might be more tolerant to stressors and occupy broader niches; (ii) local evolutionary adaptations might allow to exploit different niches. For instance, populations that live at the warmer edge of a specie's range (e.g. at low altitude or at the southern limits) could have evolved adaptations favoring species persistence and evolution under warming climates. Despite progresses in understanding how species can respond to global changes, very little is known about how intra-specific diversity can affect the adaptive potential of any given species, and intra-specific genetic variation is rarely integrated into analyses of the response of species to environmental change.

The situation is particularly problematic for endemic species, which are restricted to narrow areas and can be particularly sensitive to global changes, being among species expected to suffer the fastest declines. Effective strategies for the conservation of endemic species

require to identify local adaptations exists, and to evaluate how evolutionary distinct populations will respond to global changes.

Italy is among the European countries with the largest number of endemic species, and also hosts an amazing level of unexplored variation, with new endemic species and lineages described every year. Endemic reptiles will be used as model group, because of their vulnerability to climatic and habitat changes, and because they are particularly suitable for both modelling and genetic analyses.

The aims of the project are:

1) measuring genetic diversity in representative reptile species using genetic markers covering the whole genome (e.g. Rad-SEQ). This will provide unforeseen information on the intra-specific variation of endemic species, allowing to identify evolutionary significant units that require special attention for conservation

2) linking genetic variation with present-day environmental variation (e.g. along climatic gradients). This allows to identify local adaptations, for instance populations of a given species that are expected to better persist under climate change scenarios and could be suitable targets for future conservation actions

3) integrating information on intra-specific variation with species distribution models (SDM). SDM are perhaps the most used approach to assess the impact of climate change on biodiversity, but generally assume that all populations of a species have similar response to environmental changes and occupy the same ecological niche. Integrating information on intra-specific diversity into SDM will improve our understanding and prediction of the impact of environmental changes on biodiversity. The improved models will consider the role of genetic diversity on species tolerance, and will also take into account the possibility of evolutionary adaptations of populations.

This project will produce unprecedented information on the response of endemic species to fast environmental changes.

Research team and environment

The PhD candidate will be part of the animal biodiversity and conservation (ABC) team at the department of Environmental Sciences and Policy (University of Milano). ABC is a dynamic group of researchers analyzing the impacts of global changes on multiple facets of biodiversity, and is a world leader in the use of emerging tools (e.G. Environmental DNA; population genomics; ecological modelling). The team is funded by the European Research Council, by PRIN, and by other national and international funding agencies. ABC is an international team and includes researchers from both Europe and other continents, with two permanent researchers, four PhD students and five post-doctoral researchers. The researchers work together and share their interdisciplinary and complementary competences. Our team has state-of-the-art facilities and laboratories for multiple

approaches to biodiversity analysis, including both traditional and environmental DNA analyses, and data analysis.

Suggested skills for this research topic

We are looking for young candidates with a strong attitude toward the use of advanced statistical techniques to understand ecological processes. Applicants for the position will be enthusiastic, hard-working, independently motivated and willing to lead a significant part of the research Project, and will join a highly-dynamic work group, with a strong emphasis on research excellence.

Candidates must be available to perform field activities in natural environments.

Candidates with experience in population genetics, population genomics and / or in species distribution models will be favored

Type of scholarship and obligations

The type of this scholarship is: Transizioni Digitali ed Ambientali (Digital and Environmental Transitions). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.06

Curriculum: 6. Health and Ecosystems

Contaminants of Emerging Concerns in Marine Ecosystems: Evaluation of Presence and Ecotoxicological Effects

Reference Person: Gorbi Stefania (s.gorbi@univpm.it)

Host University/Institute: Università Politecnica Delle Marche

Research Keywords:	Contaminant of Emerging Concerns (CECs) Marine Ecosystems Bioindicators and biomarkers
Reference ERCs:	LS8_5 Biological aspects of environmental change, including climate change LS8_13 Marine biology and ecology LS8_14 Ecophysiology, from organisms to ecosystems
Reference SDGs:	GOAL 6: Clean Water and Sanitation, GOAL 13: Climate Action, GOAL 14: Life Below Water

Description of the research topic

Contaminants of emerging concern (CECs) comprise a vast array of contaminants that have only recently appeared in water, or that are of recent concern because they have been detected at concentrations significantly higher than expected, and/or their risk to human and environmental health may not be fully understood. CECs span natural and artificial chemical substances including pharmaceuticals, microplastics and their additives, but also bioactive natural molecules such as biotoxins.

There are many evidences that CECs can alter the normal biological physiological functions of marine organisms and evaluating these effects may require testing methodologies not typically available, along with endpoints not previously evaluated using current guidelines.

The project aims to evaluate the presence and the ecotoxicological hazard of CECs in marine ecosystems through a multidisciplinary approach. The involved steps will be: i) development/validation of analytical protocols for CECs determination in different marine matrices (including water, sediment and organisms); ii) measurement of their occurrence in representative key sentinel species (bioindicators) collected in Mediterranean Sea; iii) laboratory exposures of marine invertebrates (such as mussels Mytilus galloprovincialis) to a

selected group of CECs in order to investigate uptake/excretion kinetics and adverse biological effects at transcriptional, biochemical and cellular level.

Research team and environment

The project will be carried out at the Ecotoxicology and Environmental Chemistry Lab, Department of Life and Environmental Sciences of the Polytechnic University of Marche (DISVA).

DISVA includes more than 100 interdisciplinary laboratories, ranging from biological physics, cell and molecular biology, biochemistry and genetic organic biology, microbiology and applicative biotechnology, physiology and reproductive biology, marine ecotoxicology and oceanography.

Http://www.Disva.Univpm.It/

The Ecotoxicology and Environmental Chemistry Lab team in mainly involved in the following research topics: use of organisms as bioindicators of chemical pollution; molecular and cellular effects induced by pollutants; analysis of contaminants along food networks, food risk and enhancement of fish resources; development of environmental risk analysis models; environmental impact analysis in port areas and off-shore extraction platforms; monitoring of industrial complexes, plants at environmental risk, and in emergency conditions; emerging contaminants: microplastics and drugs; ecotoxicological effects of biotoxins and algal metabolites; mechanisms of adaptation to extreme environments.

