

Mauremys rivulata in Croatia: habitats, distribution, population parameters, threats to survival and suggestions for conservation

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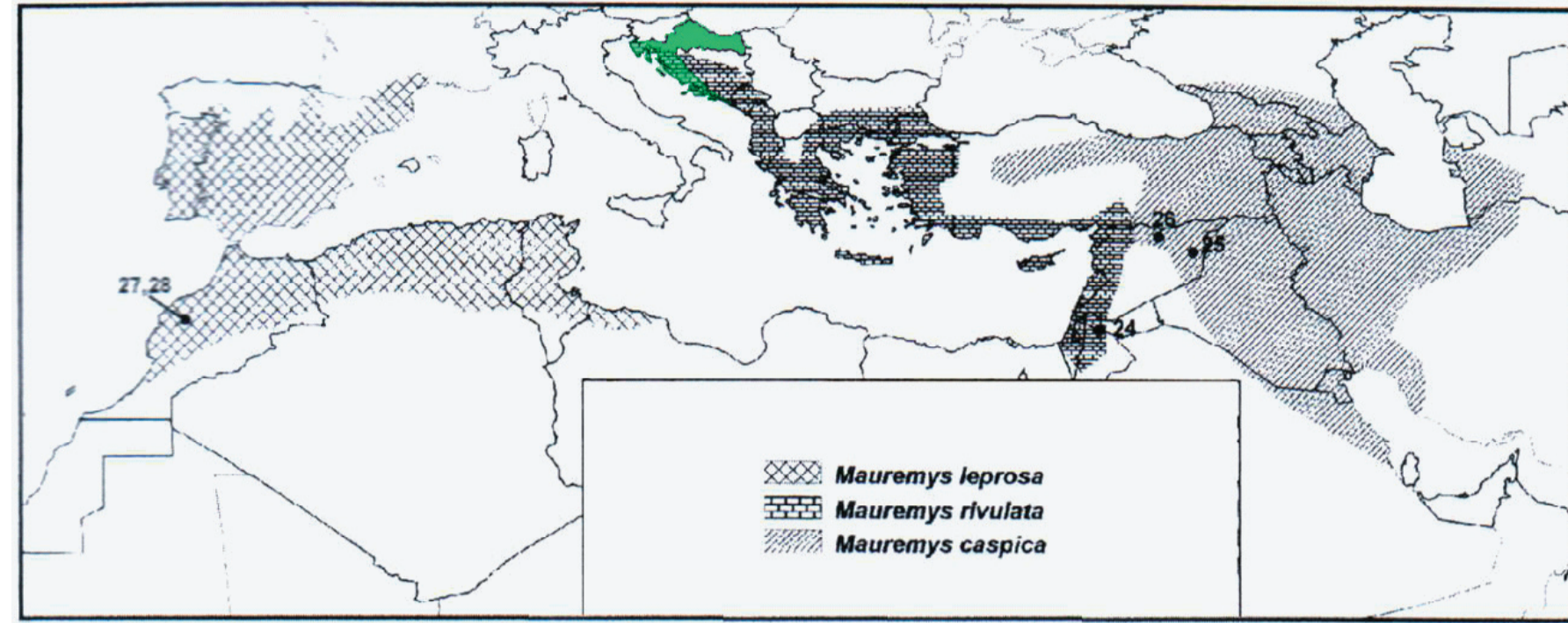
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Introduction

- Kingdom > ANIMALIA
• Class > REPTILIA
– Ordo > CHELONII
• Family > GEOEMYDIDAE
– Genus > MAUREMYS
» Species > *Mauremys rivulata* (Valenciennes, 1833)
- source NeMys: EUROHERP on-line database, nemys.ugent.be



Picture 1. Distribution of former *Mauremys caspica* subspecies in the Mediterranean region, (Mantziou et al. 2004), Croatia highlighted

Balkan terrapin (*Mauremys rivulata*) has until recently been classified as a subspecies of the Caspian terrapin (*Mauremys caspica*). Based on morphometric and biochemical evidence by Fritz and Wichuf (1997) it is now considered a separate species. Mantziou et al. (2004) have further confirmed the species status of Balkan terrapin based on mitochondrial DNA analysis. Balkan and Caspian terrapin are separated by a geographical barrier and a difference in habitat preferences (Fritz and Wischuf 1997.).

