



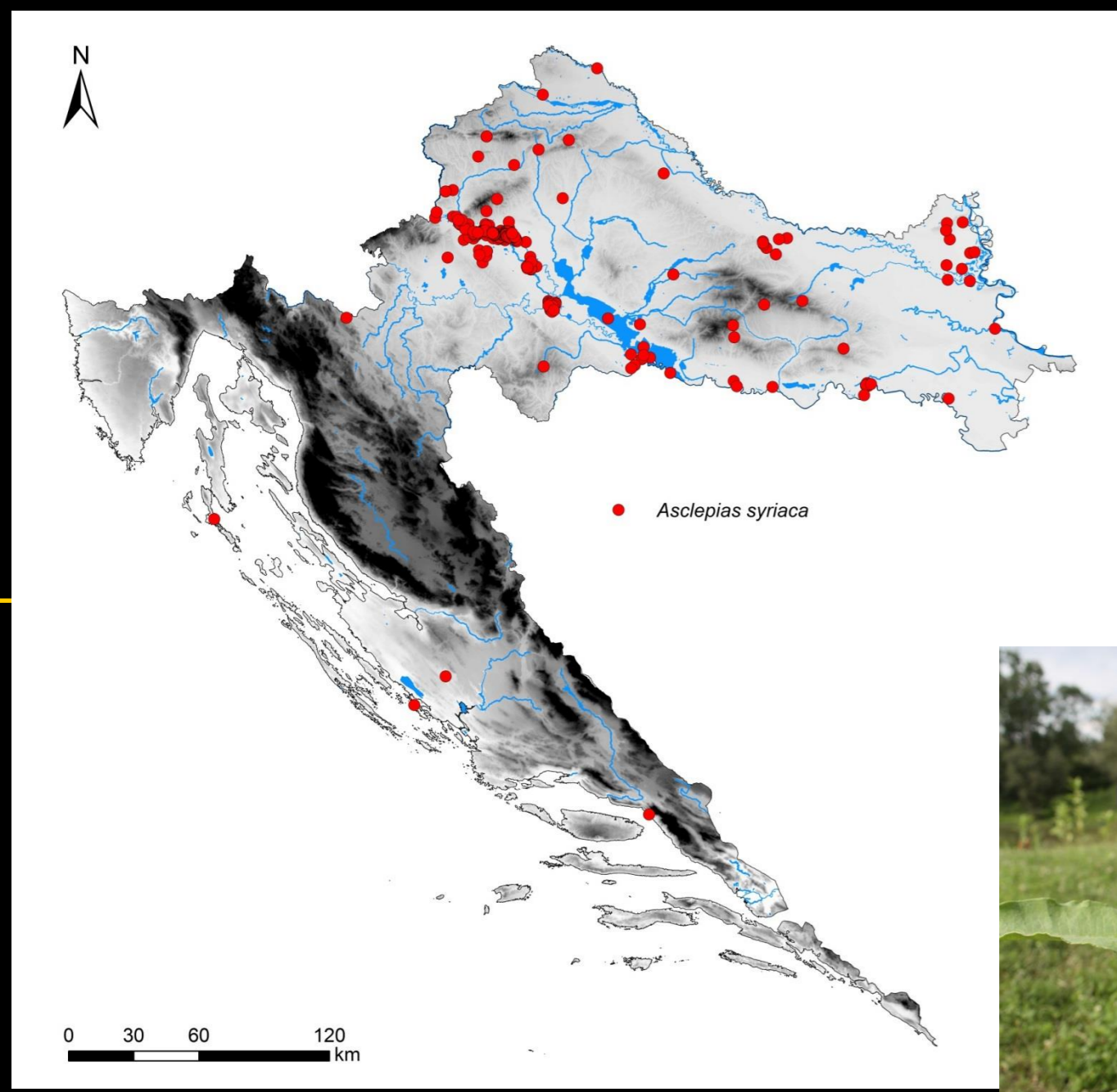
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The problem of invasive alien species at European Union level is systematically dealt with the Regulation (EU) No. 1143/2014 on the prevention and management of the introduction and spread of invasive alien species, which entered into force on 1 January 2015. It sets out rules to prevent, minimize and mitigate the adverse impacts on biodiversity of intentional and unintentional introduction and spread of invasive alien species. Framework for its implementation in Croatian legislation is set by the new Act on Prevention and Management of the Introduction and Spread of Alien and Invasive Alien Species (Official Gazette 15/18) and its subordinate legislation. The Regulation refers to the list of invasive alien species of Union concern ("Union List"), which is delivered through implementing acts. They are:

- Commission Implementing Regulation (EU) 2016/1141 of 13 July 2016, which includes 37 species, and
- Commission Implementing Regulation (EU) 2017/1263 of 12 July 2017, which includes 12 more species.

Currently there are 49 invasive alien species on the Union List, 17 of which are present in Croatia.

We reviewed all available literature and databases (e.g. Croatian Agency for the Environment and Nature database (CAEN 2018), FCD (Nikolić 2018)) for all 17 species of Union concern that occur in Croatia, we report their current distribution, and we summarize their impacts and possible control methods.