Http://www.Disva.Univpm.It/content/laboratorio-di-ecotossicologia-e-chimica-ambientale

The DISVA offers the possibility to use the Actea Mobile Laboratory to sampling activities and hosts the ""Aquarium"" Laboratory representing a unique infrastructure at National level. Recently, thanks to the Italian Excellence Department Projects, the DISVA of UNIVPM has developed a well-advanced technical platform fully equipped for chemical analyses of all classes of environmental pollutants and ecotoxicological analyses.

Suggested skills for this research topic

Successful candidates are expected to have a background in marine biology, with an interest in ecotoxicology and biological effects of anthropogenic pollutants.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.07

Curriculum: 6. Health and Ecosystems

Climate Change Impacts in Polar and Alpine permafrost areas

Reference Person: Guglielmin Mauro (mauro.guglielmin@uninsubria.it)

Host University/Institute: Università dell insubria

Research Keywords:	Permafrost
	POlar areas
	Alpine
Reference ERCs:	PE10_3 Climatology and climate change
	PE10_18 Cryosphere, dynamics of snow and ice cover, sea ice, permafrosts and ice sheets
	PE10_13 Physical geography, geomorphology
Reference SDGs:	GOAL 13: Climate Action, GOAL 15: Life on Land

Description of the research topic

The research will be focused on the analyses of the impacts of the climate change on permafrost environments and the related ecosystems in polar areas and alpine mountains. In these areas permafrost is thawing almost everywhere ,changing deeply the landscape and triggering surface instability that interacts with the evolution of the ecosystems and with the CO2 and CH4 fluxes. The

Research will be focused on these complex and dynamic relationships in Alaska where Insubria will open in 2022 his international Branch and, for comparison in the Italian Alps where Insubria had traditional study sites in Upper Valtellina. This comparison will be important because both the areas are suffering the more intense warming in the planet.

Research team and environment

This PhD is within the framework of Climate Change Research Center of Insubria University where it will be

Possible work in a multidisciplinar team including the CRyosphere Lab (resp. Prof. Mauro Guglielmin) with a Researcher (Dr. S. Ponti, expert in remote sensing), one Post Doc (dr. Alessandro Longhi, expert in soils) and twp PhD dr. Silvia Picone (expert in debris flows and permafrost hydrology) and dr. Vasudha Chaturvedy. (expert of CH4 emissions modelling and remote sensing). THis group interacts with the Botany and Climate Change Lab (Resp. Prof. Nicoletta Cannone) in which other experts of vegetation and terrestrial ecology of alpine and polar areas are working. The Climate Change Research Center of Insubria will have since 2022

the possibility to use the International Branch of Insubria at Barrow (USA, Alaska). The team is working in cooperation of many national and international Instititution like the British Antarctic Survey, the Alfred Wegener Institute, the Trieste University and many other foreigner universities.

Suggested skills for this research topic

The candidate should have basic knowledge on the climate change, on the climate change impacts on the

Cryosphere and on the ecosystems of periglacial environment. Basic knowledge on GIS and statistical analyses are also welcome. The candidates should be ready to work in a dynamic, international context with an important field work activity in polar environment.

PhD SDC
SUSTAINABLE DEVELOPMENT
AND CLIMATE CHANGE

Scholarship code

CU6.08

Curriculum: 6. Health and Ecosystems

Evaluation of global warming effects on pathogenesis of aquatic Mycobacterioses

Reference Person: Marino Fabio (marinof@unime.it)

Host University/Institute: University of Messina

Research Keywords: Global warming in Aquaculture and Fisheries
Aquatic infectious and parasitic diseases
In vivo aquatic models

Reference ERCs: LS9_10

Reference SDGs: GOAL 3: Good Health and Well-being, GOAL 14: Life Below Water

Description of the research topic

Climate change and in particular global warming can have direct and indirect effects on the health status of farmed and wild aquatic organisms, in both fresh and saltwater ecosystems. At this regard, the impact of bacterial and parasitic pathogens whose pathogenic potential is known to be influenced by high temperatures should be placed under surveillance in order to predict and avoid devastating changes and already occurred mass mortality events (MMEs) in aquatic populations. At this regard, bacterial diseases due to atypical Mycobacteria should be primarily considered for their possible impact on teleost and mollusk populations in the context of climate change, evaluating in the meanwhile the abiotic and biotic factors characterizing the hosting aquatic environments. Mycobacteria have recently been reported as cause of MMEs in the Pen Shell (Pinna nobilis) and possible related to global warming (Carella et al. 2019), moreover, these atypical acid-fast bacilli have been widely reported to affect wild and farmed fish, causing high mortality rates. The research proposal aims to perform in vivo experimental infections, to test pathogenicity of infectious agents and susceptibility of aquatic organisms, that will be carried out at the Centre for Experimental Fish Pathology (CISS) of the University of Messina, using isolated mycobacteria strains.

Specimens will be sampled from farms and housed at CISS in 120 l tanks, water parameter will be constantly monitored through Tecnos oxywifi 2 system. Health status of aquatic organisms will be randomly controlled throughout a complete health monitoring program with bacteriology, histopathology and molecular techniques. After a 45 days acclimation period, specimens will be injected with pathogens at DL 50 and subdivided in two groups reared at different temperatures and housed up to 120 days. During the period of the experimental trial specimens will be sacrificed every 15 days and analysed for histopathology, haematology and immune system evaluation. All kind of fish handling procedures will be

carried out prior anaesthesia with MS-222. Anaesthesia and euthanasia procedures with MS-222 will be carried out according to 2010/63/EU. For haematology and immune system evaluation, from each specimen blood and hemolymphwill be collected for the evaluation of haematological, immune, oxidative and antioxidative parameters. Sera will be used for the evaluation of the immune parameters. The evaluation of oxidative and anti-oxidative parameters, will be performed by using spectrophotometric and molecular methods. Tissues samples under experimental challenge on mycobacteria will be subjected to immunohistochemical (IHC) evaluation to characterize the inflammatory response against pathogens.

