Assessing ecocide impacts for developing a conservation strategy in Ukraine

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Dedicated to scientists who protect the whole world from evil at the frontline in Ukraine

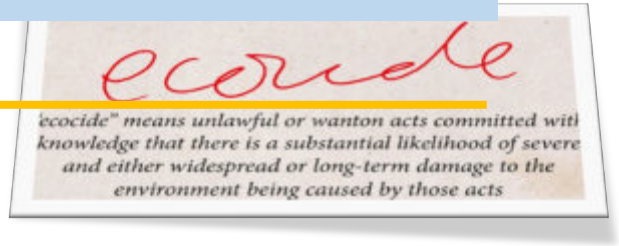
General context

- **Military actions have a negative impact** on the environment, leading to long-term ecological damage estimated at **~56 billion €**.
- **Documented 5118 cases of damage** confirm the extensive range of negative effects of military actions on the environment.

  (https://ecozagroza.gov.ua/en)
- Russia's war **accelerating global climate emergency** and led to **a loss of biodiversity.**

  (https://www.theguardian.com/environment/)

General context:Ecocide



(https://www.stopecocide.earth/legal-definition)

Article 441. Ecocide

(CRIMINAL CODE OF UKRAINE)

Mass destruction of flora and fauna, poisoning of air or water resources, and also any other actions that may cause an environmental disaster.

(https://zakon.rada.gov.ua/laws/show/en/2341-14#Text)

- A deliberate destruction of nature by humans
- The environmental catastrophe (ecocide) led to a loss of biodiversity

The Kakhovka dam destruction

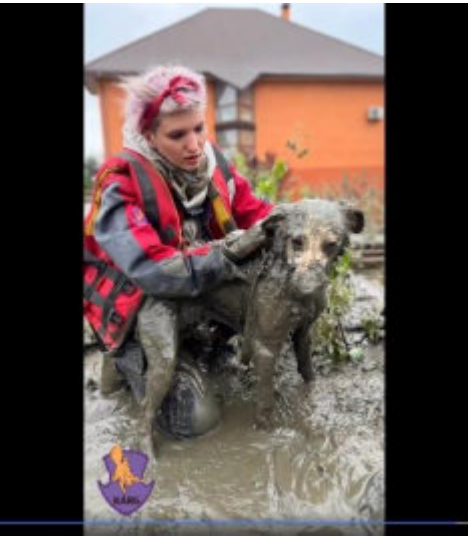
(6 June 2023)

referred as ecocide by Ukrainian authorities

~18 km3 of water flooding in the lower Dnipro National Park (80,000 ha of protected areas with rare species).








After the destruction of the Kakhovka dam, houses, zoos, farms were destroyed - people and wild and domestic animals died

- https://www.facebook.com/KARG.kyivanimalrescuegroup/videos/474484371919710/
- https://www.facebook.com/photo.php?fbid=805363505071278&set=pb.100067929061401.-2207520000&type=3
- patreon.com/wildanimalsrescueua
- campsite.bio/helpwildanimalsua

In occupied Novaya Kakhovka, approximately 300 animals from the local zoo drowned - monkeys, raccoons, donkeys, ponies, nutria, various birds, porcupines, marmots, turtles and others.

Scientific context

A key issue: assessing impacts of war on wild nature.

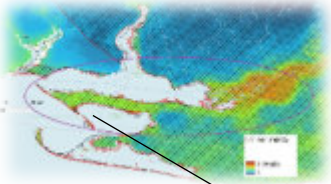
An integrated approach that combines data collection on ecocide and modeling the distribution of rare species is key to assessing the impact of war on wildlife. Modeling allows for data analysis, filling in data gaps, and reducing risks for researchers.

Protocols/methods. Research question

The following methods were used for the research:

*How can **GIS-modelling** helps assessing ecocide impacts?*
Helps make a preliminary assessment, remotely

- Monitoring, creating/updating databases
- Documenting of the known cases
- **GIS-modelling**
- Analysis, Evaluation
- Recommendation
- Interviews
- Photo- & video-evidences
- Saving biodiversity data



flooded

Dead animals found in the sea soon after the destruction of the Kakhovka dam © Oksana Nekrasova

The main ecological consequences include:

1. **Soil and water pollution**: Shelling and destruction cause the leakage of toxic substances, contaminating the environment with heavy metals, petroleum products, and other dangerous elements.