LEGAL PROTECTION:

Habitats directive*: Annex 2 and 4
Convention on the Conservation of European Wildlife and Natural Habitats*: Annex 2
Croatian law on nature protection: strictly protected species
*referenced under the name *Mauremys caspica*
New proposal of species for Annexes 2 and 4 Habitats directive

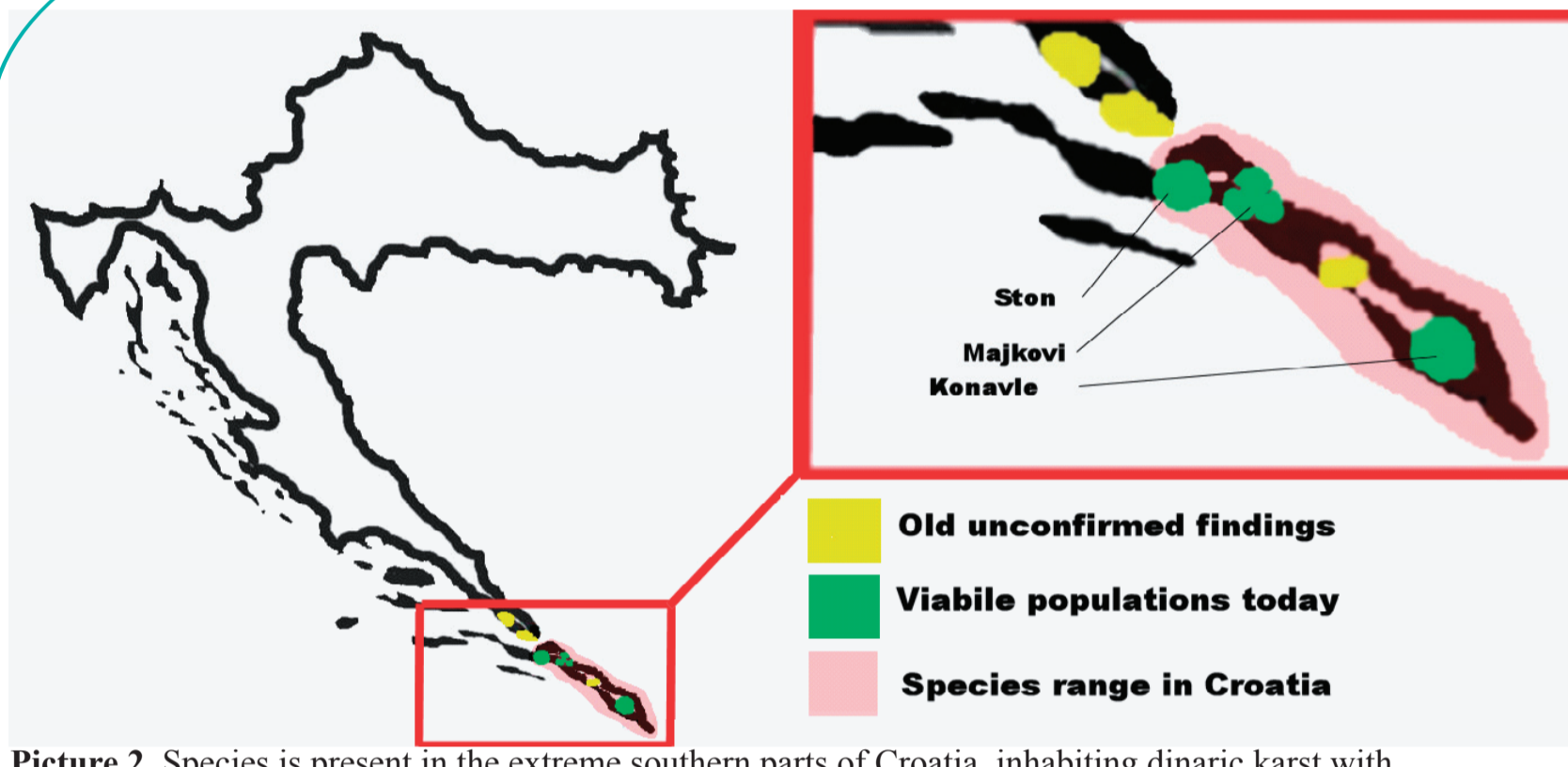
IUCN status**
globally: NE
regionally: CR A2ac; B2b (iii, iv)
***Mauremys rivulata*

