

INTRODUCTION

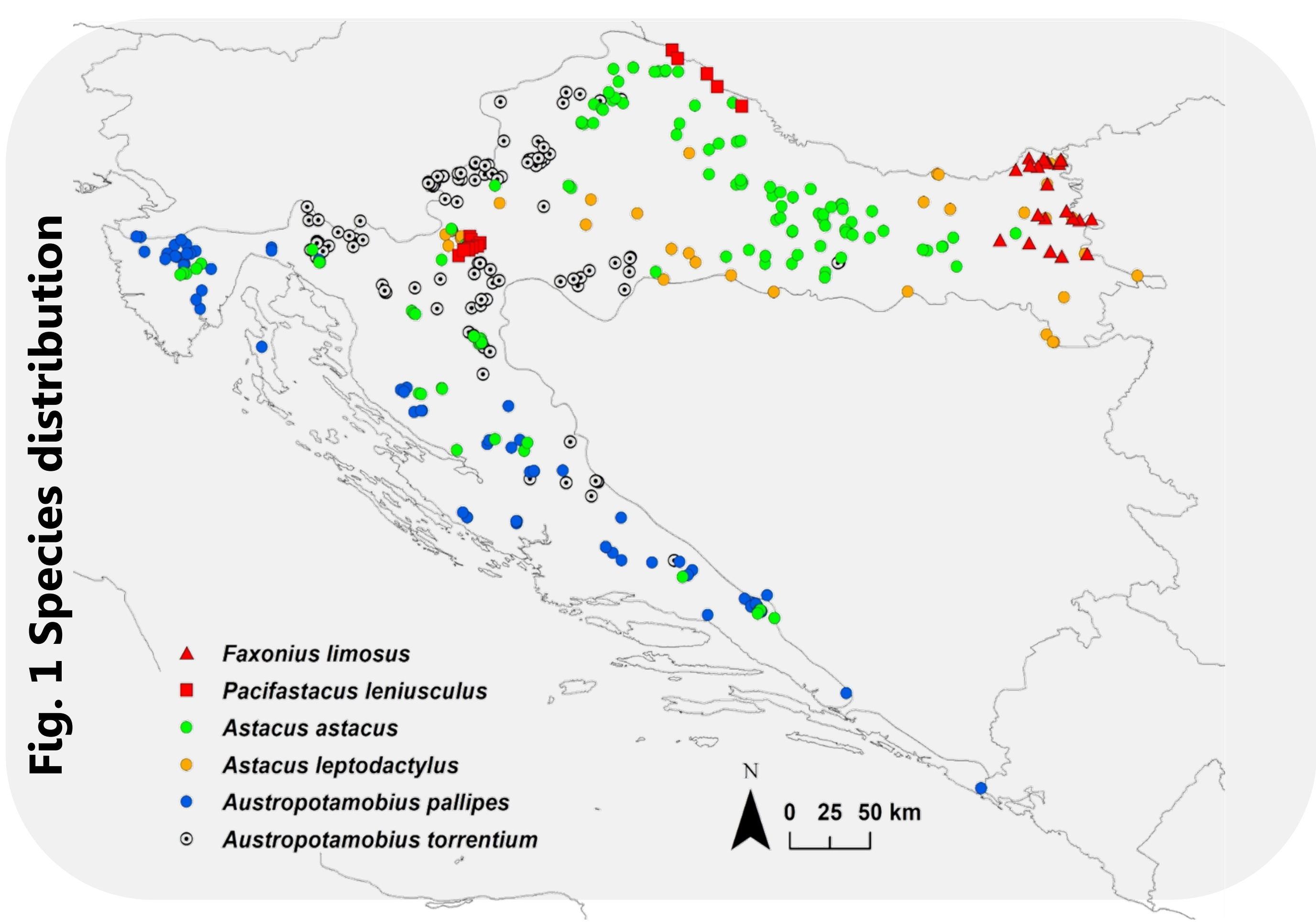
- European **indigenous crayfish species (ICS)** → populations' sizes and numbers decline across their ranges due to habitat degradation & pollution, overexploitation, climate change and spreading of **non-indigenous crayfish species (NICS)**
- NICS outcompete ICS through direct competitive exclusion and transmission of diseases (e.g. crayfish plague)
- In Croatia four ICS and three NICS are distributed, severe declines in ICS numbers and prevalence recorded

**urgently needed:** development of effective conservation and management plans for threatened ICS and threatening NICS

**study aim:** to forecast potential future distribution for two ICS (noble and stone crayfish) and two NICS (signal and spiny-cheek crayfish) in Croatian freshwater habitats under different climate change scenarios