2. **Destruction of flora and fauna**: Direct and indirect, Unethical behaviours.

3. **Landscape change**: Fires, explosions, and the construction of defensive structures can drastically change the landscape, fragmenting, affecting the ecosystem as a whole.

1. Soil and water pollution:

Soil pollution. Damage 16.46 billion UAH. Contaminated soil 848,147 m².
(https://ecozagroza.gov.ua/en)

Remains from different types of projectiles. Chernihiv, 2022 (© K. Polianska)

Result of the work of sappers of the State Emergency Service. Mykolaiv region 2022, the road to Snigurivka (© K. Polianska)

Explosion craters are contaminated with heavy metals (nickel, zinc, lead, etc.).

Official map of the State Emergency Service of Ukraine on pollution explosive objects (~30% of the state area)

2. Destruction of flora and fauna:

- Direct destruction
  - By vehicles
  - By people (soldiers)
  - Habitat of animals
- Indirect Destruction
  - Physical traps (trenches)
  - Thermo-traps (warm dugouts)
- Unethical behaviours

"Secret Service. Z. Glory to Russia. MF RF (Military Forces Russian Federation)"

3. Landscape change

Reporting the Kakhovka HPP dam destruction case

6 June 2023

About **₴337 million Euro** - estimated amount of environmental damage; 1144 populated areas flooded; 14.395 billion cubic km - reduction in water volume; 63,447 ha - area of flooded forests.