Methods

- Locations suitable for life were visited. The species presence was determined by visual inspection and capture of bottom-dwelling animals using umbrella drop nets.
- The localities with Balkan Terrapin presence confirmed were described regarding habitat type and water body dimensions were measured using rope.
- Salinity was measured using WTW LF 320 sonde
- The number of animals was assessed using M-RC techniques. Fisher-Ford estimation for open populations was used to estimate population size in Majkovi.
- Population number in Konavosko field was assessed using transect zonation within river bed.
- Both estimations implemented time-restricted catch effort standardization and assumption of random sample without replacement.
- Individuals were sexed according to morphological characteristics (position of cloaca on the tail and plastral shape) and ratio of males and females was obtained. The individuals that could not be sexed were regarded as juveniles and subadults.
- Population structure is indicated using weight categories
- Threats to populations are assessed using a combination of nominal and ordinal scale of three degrees.

Results

Distribution



Picture 2. Species is present in the extreme southern parts of Croatia, inhabiting dinaric karst with eumediterranean and stenomediteranean characteristics

Populations



Picture 3. The populations are mutually isolated by geographic barriers and the lack of suitable habitats connecting the sites.



Picture 4. Irrigation canals in Stonsko polje



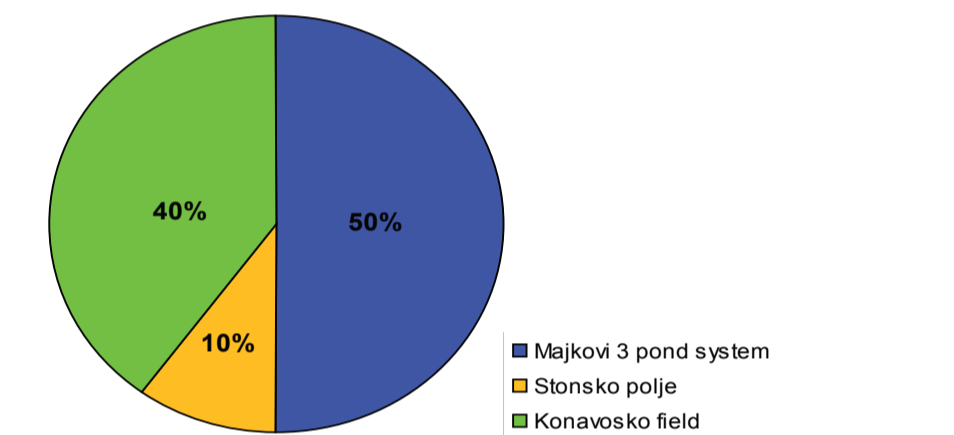
Picture 5. One of the ponds of the Majkovi three-pond system (Majkovi A)



Picture 6. River Konavočica

POPULATION IN STONSKO POLJE

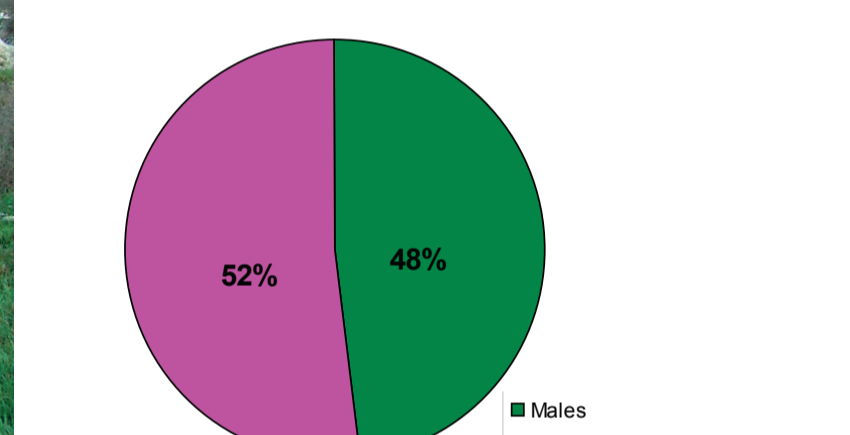
On the very verge of extinction the size of this population could not be measured using mark-recapture method, due to inability to produce catch efforts resulting in sample sizes large enough for the most sensitive of statistic methods. From the sample of only one individual caught employing extremely high catch efforts we can derive approximate estimate of one individual per 1.500 m of canals with 1,5 m diameter. This shows approximate 4 individuals/ha of water surface. Videos made by Jirij Haleš show farmore numerous population two decades ago.