MATERIAL AND METHODS

- **Species distribution models (SDMs)** - based on the relationship between the **species occurrences** (Fig. 1) and **environmental variables** (Tab. 1)
- Models developed using an ensemble approach implemented in R package BIOMOD2



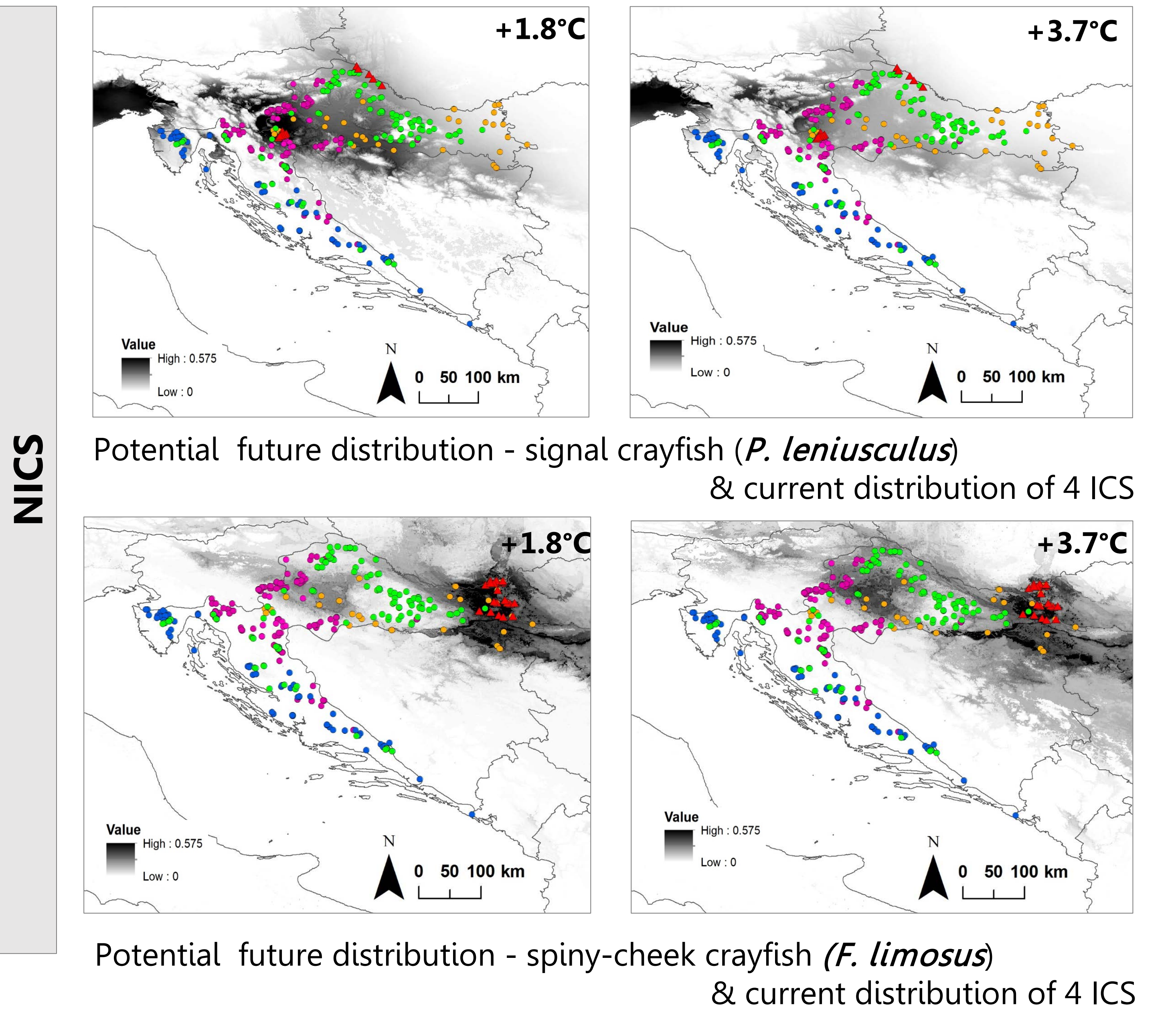
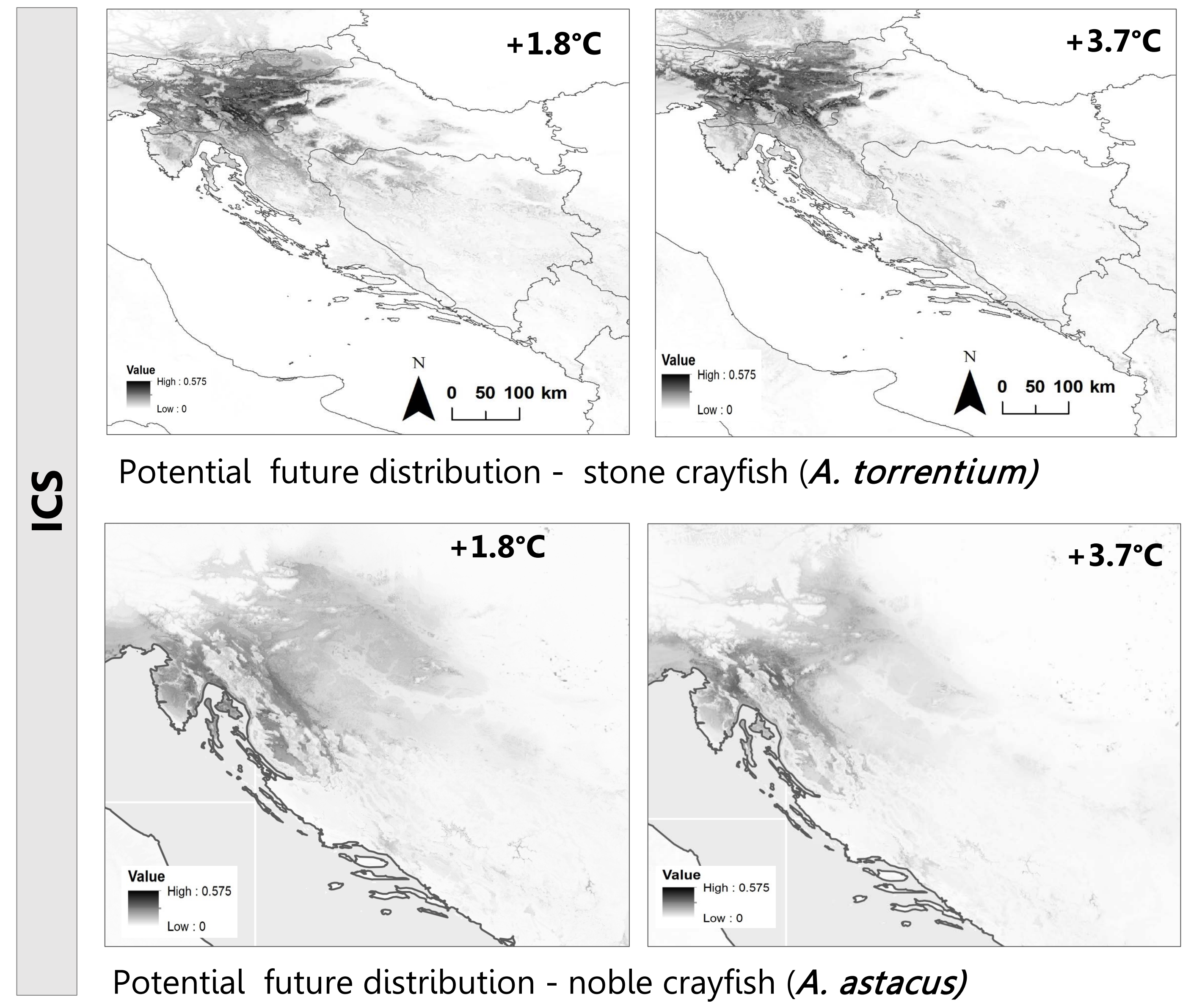
**Modeling current distributions** – 3 algorithms: Random Forest – **RF** / Generalized Additive Models – **GAM** / **Maxent**

**Modeling future distributions** - 5 Global circulation models (GCMs):  
- CCSM4, MIROC5, IPSL-CM5A-LR, HadGEM2-CC,MPI-ESM-LR  
- 2 climate change scenarios for 2070: RCP 4.5 (+1.8°C) & RCP 8.5 (+3.7°C)

**Tab. 1 Environmental variables in models** – ecol. relevant and available

ID	Variable
bio2	Mean Diurnal Range (Mean of monthly max temp - min temp)
bio4	Temperature Seasonality (standard deviation *100)
bio5	Max Temperature of Warmest Month
bio14	Precipitation of Driest Month
bio15	Precipitation Seasonality (Coefficient of Variation)
bio18	Precipitation of Warmest Quarter
bio19	Precipitation of Coldest Quarter
alt	Altitude
slope	Slope

RESULTS AND DISCUSSION



- **ICS in continental Croatia** will be under the **highest negative impacts of NICS: stone crayfish** – future strong negative impact of *signal crayfish* & *noble crayfish*– future strong negative impact of *spiny-cheek crayfish*
- In order to protect threatened ICS in Croatia, and slow down invasion range expansion rates of the two NICS, **management programs** should be **urgently developed and applied** focusing on the in **tributaries of larger rivers in continental Croatia**