University of Maribor

FRAMEWORK PROGRAMME OF EARLY STAGE RESEARCHER TRAINING[1]

1. BASIC DATA

Mentor's name and surname	**Nina Šajna**	Mentor's register number at ARIS (SICRIS):	**24674**
Mentor's e-mail:	nina.sajna@um.si	Mentor's tel. no.:	+38631341116
Research programme (RP) leader's name and surname:	Matjaž Perc	RP leader's register number at ARIS (SICRIS):	23428
Title of research programme:	Computationally intensive complex systems	RP's Register number at ARIS (SICRIS):	P1-0403
Research organisation (RO) of University of Maribor, where training shall be conducted:	Faculty of Natural Sciences and Mathematics (FNM UM)	RO Register number at ARIS (SICRIS):	2547
Research field according to ARIS classification:	1.03.03	Research field according to EURAXESS classification	118

2. DEFINITION OF RESEARCH PROBLEM AND GOALS OF DOCTORAL RESEARCH[2]

Starting point of research task of the early stage researcher and its position in the research programme, where the mentor is included, work hypothesis, research goals and foreseen result with emphasis on an original contribution to science:

The candidate will join the research programme Computationally intensive complex systems P1-0403 as a Young Researcher. Complex systems are multi-level networks of interactions in simultaneous coevolution. The physical and mathematical concepts of complexity can also be recognized in living nature across many different systems: in the diversity of interactions between organisms, in selection principles, and in systems with constraints and trade-offs. Ecological systems are complex systems defined by the mutual relationships among all involved components, where these relationships are also interdependent on environmental conditions. The complexity of an ecosystem is further increased if invasive non-native species enter the ecosystem, because of their traits introduce new variables into the system. An excellent research example

[1] *Term early stage researcher (ESR) is written in male form and used as neutral for women and men.*

[2] *Research and study programme of training have to harmonise with contents of the research programme, where the mentor is a member.*

are novel interactions between native and non-native species and particularly those among non-native species in the new range. These inevitable interactions create mutual interdependencies across multiple levels, therefore coexistence within an ecosystem encompasses a wide spectrum of processes, including predation, facilitation as well as intra- and interspecific competition. A species' coexistence ability enhances its chances of survival and persistence in the local ecosystem, while on a global scale it directly influences evolution. Because describing ecological systems requires a large number of variables that are nonlinearly interconnected, this poses a major challenge for finding solutions and often necessitates the use of numerical methods. The candidate will extend the highly successful research of RP P1-0403 established on an existing, real-life complex network of model organisms by studying two non-native host plants and their three newly established non-native seed predatory beetle species. The candidate is going to investigate the interdependance of novel interactions between non-native species that lack a shared evolutionary history and compare them to those with sympatric evolution. This is key to understanding invasion ecology to address global ecological problems that also affect human well-being because invasive non-native species are significant drivers of the loss and homogenization of global biodiversity. Further on, the emphasis of the candidate's research is going to be on advancing our (P1-0403) identication of newly formed interactions among non-native species in novel environments and habitats by extending the research across three trophic levels, including a particularly interesting and very poorly explained relationship with parasitoids. In previous work of the RP P1-0403, we have already detected at least 4 parasitoids, some of which are specialized on adult beetles and one on the egg stage. By identifying them the candidate is going to describe at least one of them as a new species to science. We can hypothesize that this group of predatory specialists (parasitoids) represents an example of potential natural biocontrol model for limiting the invasiveness of non-native species. Continuously emerging interactions among non-native species are difficult to predict, however, the complexity of the model system increases signifficantly if novel interactions with parasitoids are added, and there are no studies in the scientific literature that comprehensively address this issue. The goal of candidate's research is to elucidate and explain mentioned complexities by identifying the key coexsistence traits of non-native species and define the interactions that enable, predetermine or slow down their invasion success. The candidate is going to obtain experimental data and gain extensive ecological understanding, which will be further assessed by using systemic approaches and in-depth knowledge from multiple scientific fields represented by research members of the RP P1-0403. This will provide a new level of quality in the description and prediction of the impacts of bioinvasions on existing ecosystems. The final outcome will be a more comprehensive understanding and an improved description of novel interactions, based on an experimental study. Given that the effects of bioinvasions are generally heterogeneous and not unidirectional, and that they can vary even within the impacts of a single species, we expect the results to also illuminate the connections and interactions between these effects across multiple trophic levels of an ecosystem.

3. STUDY PROGRAMME

Foreseen study programme, to which early stage researcher shall be enrolled in academic year 2026/2027:

Ecological Sciences at the Faculty of Natural Sciences and Mathematics, University of Maribor

4. DESCRIPTION OF WORK AND TASKS

The candidate is going to conduct experimental studies in a laboratory, rear and sustain experimental mesocosms, and perform field work to obtain empirical data on species' interactions and their effects across trophic levels. The candidate will perform molecular genetic analyses (e.g. preparation for sequencing) and

evaluate results. Tasks will include the identification of the key traits of non-native species for coexistence. The candidate will define the various interactions that enable or predetermine invasion success. Work will include a development and application of numerical and computational models to describe the complexity of studied model species in mesocosms. Additionally, the candidate is going to integrate the obtained data and address the data from various view points of different scientific fields in cooperation with research members of the RP P1-0403 (e.g. mathematicians, physicists) to achieve a more comprehensive, across trophic level understanding of novel interactions and bioinvasion success and their heterogeneous, non-unidirectional impacts.

5. REQUESTED LEVEL OF EDUCATION

Master of Science (EU) or equivalent

6. REQUESTED FIELD OF EDUCATION

Ecology, Biology, Microbiology, Biophysics, Agronomy, Forestry

7. KLASIUS SRV

17003

8. KLASIUS P

0521

9. REQUESTED KNOWLEDGE

Basic knowledge of GIS, statistics (e.g. R), and genetic laboratory skills.

10. REQUESTED SPECIAL REQUIREMENTS

None

11. REQUESTED LANGUAGES

English

12. REQUESTED WORK EXPERIENCE

None

13. FORESEEN POSTDOCTORAL TRAINING

Career development as an Early Stage Researchers can be undertaken with application to ARIS Postdoc projects or MSCA calls.

Mentor's signature:

Nina Šajna
Digitalno podpisal Nina Šajna
Datum: 2026.06.07 10:40:46 +02'00'

Research programme leader's signature:

Matjaž Perc
Digitally signed by Matjaž Perc
Date: 2026.06.07 12:33:43 +02'00'

Name and surname of Dean or authorised person[3]:
Iztok Banič, dean

Signature of dean or authorised person:

IZTOK BANIČ
Izdajatelj: RekonoSign RSA Q
Datum: 08.06.2026 00:23

Place and date:

Maribor

Kliknite ali tapnite tukaj, če želite vnesti datum.

Stamp:

[3] The training program is signed by the dean of the member where the ESR's employment and training will take place.