Research team and environment

The veterinary comparative pathology research team, of the Dept. Of Chemical, Biological, Pharmaceutical and Environmental Sciences of the University of Messina, carries out experimental research in the field of comparative veterinary pathology, with particular attention to the diseases affecting livestock and affection animals as well as aquatic organisms destined for production in aquaculture and wild. The group also carries out preclinical research on aquatic models, always in the context of applied and translational pathology. Experimental procedures of the research team are carried out at the Centre for Experimental Fish Pathology (CISS) of Department of Veterinary Sciences, University of Messina, Italy. CISS is accredited since 2006 for use and since 2010 for production of aquatic organisms for experimental research (DM n¬∞39/ Marzo/2006).

Suggested skills for this research topic

Candidates should possess a degree in veterinary medicine or marine biology and have achieved experiences and knowledges in the field of fish pathology and aquatic experimental models.

Type of scholarship and obligations

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PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.09

Curriculum: 6. Health and Ecosystems

Use of microalgae for the sustainable treatment of dairy wastewater and as a renewable source of compounds for plant biostimulation and protection

Reference Person: Mattei Maria Benedetta (mariabenedetta.mattei@univaq.it)

Host University/Institute: University of L'Aquila

Research Keywords:	Microalgae-based wastewater treatment
	Biostimulants and biopesticides from microalgae
	Plant immunity
Reference ERCs:	LS9_8 Applied plant sciences, plant breeding, agroecology and soil biology
	LS9_11 Biomass production and utilisation, biofuels
	LS9_9 Plant pathology and pest resistance
Reference SDGs:	GOAL 2: Zero Hunger, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action

Description of the research topic

Microalgae have received increasing interest as part of wastewater treatment, based on their ability in mixotrophic cultivation to utilize organic and inorganic carbon, as well as inorganic nitrogen and phosphorous, reducing the concentration of these substances in the water. Moreover, the use of microalgae can improve the purification performance of bacterial systems (microalgae-bacteria aggregates) by providing additional oxygen from photosynthesis, thus reducing the total energy costs of oxygen supply.

Microalgae are also a renewable source for biomass and for biologically active metabolites with potential application in the pharmaceutical and agrifood industries. Preliminary evidences show that plant treatment with microalgae extracts can stimulate both their productivity and immunity, conferring a broad spectrum resistance.

The aim of the research project is to use microalgae grown in dairy wastewater to obtain a biostimulating product for agricultural sector, able to replace chemical fertilizers and pesticides.

Currently, agricultural production is dependent on the massive use of fertilizers and pesticides with damage to the environment and human health. However, sustainable control

of plant diseases is possible by exploiting the innate immunity of plants, that can counteract the infection of the plant by microorganisms.

The multidisciplinary approach, in a natural synergy between environmental sciences, plant physiology and biotechnology, includes:

1) optimization of microalgae growth in small to medium scale dairy wastewater under non-axenic conditions,

2) microbiological and chemical analysis on both the algal biomass and the dairy wastewater,

3) preparation and characterization of various formulations of algal extract using eco-sustainable extraction techniques,

4) treatment of Arabidopsis thaliana and Solanum lycopersicum with the different formulations of algal extract and evaluation of:

A) productivity and nutritional quality of treated plants

B) pest and disease control (infection test with different plant pathogens, both fungal and bacterial),

5) treatment of human umbilical vein cells (HUVEC) in culture with the various formulations of algal extract, to estimate any toxic effects for humans that may derive from their use in the agrifood sector,

6) evaluation of the economic convenience deriving from the use of algal extracts in use of current pesticides through a ""technical-economic"" evaluation,

7) evaluation of the potential risks deriving from the use of algal extracts in agriculture through a life cycle assessment (LCA).

The use of microalgae for wastewater biodepuration, reducing the need for expensive treatments before their discharge, represents an important goal with social and economic consequences.

The cultivation of microalgae provides valuable biomass for different industrial sectors, as a source of innovative biological compounds such as pharmaceuticals, biofertilizers / biostimulants for agriculture, cosmetics and fine chemicals.

The development of efficient microalgae treatments is necessary to profitably and sustainably exploit the potential of these biomasses, recovering and separating high value-added components and minimizing waste generation.

Furthermore, the research will also concern the protection of plants from diseases, an important field of scientific and applied research. The impact that climate change has on the biodiversity of plants and microorganisms, and consequently on agricultural crops, is a

current issue of growing scientific interest for the protection of species of agronomic importance.

Research team and environment

The Laboratory of plant physiology and biotechnology of UNIVAQ has a long and recognized experience in the field of plant biotechnology and biochemistry, and in particular in the study of oligosaccharins derived by the plant cell wall that act as elicitors of plant defense responses. The research team is composed by the PI prof. Mattei and 3 researchers. Using biochemistry and molecular biology techniques, the group contributed to identifying oligosaccharin oxidases involved in the defense against plant pathogens. In recent years, the laboratory has devoted its attention to the growth of microalgae for wastewater treatment and for the production of bio-fuels. This research activity has been recognized at national and international level, as evidenced by publications on high impact scientific journals, patents and national and international research projects coordinated by the same operating unit. The research unit has active partnerships with industrial and university colleges and research organizations at national level. Collaborations already established with agrifood and biotechnology companies have allowed the research unit to develop industrial research and development activities. Equipment available at MESVA includes molecular and biochemical biology laboratories equipped with all basic equipment, growth chambers for microalgae and plants, filamentous fungi, yeasts and bacteria. Specific instruments for biochemical and molecular biology analysis available are: HPLC; FPLC; cell counter; Multi-Cultivator, a photobioreactor for small-scale screening experiments of phototrophic organisms as algae, cyanobacteria and plant cells; Real Time PCR.