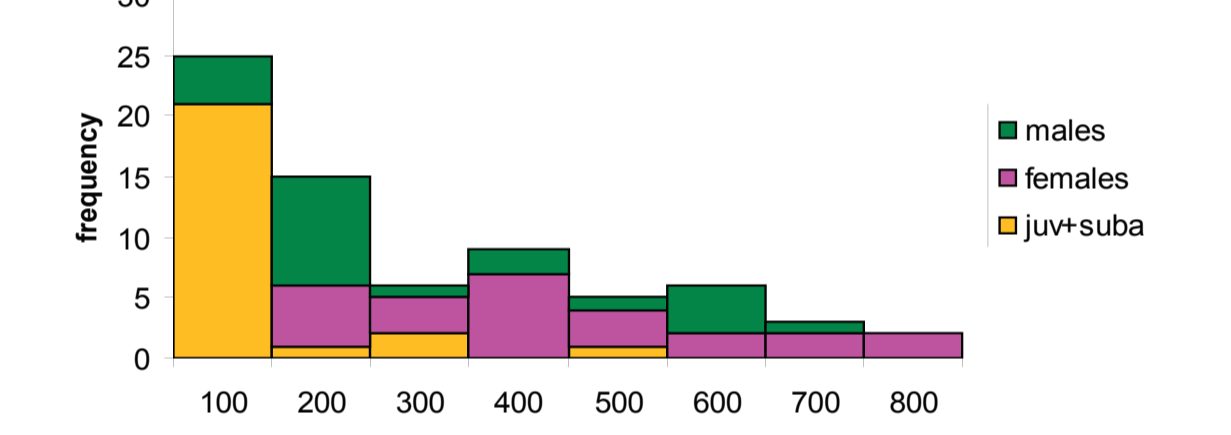
Picture 9. Relative size of the three populations in Croatia

POPULATION IN MAJKOVI

119 terrapins were estimated to use the pond B in Majkovi, showing population density of 5.050 individuals/ha of water surface. population density of the whole three-pond system is somewhat lower due to lesser counts in pond A in Majkovi and the third pond in Prjevići.



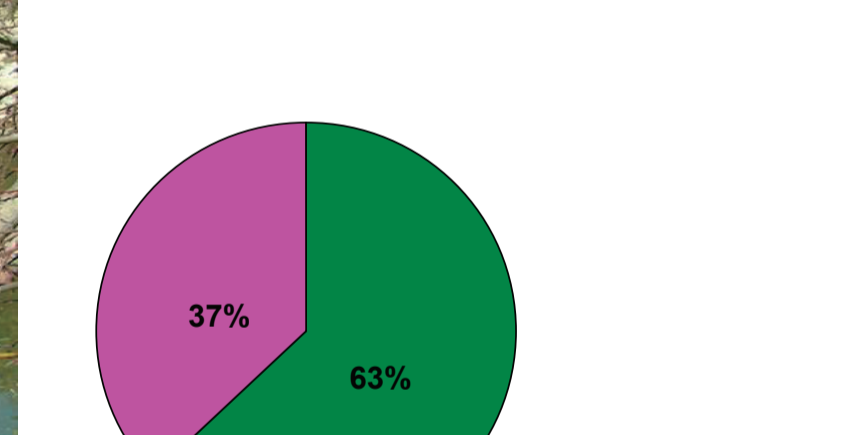
Picture 10. 22 males and 24 females were captured giving a ratio of 1 M : 1,091 F in favor of the females