https://ecozagroza.gov.ua/en

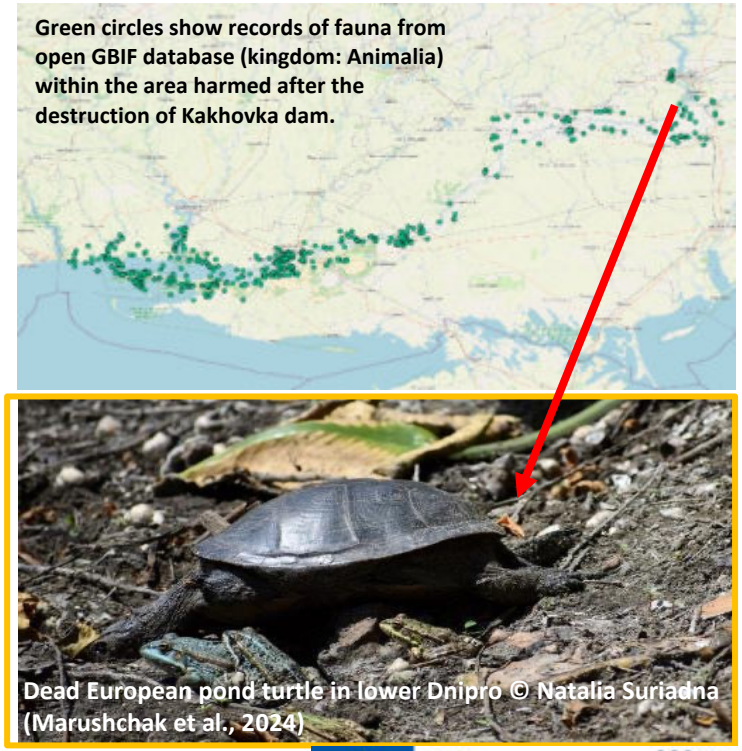
September 16, 2023
© K. Polyanska

3. Landscape change

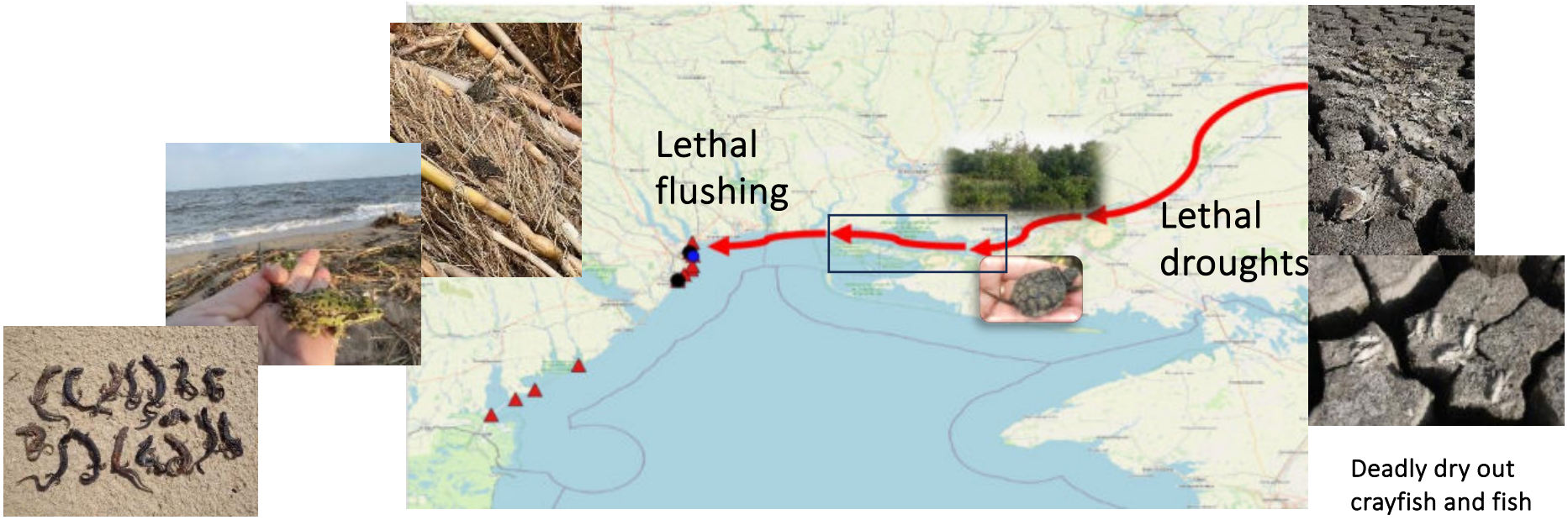
Species occurring in lower Dnipro

- 22 classes/orders (based on **GBIF** open database)
- 1073 species
- **119 species in Red Data Book of Ukraine**

Class/Order	N species	Species in Red Data Book of Ukraine	Species in Red Data Book of Ukraine (%)
Mammalia	78	24	31%
Aves	286	46	16%
Bivalvia	7	1	14%
Reptilia	11	5	45%
Amphibia	11	1	9%
Insecta	489	38	8%
Malacostraca	19	2	11%
Arachnida	30	1	3%
Clitellata	82	1	1%



Reporting the Kakhovka dam destruction case



Deadly dry out
crayfish and fish

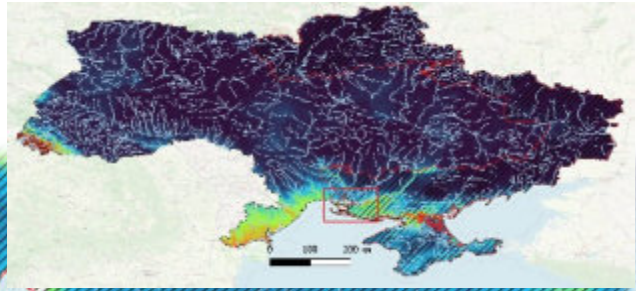
Flushed *Pelophylax esculentus* complex, *Triturus dobrogicus, Emys orbicularis*
© K. Polianska, N. Brusentsova, O. Nekrasova

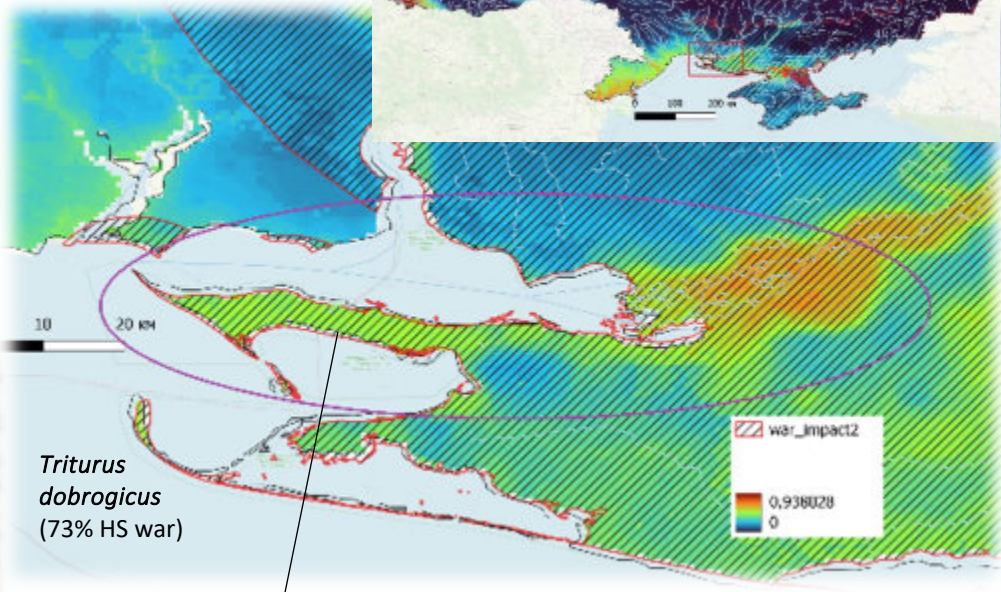
GIS modeling: Species Distribution Model - Amphibia