Suggested skills for this research topic

The candidate will need skills in plant/microalgae growth, physiology and molecular biology, extraction and analysis of bioactive compounds, plant defense responses towards biotic and abiotic stresses.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.10

Curriculum: 6. Health and Ecosystems

Climate sensitive diseases in a changing environment: a one-health approach

Reference Person: Maule Milena (milena.maule@unito.it)

Host University/Institute: University of Turin

Research Keywords:	One Health Emerging infectious diseases Environmental changes
Reference ERCs:	LS7_9 Public health and epidemiology LS8_5 Biological aspects of environmental change, including climate change SH7_6 Environmental and climate change, societal impact and policy
Reference SDGs:	GOAL 3: Good Health and Well-being, GOAL 11: Sustainable Cities and Communities, GOAL 13: Climate Action

Description of the research topic

Climate change has been defined as the biggest global health threat of the 21st century. Among its many possible effects on health, climate change influences the spread of infectious diseases. Vector-borne diseases (VBDs) are particularly sensitive to changes in the environmental conditions, given the multiple interactions between the environment-vector-pathogen-host. Potentially, any factor influencing the presence of the vector species, such as urbanization, land use and climatic parameters, can modify the probability of disease transmission. Estimating the effects of climate change on VBDs spread is challenging because the underlying mechanisms imply complex interactions between causal components acting at different spatial and temporal scales. In recent years, the idea of a one-health approach has been emerging that addresses this complexity and recognizes that the health of people is closely connected to that of animals and of our shared environment.

The research project aims to explore the role of environmental, meteorological, and climatic parameters in shaping the epidemiology of VBDs in Italy and Europe through a One Health approach. Possible topics to be addressed are: a) understanding the recent spatio-temporal patterns of VBDs spread; b) evaluating the association between climatic and environmental parameters (temperature, precipitation, Normalized Difference Vegetation Index (NDVI), etc) and VBDs; c) estimating dose-response relationships and lag-effects of weather conditions

on the incidence of VBDs; d) modelling the relationships between human cases and circulating vectors in relation to different environmental factors; e) projecting future trends under different climate change scenarios. Environmental, entomological, animal, and human datasets will be interrogated for the generation and testing of research hypotheses. Climatic data will span from land-based meteorological data for specific locations to high-resolution gridded satellite data. Health outcomes data will be obtained at the regional, national, and European level. Methodological aspects will involve epidemiological methods for spatio-temporal epidemiology (geostatistical analysis, point-pattern analysis, disease mapping, time-series analysis), machine learning techniques, causal inference approaches to explore the pathways from environmental and climatic drivers to health, mechanistic mathematical models to simulate and investigate VDBs epidemiology under different climate change scenarios.

Research team and environment

The research team includes a multidisciplinary group working on environmental, social, life-course and molecular epidemiology and includes, among others, epidemiologists, biostatisticians, computer scientists and molecular biologists. The team is based at the Cancer Epidemiology Unit of the Department of Medical Science (DMS) of the University of Turin. DMS is a large multi-disciplinary department with broad research interests, encompassing 16 medical disciplines, including epidemiology. The DMS has been ranked by the Minister of Education, University and Research (MIUR) as one of the Department of Excellence, and is an ideal place to carry out multidisciplinary projects thanks to the presence of shared facilities and collaborations among scientific domains, within the department and the whole University, such as the Competence Centre for Scientific Computing (https://c3s.Unito.It/). The research team is involved in several other collaborations, such as with the Istituto Zooprofilattico Sperimentale and the HPC for biomed and AI laboratory in ICxT of the Department of Computer Sciences of the University of Turin, and is a member of the Italian Network for Environmental Health.

Potential data will be available at the Regional level (Healthcare System and Istituto Zooprofilattico Sperimentale), National level (Ministry of Health and Istituto Superiore di Sanità) and European level (European Center for Disease Control and prevention). Examples of sources of environmental data of potential interest are the Copernicus Land Monitoring Centre database and environmental monitoring stations.

Suggested skills for this research topic

Multidisciplinary attitude, basic knowledge in quantitative research (biostatistics, epidemiology, statistical softwares), interest in environmental determinants of human health, one health approach and epidemiology of vector borne diseases, teamwork, willingness to learn and acquire new skills.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.11

Curriculum: 6. Health and Ecosystems

Alternative protein sources for human nutrition

Reference Person: Muscaritoli Maurizio (maurizio.muscaritoli@uniroma1.it)

Host University/Institute: Sapienza University of Rome

Research Keywords:	Alternative protein sources Environmental sustainability Proteins, ecosystems, health, disease
Reference ERCs:	LS4_5 Metabolism, biological basis of metabolism-related disorders LS7_11 Environmental health, occupational medicine LS7_9 Public health and epidemiology
Reference SDGs:	GOAL 3: Good Health and Well-being, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action, GOAL 15: Life on Land

Description of the research topic

Proteins represent an indispensable dietary macronutrient both in healthy conditions and during acute and chronic diseases. In fact, protein shortage is associated with severe consequences in healthy subjects and in particular in chronically ill patients and in older adults that are associated with poor prognosis including disabilities and reduced survival.

The environmental cost (greenhouse gas emission, global warming, water consumption, deforestation) of protein-rich animal food production is a real threat for next generations, particularly when considering the expected planet population growth.

The search for alternative protein sources represents an inevitable policy option in order to reduce the impact on ecosystems. Besides plant-derived protein sources, protein-rich insect meals should be considered as a challenging solution. Nowadays the knowledge and the availability of this new protein sources is limited and research on this topic should be implemented particularly in PhD programs.

Preliminary data from clinical trials show that insect-derived protein meals may increase plasma aminoacid concentrations and muscle protein synthesis rate in a fashion similar to whey proteins.

Experimental and clinical studies are urgently needed to confirm the nutritional validity of alternative animal sources, respecting the ecosystems, as well as their safety in health and

disease. Also, research will focus on the potential differences of these new protein sources with regard to the activation of specific metabolic pathways which regulate protein and fat body mass.

Research team and environment

The research team will involve researchers of the Departments of Translational and Precision Medicine, Experimental Medicine, Public Health and Infectious Diseases, Biology and Biotechnologies, Physiology and Pharmacology Sapienza University. In addition, to the refenrence person Prof Maurizio Muscaritoli, the professors Marco Casini, Livio Santoli, Carlo Rondinini, Maurizio Barbieri, Fausto Manes, Angelo Lalli, Mariella Nocenzi. International research links are active among other European universities and with leading industrial partners.