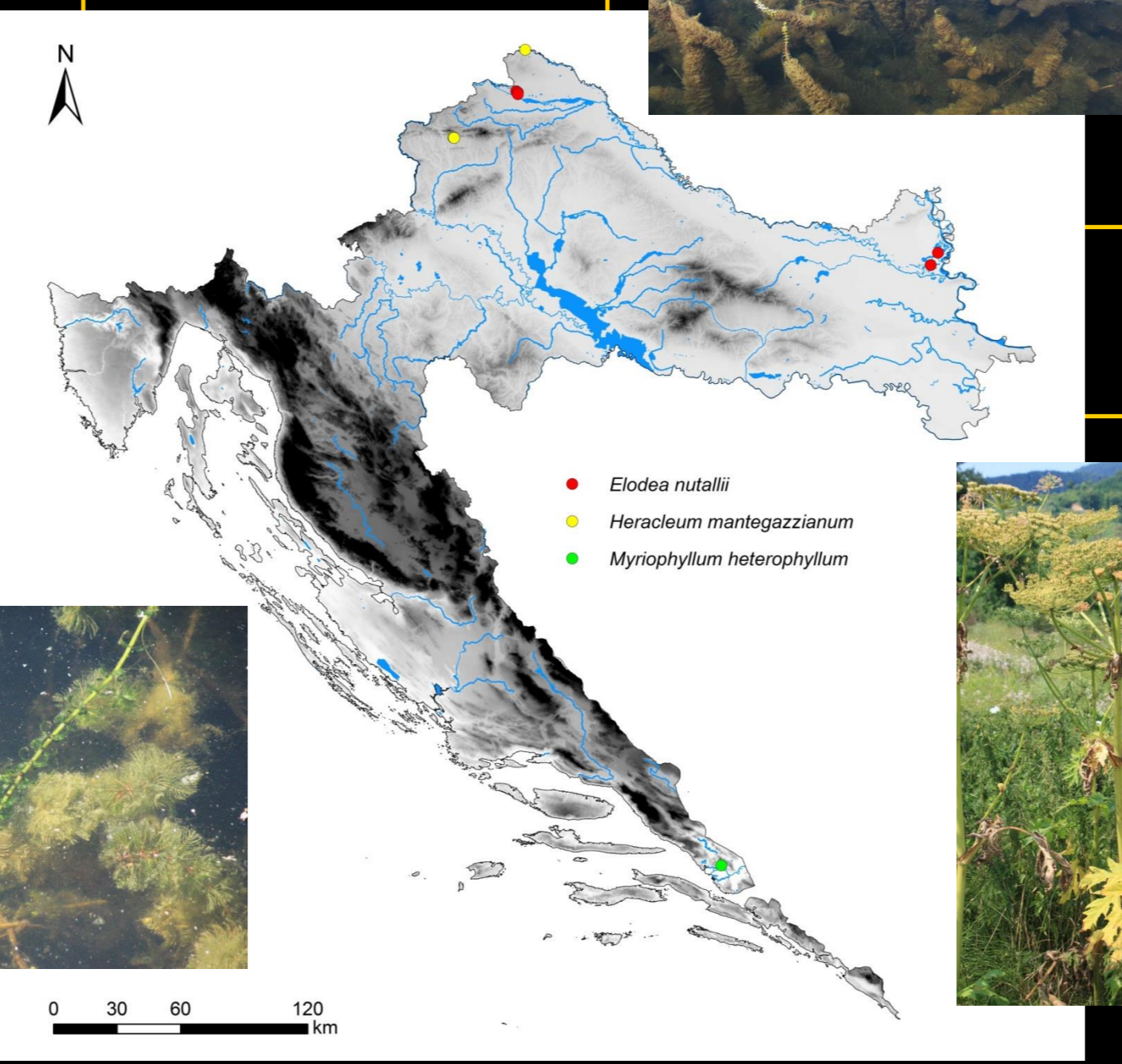
Asclepias syriaca L.

IMPACTS: change of composition of native communities through shading and space occupation; agricultural weed that causes crop losses; detraction of pollinators; negative allelopathic effects; poisonous to livestock; host of plant pathogenic viruses and their insects vectors



Elodea nuttallii (Planch.) St. John

IMPACTS: change of the chemical composition of water; reduction of water flow in the drainage canals; negative impact on water resources and recreational activities; displacement and change in the composition of native plant species due to competition for nutrients and shading; impact on animal species