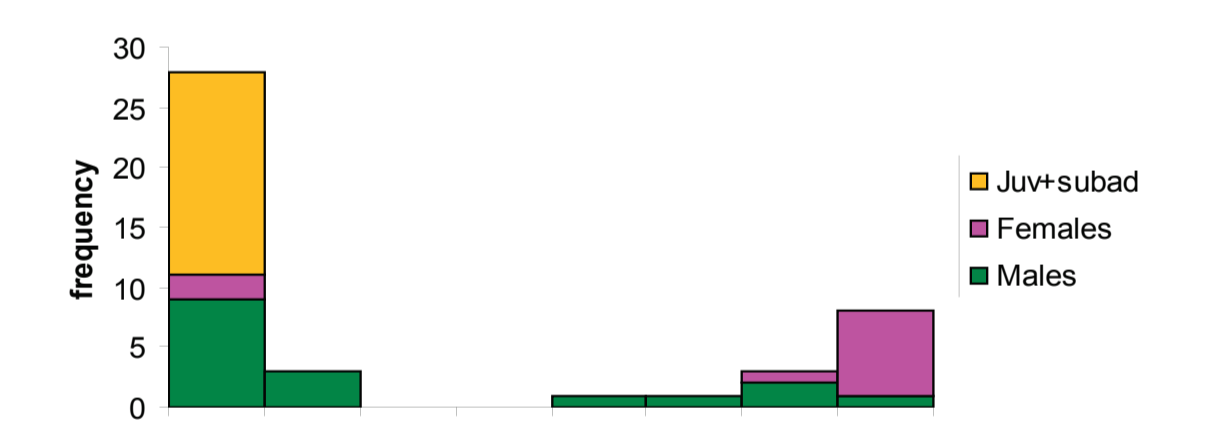
Picture 11. Cumulative frequencies of weight categories on the sexed sample of 22 males, 24 females and 27 subadult and juvenile individuals

POPULATION IN KONAVOSKO POLJE

Density is between the former two extremes with 72 individuals/ha of riverbed of Konavočica river (measured during summer period when the river bed is mosaic of dry and marshy areas with sporadic water residuals).



Picture 13. In the sample of 27 individuals sex ratio is 1,7 M : 1 F in favor of the males



Picture 12. Cumulative frequencies of weight categories on the sexed sample of 17 males, 10 females and 17 subadult and juvenile individuals.

- Three distinct populations exist in the southernmost part of Croatia:**
- Stonsko polje:** a former brackish swamp which has been trenched for agricultural use. The terrapins use some of the canals and a remnant patch of marshy terrain
 - Gornji Majkovi:** a three pond system, two of which are in close proximity with the third approximately 5 km away
 - Konavosko polje:** a karstic field intercepted with three rivers. The terrapins use mainly the river Konavočica, its tributary streams and a fishpond

Altitudinal distribution of population localities is 0–250 m

Habitats

- In Croatia, Balkan terrapin inhabits rivers, streams, ponds and marshes, as may be expected from what is known about this species' habitat preferences.
 - Species in Croatia inhabits Mediterranean karstic pond type, mainly used and maintained in the past, and sometimes constructed, by local people.
 - The river Konavočica, hosting a significant proportion of Croatian population is of Mediterranean karstic type, which are steeper, shorter in length and have smaller basins. There are two water content maxima, in spring and autumn, but the summer minimum is much more pronounced than the winter one (Bertić 1993). Streams and rivers in Konavosko polje are of torrential character in the spring with pronounced erosive influence.
 - The area climate is Mediterranean, with long, tranquil and warm summers reaching at least 34°C during July and August and autumns warmer and wetter than springs. Winter temperature minimum reaches -7°C. Precipitation ranges from 35 mm/month during summer to 200 mm/month during winter time, culminating in the beginning of winter period.
 - Regarding plant communities, two major types of vegetation are present in the area:
 - Stenomediteranean with Aleppo pine (*Pinus halepensis*) as a vegetation climax
 - Eumediterranean with Holm oak (*Quercus ilex*) as a vegetation climax
- As the area has long been a site of high human impact, most of the original forests have been cut down, and vegetation climaxes are rarely developed. Instead, the vegetation cover takes the form of various degradation forms like macchia and garigue.

HABITAT CHARACTERISTIC	LOCALITY		
	Stonsko polje	Majkovi	Konavosko polje
water flow	very slow or still	still	slow
aquatic vegetation	emergant, submerged, floating	submerged	emergant
shape	elongate	round	elongate with round pools
maximum depth (m)	0,5 - 1	0,5, 1,5, 0,7	2
surroundings	agricultural patchwork, agriculture intensity: medium	agricultural patchwork, agriculture intensity: low	agricultural patchwork, agriculture intensity: high
salinity (%)	1	0	0