Suggested skills for this research topic

In order to perform successful research, a master's degree in Medicine and Surgery, Biology, Biotechnology, Pharmacy is needed. Ideally, the successful candidate should be able to work in a multidisciplinary team and an international context and have a basic knowledge of:

- Basic Nutrition
- Applied Nutrition
- Clinical Nutrition
- Metabolism
- Food technology
- Alternative food sources for human consumption
- Ecosystems and interactions with health

Type of scholarship and obligations

The type of this scholarship is: Pubblica Amministrazione (Public Administration). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.12

Curriculum: 6. Health and Ecosystems

Ecological, morphological and human safety impacts of hydropeaking mitigation measurements

Reference Person: Pisaturo Giuseppe Roberto (gpisaturo@unibz.it)

Host University/Institute: Free University of Bozen-Bolzano

Research Keywords:	Hydropeaking Ecological impacts Human safety
Reference ERCs:	PE8_3 Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment PE8_11 Sustainable design (for recycling, for environment, eco-design) LS8_1 Ecosystem and community ecology, macroecology
Reference SDGs:	GOAL 7: Affordable and Clean Energy, GOAL 11: Sustainable Cities and Communities, GOAL 14: Life Below Water

Description of the research topic

The increasing attention on climate change has shown that there has been and continues to be a change in the rainfall and hydrological regime that affects the globe and in particular mountain areas. Short and very intense precipitation events are becoming more frequent and consequently also the management of hydraulic structures in mountain areas will have to be adapted to the new hydrological conditions. In particular, it is also necessary to modify the management of hydropower plants with reservoirs. Among the currently used energy sources, hydropower plants are considered as renewable sources and their main characteristic, especially for reservoir hydropower plants, is to be able to satisfy the electricity demand almost instantaneously and therefore to supply the peaks of energy demand during the day. This type of hydropower plant therefore has the possibility and the capacity to switch from minimum to maximum power generation in a very short time (<10 minutes) and consequently to process and release a very high water flow rate into downstream rivers in short time. These rapid changes in flow rates in receiving rivers are called hydropeaking and, depending on their intensity, can cause negative effects in the downstream ecosystem (morphological changes, effects on Benthos and fish) and effects on hydraulic safety for people. Scientific studies have tried to investigate possible solutions for the mitigation of the effects of hydropeaking on the river system but focusing sectorial aspects (especially effects on Benthos and fish) and consequently not looking for a solution

or at least a synergy between the various aspects involved. The proposed solutions against hydropeaking are of different types and include management aspects of the plant, morphological interventions in the receiving watercourse and structural interventions such as compensation basins or bypasses.

This research project aims to create a synergy of all the aspects involved and to analyse which mitigation measures can maximise habitat, hydraulic safety, and morphological aspects. The research project will have as case studies hydropower plants located in the province of Bolzano and there will be a direct contact with the plant operators.

Preliminary bibliographic research will give an overview of the current scientific knowledge on the issue. It will also allow to focus on the still open questions that have to be investigated during the research project. In particular, flow data will be collected in the rivers under study, habitat quality measurements for benthos and fish, surveys for the understanding of hydraulic safety and substrate sampling. All this information will be used to use and eventually implement models of ecological and global quality of the river system. These models will then be used for modelling mitigation measures against hydropeaking effects to understand which interventions maximise all aspects considered.

Research team and environment

The PhD candidate will be part of the Faculty of Science and Technology at the Free University of Bozen-Bolzano. The research team he will join consists of various experts in the fields of hydraulics, hydropower, ecosystems and hydraulic safety. Despite its young age, the team consists of experienced researchers. There are many opportunities for contact with external provincial and private entities and with local hydroelectric companies, which operate the main hydroelectric plants in South Tyrol. The contact person for this research topic usually co-operates with the hydroelectric operators and the provincial authorities in order to create a dialogue between the public and the private sector with regard to the management of hydropower plants.

Suggested skills for this research topic

The main skills required of the candidate are the willingness to participate in the working team, creating a relaxed environment but pursuing clear research aims. Furthermore, it is necessary that the candidate has a desire to learn and to get to know new aspects. From the point of view of technical skills, the candidate should have the basics of programming (Fortran and/or Matlab) or the use of at least 2D hydraulic modelling software (Basement, Flow-2D, etc.). He/she should show willingness to perform field sampling that will mainly concern liquid flow measurements, substrate sampling and as support to eventual fish and benthos sampling.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.13

Curriculum: 6. Health and Ecosystems

Biomolecules and biomaterials for ecosystems protection and human health (acronym: BREATH: BiomateRial for hEAITH)

Reference Person: Pucciarelli Sandra (sandra.pucciarelli@unicam.it)

Host University/Institute: University of Camerino

Research Keywords:	Biomaterials and Bioactive compounds
	Environmental decontamination
	Biodiversity protection
Reference ERCs:	LS9_4 Microbial biotechnology and bioengineering
	LS8_12 Microbial ecology and evolution
	PE5_7 Biomaterials synthesis
Reference SDGs:	GOAL 3: Good Health and Well-being, GOAL 6: Clean Water and Sanitation, GOAL 13: Climate Action

Description of the research topic

The demand for bioactive molecules and materials with desirable properties is constantly growing. Several molecules that we use for everyday life, such as cellulose, pigments and drugs, are obtained from exploitation of natural resources. The extraction of these substances from the environment can lead to severe consequences like mineral depletion, loss of biodiversity, food insecurity and climate changes (10.1016/j.Jenvman.2017.12.048). Nowadays, we are using more ecological resources than nature can regenerate in different ways. Preservation of the forestry, particularly trees, is essential for keeping global warming in check. Deforestation is also caused by cellulose extraction. Natural resources exploitation can be avoided by finding alternative sources of these compounds.

Marine organisms living in extreme environments have capacity in biosynthesizing novel bioactive compounds, which are potentially useful for pharmaceutical, cosmeceutical, and biotechnological applications (doi: 10.3390/md18120657). For example, Antarctic bacteria can produce different drugs (doi: 10.3390/antibiotics7040090).