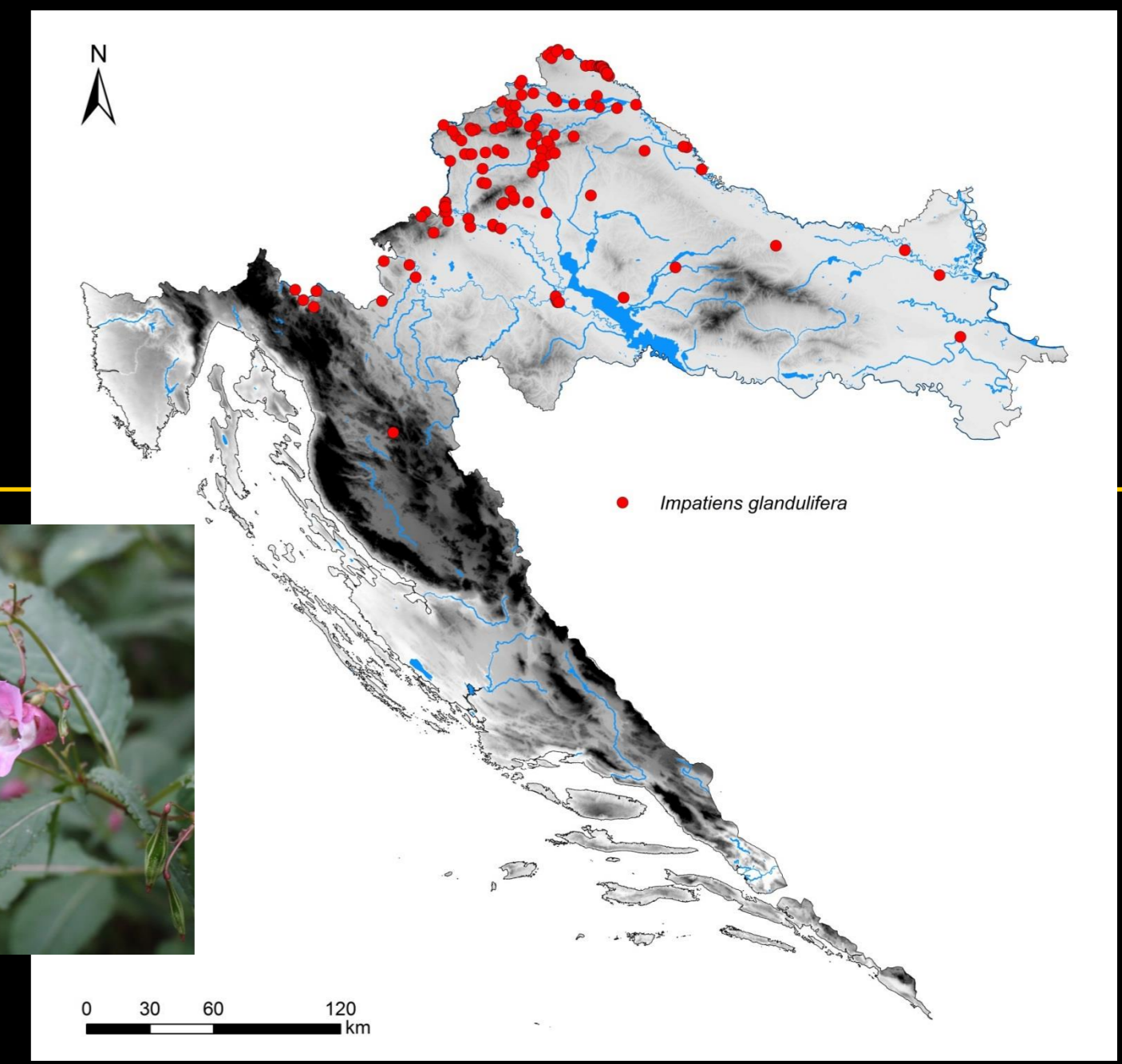
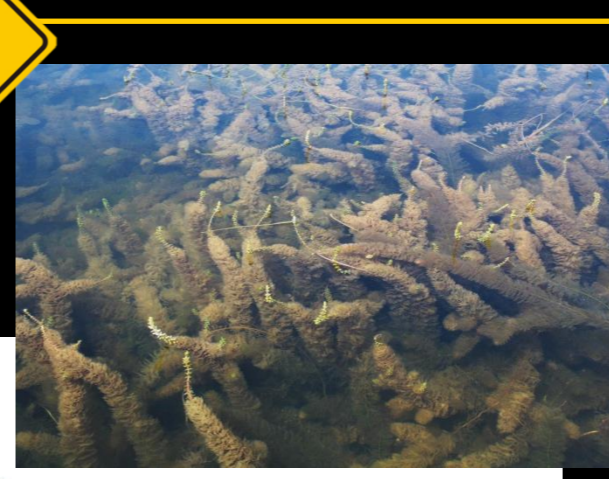
Heracleum mantegazzianum Sommier & Levier

IMPACTS: negative physical effects (shade and space occupation) in invaded habitats; outcompeting and replacing native species; negative impact on human health because of phototoxic sap, which causes severe skin burns