Picture 14. *Mauremys rivulata*, Balkan terrapin

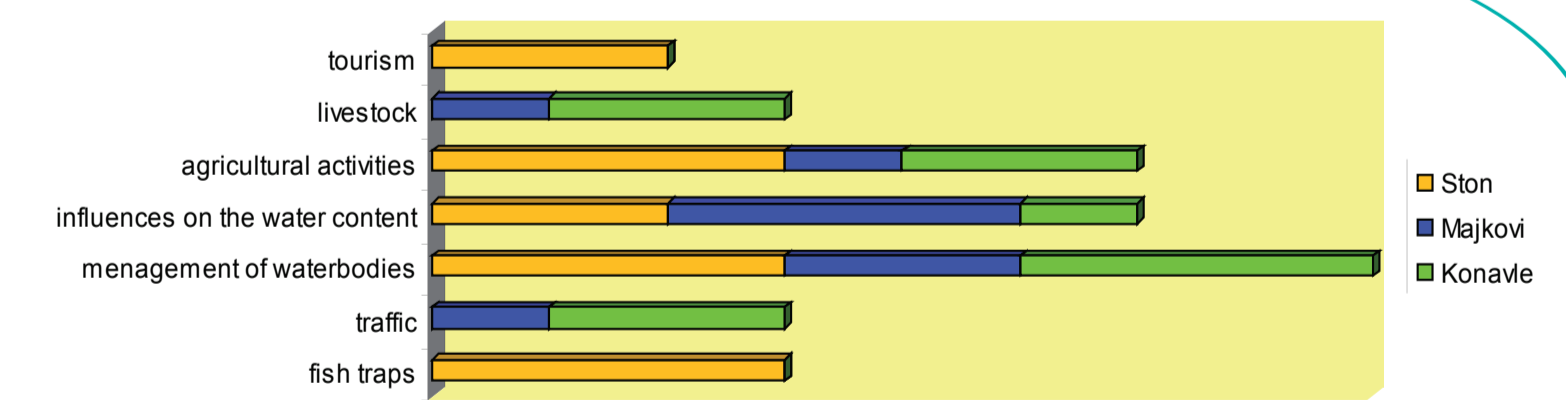
Threats

DIRECT THREATS

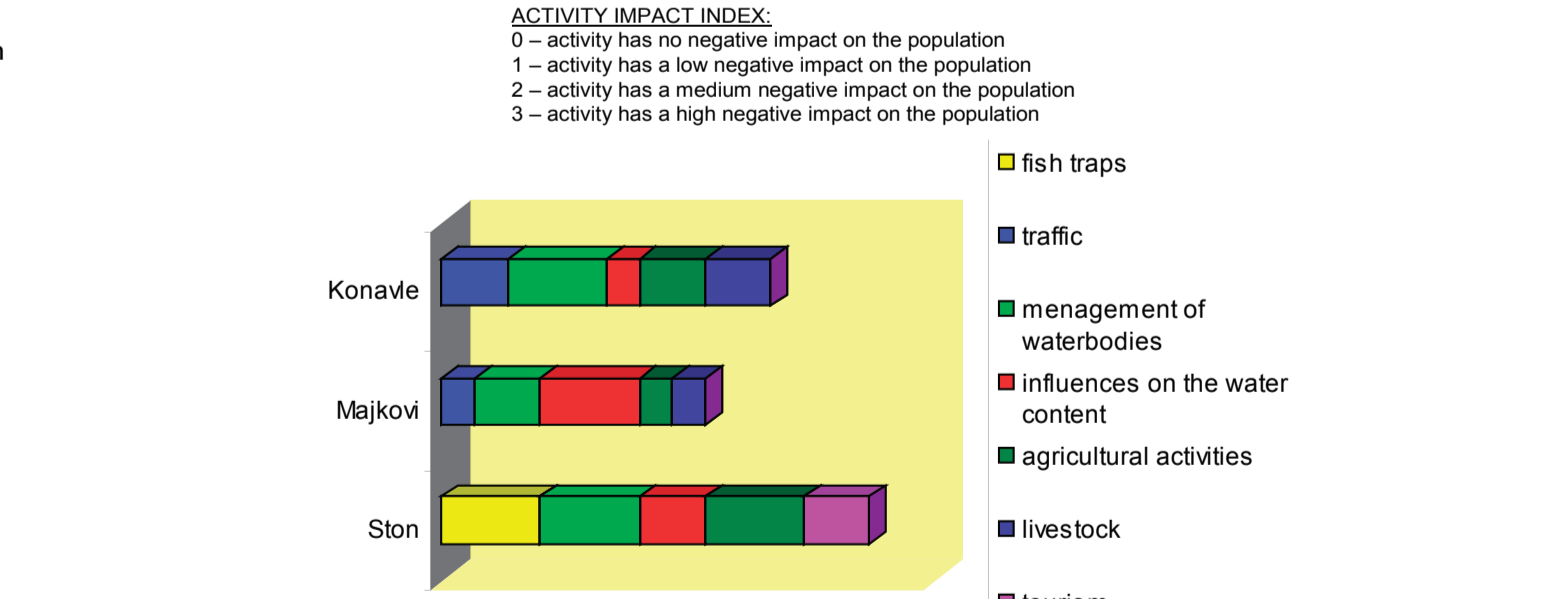
- FISH TRAPS**
 - Used for catching fish and frogs (illegal). If terrapins get caught inside they usually drown.
- TRAFFIC**
 - Terrapins are run over while migrating towards nesting sites, hibernation spots or between aquatic habitats during March to May