The goal of this PhD project is to characterize useful and sustainable biomolecules produced by bacteria. New Antarctic bacterial strains are available in the laboratory of the Reference person. The genomes from these strains have been sequenced and ready to be analyzed to discover metabolic pathways involved in the synthesis of molecules of interest.

Some metabolic features of these Antarctic microorganisms are already known and can be exploited in several different applications:

, Ä¢ These strains can degrade hydrocarbons and, in the presence of heavy metals, can synthesize metal nanoparticles. Therefore, these bacteria can be used in bioremediation to remove pollutants from the environments and to transform them into useful materials. Indeed, these bio nanoparticles have been shown to possess antimicrobial activity against pathogens, including Streptococcus and Candida (granted patent n. PCT/EP2020/071193).

, Ä¢ in different growing conditions such as the presence of glutamate or biodiesel, these bacteria can produce siderophores and biosurfanctants (granted patent n PCT/EP2020/071193).

, Ä¢ in the presence of different sugars (or food waste) these bacteria can synthesize biocellulose (patents PCT/EP2021/086747 and PCT/EP2021/086800).

The PhD candidate will work on: 1- characterization of the metabolic pathways involved in biomolecules and biomaterial synthesis in order to discover new potentiality; 2- biomolecules characterization by Scanning Electron Microscopy (SEM), Fourier transform infrared (FTIR) and UV-Vis spectroscopy; 3- protocols optimization for the biosynthesis and definition of potential uses;in collaboration with industrial partners; 4- possible application of these bacteria in bioremediation, in particular for hydrocarbons and heavy metals (the methods are reported in patent PCT/EP2020/082865).

Activity timetable is reported in the GANNT.(see image).

This PhD project is interdisciplinary since implies applications of bioinformatics, biochemistry, microbiology, and biotechnology. Furthermore, it foreseen both basic and applied research. The PhD student will spend a stage of at least 6 months in associated industrial partners. The outputs of the research can bring to the development of new and more cost-effective bioproducts, as biocompatible wound dressings with antibiotic activity. These production of biomolecules of interest avoiding natural resources exploitation gives a contribution to ecosystems and public health preservation.

Research team and environment

Sandra Pucciarelli is a Senior researcher (with habilitation) in the field of environmental adaptation and microbiology. She is also expert in molecular biology and biotechnology. From a long time, she is part of a research group working on environmental adaptation and molecular evolution in Antarctic microorganisms. Recently, her research moved in the synthesis of biomaterials using bacteria, focusing mainly on metal nanoparticles with

antibiotic activity, and bio active fluorescent pigments. Furthermore, she optimized a protocol for large scale production and purification of biocellulose.

Being the President of the startup IrIdES (https://www.Irides.Eu/wp/homepage/), she can rely on the expertise of the other members of the company in the field of environmental/analytical chemistry, environmental remediation, functional nanomaterials, characterization, and application of natural dyes. The team is also composed by young researchers with skills in microbiology and bioinformatics.

The research group can also rely on international collaborators: Prof Pietro Li√≤ (University of Cambridge) that can support the bioinformatics approach, and prof. Ilidio Correia (Universidade da Beira Interior) that can provide his expertise in the application of biocellulose and metal nanoparticles in the production of wound healing materials.

Paper mills can support the PhD student in biocellulose production.

The research group is operating at the School of Bioscience and Veterinary Medicine of the University of Camerino (UNICAM) that hosts the coordination of the PhD course in Life and Health Sciences. The University has a strong commitment to doctoral training and internationalization. From 2005 the School of Advanced Studies at UNICAM promotes structured doctoral courses with high level of internationalization and collaborative interaction with industries.

For this scholarship it is planned a period of internship at *IRIDES, Camerino*

Suggested skills for this research topic

Basic skills in microbiology, engineering, biotechnology,

Type of scholarship and obligations

The type of this scholarship is: Dottorati Innovativi (Innovative PhD course). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT
AND CLIMATE CHANGE

Scholarship code

CU6.14

Curriculum: 6. Health and Ecosystems

Tick-pathogen interactions: impact on ecology and transmission of tick-borne diseases

Reference Person: Salata Cristiano (cristiano.salata@unipd.it)

Host University/Institute: Università degli Studi di Padova

Research Keywords: Tick-borne diseases
Ticks genetic variability
Vector competence

Reference ERCs: LS8_10 Ecology and evolution of species interactions
LS6_8 Biological basis of prevention and treatment of infection
LS2_6 Metagenomics

Reference SDGs: GOAL 3: Good Health and Well-being

Description of the research topic

Ticks are hematophagous ectoparasitic arthropods that parasitize a wide range of vertebrates, thrive in variable settings from the Arctic to the tropical regions, and transmit a greater variety of pathogens (bacteria, viruses, protozoa, and helminths) than any other group of arthropod vectors. Climate changes are favoring the spread of different tick species in new areas, both in terms of latitude and altitude. This results in an increase in the risk of transmission of pathogens to humans and domestic/wild animals with important socio-economic and ecological impacts. Arthropod vectorial capacity is a complex process governed by a multifaceted suite of genetic mechanisms. First, interaction with a new pathogen generally induces antimicrobial molecular activity, thereby establishing a strong vectorial resistance. Second, the novel metabolite pool resulting from the initial (and potentially recurrent) pathogenic infection may impose permanent and unique changes in the vector's existing epigenetic landscape, thus initiating vectorial tolerance. Finally, during future infections, the newfound vectorial tolerance could usher a mutually beneficial relationship between the vector and pathogen.

The research proposal is aimed at studying the vector capacity of ticks by evaluating their genomic variability in relation to functional aspects (such as the microbiome and virome) analyzing ticks collected from different Italian regions. In particular, we will focus on the identification of molecular markers of infection and factors affecting the vector capacity. Furthermore, performing experimental infections of tick cell lines and whole ticks with viral and/or bacteria models, we will characterize: i) the immune mechanisms associated to

control of pathogens proliferation in ticks; ii) the putative markers of infections; iii) if the infection can increase the efficiency of the pathogen to spread in the environment modifying the behavior and fitness of infected ticks.