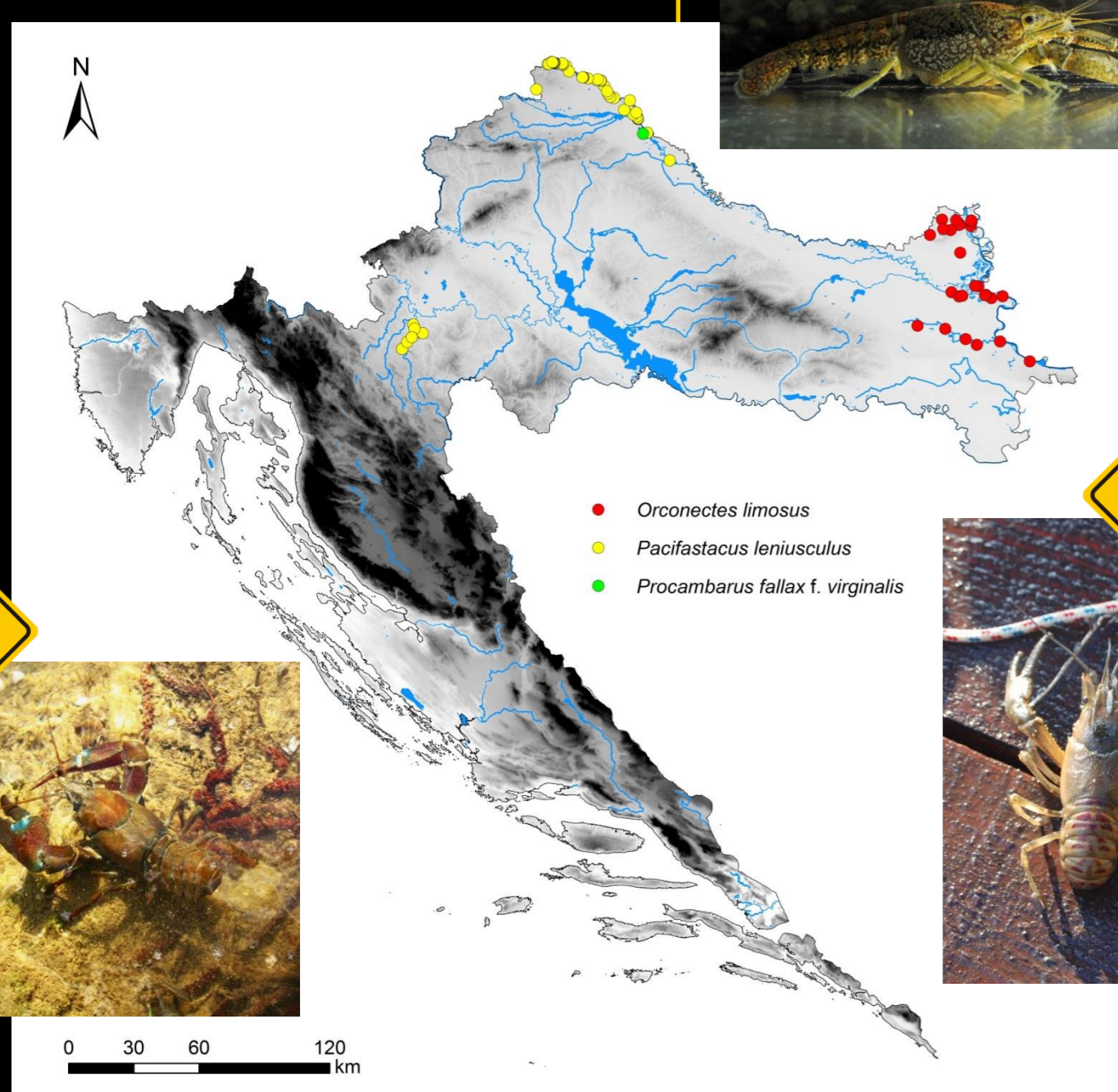
Myriophyllum heterophyllum Michaux.

IMPACTS: outcompeting native aquatic plants; reduction of oxygen availability and sunlight; negative effects on human activities in water



Impatiens glandulifera Royle

IMPACTS: changes in the cover and composition of native species in invaded habitats (predominantly along river banks); competition with native species for pollinators and changes of invertebrate communities; increased susceptibility of river banks to erosion during winters



Pacifastacus leniusculus (Dana, 1852)

IMPACTS: competition with native crayfish for food and habitat; vector of crayfish plague pathogen *Aphanomyces astaci* and parasite *Psorospermium haeckeli*; degradation of streambed stability due to burrowing behaviour



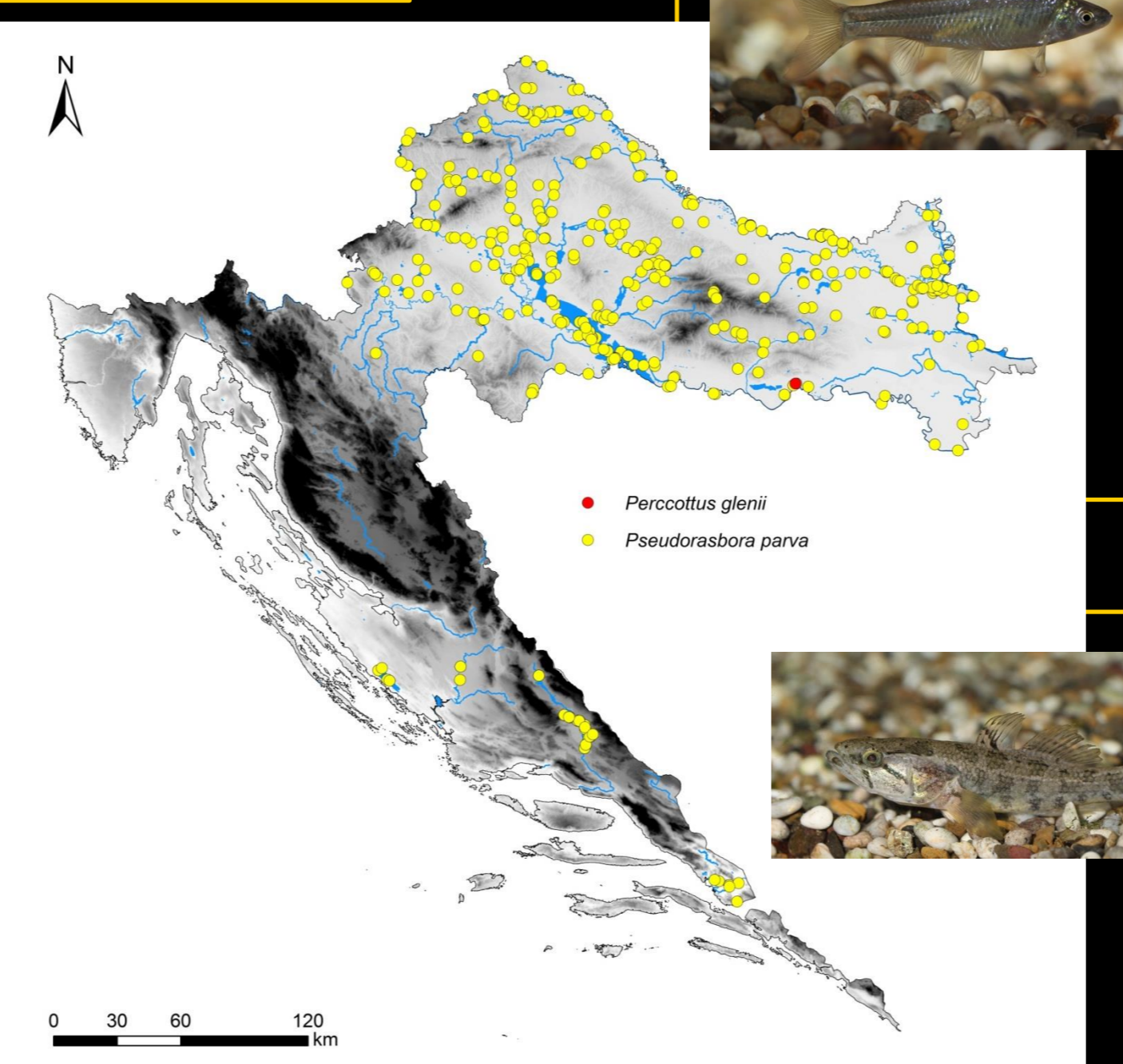
Procambarus fallax (Hagen, 1870) f. *virginalis*