HABITAT THREATS

- INAPPROPRIATE MANAGEMENT OF THE WATERBODIES**
 - Maintenance of irrigation canals is sometimes done using dredgers, which results in steep shorelines. Occasionally herbicides are employed for preventing reed and bulrush overgrowth
 - Alien invertebrate and fish species introduction (illegal)
 - Laying the banks of waterflow beds with concrete
 - Waste dumping
 - Gravel excavation (illegal)
- INFLUENCES ON THE WATER CONTENT**
 - Water extraction for agriculture
 - Water extraction for drinking water supply
- AGRICULTURAL ACTIVITIES**
 - Use of pesticides and artificial fertilizers
 - Discarding of pesticide and fertilizer packaging in the surroundings
- LIVESTOCK**
 - Animals defecating into ponds
 - Animals stomping shallow areas of ponds
- TOURISM**
 - Increased need for drinking water supply
 - Increased production of waste



Picture 7. Representation of categorized threats impacts in Sten, Majkovi and Konavle populations. Each threat is evaluated on the relative scale of four degrees of impact on the population.



Picture 8. Degree of threats impacts (categorized) in Sten, Majkovi and Konavle populations. Each threat is evaluated on the relative scale of three degrees of impact on the population.

Conclusions

- Of the three populations, the most northern one is experiencing a potentially devastating population crash, which may be an extension of ongoing southward retreat of species areal in Croatia. On the other hand, threat analysis shows pronounced negative human impact on habitats and severe direct threats to individuals, which makes them less able to respond to changes in climate and habitat quality.
- The greatest threat to survival in Croatia is habitat alteration, destruction and fragmentation occurring as a result of human activities, which have increased and intensified over the last 50 years (especially growing chemical agents use in agriculture)
- The species in Croatia may be especially vulnerable since the populations are all mutually isolated, and only the southernmost population in Konavosko Montenegro. The more northern populations may have been isolated for a longer period of time and thus have a greater probability of gene fixation occurring, which makes them less able to respond to changes in climate and habitat quality.

Suggestions for conservation

- Enabling communication between populations by creating network of small waterbodies along Adriatic coast:** karstic ponds, canals, temporary and permanent waterflows from Stonsko polje to Croatia and Montenegro border
- Ex-situ breeding of Stonsko polje population and its reintroduction into restored habitat**
 - Precise analysis of the causes for drastic population crash in Stonsko polje
 - Restoration of a part of habitat in Stonsko polje
- In-situ protection - adequate management of water bodies:**
 - Avoidance of grater melioration procedures
 - Regular maintenance of ponds using traditional, noninvasive methods
 - Prevention of illegal fish traps
 - Maintenance of a predetermined minimum water content in all water bodies
 - Supervision of pond use by livestock and their possible use in regulation of *Cynodon dactylon* overgrowth
 - Prevention of further alien species introduction
 - Prevention of gravel extraction
- Raising awareness of local inhabitants about the species and environment**
 - Improving inspection of herbicide, pesticide and artificial fertilizer use and packaging disposal
 - Encouraging sustainable forms of agriculture with low-chemistry usage
 - Reinforcing the law of nature protection
 - Implementing waste management programmes

References

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Jirij Haleš from Czech organization of nature protectors - for sharing his rich experience in observing the accounted populations and providing some of the data were used to estimate population size in Majkovi.
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