The identification of markers of infection may lead to the development of new models for monitoring and assessing the risk of transmission of infections as well as new systems to control the spread of tick-borne diseases.

Research team and environment

The research team includes experts in microbiology, parasitology and bioinformatics.

The enrolled student will take part in laboratory activities inside the BSL2 and 3 facilities using the most common cellular and molecular biology techniques. He/she will have to work in a team of young and senior scholars. The ideal candidate should be also opened to learn and implement the team's skills and competences with new approaches and ideas to tackle the objectives of the proposed research.

Suggested skills for this research topic

Candidates should be motivated and have skills in: i) tick-borne pathogens; ii) manipulation of microorganisms in Biosafety level 2 and 3 facilities; iii) cellular and molecular biology techniques.

Type of scholarship and obligations

The type of this scholarship is: Ricerca PNRR (PNRR Research). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.15

Curriculum: 6. Health and Ecosystems

Novel methodology for development of Safe and Sustainable by Design products using systems biology and bioinformatics methods.

Reference Person: Sarigiannis Denis (denis.sarigiannis@iusspavia.it)

Host University/Institute: IUSS Pavia

Research Keywords:	Sustainability Safety Systems biology
Reference ERCs:	LS9 Biotechnology and Biosystems Engineering LS9_1 Bioengineering for synthetic and chemical biology
Reference SDGs:	GOAL 3: Good Health and Well-being, GOAL 9: Industry, Innovation and Infrastructure, GOAL 12: Responsible Consumption and Production, GOAL 17: Partnerships to achieve the Goal

Description of the research topic

The research object of the present study concerns the development of systems biology models and bioinformatics models in order to link the integrated exposure assessment to multiple chemicals with the identification of toxicity pathways and the dose-relationship relationship associated with adverse outcome pathways associated with industrial chemicals, before their production phase, aiming at sustainable and safe products. It is important to determine the quantitative relationships between key events, utilizing data from transcriptional and metabolic analysis from a combination of in vitro and in vivo data, as well as data from structure-activity relationships, and chemical groups associated with specific forms of toxicity. For this purpose, data from transcriptional and metabolic analysis will be utilized after a range of expected environmentally related doses of combined exposure to chemicals expected to be found in consumer products, taking their entire life cycle. In this sense, predictive tools will be developed, able to identify risks related to chemicals and products at an early stage of design.

Research team and environment

The Environmental Health Engineering Research Team in IUSS consists of Prof. Sarigiannis and 4 PhD students working on salient aspects of sustainable development and the health impacts of climate and environmental change. The research team is expected to grow

significantly with research associates and PhD students during the coming years based on funding coming primarily from the EU research programs Horizon 2020 and Horizon Europe. Our research projects focus on deciphering the link between environment, climate and human health through the use of the human exposome concept, urban health and the promotion of safe and sustainable by design chemicals, materials and products. The team is embedded in the CORDA (Complex Risk Data Analysis) research centre of IUSS, which is directed by Prof. Sarigiannis. CORDA comprises 5 IUSS professors and over 10 researchers and PhD students who work on advanced risk analysis methods including big data analytics for natural and technological hazards, the climate crisis and environmental and industrial chemicals. Prof. Sarigiannis and the Environmental Health Engineering research team also lead the IUSS Department of Excellence with particular emphasis on the line of work on complex hazards affecting critical infrastructures. The Environmental Health Engineering Research Team of IUSS is part of the EU partnerships on chemical risk assessment and human biomonitoring; it also leads the urban health cluster of the EU and EU research projects that tackle climate change and urban air pollution towards the development of win-win solutions that address the link between climate, environmental change and public health.

Suggested skills for this research topic

Degree in Chemical Engineering or Chemistry or Biology, with a diploma thesis in chemical and / or bioinformatics techniques of biological systems. Experience in using biological systems modeling tools (e.G. Cytoscape) and / or bioinformatics (e.G. Panther, Bioconductor, Agilent Genesping), programming knowledge (R or Python or C ++ or Matlab)

Type of scholarship and obligations

The type of this scholarship is: Ricerca PNRR (PNRR Research). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.16

Curriculum: 6. Health and Ecosystems

Plastics in marine Environment

Reference Person: Span√≤ Nunziacarla (spano@unime.it)

Host University/Institute: University of Messina

Research Keywords:	Biodiversity Plastics Pollution Marine Environment
Reference ERCs:	LS8_2 LS8_5 LS8_13
Reference SDGs:	GOAL 3: Good Health and Well-being, GOAL 6: Clean Water and Sanitation, GOAL 13: Climate Action

Description of the research topic

BIOdiversity and PLAStic pollution: exploring the ecological and biological effects of plastic debris in marine environments

BIOPLAS

Conservation of marine habitats biodiversity is of fundamental importance to maintain ecosystem services and permit a sustainable exploitation of natural resources. As required by Directive 92/43/EEC (Habitat Directive), European member states should adopt conservation measures in order to preserve the integrity of habitats or stop their degradation. Furthermore, the Marine Strategy Framework Directive 2008/56/EC, requires a deepening of the knowledge on the characteristics and conservation status of marine habitats and living species in order to protect and preserve the marine-coastal environments. These actions could help to reduce degradation and biodiversity loss to maintain and/or reach a ""Good Environmental Status"" for national marine waters in the near future.

In order to pursue this goal, the first step is the evaluation of the biodiversity status of such areas and the possible environmental pressures that could alter them.

It is by now clear that one of the most severe threat to maintain coastal biodiversity is the increasing abundance and distribution of plastic litter. In fact, plastic polymers due to their versatility and durability have become the most used materials. Thanks to their properties,

plastics, once entered in the marine environment, are difficult removed. Nano-plastic (<100 nm) and micro (<5 mm) particles, directly produced or resulting from degradation and fragmentation processes in the natural environment, are one of the most important sources of anthropogenic pollution, bioaccumulating along the trophic network in marine and terrestrial ecosystems.

To date, plastic polymer pollution has been examined primarily in marine environments. However, some studies have emphasized the lack of knowledge about the impact of plastic microparticles in these environments, although it is known that aquatic organisms can be affected at ecological, molecular, cellular and organic level.