IMPACTS: competition with native crayfish for food and habitat; vector of crayfish plague pathogen *Aphanomyces astaci*



Orconectes limosus (Rafinesque, 1817)

IMPACTS: competition with native crayfish for food and habitat; vector of crayfish plague pathogen *Aphanomyces astaci*



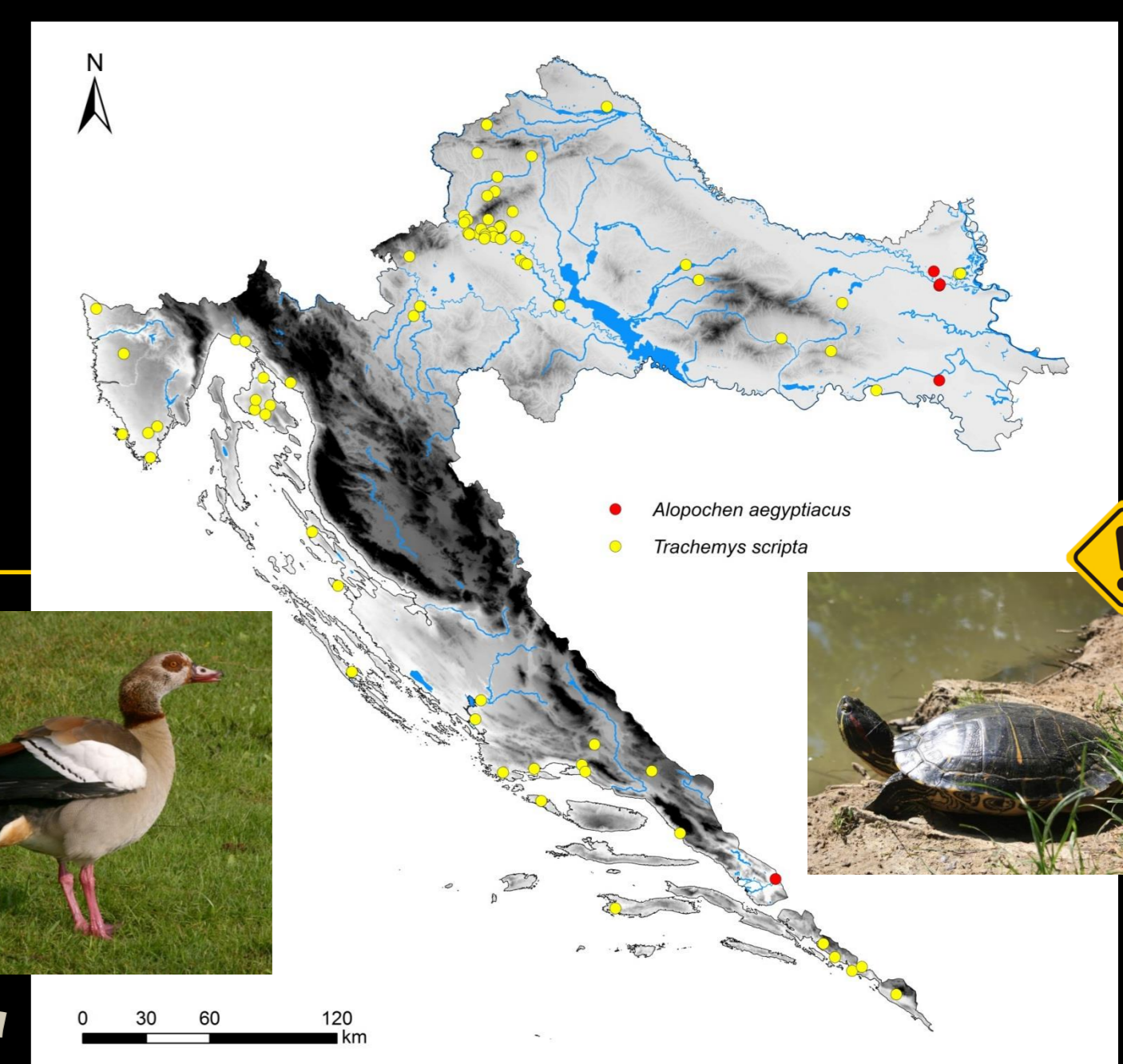
Percottus glenii (Temminck & Schlegel, 1846)