Identifying the highest habitat suitability (HS) for rare species of Amphibia - *Triturus cristatus* complex (Red Book of Ukraine)

- *Triturus dobrogicus*

→ The only population of *T. dobrogicus* within Lower Dnipro (Kherson region) was probably destroyed: 149 died and 55 alive individuals were found on Black Sea coast, Odesa region, 10-11 June 2023





Triturus dobrogicus (73% HS war)

flooded

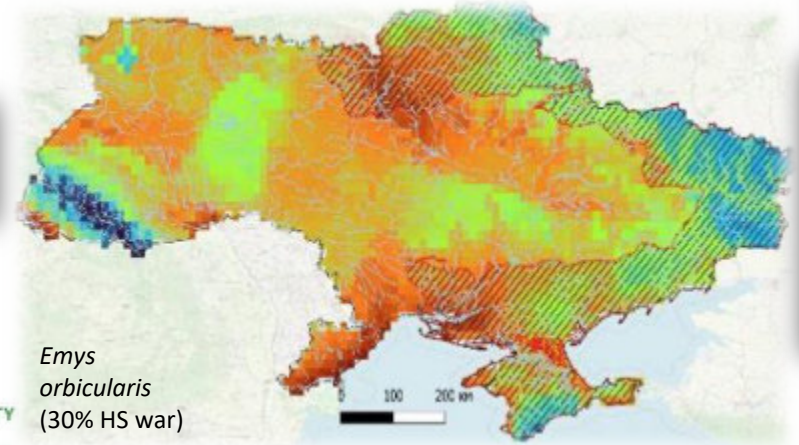
GIS modeling: Species Distribution Model - Reptilia

Reptiles suffered the most. Identifying the highest habitat suitability (HS) for rare species of Reptilia (Red Book of Ukraine)

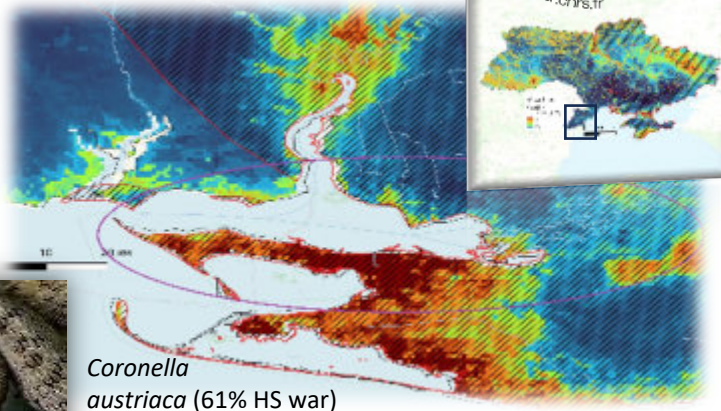
- snakes (*Coronella austriaca* and *Elaphe sauromates)*
- turtle (*Emys orbicularis)*

→Areas along the Black Sea coast (especially Kinburn Spit) and the lower Dnipro are major areas for the conservation –