The aim of this project is to establish the impact of plastic pollution on marine biodiversity using a multidisciplinary approach. It will be considered the evaluation of selected coastal areas affected by various plastic contamination degrees. The first step of the project will be the evaluation of faunal and floral aquatic biodiversity using both traditional and innovative methods, as UVC, BRUVS and eDNA. Simultaneously, plastic litter presence and abundance will be evaluated in water, sediment and selected aquatic species. Once obtained preliminary data, microcosm experiments will be performed on model organisms (i.E.Microalgae, zooplankton, fish) for the evaluation of different biological effects caused by virgin and environment-derived nano and microplastics.

The correlation of all obtained data will be useful for the definition of a standard protocol to establish the degree of biodiversity loss risks in MPA and other coastal areas.

Research team and environment

TEAM

Prof. Nunziacarla Span√≤

Prof. Gioele Capillo

Prof. Serena Savoca

Laboratories

Department of Biomedical and Dental Sciences and Morphofunctional imaging

Department of Chemical, Biological, Pharmaceutical and Environmental Sciences

University of Messina

Stazione Zoologica Anton Dohrn - Messina

Suggested skills for this research topic

The candidate must have sampling experience at sea. In addition, he / she must have at least 1 year of experience in laboratories specialized in researching plastics in marine organisms

Type of scholarship and obligations

The type of this scholarship is: Ricerca PNRR (PNRR Research). This scholarship is funded by the Italian National Recovery and Resilience Plan (PNRR) of the Next Generation EU Fund. The definitive assignment of the scholarship is subject to the positive verification of eligibility and to the final confirmation by the Ministry of University and Research (MUR). The acceptance of the scholarship entails additional obligations as set out by art. 9 of the announcement.

PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Scholarship code

CU6.17

Curriculum: 6. Health and Ecosystems

Active and Healthy Ageing for Sustainability

Reference Person: Vercelli Alessandro (alessandro.vercelli@unito.it)

Host University/Institute: University of Torino

Research Keywords:	Brain
	Muscle
	Green environment
Reference ERCs:	LS5_11 Neurological and neurodegenerative disorders
	LS5_15 Neuroimmunology, neuroinflammation
	LS2_3 Epigenetics
Reference SDGs:	GOAL 3: Good Health and Well-being

Description of the research topic

The costs of age-related clinical care is increasing in the gray economy. Ageing is associated with physical, cognitive, psychological and social frailties which impair the autonomy of elderly people which is no more sustainable by our society. This project will aim to underline the multilevel (molecular, cellular and system) impact of nature on the prevention of frailty, on muscular weakness, on depression and on neuroinflammation in order to promote independent living of the elderly. The effects of different molecules released by trees (such as fitocides, therpens and therpenoids) will be studied in the blood of the elderly. The same molecules will be tested in vitro and in animal models of disease to study their effect on neuroinflammation, muscle trophism and autophagy. For the study in human subjects, it is under examination by the local ethical committee: it involves elderly subjects which will be administered several cognitive and psychological tests and blood samples will be collected after living in a green (park) environment. Blood samples will be screened for complement, IL-6, IL-10, TNFŒ±, cortisol, BDNF (brain derived neurotrophic factor) and serotonin. Moreover, epigenetic modifications in terms of acetylation/deacetylation and methylation of histones induced by living in a green environment will be studied in PBMCs (peripheral blood mononuclear cells). Molecules known to be effective in this environment will be tested in vitro in different types of cells (muscle cells, neurons, astrocytes) and in vivo in mouse model of disease (sarcopenia and neurodegenerative diseases). The readout will be the different morphological and behavioral parameters, and the involvement of autophagic process to remove cellular debris in neurodegenerative diseases.

This project could demonstrate a role of exposure to nature, whether green or blue, in neuropsychiatric diseases. There is already reasonable evidence that this may hold true, and

we intend to demonstrate its epidemiological aspects on the one hand and some biological mechanisms on the other. This project could open new horizons in the field of green economy, one of the founding themes of the next framework program of the European community.

The results of this project could have a major impact in inspiring the urban planning principles of the future, and in involving the various stakeholders (public bodies, architects, builders) involved in urban planning. Furthermore, it could give new pathogenetic and unconventional therapeutic indications, which allow to reduce the dosages of neuropsychiatric drugs.

The results will be shared with the scientific community at meetings and published on peer-reviewed journals, and disseminated to the public: to this aim, the group is already collaborating with the Mountain Museum of Turin.

Research team and environment

The research team works at the Neuroscience Institute Cavalieri Ottolenghi of Torino (https://www.Nico.Ottolenghi.Unito.It/eng) of which AV is scientific director. The main goal of NICO research center is to study the fundamental biological mechanisms of nervous system function, whose knowledge is essential for the development of innovative therapeutic approaches for neurodegenerative diseases and psychiatric disorders. The team is large (https://www.Nico.Ottolenghi.Unito.It/eng/Research/Research-Groups/Brain-development-and-disease), and is involved in two University spinoffs. The team, belonging to the Department of Neuroscience of UNITO, has many collaborations with clinicians. We study the development of the central nervous system from the embryo to the aged, and the common neurobiological mechanisms and molecular pathways which lead to normal development and to neurodegeneration. We believe that basic and applied neuroscience are strongly interconnected. Since many neurobiological molecular mechanisms can be studied at different levels, we use cell cultures and in vivo models, from simple organisms to rodents.

We are interested in the molecular pathways leading to neurogenesis and neuronal cell death, which we study in development and in experimental models of transient/permanent cerebral ischemia, acute/chronic glaucoma, epilepsy and Alzheimer's disease. Finally, we are studying the immunomodulatory, neuroprotective and growth promoting roles of cell therapy in SMA, ALS and spinal cord injury, particularly related to neuroinflammation.

Suggested skills for this research topic

The candidate should have a degree in Medicine & Surgery, Medical Biotechnology, Molecular Biotechnology, Neuroscience, Biology or Biomedical Engineering

He/she should have an experience in a biomedical laboratory, including molecular biology and histology, possibly of the nervous system.