IMPACTS: competition with native species for food and habitat; predation on fish eggs and fry



Pseudorasbora parva Dybowski, 1877

IMPACTS: competition with native species for food and habitat; predation on fish eggs and fry; potential disease transmission; eutrophication of freshwater habitats; potential hybridization with native species



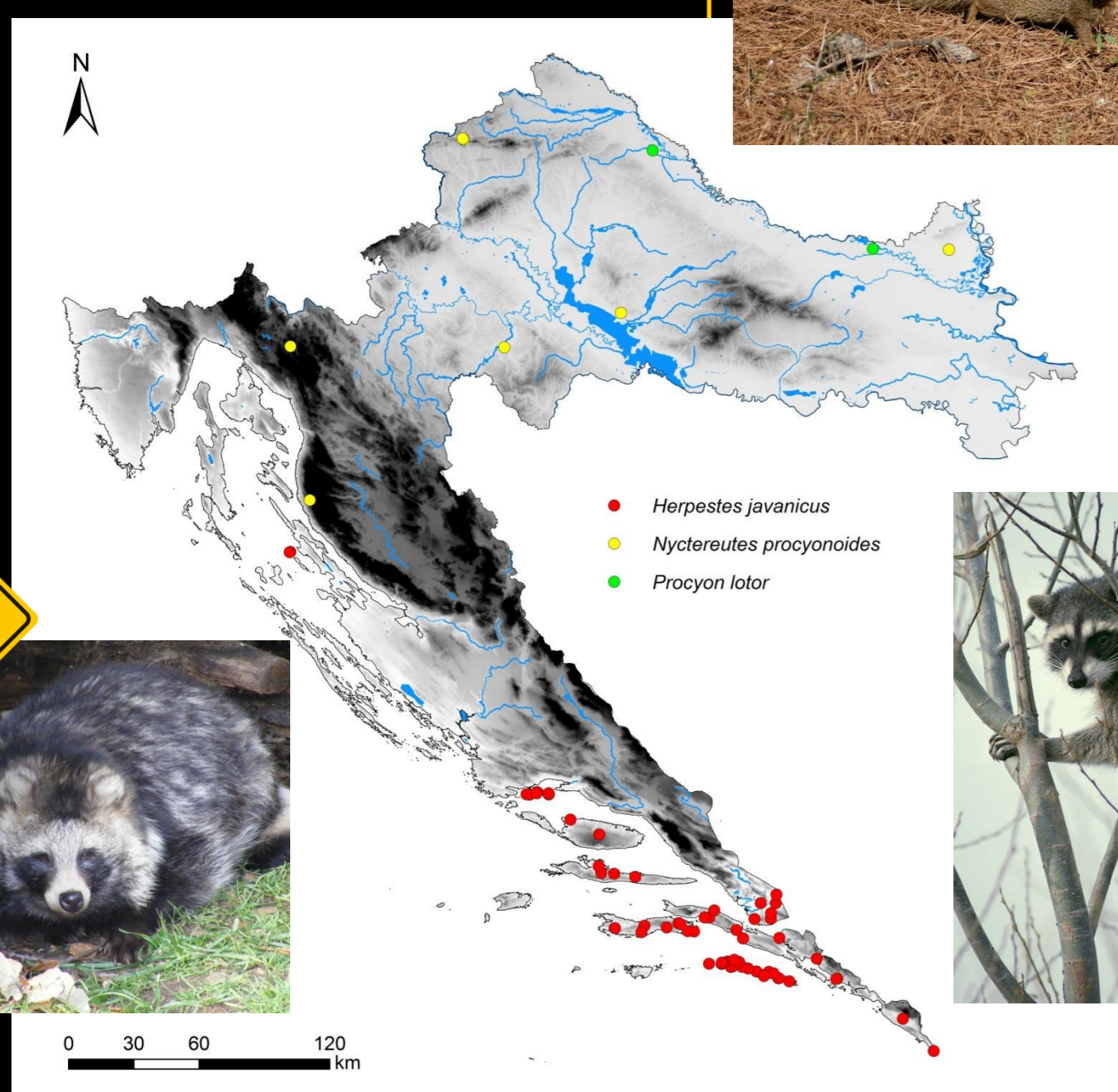
Alopochen aegyptiaca (Linnaeus, 1766)

IMPACTS: competition with native species for food and nesting sites; hybridization with native bird species; eutrophication of freshwater habitats; possible threat to air navigation safety; vector of avian influenza



Trachemys scripta (Schoepff, 1792)