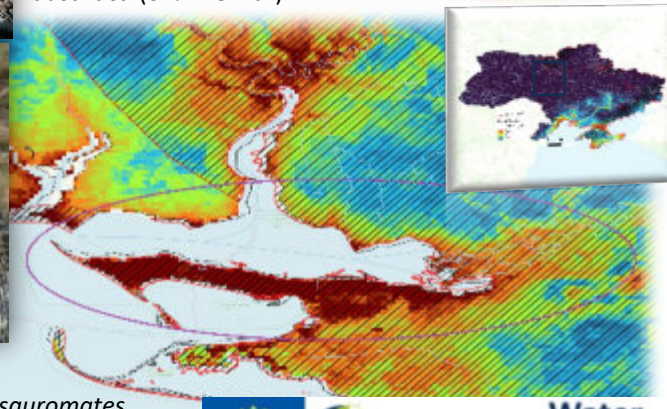
Coronella austriaca, Elaphe sauromates and *Emys orbicularis*



Emys orbicularis (30% HS war)



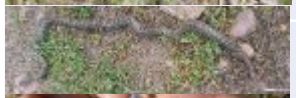
Coronella austriaca (61% HS war)

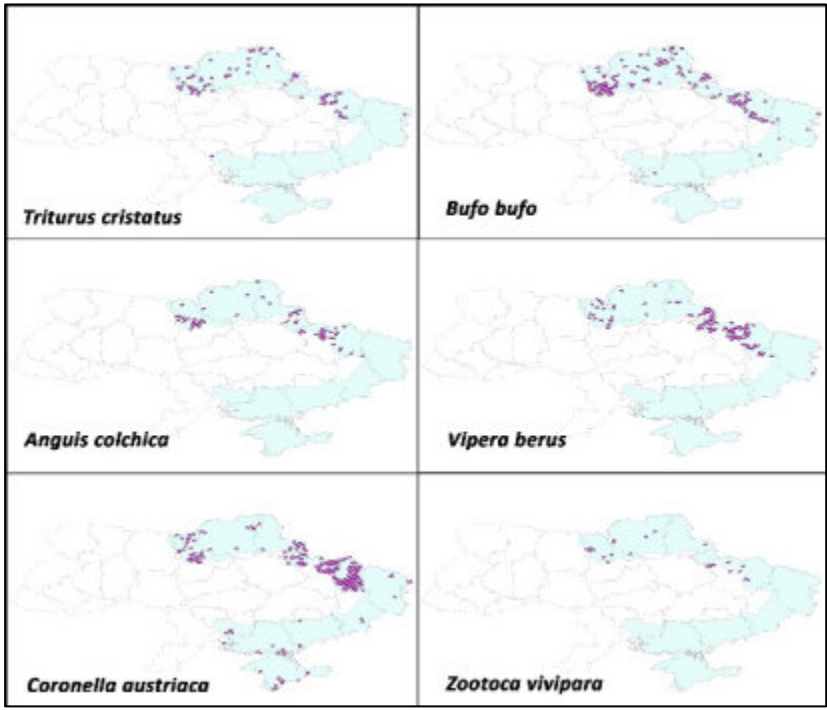


Elaphe sauromates (61% HS war)

GIS modeling: species distribution since 2022

Distribution of 6 forest-connected species impacted by mass fires (based on GBIF)

	Species	Initial N of points (gbif)	N points on fires (%)	N points on war impact zone	% of habitats affected by fires (calculated from S habitats in the warzone)
	*Triturus cristatus*	619	5 (0.81%)	109 (17.6%)	8.7
	*Bufo bufo*	1335	19 (1.4%)	401 (30.0%)	9.1
	*Anguis colchica*	535	1 (0.2%)	223 (41.7%)	7.6
	*Vipera berus*	617	20 (3.2%)	329 (53.3%)	8.3
	*Coronella austriaca*	1055	71 (6.7%)	586 (55.5%)	8.9
	*Zootoca vivipara*	480	2 (0.4%)	51 (10.6%)	6.1



Summary

In aggressed Ukraine, multiple proofs of war-related ecocides yet hard to assess through robust protocols (the war continues).

Urgent need for actions to address the environmental damages caused by war:

- providing resources for cleanup and restoration efforts
- estimating the best restoration strategies after victory
- monitoring and mitigating long-term ecological and health risks
- creation of animal rescue centers

Long-term perspectives:

- It is necessary to reserve valuable territories identified through GIS modeling and currently under military actions, which are now unsafe for humans and require special protective measures for restoration

Take home message

Implementing international legal frameworks for ecocide is fundamental for long term recovery of aggressed territories and for best assessing the damages caused to seek for compensation from the aggressor after victory

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