IMPACTS: competition with native species for food and habitat; predation and potential disease transmission; negative impact on human health through possible transmission of human salmonellosis



Nyctereutes procyonoides (Gray, 1834)

IMPACTS: predation on native species; competition with native carnivores; transmittal of rabies and parasites on wild and domesticated animals



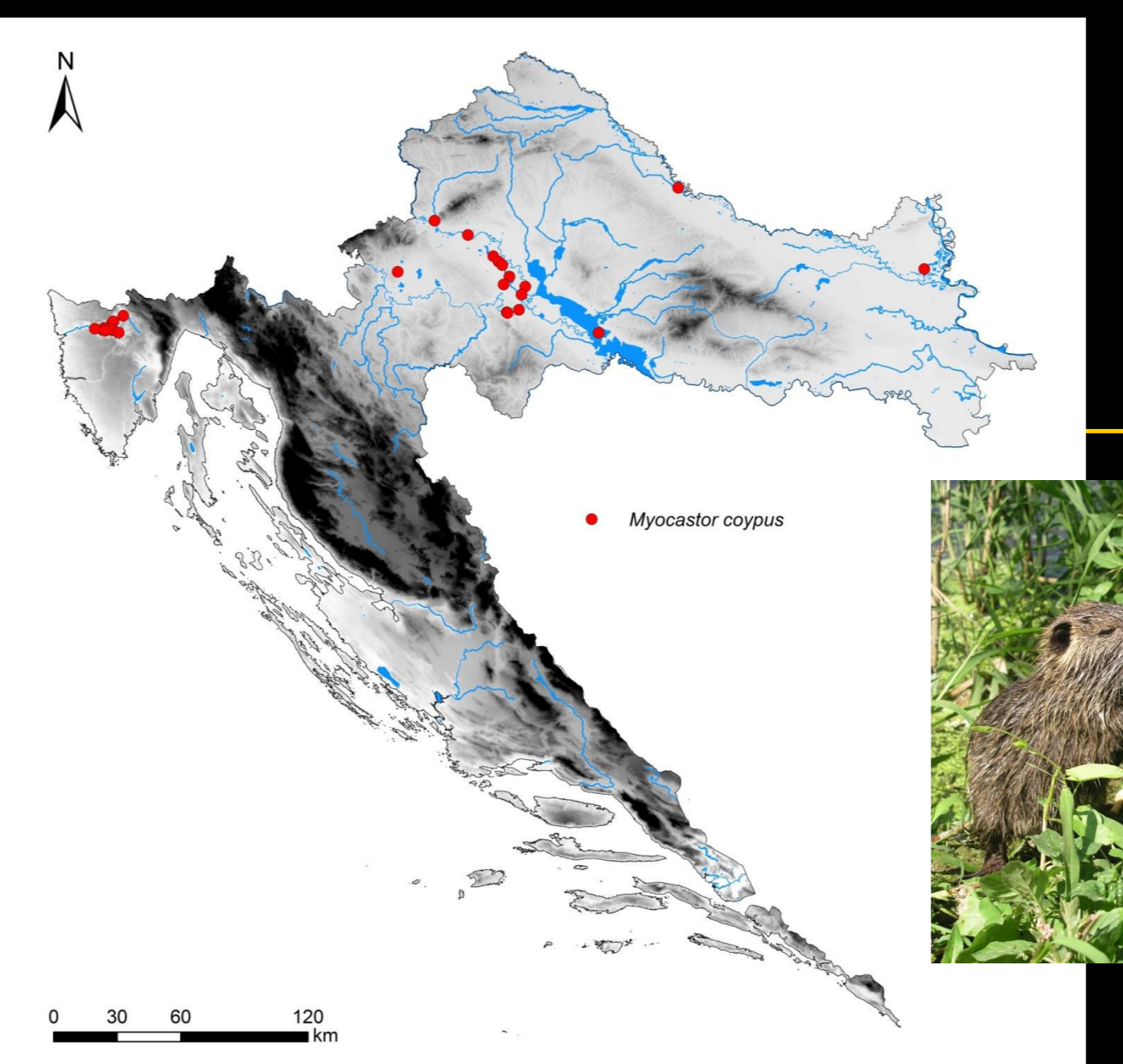
Herpestes javanicus (É. Geoffroy Saint-Hilaire, 1818)

IMPACTS: predation on native species; damage to crop plants and poultry; vector of human and animal diseases, including rabies and human *Leptospira* bacterium



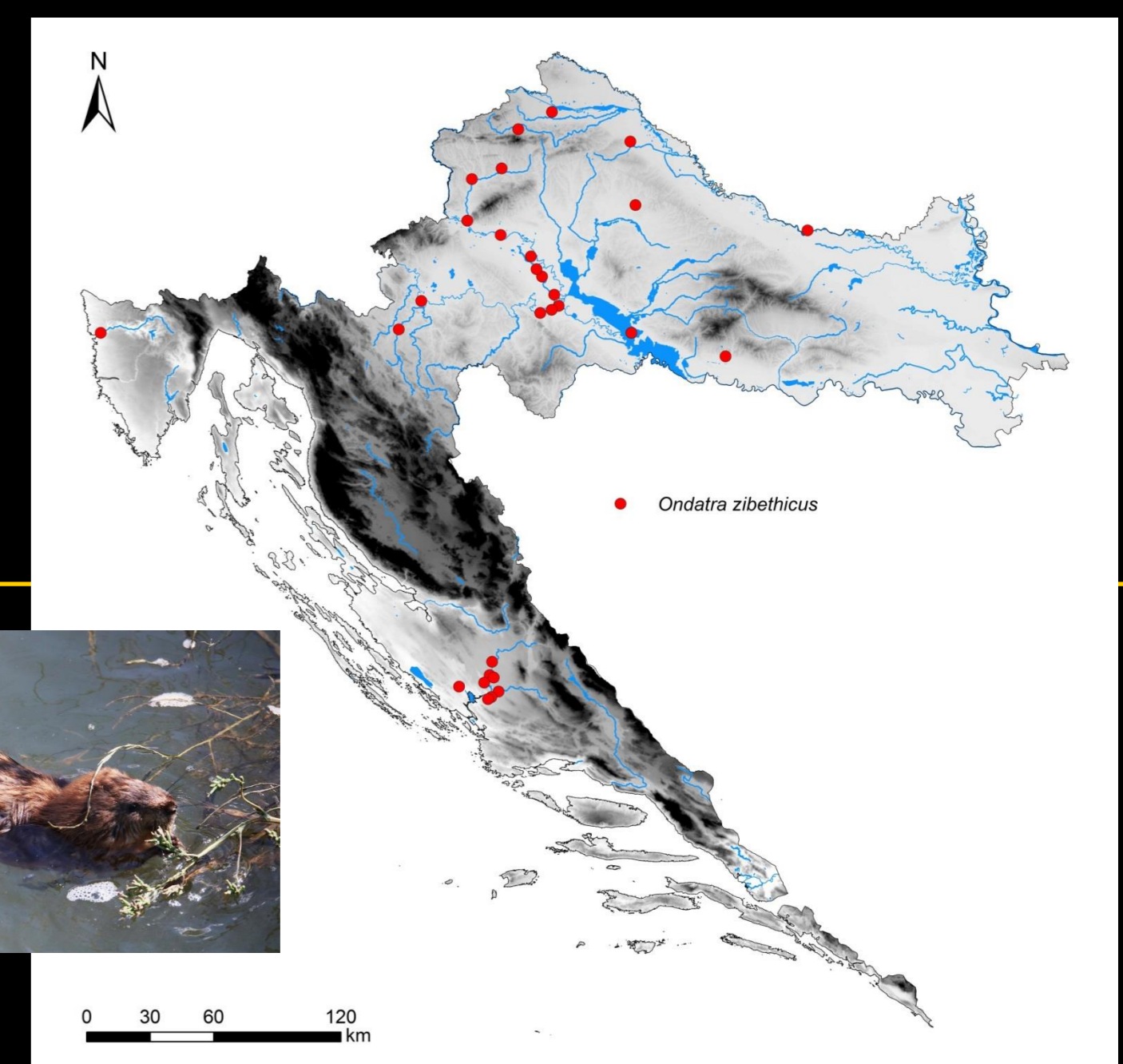
Procyon lotor (Linnaeus, 1758)

IMPACTS: predation on native species; competition with native mammals; vector of diseases and parasites; destruction of crops in urban areas; structural damage to houses



Myocastor coypus (Molina, 1782)

IMPACTS: destruction of native vegetation and agricultural crops by grazing; water birds nest disturbance; damage of river banks and ditches due to burrowing activities; transmittal of parasites and disease to livestock, wildlife, and humans



Ondatra zibethicus (Linnaeus, 1766)

IMPACTS: destruction of native vegetation and agricultural crops by grazing; loss of nursery sites for fishes; competition for resources with native semi-aquatic rodents; predation on freshwater invertebrates; damage of river banks and ditches due to burrowing activities



MANAGEMENT

Invasive alien species of Union concern are not allowed to be brought into the Union, kept, bred, transported, placed on the market, used or exchanged, permitted to reproduce, grown or cultivated, or released into the environment. Widely spread invasive alien species of Union concern have to be effectively managed, with an aim to eradicate, control or contain their populations.

Management of invasive plants, in general, includes mechanical (mowing, cutting, uprooting, deadheading etc.) and chemical methods, or their combination. Water plants are more difficult to manage, with chemical methods not recommended for use.

Management of invasive crayfish includes intensive trapping, drying out small, standing water bodies, sterile-male method or shock treatment (by blasting) and gamma irradiation of crayfish in refuges in banks. There are no biocides selective for crayfish and suitable for use in water. Natural pyrethrum was used on small sites, but it can affect other aquatic organisms.

Management of invasive freshwater fish includes physical removal of individuals, use of chemical substances, and drying out the isolated water body. Those methods are not species-specific (except physical removal of individuals) and they are impractical for larger water bodies, costly and with questionable outcome.

Successful **management of invasive mammals** needs to integrate different methods. Trapping and shooting are some of the methods used to control the population density, prevent further spread, or for eradication. In cases of well-established populations the protection of most sensitive areas by exclusion methods, such as fences or other structures, can also be effective, but is costly and impractical for larger areas.

REFERENCES

CAEN (2018): Croatian Agency for Environment and Nature database. Nikolić, T. (ed.) (2018): Flora Croatica Database. On-Line (<http://hir.botanic.hr/fcd>). Department of Botany and Botanical Garden, Faculty of Science, University of Zagreb, Zagreb. Date of access 13/06/2018.